NUREG-1437
Supplement 22

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 22

Regarding
Millstone Power Station, Units 2 and 3

Draft Report for Comment

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555-0001

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NUREG-1437
Supplement 22

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

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Regarding Millstone Power Station, Units 2 and 3

Draft Report for Comment

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Office of Nuclear Reactor Regulation
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Washington, DC 20555-0001

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Abstract

The U.S. Nuclear Regulatory Commission (NRC) considered the environmental impacts of renewing nuclear power plant operating licenses (OLs) for a 20-year period in its *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2, and codified the results in 10 Code of Federal Regulations (CFR) Part 51. In the GEIS (and its Addendum 1), the staff identifies 92 environmental issues and reaches generic conclusions related to environmental impacts for 69 of these issues that apply to all plants or to plants with specific design or site characteristics. Additional plant-specific review is required for the remaining 23 issues. These plant-specific reviews are to be included in a supplement to the GEIS.

This draft supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted to the NRC by the Dominion Nuclear Connecticut (Dominion) to renew the OLs for Millstone Power Station, Units 2 and 3 (Millstone) for an additional 20 years under 10 CFR Part 54. This draft SEIS includes the NRC staff's analysis that considers and weighs the environmental impacts of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's preliminary recommendation regarding the proposed action.

Regarding the 69 issues for which the GEIS reached generic conclusions, neither Dominion nor the staff has identified information that is both new and significant for any issue that applies to Millstone. In addition, the staff determined that information provided during the scoping process did not call into question the conclusions in the GEIS. Therefore, the staff concludes that the impacts of renewing the Millstone OLs will not be greater than impacts identified for these issues in the GEIS. For each of these issues, the staff's conclusion in the GEIS is that the impact is of SMALL[a] significance (except for collective offsite radiological impacts from the fuel cycle and high-level waste and spent fuel, which were not assigned a single significance level).

Regarding the remaining 23 issues, those that apply to Millstone are addressed in this draft SEIS. The staff concludes that the significance of the potential environmental impacts of renewal of the OLs is SMALL for each applicable issue with two exceptions. For entrainment, the staff concludes that the impact is MODERATE, and the magnitude of impact for the chronic effects of electromagnetic fields is "uncertain". The staff also concludes that additional mitigation measures are not likely to be sufficiently beneficial as to be warranted. The staff determined that information provided during the scoping process did not identify any new issue that has a significant environmental impact.

(a) Environmental impacts are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

Abstract

The NRC staff's preliminary recommendation is that the Commission determine that the adverse environmental impacts of license renewal for Millstone are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2) the Environmental Report submitted by Dominion; (3) consultation with Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments received during the scoping process.

Contents

Abstract . . . iii

Executive Summary . . . xv

Abbreviations/Acronyms . . . xx

1.0 Introduction . . . 1-1

1.1 Report Contents . . . 1-2
1.2 Background . . . 1-3

1.2.1 Generic Environmental Impact Statement . . . 1-3
1.2.2 License Renewal Evaluation Process . . . 1-5

1.3 The Proposed Federal Action . . . 1-8
1.4 The Purpose and Need for the Proposed Action . . . 1-8
1.5 Compliance and Consultations . . . 1-9
1.6 References . . . 1-9

2.0 Description of Nuclear Power Plant and Site and Plant Interaction with the Environment . . . 2-1

2.1 Plant and Site Description and Proposed Plant Operation During the Renewal Term . . . 2-1

2.1.1 External Appearance and Setting . . . 2-2
2.1.2 Reactor Systems . . . 2-6
2.1.3 Cooling and Auxiliary Water Systems . . . 2-6
2.1.4 Radioactive Waste Management Systems and Effluent Control Systems . . . 2-8

2.1.4.1 Liquid Waste Processing Systems and Effluent Controls . . . 2-9
2.1.4.2 Gaseous Waste Processing Systems and Effluent Controls . . 2-10
2.1.4.3 Solid Waste Processing . . . 2-11

2.1.5 Nonradioactive Waste Systems . . . 2-12
2.1.6 Plant Operation and Maintenance . . . 2-12
2.1.7 Power Transmission System . . . 2-13

2.2 Plant Interaction with the Environment . . . 2-15

2.2.1 Land Use . . . 2-15
2.2.2 Water Use . . . 2-16

2.2.3 Water Quality 2-17
2.2.4 Air Quality 2-18
2.2.5 Aquatic Resources 2-20

2.2.5.1 General Water Body Characteristics 2-22
2.2.5.2 Chemical Contaminants Near Millstone 2-23
2.2.5.3 Expected Changes or Modifications to Water Body Over Life of Plant 2-23
2.2.5.4 Important Fish and Shellfish Communities Near Millstone . . . 2-24
2.2.5.5 Population Trends Associated with Important Fish and Shellfish Species 2-24
2.2.5.6 Other Important Aquatic Resources 2-30
2.2.5.7 Threatened or Endangered Aquatic Species 2-31

2.2.6 Terrestrial Resources 2-35

2.2.6.1 Site Terrestrial Resources 2-35
2.2.6.2 Threatened and Endangered Terrestrial Species 2-36

2.2.7 Radiological Impacts 2-41
2.2.8 Socioeconomic Factors 2-43

2.2.8.1 Housing 2-43
2.2.8.2 Public Services 2-46
2.2.8.3 Offsite Land Use 2-52
2.2.8.4 Visual Aesthetics and Noise 2-54
2.2.8.5 Demography 2-54
2.2.8.6 Economy and Taxes 2-57

2.2.9 Historic and Archaeological Resources 2-60

2.2.9.1 Cultural Background 2-60
2.2.9.2 Historic and Archaeological Resources at and near Millstone . 2-63

2.2.10 Related Federal Project Activities and Consultations 2-65

2.3 References 2-66

3.0 Environmental Impacts of Refurbishment 3-1

3.1 References 3-3

4.0 Environmental Impacts of Operation 4-1

4.1 Cooling System 4-2

4.1.1 Entrainment of Fish and Shellfish in Early Life Stages 4-9
4.1.2 Impingement of Fish and Shellfish 4-21

4.1.2.1 Impingement Monitoring 4-22
4.1.2.2 Impingement Mortality 4-25
4.1.2.3 Assessment of Impact 4-26

4.1.3 Heat Shock 4-27

4.2 Transmission Lines 4-29

4.2.1 Electromagnetic Fields—Acute Effects 4-33
4.2.2 Electromagnetic Fields—Chronic Effects 4-34

4.3 Radiological Impacts of Normal Operations 4-35
4.4 Socioeconomic Impacts of Plant Operations During the License Renewal Period 4-36

4.4.1 Housing Impacts During Operations 4-38
4.4.2 Public Services: Public Utility Impacts During Operations 4-40
4.4.3 Offsite Land Use During Operations 4-41
4.4.4 Public Services: Transportation Impacts During Operations 4-43
4.4.5 Historic and Archaeological Resources 4-44
4.4.6 Environmental Justice 4-45

4.5 Ground-Water Use and Quality 4-50
4.6 Threatened or Endangered Species 4-51

4.6.1 Aquatic Species 4-52
4.6.2 Terrestrial Species 4-52

4.7 Evaluation of Potential New and Significant Information on Impacts of Operations During the Renewal Term 4-53
4.8 Cumulative Impacts of Operations During the Renewal Term 4-56

4.8.1 Cumulative Impacts Resulting from Operation of the Plant Cooling System 4-56
4.8.2 Cumulative Impacts Resulting from Continued Operation of the Transmission Lines 4-57
4.8.3 Cumulative Radiological Impacts 4-57
4.8.4 Cumulative Socioeconomics Impacts 4-58
4.8.5 Cumulative Impacts on Ground-water Use and Quality 4-59
4.8.6 Cumulative Impacts on Threatened or Endangered Species 4-59

4.9 Summary of Impacts of Operations During the Renewal Term 4-59
4.10 References 4-60

5.0 Environmental Impacts of Postulated Accidents 5-1

5.1 Postulated Plant Accidents 5-1

5.1.1 Design-Basis Accidents 5-2
5.1.2 Severe Accidents 5-3

5.2 Severe Accident Mitigation Alternatives 5-4

5.2.1 Introduction 5-4
5.2.2 Estimate of Risk 5-6
5.2.3 Potential Plant Improvements 5-9
5.2.4 Evaluation of Risk Reduction and Costs of Improvements 5-10
5.2.5 Cost-Benefit Comparison 5-11
5.2.6 Conclusions 5-12

5.3 References 5-13

6.0 Environmental Impacts of the Uranium Fuel Cycle and Solid-Waste Management . 6-1

6.1 The Uranium Fuel Cycle 6-2
6.2 References 6-9

7.0 Environmental Impacts of Decommissioning 7-1

7.1 Decommissioning 7-2
7.2 References 7-4

8.0 Environmental Impacts of Alternatives to License Renewal 8-1

8.1 No-Action Alternative 8-1
8.2 Alternative Energy Sources 8-6

8.2.1 Coal-Fired Generation 8-8

8.2.1.1 Closed-Cycle Cooling System 8-9
8.2.1.2 Once-Through Cooling System 8-23

8.2.2 Natural Gas-Fired Generation 8-24

8.2.2.1 Closed-Cycle Cooling System 8-25
8.2.2.2 Once-Through Cooling System 8-33

8.2.3 Nuclear Power Generation 8-34

8.2.3.1 Closed-Cycle Cooling System 8-35
8.2.3.2 Once-Through Cooling System 8-43

8.2.4 Purchased Electrical Power 8-43
8.2.5 Other Alternatives 8-44

8.2.5.1 Wind Power 8-45
8.2.5.2 Solar Power 8-46
8.2.5.3 Hydropower 8-46
8.2.5.4 Geothermal Energy 8-47
8.2.5.5 Wood Waste 8-47
8.2.5.6 Municipal Solid Waste 8-48
8.2.5.7 Other Biomass-Derived Fuels 8-49
8.2.5.8 Fuel Cells 8-49
8.2.5.9 Delayed Retirement 8-50
8.2.5.10 Utility-Sponsored Conservation 8-50

8.2.6 Combination of Alternatives 8-50

8.3 Summary of Alternatives Considered 8-51
8.4 References 8-54

9.0 Summary and Conclusions 9-1

9.1 Environmental Impacts of the Proposed Action—License Renewal 9-4

9.1.1 Unavoidable Adverse Impacts 9-6
9.1.2 Irreversible or Irretrievable Resource Commitments 9-6
9.1.3 Short-Term Use Versus Long-Term Productivity 9-6

9.2 Relative Significance of the Environmental Impacts of License Renewal and Alternatives 9-7
9.3 Staff Conclusions and Recommendations 9-9
9.4 References 9-9

Appendix A - Comments Received on the Environmental Review A-1

Appendix B - Contributors to the Supplement B-1

Appendix C - Chronology of NRC Staff Environmental Review Correspondence Related to the Dominion Nuclear Connecticut, Inc's. Application for License Renewal of Millstone Power Station Units 2 and 3 . . . . C-1

Contents

Appendix D - Organizations Contacted D-1

Appendix E - Millstone Compliance Status and Consultation Correspondence E-1

Appendix F - GEIS Environmental Issues Not Applicable to Millstone Power Station Units 2 and 3 . . . . F-1

Appendix G - Connecticut state-Listed Terrestrial Species for Hartford, Middlesex, New London, and Tolland counties with the Potential to Occur at the Millstone Site or along associated Transmission Line Rights-of-Way G-1

Appendix H- NRC Staff Evaluation of Severe Accident Mitigation Alternatives (SAMAs) for Millstone Power Station, Unit 2, in Support of License Renewal Application Review H-1

Appendix I- NRC Staff Evaluation of Severe Accident Mitigation Alternatives (SAMAs) for Millstone Power Station, Unit 3, in Support of License Renewal Application Review I-1

Figures

2-1 Location of Millstone, 80-km (50-mi) Region 2-3
2-2 Location of Millstone, 10-km (6-mi) Region 2-4
2-3 Millstone Site Layout 2-5
2-4 Millstone Transmission Lines 2-14
2-5 Millstone Point, Location of Millstone Cooling Water Intakes and Discharges 2-21
2-6 Comparison of Winter Flounder Population Trends in Niantic River and Long Island Sound 2-26

4-1 Geographic Distribution of Minority Populations (shown in shaded areas) Within 80 km (50 mi) of Millstone Based on Census Block Group Data 4-47
4-2 Geographic Distribution of Low-Income Populations (shown in shaded areas) Within 80 km (50 mi) of Millstone Based on Census Block Group Data 4-48

Tables

2-1 Millstone Transmission Rights-of-Way 2-13
2-2 Aquatic Species Listed as Endangered or Threatened by the State of Connecticut, the FWS, or NOAA Fisheries and Proposed for Candidacy or that Are Known to Occur or Potentially Occur Within Millstone Site or the Associated Transmission Line Rights-of-Way 2-32
2-3 Terrestrial Species Listed as Endangered or Threatened by the State of Connecticut or the FWS and Proposed for Candidacy or that Are Known to Occur or Potentially Occur Within Millstone Site or the Associated Transmission Line Rights-of-Way 2-37
2-4 Millstone Employee Residence Information by County 2-44
2-5 Housing Units and Housing Units Vacant (Available) by County During 1990 and 2000 2-45
2-6 Major New London County Public Water Supplies and Capacities 2-46
2-7 Traffic Counts for Roads in the Vicinity of Millstone 2-51
2-8 Land Use in Southeastern Connecticut 2-53
2-9 Population Growth and Trend in Connecticut and New London County 1980 to 2040 2-55
2.10 Population Growth in Vicinity of Millstone 1980 to 2000 2-55
2-11 Major Employment Facilities in Southeastern Connecticut 2-58
2-12 Millstone Tax Payments to Waterford 1996 to 2000 2-60

3-1 Category 1 Issues for Refurbishment Evaluation 3-2
3-2 Category 2 Issues for Refurbishment Evaluation 3-3

4-1 Category 1 Issues Applicable to the Operation of the Millstone Cooling System During the Renewal Term 4-2
4-2 Category 2 Issues Applicable to the Operation of the Millstone Cooling System During the Renewal Term 4-9
4-3 Percent Composition of Fish Larvae Collected at the Millstone Discharges from June 1976 Through May 2002, and Fish Eggs from 1979 Through 2001 (April Through September Inclusive), Compared to the Percent Composition of Fish Larvae Taken During June 2002 Through May 2003 and Fish Eggs During April Through September 2002. 4-12
4-4 Estimated Number of Anchovy, Winter Flounder, American Sand Lance, and Grubby Larvae Entrained Each Year from 1976 Through 2002 at Millstone, and the Volume of Cooling Water on Which the Entrainment Estimates Were Based. 4-13
4-5 Estimated Number of Cunner, Tautog, and Anchovy Eggs Entrained Each Year from 1979 through 2001 at Millstone, and the Volume of Cooling Water on Which the Entrainment Estimates Were Based. 4-14
4-6 Total and Range of Total Annual Impingement Estimates of Fishes and Macroinvertebrates at Millstone from 1976 through 1987 (Units 1 and 2 combined for 1976 to 1983 and Unit 2 alone for 1984 to 1987). 4-24

4-7 Impingement Survival of Significant Species Collected at the Millstone Units 2 and 3 Aquatic Returns. (Data for Unit 2 were collected biweekly from July 2000 to June 2001. Data for Unit 3 were collected biweekly from January to December 1993). 4-26
4-8 Category 1 Issues Applicable to the Millstone Transmission Lines During the Renewal Term 4-30
4-9 Category 2 and Uncategorized Issues Applicable to the Millstone Transmission Lines During the Renewal Term 4-33
4-10 Category 1 Issues Applicable to Radiological Impacts of Normal Operations During the Renewal Term 4-35
4-11 Category 1 Issues Applicable to Socioeconomics During the Renewal Term 4-36
4-12 Environmental Justice and GEIS Category 2 Issues Applicable to Socioeconomics During the Renewal Term 4-38
4-13 Category 1 Issues Applicable to Ground-water Use and Quality During the Renewal Term 4-50
4-14 Category 2 Issue Applicable to Threatened and Endangered Species During the Renewal Term 4-51

5-1 Category 1 Issue Applicable to Postulated Accidents During the Renewal Term 5-3
5-2 Category 2 Issue Applicable to Postulated Accidents During the Renewal Term 5-4
5-3 Core Damage Frequency for Unit 2 5-7
5-4 Core Damage Frequency for Unit 3 5-8
5-5 Breakdown of Population Dose by Containment Release Mode (Unit 2) 5-9
5-6 Breakdown of Population Dose by Containment Release Mode (Unit 3) 5-9

6-1 Category 1 Issues Applicable to the Uranium Fuel Cycle and Solid-Waste Management During the Renewal Term 6-2

7-1 Category 1 Issues Applicable to the Decommissioning of Millstone Units 2 and 3 Following the Renewal Term 7-2

8-1 Summary of Environmental Impacts of the No-Action Alternative 8-3
8-2 Summary of Environmental Impacts of Coal-Fired Generation at Millstone Site and an Alternate Site Using Once-Through Cooling 8-10
8-3 Summary of Environmental Impacts of Coal-Fired Generation at the Millstone Site with Once-Through Cooling 8-23
8-4 Summary of Environmental Impacts of Natural Gas-Fired Generation at Millstone and an Alternate Site Using Closed-Cycle Cooling 8-25
8-5 Summary of Environmental Impacts of Natural Gas-Fired Generation at the Millstone Site with Once-Through Cooling 8-34

8-6 Summary of Environmental Impacts of New Nuclear Power Generation at the Millstone Site and an Alternate Site Using Closed-Cycle Cooling 8-35
8-7 Summary of Environmental Impacts of a New Nuclear Power Plant Sited at the Millstone Site with Once-Through Cooling 8-44
8-8 Summary of Environmental Impacts of 1000 MW(e) of Natural Gas-Fired Generation, 524 MW(e) from Purchased Power and 500 MW(e) from Demand-Side Management Measures 8-52

9-1 Summary of Environmental Significance of License Renewal, the No-Action Alternative, and Alternative Methods of Generation Using Once-Through Cooling 9-8

A-1 Individuals Providing Comments During Scoping Comment Period A-3

E-1 Consultation Correspondence E-1
E-2 Federal, State, Local, and Regional Licenses, Permits, Consultations, and Other Approvals for Millstone E-3

F-1 GEIS Environmental Issues Not Applicable to Millstone Power Station Units 2 and 3 . F-1

G-1 Connecticut State-Listed Terrestrial Species for Hartford, Middlesex, New London, and Tolland Counties with the Potential to Occur at the Millstone Site or Along Associated Transmission Line Rights-of-Way G-1

H-1 Millstone Unit 2 Core Damage Frequency H-3
H-2 Breakdown of Population Dose by Containment Release Mode (Unit 2) H-4
H-3 SAMA Cost/Benefit Screening Analysis for Millstone Power Station, Unit 2 . . . . H-16

I-1 Millstone Unit 3 Core Damage Frequency I-3
I-2 Breakdown of Population Dose by Containment Release Mode (Unit 3) I-4
I-3 SAMA Cost/Benefit Screening Analysis for Millstone Power Station, Unit 3 . . . . I-14

Executive Summary

By letter dated January 20, 2004, the Dominion Nuclear Connecticut, Inc. (Dominion) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating licenses (OLs) for Millstone Power Station, Units 2 and 3 for an additional 20-year period. If the OLs are renewed, State regulatory agencies and Dominion will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners. If the OLs are not renewed, then the plants must be shut down at or before the expiration dates of the current OLs, which are July 2015 for Unit 2 and November 2025 for Unit 3.

The NRC has implemented Section 102 of the National Environmental Policy Act (NEPA) (42 United States Code [USC] 4321) in 10 CFR Part 51. In 10 CFR 51.20(b)(2), the Commission requires preparation of an environmental impact statement (EIS) or a supplement to an EIS for renewal of a reactor OL. In addition, 10 CFR 51.95(c) states that the EIS prepared at the OL renewal stage will be a supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plant*s (GEIS), NUREG-1437, Volumes 1 and 2.[a]

Upon acceptance of the Dominion application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing a notice of intent to prepare an EIS and conduct scoping. The NRC staff visited the Millstone site in May 2004 and held public scoping meetings on May 18, 2004, in Waterford, Connecticut. In the preparation of this draft supplemental environmental impact statement (SEIS) for Millstone, the staff reviewed the Dominion Environmental Report (ER) and compared it to the GEIS, consulted with other agencies, conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1, the *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*, and considered the public comments received during the scoping process. The public comments received during the scoping process that were considered to be within the scope of the environmental review are provided in Appendix A, Part 1, of this draft SEIS.

The staff will hold two public meetings in Waterford Connecticut, in January 2005, to describe the preliminary results of the NRC environmental review, to answer questions, and to provide members of the public with information to assist them in formulating comments on this draft SEIS. When the comment period ends, the staff will consider and address all of the comments received. These comments will be addressed in Appendix A, Part 2 of the final SEIS.

This draft SEIS includes the NRC staff's preliminary analysis, which considers and weighs the environmental effects of the proposed action, the environmental impacts of alternatives to the

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

proposed action, and mitigation measures for reducing or avoiding adverse effects. It also includes the staff's preliminary recommendation regarding the proposed action.

The Commission has adopted the following statement of purpose and need for license renewal from the GEIS:

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decisionmakers.

The evaluation criterion for the staff's environmental review, as defined in 10 CFR 51.95(c)(4) and the GEIS, is to determine

> . . . whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

Both the statement of purpose and need and the evaluation criterion implicitly acknowledge that there are factors, in addition to license renewal, that will ultimately determine whether an existing nuclear power plant continues to operate beyond the period of the current OL.

NRC regulations [10 CFR 51.95(c)(2)] contain the following statement regarding the content of SEISs prepared at the license renewal stage:

> The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) ["Temporary storage of spent fuel after cessation of reactor operation–generic determination of no significant environmental impact"] and in accordance with § 51.23(b).

The GEIS contains the results of a systematic evaluation of the consequences of renewing an OL and operating a nuclear power plant for an additional 20 years. It evaluates

92 environmental issues using the NRC's three-level standard of significance—SMALL, MODERATE, or LARGE—developed using the Council on Environmental Quality guidelines. The following definitions of the three significance levels are set forth in footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

> SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

For 69 of the 92 issues considered in the GEIS, the analysis in the GEIS reached the following conclusions:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

These 69 issues were identified in the GEIS as Category 1 issues. In the absence of new and significant information, the staff relied on conclusions as amplified by supporting information in the GEIS for issues designated as Category 1 in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

Of the 23 issues that do not meet the criteria set forth above, 21 are classified as Category 2 issues requiring analysis in a plant-specific supplement to the GEIS. The remaining two issues, environmental justice and chronic effects of electromagnetic fields, were not categorized. Environmental justice was not evaluated on a generic basis and must be addressed in a plant-specific supplement to the GEIS. Information on the chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared.

This draft SEIS documents the staff's consideration of all 92 environmental issues identified in the GEIS. The staff considered the environmental impacts associated with alternatives to license renewal and compared the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that were considered include the no-action alternative (not renewing the OLs for Millstone) and alternative methods of power generation. Based on projections made by the U.S. Department of Energy's Energy Information Administration, gas- and coal-fired generation appear to be the most likely power-generation alternatives if the power from Millstone is replaced. These alternatives are evaluated assuming that the replacement power generation plant is located at either the Millstone site or some other unspecified alternate location.

Dominion and the staff have established independent processes for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. Neither Dominion nor the staff has identified information that is both new and significant related to Category 1 issues that would call into question the conclusions in the GEIS. Similarly, neither the scoping process nor the staff has identified any new issue applicable to Millstone, that has a significant environmental impact. Therefore, the staff relies upon the conclusions of the GEIS for all of the Category 1 issues that are applicable to Millstone.

Dominion's license renewal application presents an analysis of the Category 2 issues. The staff has reviewed the Dominion analysis for each issue and has conducted an independent review of each issue. Six Category 2 issues are not applicable, because they are related to plant design features or site characteristics not found at Millstone. Four Category 2 issues are not discussed in this draft SEIS, because they are specifically related to refurbishment. Dominion has stated that its evaluation of structures and components, as required by 10 CFR 54.21, did not identify any major plant refurbishment activities or modifications as necessary to support the continued operation of Millstone for the license renewal period. In addition, any replacement of components or additional inspection activities are within the bounds of normal plant operation, and are not expected to affect the environment outside of the bounds of the plant operations evaluated in the U.S. Atomic Energy Commission's 1973 *Final Environmental Statement Related to the Continuation of Construction of Unit 2 and the Operation of Units 1 and 2, Millstone Nuclear Power Station* and in the NRC's 1984 *Final Environmental Statement related to operation of Millstone Nuclear Power Station, Unit No. 3.*

Eleven Category 2 issues related to operational impacts and postulated accidents during the renewal term, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this draft SEIS. Five of the Category 2 issues and environmental justice apply to both refurbishment and to operation during the renewal term and are only discussed in this draft SEIS in relation to operation during the renewal term. For 10 of the Category 2 issues and environmental justice, the staff concludes that the potential environmental effects are of SMALL significance in the context of the standards set forth in the GEIS. For entrainment, the staff concludes that the potential environmental effects are of MODERATE significance in the context of the standards set forth in the GEIS. In addition, the staff determined that appropriate Federal health agencies have not reached a consensus on the existence of chronic adverse effects from electromagnetic fields. Therefore, no further evaluation of this issue is required. For severe accident mitigation alternatives (SAMAs), the staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for Millstone and the plant improvements already made, the staff concludes that one of the candidate SAMAs is cost-beneficial for Unit 2. One additional SAMA for each unit could be cost-beneficial if it can be implemented by severe accident management guidelines without hardware modifications.

If the Millstone operating licenses are not renewed and the units cease operation on or before the expiration of their current operating licenses, the adverse impacts of likely alternatives will not be smaller than those associated with continued operation of Millstone. The impacts may, in fact, be greater in some areas.

The preliminary recommendation of the NRC staff is that the Commission determine that the adverse environmental impacts of license renewal for Millstone are not so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2) the ER submitted by Dominion; (3) consultation with other Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments received during the scoping process.

Abbreviations/Acronyms

°	degree
µm	micrometer(s)
ac	acre(s)
AC	alternating current electricity
ACC	averted cleanup and decontamination costs
AD	Anno Domini
ADAMS	Nuclear Regulatory Commission's Agency Wide Document Access and Management System
AE	assessment endpoint
AEC	U.S. Atomic Energy Commission
AFW	auxiliary feedwater
AOC	present value of averted offsite property damage costs
AOE	present value of averted occupational exposure costs
AOV	air-operated valve
AOSC	present value of averted onsite costs
APE	present value of averted public exposure
ATWS	anticipated transients without scram
BC	Before Christ
Bq	becquerel(s)
Bq/L	bequerels per liter
Btu	British thermal unit(s)
Btu/kWh	British thermal Units per kilowatt-hour
C	Celsius
CCF	common cause failure
CCW	component cooling water
CDF	core damage frequency
CE	Combustion Engineering
CEOG	Combustion Engineering Owners Group
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Ci	curie(s)
CL&P	Connecticut Light and Power
cm	centimeter(s)
COE	cost of enhancement
COOL	loss of cooling water to primary side components
CTDEP	Connecticut Department of Environmental Protection
CWA	Clean Water Act

DBA	design-basis accident
DC	direct current electricity
DOE	U.S. Department of Energy
Dominion	Dominion Nuclear Connecticut, Inc.
DSM	demand-side management
DWST	demineralized water storage tank
EDG	emergency diesel generator
EIA	Energy Information Administration (of U.S. DOE)
EIS	environmental impact statement
ELF-EMF	extremely low frequency-electromagnetic field
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
ER	Environmental Report
ESA	Endangered Species Act
ESF	Engineered safeguards feature
ESFRS	Engineered safeguards feature room service
F	Fahrenheit
FAA	Federal Aviation Administration
FES	Final Environmental Statement
FR	Federal Register
FSAR	Final Safety Analysis Report
ft	foot/feet
ft^3	cubic feet
ft^3/s	cubic feet per second
FWS	U.S. Fish and Wildlife Service
gal	gallon
gpd	gallons per day
gpm	gallons per minute
GEIS	Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437
Gy	gray (1 joule per kilogram)
ha	hectare(s)
HCLPF	high confidence low probability of failure
HEPA	high-efficiency particulate air (filter)
HLW	high-level waste
HPSI	high pressure safety injection

hr	hour(s)
HRA	human reliability analysis
Hz	Hertz
I	Interstate
in.	inch(es)
IPE	Individual Plant Examination
IPEEE	Individual Plant Examination of External Events
ISLOCA	interfacing systems loss-of-coolant accident
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer
kV	kilovolt(s)
kWh	kilowatt hour(s)
L	liter(s)
L/d	liters per day
lb	pound
LOCA	loss-of-coolant accident
LOOP	loss of offsite power
LPSI	low pressure safety injection
LWR	light-water reactor
m	meter(s)
MACCS2	MELCOR Accident Consequence Code 2
m/s	meter(s) per second
m^3/s	cubic meter(s) per second
mA	milliampere(s)
ME	measurement endpoints
MG	motor generator
mGy	milligray
mi	mile(s)
mi^2	square mile(s)
Millstone	Millstone Power Station, Units 2 and 3
mL	milliliter(s)
MOV	motor-operated valve
mph	miles per hour
mrad	millirad(s)
MPS2	Millstone Power Station, Unit 2
MPS3	Millstone Power Station, Unit 3

mrem	millirem(s)
MSIV	main steam isolation valve
mSv	millisieverts
MT	metric ton(s) (or tonne[s])
MTHM	metric ton(s) heavy metal
MT/y	metric tons per year
MW	megawatt(s)
MW(e)	megawatt(s) electric
MW(t)	megawatt(s) thermal
MWh	megawatt hour(s)
NAS	National Academy of Sciences
NEPA	National Environmental Policy Act of 1969
NESC	National Electric Safety Code
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service
NNECO	Northeast Nuclear Energy Company
NO_x	nitrogen oxide(s)
NOAA	National Oceanic and Atmospheric Adminstration
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NU	Northeast Utilities
NUSCO	Northeast Utilities Service Company
ODCM	Offsite Dose Calculation Manual
OL	operating license
pCi	picocuries
pCi/L	picocuries per liter
PDS	plant damage state
persons/km^2	persons per square kilometer
persons/mi^2	persons per square mile
PORV	pilot-operated relief valve
PRA	Probabilistic Risk Assessment
PWR	pressurized water reactor
RAI	Request for additional information
RBCCW	reactor building closed cooling water
RCP	reactor coolant pump
RCRA	Resource Conservation and Recovery Act

REMP	radiological environmental monitoring program
rem	roentgen equivalent man
RPC	replacement power costs
RPS	reactor protection system
RWST	refueling water storage tank
s	second(s)
SAMA	Severe Accident Mitigation Alternative
SAMG	severe accident management guideline
SBO	station blackout
SAR	Safety Analysis Report
SCCOG	Southeastern Connecticut Council of Governments
SEIS	Supplemental Environmental Impact Statement
SER	Safety Evaluation Report
SGTR	steam generator tube rupture
SMA	Seismic Margins Assessment
SNEMA	Southern New England Mid-Atlantic
SO_2	sulfur dioxide
SO_x	sulfur oxide(s)
SW	service water
Sv	sievert(s)
U.S.	United States
USACE	United States Army Corps of Engineers
USC	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
WOG	Westinghouse Owners Group
V	volt
yr	year

1.0 Introduction

Under the Nuclear Regulatory Commission's (NRC) environmental protection regulations in Title 10 of the Code of Federal Regulations (CFR) Part 51, which implement the National Environmental Policy Act (NEPA), renewal of a nuclear power plant operating license (OL) requires the preparation of an environmental impact statement (EIS). In preparing the EIS, the NRC staff is required first to issue the statement in draft form for public comment, and then issue a final statement after considering public comments on the draft. To support the preparation of the EIS, the staff has prepared a *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[a] The GEIS is intended to (1) provide an understanding of the types and severity of environmental impacts that may occur as a result of license renewal of nuclear power plants under 10 CFR Part 54, (2) identify and assess the impacts that are expected to be generic to license renewal, and (3) support 10 CFR Part 51 to define the number and scope of issues that need to be addressed by the applicants in plant-by-plant renewal proceedings. Use of the GEIS guides the preparation of complete plant-specific information in support of the OL renewal process.

The Dominion Nuclear Connecticut, Inc. (Dominion) operates Millstone Power Station, Units 2 and 3 (Millstone) in Connecticut under OLs DPR-65 and NPF-49, which were issued by the NRC. These OLs will expire in July 2015 for Unit 2 and November 2025 for Unit 3. On January 20, 2004, Dominion submitted an application to the NRC to renew the Millstone Power Station, Units 2 and 3 OLs for an additional 20 years under 10 CFR Part 54. Dominion is a *licensee* for the purposes of its current OLs and an *applicant* for the renewal of the OLs. Pursuant to 10 CFR 54.23 and 51.53(c), Dominion submitted an Environmental Report (ER) (Dominion 2004a) in which Dominion analyzed the environmental impacts associated with the proposed license renewal action, considered alternatives to the proposed action, and evaluated mitigation measures for reducing adverse environmental impacts.

This report is the draft plant-specific supplement to the GEIS (the supplemental EIS [SEIS]) for the Dominion license renewal application. This draft SEIS is a supplement to the GEIS because it relies, in part, on the findings of the GEIS. The staff will also prepare a separate safety evaluation report in accordance with 10 CFR Part 54.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

1.1 Report Contents

The following sections of this introduction (1) describe the background for the preparation of this SEIS, including the development of the GEIS and the process used by the staff to assess the environmental impacts associated with license renewal, (2) describe the proposed Federal action to renew the Millstone OLs, (3) discuss the purpose and need for the proposed action, and (4) present the status of Dominion's compliance with environmental quality standards and requirements that have been imposed by Federal, State, regional, and local agencies that are responsible for environmental protection.

The ensuing chapters of this SEIS closely parallel the contents and organization of the GEIS. Chapter 2 describes the site, power plant, and interactions of the plant with the environment. Chapters 3 and 4, respectively, discuss the potential environmental impacts of plant refurbishment and plant operation during the renewal term. Chapter 5 contains an evaluation of potential environmental impacts of plant accidents and includes consideration of severe accident mitigation alternatives. Chapter 6 discusses the uranium fuel cycle and solid-waste management. Chapter 7 discusses decommissioning, and Chapter 8 discusses alternatives to license renewal. Finally, Chapter 9 summarizes the findings of the preceding chapters and draws conclusions about the adverse impacts that cannot be avoided; the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity; and the irreversible or irretrievable commitment of resources. Chapter 9 also presents the staff's preliminary recommendation with respect to the proposed license renewal action.

Additional information is included in appendices. Appendix A contains public comments related to the environmental review for license renewal and staff responses to those comments. Appendices B through I, respectively, list the following:

- The preparers of the supplement

- The chronology of NRC staff environmental review correspondence related to this SEIS

- The organizations contacted during the development of this SEIS

- Dominion's compliance status in Table E-1 (this appendix also contains copies of consultation correspondence prepared and sent during the evaluation process)

- GEIS environmental issues that are not applicable to Millstone

- GEIS State-listed Threatened and Endangered Species

- Severe accident mitigation alternatives — Unit 2
- Severe accident mitigation alternatives — Unit 3

1.2 Background

Use of the GEIS, which examines the possible environmental impacts that could occur as a result of renewing individual nuclear power plant OLs under 10 CFR Part 54, and the established license renewal evaluation process supports the thorough evaluation of the impacts of renewal of OLs.

1.2.1 Generic Environmental Impact Statement

The NRC initiated a generic assessment of the environmental impacts associated with the license renewal term to improve the efficiency of the license renewal process by documenting the assessment results and codifying the results in the Commission's regulations. This assessment is provided in the GEIS, which serves as the principal reference for all nuclear power plant license renewal EISs.

The GEIS documents the results of the systematic approach that was taken to evaluate the environmental consequences of renewing the licenses of individual nuclear power plants and operating them for an additional 20 years. For each potential environmental issue, the GEIS (1) describes the activity that affects the environment, (2) identifies the population or resource that is affected, (3) assesses the nature and magnitude of the impact on the affected population or resource, (4) characterizes the significance of the effect for both beneficial and adverse impacts, (5) determines whether the results of the analysis apply to all plants, and (6) considers whether additional mitigation measures would be warranted for impacts that would have the same significance level for all plants.

The NRC's standard of significance for impacts was established using the Council on Environmental Quality terminology for "significantly" (40 CFR 1508.27, which requires consideration of both "context" and "intensity.") Using the Council on Environmental Quality terminology, the NRC established three significance levels—SMALL, MODERATE, and LARGE. The definitions of the three significance levels are set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, as follows:

> SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The GEIS assigns a significance level to each environmental issue, assuming that ongoing mitigation measures would continue.

The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, **Category 1** issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required in this SEIS unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria of Category 1, and therefore, additional plant-specific review for these issues is required.

In the GEIS, the staff assessed 92 environmental issues and determined that 69 qualified as Category 1 issues, 21 qualified as Category 2 issues, and 2 issues, environmental justice and chronic effects of electromagnetic fields, were not categorized. Environmental justice was not evaluated on a generic basis and must be addressed in a plant-specific supplement to the GEIS. Information on the chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared.

Of the 92 issues, 11 are related only to refurbishment, 6 are related only to decommissioning, 67 apply only to operation during the renewal term, and 8 apply to both refurbishment and operation during the renewal term. A summary of the findings for all 92 issues in the GEIS is codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

1.2.2 License Renewal Evaluation Process

An applicant seeking to renew its OLs is required to submit an ER as part of its application. The license renewal evaluation process involves careful review of the applicant's ER and assurance that all new and potentially significant information not already addressed in or available during the GEIS evaluation is identified, reviewed, and assessed to verify the environmental impacts of the proposed license renewal.

In accordance with 10 CFR 51.53(c)(2) and (3), the ER submitted by the applicant must

- provide an analysis of the Category 2 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B in accordance with 10 CFR 51.53(c)(3)(ii); and

- discuss actions to mitigate any adverse impacts associated with the proposed action and environmental impacts of alternatives to the proposed action.

In accordance with 10 CFR 51.53(c)(2), the ER does not need to

- consider the economic benefits and costs of the proposed action and alternatives to the proposed action except insofar as such benefits and costs are either (1) essential for making a determination regarding the inclusion of an alternative in the range of alternatives considered, or (2) relevant to mitigation;

- consider the need for power and other issues not related to the environmental effects of the proposed action and the alternatives;

- discuss any aspect of the storage of spent fuel within the scope of the generic determination in 10 CFR 51.23(a) in accordance with 10 CFR 51.23(b); or

- contain an analysis of any Category 1 issue unless there is significant new information on a specific issue—this is pursuant to 10 CFR 51.23(c)(3)(iii) and (iv).

New and significant information is (1) information that identifies a significant environmental issue not covered in the GEIS and codified in Table B-1 of 10 CFR Part 51, Subpart A,

Appendix B, or (2) information that was not considered in the analyses summarized in the GEIS and that leads to an impact finding that is different from the finding presented in the GEIS and codified in 10 CFR Part 51.

In preparing to submit its application to renew the Millstone OLs, Dominion developed a process to ensure that information not addressed in or available during the GEIS evaluation regarding the environmental impacts of license renewal for Millstone would be properly reviewed before submitting the ER and to ensure that such new and potentially significant information related to renewal of the licenses for Units 2 and 3 would be identified, reviewed, and assessed during the period of NRC review. Dominion reviewed the Category 1 issues that appear in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, to verify that the conclusions of the GEIS remained valid with respect to Millstone. This review was performed by personnel from Dominion and its support organization who were familiar with NEPA issues and the scientific disciplines involved in the preparation of a license renewal ER.

The NRC staff also has a process for identifying new and significant information. That process is described in detail in *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*, NUREG-1555, Supplement 1 (NRC 2000a). The search for new information includes (1) review of an applicant's ER and the process for discovering and evaluating the significance of new information; (2) review of records of public comments; (3) review of environmental quality standards and regulations; (4) coordination with Federal, State, and local environmental protection and resource agencies; and (5) review of the technical literature. New information discovered by the staff is evaluated for significance using the criteria set forth in the GEIS. For Category 1 issues where new and significant information is identified, reconsideration of the conclusions for those issues is limited in scope to the assessment of the relevant new and significant information; the scope of the assessment does not include other facets of the issue that are not affected by the new information.

Chapters 3 through 7 discuss the environmental issues considered in the GEIS that are applicable to Millstone. In each chapter, at the beginning of the discussion of each set of issues, there is a table that identifies the issues to be addressed and lists the sections in the GEIS where the issue is discussed. Category 1 and Category 2 issues are listed in separate tables. For Category 1 issues for which there is no new and significant information, the table is followed by a set of short paragraphs that state the GEIS conclusion codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, followed by the staff's analysis and conclusion. For Category 2 issues, in addition to the list of GEIS sections where the issue is discussed, the tables list the subparagraph of 10 CFR 51.53(c)(3)(ii) that describes the analysis required and the draft SEIS sections where the analysis is presented. The draft SEIS sections that discuss the Category 2 issues are presented immediately following the table.

The NRC prepares an independent analysis of the environmental impacts of license renewal and compares these impacts with the environmental impacts of alternatives. The evaluation of the Dominion license renewal application began with publication of a notice of acceptance for docketing and opportunity for a hearing in the *Federal Register* (NRC 2004a) on March 12, 2004. The staff published a notice of intent to prepare an EIS and conduct scoping (NRC 2004b) on April 7, 2004. Two public scoping meetings were held on May 18, 2004, in Waterford, Connecticut. Comments received during the scoping period were summarized in the *Environmental Impact Statement Scoping Process: Summary Report – Millstone Power Station, Units 2 and 3, New London County,Connecticut* (NRC 2004c) dated August 27, 2004. Comments that are applicable to this environmental review are presented in Part 1 of Appendix A.

The staff followed the review guidance contained in NUREG-1555, Supplement 1, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC 2000). The staff and contractor retained to assist the staff visited the Millstone site on May 19 and 20, 2004, to gather information and to become familiar with the site and its environs. The staff also reviewed the comments received during scoping, and consulted with Federal, State, regional, and local agencies. A list of the organizations consulted is provided in Appendix D. Other documents related to Millstone were reviewed and are referenced.

This draft SEIS presents the staff's analysis that considers and weighs the environmental impacts of the proposed renewal of the OLs for Millstone, the environmental impacts of alternatives to license renewal, and mitigation measures available for avoiding adverse environmental impacts. Chapter 9, "Summary and Conclusions," provides the NRC staff's preliminary recommendation to the Commission on whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable.

A 75-day comment period will begin on the date of publication of the U.S. Environmental Protection Agency Notice of Filing of the draft SEIS to allow members of the public to comment on the preliminary results of the NRC staff's review. During this comment period, two public meetings will be held in Waterford, Connecticut, in January 2005. During these meetings, the staff will describe the preliminary results of the NRC environmental review and answer questions related to it to provide members of the public with information to assist them in formulating their comments.

1.3 The Proposed Federal Action

The proposed Federal action is renewal of the OLs for Millstone. The Millstone site is located in Waterford, Connecticut on the coast between the Niantic and Thames Rivers, approximately 64 km (40 mi) east of New Haven, 64 km (40 mi) southeast of Hartford, and 32 km (20 mi) west of Rhode Island. Unit 2 is a Combustion Engineering–designed pressurized-water reactor with a design power level of 2700 megawatts thermal (MW[t]) and a net power output of 870 megawatts electric (MW[e]). Unit 3 is a Westinghouse-designed pressurized-water reactor with a design power level of 3411 MW(t) and a net power output of 1154 MW(e). Plant cooling is provided by a once-through cooling-water system that is withdrawn from Niantic Bay and dissipates heat by discharge into Long Island Sound. Units 2 and 3 produce electricity to meet about 50 percent of the electrical use of Connecticut. The current OL for Unit 2 expires on July 31, 2015, and for Unit 3 on November 25, 2025. By letter dated January 20, 2004, Dominion submitted an application to the NRC (Dominion 2004b) to renew these OLs for an additional 20 years of operation (i.e., until July 31, 2035, for Unit 2 and November 25, 2045, for Unit 3).

1.4 The Purpose and Need for the Proposed Action

Although a licensee must have a renewed license to operate a reactor beyond the term of the existing OL, the possession of that license is just one of a number of conditions that must be met for the licensee to continue plant operation during the term of the renewed license. Once an OL is renewed, State regulatory agencies and the owners of the plant will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners.

Thus, for license renewal reviews, the NRC has adopted the following definition of purpose and need (GEIS Section 1.3):

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and where authorized, Federal (other than NRC) decisionmakers.

This definition of purpose and need reflects the Commission's recognition that, unless there are findings in the safety review required by the Atomic Energy Act of 1954 or findings in the NEPA environmental analysis that would lead the NRC to reject a license renewal application, the NRC does not have a role in the energy-planning decisions of State regulators and utility officials as to whether a particular nuclear power plant should continue to operate. From the perspective of the licensee and the State regulatory authority, the purpose of renewing an OL is to maintain the availability of the nuclear plant to meet system energy requirements beyond the current term of the plant's license.

1.5 Compliance and Consultations

Dominion is required to hold certain Federal, State, and local environmental permits, as well as meet relevant Federal and State statutory requirements. In its ER, Dominion provided a list of the authorizations from Federal, State, and local authorities for current operations, as well as environmental approvals and consultations associated with Millstone license renewal. Authorizations and consultations relevant to the proposed OL renewal action are included in Appendix E.

The staff has reviewed the list and consulted with the appropriate Federal, State, and local agencies to identify any compliance or permit issues or significant environmental issues of concern to the reviewing agencies. These agencies did not identify any new and significant environmental issues. The ER states that Dominion is in compliance with applicable environmental standards and requirements for Millstone. The staff has not identified any environmental issues that are both new and significant.

1.6 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

40 CFR Part 1508. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1508, "Terminology and Index."

Atomic Energy Act of 1954. 42 United States Code (USC) 2011, et seq.

Dominion Nuclear Connecticut, Inc. (Dominion). 2004a. *Applicant's Environmental Report – Operating License Renewal Stage Millstone Power Station, Units 2 and 3*. Waterford, Connecticut.

Dominion Nuclear Connecticut, Inc. (Dominion). 2004b. *Application for Renewed Operating Licenses, Millstone Power Station, Units 2 and 3*. Waterford, Connecticut.

National Environmental Policy Act of 1969 (NEPA), as amended. 42 USC 4321, et seq.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, *Section 6.3-Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants*, Final Report. NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Main Report, Supplement 1: Operating License Renewal*. NUREG-1555, Supplement 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2004a. "Notice of Acceptance for Docketing of the Application and Notice of Opportunity for a Hearing Regarding Renewal of License Nos. DPR-65 and NPF-49 for an Additional Twenty-Year Period." *Federal Register,* Vol. 69, No. 49, pp. 11897–11898. Washington, D.C. March 12, 2004.

U.S. Nuclear Regulatory Commission (NRC). 2004b. "Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register*, Vol. 69, No. 67, pp. 18409–18410. Washington, D.C. April 7, 2004.

U.S. Nuclear Regulatory Commission (NRC). 2004c. *Environmental Impact Statement Scoping Process: Summary Report – Millstone Power Station, Units 2 and 3, New London County, Connecticut*. Washington, D.C. August 27, 2004. Accession No. ML042400543.

2.0 Description of Nuclear Power Plant and Site and Plant Interaction with the Environment

Millstone Power Station, Units 2 and 3 (Millstone) is located in Waterford, Connecticut, on Millstone Point, between the Niantic and Thames Rivers on Long Island Sound. The nearest large cities are New Haven, approximately 64 km (40 mi) to the west, and Hartford, approximately 64 km (40 mi) to the northwest. The site is situated on the edge of Long Island Sound and Niantic Bay and is approximately 32 km (20 mi) west of Rhode Island. At one time, there were three operating nuclear power plants at the Millstone site. Construction on Unit 1 began in 1966, on Unit 2 in 1970, and on Unit 3 in 1974. Unit 1 was a boiling-water reactor that was permanently shut down in 1995. The facility is in long-term storage awaiting decontamination and dismantlement as part of station decommissioning. Unit 1 is not part of this license renewal application. Millstone Unit 2 is a two-loop, closed-cycle, pressurized-water nuclear reactor with a calculated electrical output of approximately 870 megawatts electric (MW[e]); while Millstone Unit 3 is a four-loop, closed-cycle, pressurized-water nuclear reactor with a calculated electrical output of approximately 1,154 MW(e) (Dominion Nuclear Connecticut Inc. [Dominion] 2004a). Millstone and its environs are described in Section 2.1, and the plant's interaction with the environment is presented in Section 2.2.

2.1 Plant and Site Description and Proposed Plant Operation During the Renewal Term

Prior to development as a power facility, Millstone Point was the site of a granite quarry that operated for approximately two centuries, until 1960. The granite from this quarry was used in the base of the Statue of Liberty, in Grand Central Terminal, and in the United Nations building in New York City, and for the foundations of the U.S. Supreme Court building in Washington D.C. (Bachman 2000). The quarry, now flooded and connected to Long Island Sound, receives the cooling water discharge from Millstone. A small settlement with its own railroad station, post office and school provided for the employees and their families prior to World War I and the advent of the widespread use of concrete. In 1951, 46 ha (114 ac) including the quarry was purchased for a coal-burning power plant, but this was instead built in Middletown, Connecticut. The site was later expanded to approximately 200 ha (500 ac) for use as a nuclear power plant (Bachman 2000). The topography consists of low rolling hills inland of the peninsular site. The maximum height above mean sea level within 4.8 km (3 mi) of the site is 76 m (250 feet). The area surrounding Millstone is a forested landscape of old New England towns and villages, interspersed with some agricultural land, industrial facilities, and undeveloped areas. The region within 10 km (6 mi) of the site includes parts of the towns of Waterford, New London, Groton, East Lyme and Old Lyme. These towns are all contiguous. The most populous community within 16 km (10 mi) of the site is Groton. The largest cities within an 80-km (50-mi) radius are Hartford and New Haven, each with a population of about 123,000. Providence, Rhode Island lies just outside of the 80-km (50-mi) radius and has a population of about 174,000 (U.S. Census Bureau [USCB] 2000). Figures 2-1 and 2-2 show the location of Millstone in relationship to the major towns and cities within an 80-km (50-mi) and 10-km (6-mi) radius, respectively.

2.1.1 External Appearance and Setting

Millstone is sited on a peninsula that includes rocky beaches, coastal tidal marshes, and second-growth hardwood forests. Old stone cobble walls and fields from when the area was farmed overlie this landscape. Facility features at the 212-ha (525-ac) Millstone site include reactor buildings, auxiliary buildings, intake and discharge structures, turbine buildings, a radioactive waste facility, fuel handling buildings, switchyard and associated transmission lines, an environmental laboratory, and training facilities (Figure 2-3). Other site features include a natural area that is approximately 20 ha (50 ac) and recreational fields licensed to the town of Waterford that comprise approximately 12 ha (30 ac). In all, about 120 ha (300 ac) exist within the site that are not developed for the power station. The site is bisected by the Northeast Corridor rail line, which is owned by Amtrak. All development at Millstone is situated south of this mostly below-grade rail line. An abandoned plant nursery adjoins both sides of the Millstone access road north of the tracks. The transmission lines that connect Millstone to the New England grid along with the switchyard equipment are owned and maintained by the Connecticut Light and Power Company (CL&P). The steel monopole transmission lines and rights-of-way corridor extend northward from the switchyard bordered by forested swaths and cross the Rope Ferry Road west of Gardiners Wood Road. The exclusion area coincides with the site property boundary. The nearest residences are single-family houses that are approximately 732 m (2400 ft) from the reactors.

The Millstone site is underlain by Monson gneiss and Westerly granite. Glacial soils, comprised of rock fragments from clay sized particles to boulders, cover the site. In some areas, fill from the quarry or the construction of Millstone overlies the glacial materials. One such pile is located west of Gardiners Wood Road near the recreational fields. This mound of excavated material, primarily associated with construction activities, occupies approximately 2.2 ha (5.5 ac) and is generally grass covered with some low shrubs. In the early 1980s, Northeast Utilities (NU) used the area to store material excavated during the construction of Millstone Power Station, Unit 3, along with miscellaneous construction debris including concrete and rebar which accounts for the majority of the material forming the mound. In 2000, in connection with the sale of Millstone, NU characterized this area and located two drums containing traces of radioactivity. No samples taken in areas outside of where the drums were found showed contamination, and the radioactivity levels of the drums were below reporting limits. NU notified

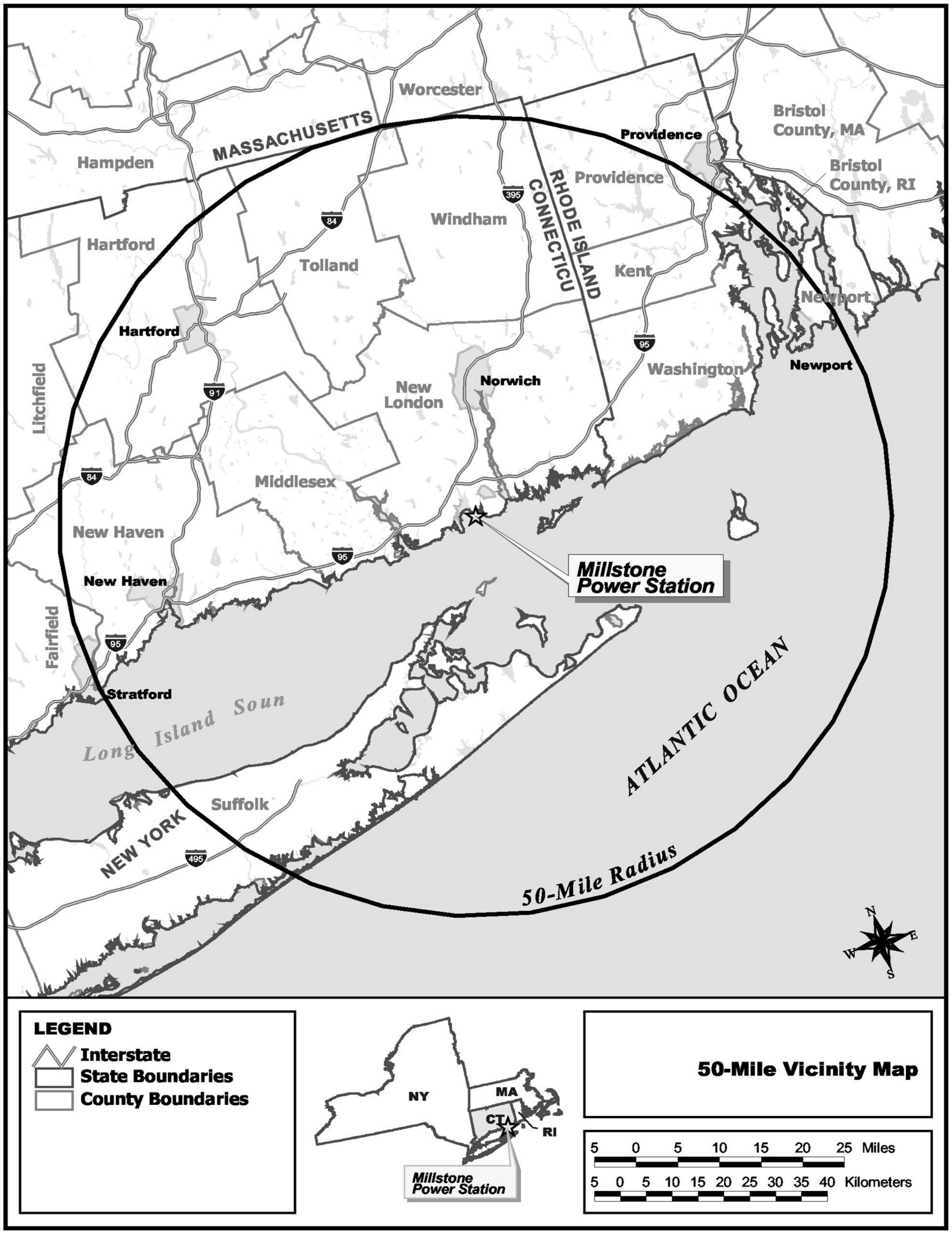


Figure 2-1. Location of Millstone, 80-km (50-mi) Region

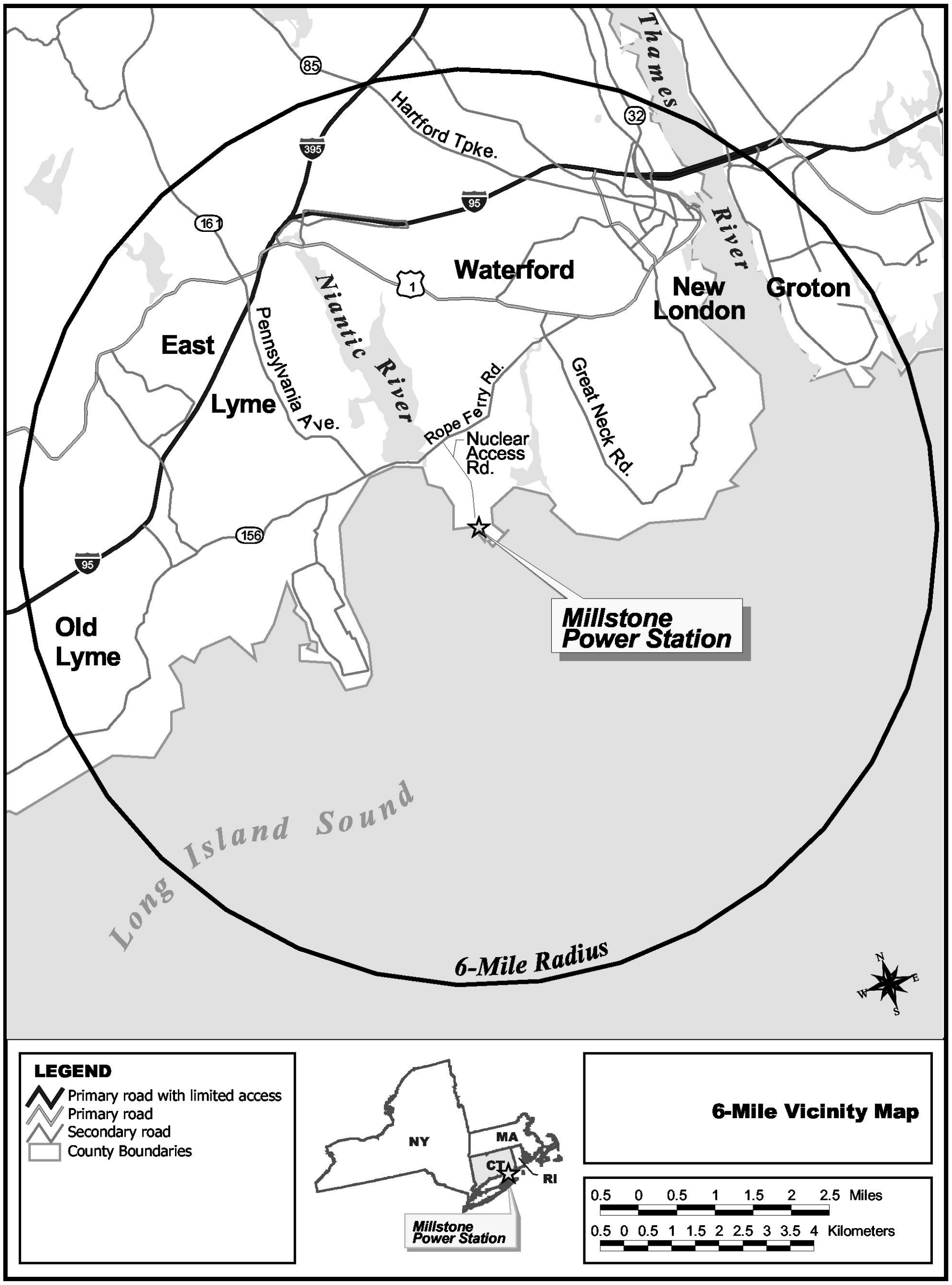
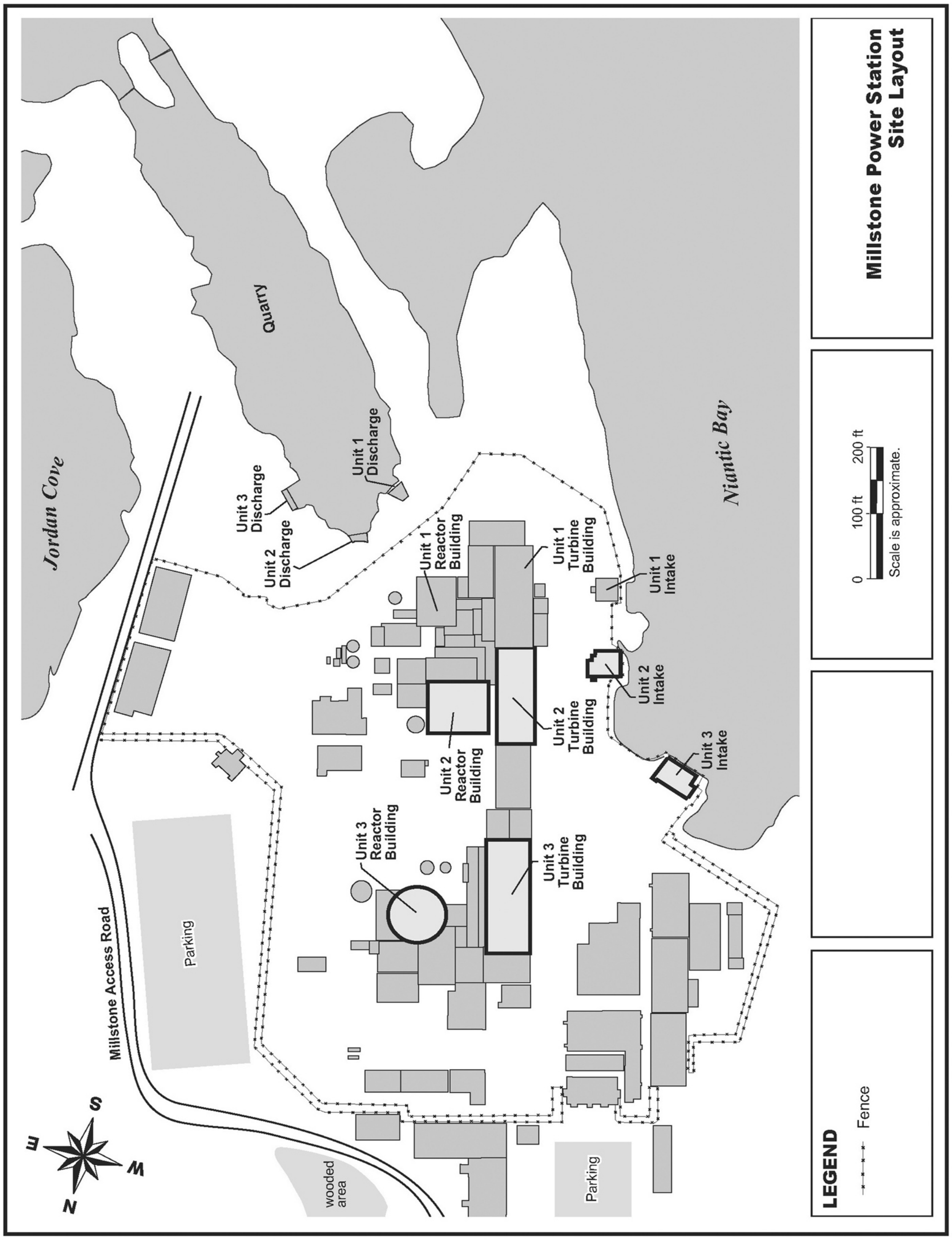


Figure 2-2. Location of Millstone, 10-km (6-mi) Region


Millstone Power Station
Site Layout
0
100 ft
200 ft
Scale is approximate.
LEGEND
Fence
Jordan Cove
Quarry
Niantic Bay
Unit 3 Discharge
Unit 2 Discharge
Unit 1 Discharge
Unit 1 Reactor Building
Unit 1 Turbine Building
Unit 1 Intake
Unit 2 Intake
Unit 3 Intake
Unit 2 Turbine Building
Unit 2 Reactor Building
Unit 3 Reactor Building
Unit 3 Turbine Building
Millstone Access Road
Parking
Parking
wooded area
N
S
E
W

the U.S. Nuclear Regulatory Commission (NRC) and the Connecticut Radiological Environmental Monitoring Office, and a representative of each organization toured the site. The drums were removed and shipped to a licensed low-level waste disposal facility.

Subsequent to the sale of Millstone, Dominion, consistent with the Connecticut Department of Environmental Protection (CTDEP) statutes and regulations relating to the transfer of the facility, has continued to assess this area. Tests of soil and ground-water samples have not detected a residual radioactive contamination. Testing has found some limited nonradiological chemical constituents that will require resolution under CTDEP remediation standards regulations.

2.1.2 Reactor Systems

Millstone has two operational reactor units (Figure 2-3). Unit 2 is a two-loop, closed-cycle, pressurized-water nuclear reactor furnished by Combustion Engineering, Inc., with a turbine-generator furnished by General Electric Company (Dominion 2004a). The remainder of the unit was designed and constructed with engineering support from Bechtel. The reactor is housed in double containment consisting of a steel-lined, prestressed concrete cylindrical structure inside the enclosure building. Unit 2 fuel is slightly enriched (less than 5 weight percent) uranium—U-235—with an average burnup for the peak rod of 62,000 megawatt days per metric ton of uranium. Unit 2 has a licensed thermal output of 2700 megawatts thermal (MW[t]), which results in a net calculated electrical output of approximately 870 MW(e).

Unit 3 is a four-loop, closed-cycle, pressurized-water, nuclear reactor steam supply system furnished by Westinghouse Electric Corporation with a turbine-generator furnished by General Electric Company (Dominion 2004a). The remainder of the unit was designed and constructed with architect-engineering support provided by Stone and Webster Engineering Corporation. The reactor is in a steel-lined, reinforced concrete, subatmospheric containment structure. Unit 3 fuel is slightly enriched to less than 5 weight percent uranium-235 with an average burnup for the peak rod of approximately 60,000 megawatt days per metric ton uranium. Unit 3 has a licensed thermal output of 3411 MW(t), which results in a net calculated electrical output of approximately 1154 MW(e).

2.1.3 Cooling and Auxiliary Water Systems

Long Island Sound is the source of water for the once-through turbine condenser cooling systems at Millstone. The system withdraws salt water from Long Island Sound though intakes, pumps the water through the condenser for cooling, and surface discharges heated water to Long Island Sound approximately 610 m (2000 ft) southeast of the withdrawal points (Dominion 2004a).

Millstone Point is located on the north shore of Long Island Sound. To the west of the site is Niantic Bay and to the east is Jordan Cove (Dominion 2004a). Intake structures for Units 2 and 3 are located on the eastern shore of Niantic Bay, which is fed by Long Island Sound. The structures consist of four reinforced-concrete bays for Unit 2 and six bays for Unit 3. When both Units 2 and 3 are operating at full power, the 10 pumps (one for each bay) pump a total of 92 m^3/s (1.46 million gpm) into 2-m (7-ft) diameter conveyance pipes. Cooling water then moves through the condensers. After passing through each unit's condensers, cooling water is discharged to the former granite quarry. The heated discharge water then flows through two cuts excavated from the bedrock at the eastern end of the quarry into Long Island Sound. Figure 2-3 shows the intake structures, quarry, and discharge points for the Millstone circulating water system.

The intake structures are designed to minimize the possibility of clogging or impingement of aquatic organisms. Before the intake water reaches the circulating water pumps, the water passes through trash racks consisting of 1-cm (3/8-in. thick) metal bars spaced horizontally on 5-cm (2-in.) centers. The water then flows through vertical traveling screens with 1-cm (3/8-in.) mesh that prevent debris and large organisms from entering the cooling system. A cutoff wall in front of the intake extends 2.7 m (9 ft) below the surface to prevent surface water debris and organisms from entering the intake. Individual trash and fish return troughs collect and sluice debris and fish from the screens. Unit 3 was originally constructed with a fish return trough, while a fish return trough was added to Unit 2 in 2000. Water velocity in front of the Unit 2 structure is estimated to be about 0.2 m/s (0.6 ft/s) (Dominion 2004a).

Biocides are added to the intake water to prevent biofouling. Sodium hypochlorite is injected on a periodic basis, and the system is designed to maintain a 0.2 parts per million (ppm) chlorine concentration (Dominion 2004a). Residual chlorine is monitored in the effluent water. Thermal backwashing is also performed to prevent mussels from fouling the intake structure pump bays.

Service water is withdrawn and diverted from the system before the water enters the condensers. This water is used in a variety of applications, including component cooling (e.g., pump bearings and spent fuel pool water) and fire protection. A maximum of 2.3 m^3/s (36,000 gpm) of service water is withdrawn.

Domestic-quality potable water, at a flow of about 1.3×10^6 L/d (3.3×10^5 gpd), is purchased by Dominion from the city of New London for drinking, sanitary purposes, and industrial processes (other than cooling). In the past, Millstone withdrew groundwater from several wells onsite for sanitary purposes, but no longer does. Dominion maintains registrations for these wells. Sanitary waste from Millstone is discharged into the wastewater treatment system operated by the city of New London.

2.1.4 Radioactive Waste Management Systems and Effluent Control Systems

Millstone liquid, gaseous, and solid radioactive waste management systems collect and treat the radioactive materials that are produced as a by-product of plant operations. The Millstone processing systems are designed and operated to meet the dose design objectives of 10 Code of Federal Regulations (CFR) Part 50, Appendix I. Solid radioactive waste is packaged, stored onsite, and transported to a licensed treatment or disposal facility.

Radioactive material produced from fission of uranium-235 and neutron activation of metals in the reactor coolant system is the primary source of liquid, gaseous, and solid waste. The radioactive fission products build up within the fuel. Most of these fission products are contained in the fuel pellets and sealed fuel rods, but small quantities escape from the fuel rods into the reactor coolant. Neutron activation of trace concentrations of metals entrained in reactor coolant such as zirconium, iron, and cobalt creates radioactive isotopes of these metals. Both fission and activation products in liquid and gaseous forms are continuously removed from reactor coolant and captured on several different types of filter media. Units 2 and 3 operate separate liquid and gaseous processing systems. Gaseous discharges for each unit are monitored separately before they are discharged to the stack or to other designated release points for each unit. All liquid discharges are directed to a canal which terminates in the old quarry and the quarry discharges to Long Island Sound. All interconnections between Units 2 and 3 and Unit 1 were separated as described in *Millstone Power Station, 2002 Radioactive Effluent Release Report* (Dominion 2002b).

The radioactive-waste reduction facility is used for low-level radioactive solid waste processing and storage. Solid waste consists of spent fuel, contaminated equipment and components removed from service, dry active waste, solidified liquid waste, and spent filtration media. Spent fuel is removed from the reactor core and stored in each unit's spent fuel pool. Millstone is in the process of obtaining a permit to construct a dry fuel storage area for additional spent fuel assemblies. Dry active waste includes contaminated protective clothing, paper, rags, and other trash generated during operation and maintenance activities. Filter media include paper and glass fiber cartridge filters, resin beads or powder, and metallic filters. Class A, B, and C solid waste, as defined in 10 CFR Part 61, may be processed for volume reduction or is shipped to a licensed disposal facility. The State of Connecticut, a member of the Southeast Low Level Waste Compact, has access to the Barnwell, South Carolina disposal facility through the renewal period.

The Radiological Effluent Monitoring Offsite Dose Calculation Manual (ODCM) provides the sampling and analysis requirements and the methods used for calculating the concentration of radioactive material in effluents and the estimated offsite doses (Dominion 2004b). The ODCM also provides guidelines for operating radioactive waste treatment systems and instrumentation in order that offsite doses are kept ALARA. Each unit's specifications for the minimum number of operable effluent monitors, alarm set points, monitoring instrumentation surveillance requirements, and required actions if the required monitors are not in service are listed in the ODCM. *Radioactive Effluent Release Reports* (Dominion 2002b; Dominion 2003b; Dominion 2004d) for 2001, 2002, and 2003 were reviewed. Data from the 2002 report were used to represent a typical year for capacity factors and operational events that impact the volume and activity of liquid, gaseous, and solid waste.

2.1.4.1 Liquid Waste Processing Systems and Effluent Controls

The liquid waste systems and effluent controls for Millstone Units 2 and 3 have the same general design and operation. There are two separate trains—one for normally tritiated, nonaerated, low-conductivity liquid waste associated with the primary coolant system and the other for all other aerated liquid wastes that are collected by the open drain systems. The primary liquid waste system contains higher radioactivity levels than are found in liquids collected from open drains. Processing of primary liquid waste occurs on a batch basis. The processing of the primary waste consist of filtration, degasification (when needed for shutdown) and ion exchange. Processed wastes are collected in monitor tanks, which are sampled prior to release. A radiation monitor in the discharge line records activity released and alarms if the activity level in the effluent exceeds predefined limits. A valve in the discharge line is actuated on a high-level alarm to terminate the release to the circulating water discharge tunnel. Both Units 2 and 3 have continuous releases from steam generator blowdown and service water and from turbine building sump discharge pathways and batch releases from low-activity liquid waste tanks. Some of the low-activity liquid waste streams, such as turbine building floor drains and steam generator blowdown, are sampled, monitored, and discharged directly to the environment during normal operations. The waste-processing systems for aerated drains, equipment drains, and sumps, although different for each unit, provide for sampling, continuous monitoring, and where appropriate, automatic termination of releases (Dominion 2004e).

Each liquid waste pathway has specific sampling, analysis, monitoring points, alarms, and operational parameters listed in the ODCM. The ODCM prescribes the alarm / trip points, which are based on 20 percent of the radiological effluent control limit (Dominion 2004b). The radioactivity released from each batch release or continuous release is recorded and reported annually to the NRC. During 2002, there were a total of 344 batch releases of liquid effluents and the volume of batched plus continuous releases were 3.34×10^{7} L (8.82×10^{6} gal) for Unit 2 and 1.78×10^{7} L (4.70×10^{6} gal) for Unit 3. Total fission and activation products released were 2.99×10^{9} Bq (0.0809 Ci) for Unit 2 and 5.51×10^{9} Bq (0.149 Ci) for Unit 3. Total tritium activity released was 7.66×10^{12} Bq (207 Ci) from Unit 2 and 4.92×10^{13} Bq (1330 Ci) from Unit 3 (Dominion 2003b). These releases are typical of annual releases from Millstone and are not expected to increase during the renewal period. These releases result in doses to members of the public that are well below the dose design objectives of 10 CFR Part 50, Appendix I, as discussed in Section 2.2.7.

2.1.4.2 Gaseous Waste Processing Systems and Effluent Controls

The Millstone waste-processing systems are designed to meet 10 CFR Part 20 and 10 CFR Part 50, Appendix I. Unit 2 processes waste gases from the reactor coolant system by storage, decay, and particulate filtration. Unit 3 processes gases removed from the reactor coolant system through a series of filter banks designed to delay noble gases and capture radioiodine. Monitors record the concentration of particulate, iodine, and noble gases released. Sampling and analysis used to identify and quantify isotopes are described in the ODCM (Dominion 2004b).

In Unit 2, process waste gases from the reactor coolant system are compressed and collected in six tanks. The six tanks provide adequate storage capacity for a decay time of 90 days. The waste-gas decay tanks are sampled prior to release and discharged through a filter to the stack. The discharge pipe contains a radiation monitor and redundant isolation valves. A high-level alarm will automatically close an isolation valve to terminate the release. Both Air Ejector and Auxiliary Building roof vents are separate monitored release paths. Containment ventilation is processed through a HEPA (high efficiency particulate air) filter and a charcoal filter and monitored prior to release in the stack. Auxiliary building, fuel building, and containment purge exhaust is processed through a HEPA filter and monitored prior to release at the enclosure building roof vent (Dominion 2004e).

For 2002, Unit 2 total fission and activation gas activity released was 4.74×10^{12} Bq (128 Ci), iodine-131 was 1.81×10^{8} Bq (4.90×10^{-3} Ci), particulates were 4.5×10^{5} Bq (1.22×10^{-5} Ci), and tritium was 1.15×10^{12} Bq (31.2 Ci) (Dominion 2003b). Historically, releases of noble gases and radioactive iodine from Unit 2 have been higher than from Unit 3 (Dominion 2003b).

Unit 3 has two separate systems for waste-gas collection and discharge. Process gas from the reactor coolant system and its support systems is passed through and filtered by charcoal bed adsorbers and HEPA filters. The charcoal adsorbers hold up noble gases long enough in comparison to their half-lives so that most of these radioisotopes are effectively removed by radioactive decay. Radioactive iodine is removed by the charcoal beds and a small quantity of noble gases are released to the stack. The process vents are designed to collect the low-activity aerated gas streams from drains, condenser air, containment vacuum system, and some of the relief valve discharges. Exhausts from the containment, fuel auxiliary, and waste-disposal buildings can be discharged directly to the reactor plant ventilation vent or processed through a HEPA / charcoal filter bank. Vents in the turbine building, steam generator blowdown tank, and safeguards building exhaust to the atmosphere during normal operations (Dominion 2004e).

For 2002, Unit 3 total fission and activation gas activity released was 9.07×10^{10} Bq (2.45 Ci), iodine-131 was 5.62×10^{4} Bq (1.52×10^{-6} Ci), particulates were 2.25×10^{6} Bq (6.08×10^{-5} Ci), and tritium was 1.75×10^{12} Bq (47.3 Ci) (Dominion 2003b). These releases from both units are typical of annual releases from Millstone and are not expected to increase during the renewal period. These releases result in doses to members of the public that are well below the dose design objectives of 10 CFR Part 50, Appendix I, as discussed in Section 2.2.7.

2.1.4.3 Solid Waste Processing

The radioactive solid waste systems are designed to collect, hold, process, dewater, solidify, package, and store waste until shipment off site. Volumes, activity levels, and number of shipments are reported in the *Radioactive Effluent Release Reports* (Dominion 2003b). Solid-waste containers, shipping casks, and methods of packaging meet applicable Federal regulations (10 CFR Part 61, Department of Transportation 49 CFR Parts 171–178). Materials processed as solid waste include the following: concentrated boric acid, spent resin, spent filter cartridges, sludges, and miscellaneous dry active wastes. Contaminated structures, equipment, and components are processed for volume reduction or prepared for direct disposal at one of the licensed low-level waste disposal facilities. Spent resins and filter media contain the highest concentration of radioactive material and require special handling and solidification. Dry active waste consisting of paper, personnel protective clothing, rags, mops, etc., are sorted and compacted. An offsite vendor may be used for further volume reduction (Dominion 2004e).

The condensate polishing facility processes spent condensate resin and is also used for storing mixed waste. Spent resins are generated from demineralizers in the primary system, the chemical and volume control system, and the spent fuel pool clean-up system. The radioactive waste storage facility and the onsite storage containers are used to store liners that contain higher-activity waste such as dewatered resin and filters. The radioactive waste storage facility is also used for sorting, processing, loading, and shipping radioactive materials. Temporary waste storage containers are shielded to protect operating personnel (Dominion 2004e).

All radioactive waste is shipped to a licensed burial site in accordance with applicable NRC, U.S. Department of Transportation, and U.S. Environmental Protection Agency (EPA) regulations, including burial site regulation requirements. The quantities shipped off site for processing and burial are reported to the NRC in the *Annual Radioactive Effluent Release* (Dominion 2003b). In 2002, Millstone made a total of three low-level waste shipments, two mixed waste shipments, one low-level waste shipment of spent resin, and 14 shipments of water, dry active waste, contaminated equipment, or sludges. Unit 2 solid waste volume was 345 m^3 (1.22×10^4 ft^3) and the total activity was 1.30×10^{12} Bq (35.2 Ci) and Unit 3 solid waste volume was 24.3 m^3 (858 ft^3) and 2.80×10^{12} Bq (75.6 Ci) (Dominion 2003b). These solid waste volumes and amounts of radioactive material are typical of annual waste shipments for both Millstone units and are not expected to increase during the renewal period.

2.1.5 Nonradioactive Waste Systems

Hazardous, nonradioactive waste is regulated under the Resource Conservation and Recovery Act (RCRA), administered by the CTDEP, which classifies Dominion as a large-quantity generator. Dominion has petitioned the CTDEP to be classified as a small-quantity generator because of a reduction in the amount of waste generated at Millstone. Dominion operates under interim RCRA status (EPA ID # CTD00084518) while its permit application is being reviewed. Dominion currently is not considered to be a significant noncomplier (EPA 2004a; Kostiuk 2004).

Millstone uses licensed commercial haulers for its solid and hazardous wastes. Common types of hazardous waste generated at Millstone are lead acid sludges and batteries, solvent rags, and sawdust contaminated with chemicals regulated under RCRA.

2.1.6 Plant Operation and Maintenance

Routine maintenance performed on plant systems and components is necessary for safe and reliable operation of a nuclear plant. Maintenance activities conducted at Millstone include inspection, testing, and surveillance to maintain the current licensing basis of the plant and to ensure compliance with environmental and public safety requirements. Certain activities can be performed while the reactor is operating. Others require that the plant be shut down. Dominion refuels Millstone on an 18-month schedule. Up to 700 to 800 additional contractor employees are employed for the approximately 30-day refueling outage (Dominion 2004a).

Millstone performed an aging management review and developed an integrated plant assessment for managing the impacts of aging on systems, structures, and components in accordance with 10 CFR Part 54. The aging management program is described in Section 3 of the Environmental Report (Dominion 2004a). The integrated plant assessment identified the programs and inspections that are managing the impacts of aging at Millstone. The integrated plant assessment did not identify any need for additional refurbishment or replacement activities. Dominion assumes that an additional 60 employees will be needed to perform all the necessary surveillance, monitoring, inspections, testing, trending, and record-keeping activities during the license renewal period.

2.1.7 Power Transmission System

Four 345-kV transmission lines connect Millstone to the power grid (Table 2-1) (Dominion 2004a). The four lines share a common right-of-way for 14.5 km (9 mi) north to Hunts Brook Junction. At Hunts Brook Junction, two lines run north to the Card Street and Manchester substations, one line runs east to the Montville station, and one line runs west to the Southington substation (Figure 2-4). All Millstone lines share rights-of-way with lines from other sources and would be maintained regardless of continued Millstone operation status.

Table 2-1. Millstone Transmission Rights-of-Way

		Length		Width		Max Area[a]	
Substation	**kV**	**km**	**(mi)**	**m**	**(ft)**	**ha**	**(ac)**
Hunts Brook Junction	345	14.5	(9)	152	(500)	220	(545)
Montville	345	6.4	(4)	99	(325)	64	(158)
Card Street	345	32	(20)	91	(300)	294	(727)
Manchester	345	61	(38)	91	(300)	559	(1382)
Southington	345	71	(44)	76	(250)	539	(1333)

(a) Max area calculations use maximum right-of-way width estimates.

The 14.5-km (9-mi) common right-of-way leading out of Millstone to Hunts Brook Junction is approximately 152 m (500 ft) wide and covers a maximum of 220 ha (545 ac). The line from Hunts Brook Junction to the Montville station is approximately 6.4 km (4 mi) long and 99 m (325 ft) wide for a maximum area of 64 ha (158 ac). The line to the Card Street substation is approximately 32 km (20 mi) long and 91 m (300 ft) wide for a maximum area of 294 ha (727 ac). The Card Street line shares most of its length with the Manchester line. The line to the Manchester substation is approximately 61 km (38 mi) long and 91 m (300 ft) wide for a maximum area of 559 ha (1382 ac). The line to the Southington substation is approximately 71 km (44 mi) long and 76 m (250 ft) wide for a maximum area of 539 ha (1333 ac).

CL&P manages vegetation within the four transmission rights-of-way with an approach it calls "two-zone maintenance" (NU 2004). The area directly beneath the transmission lines and extending out 4.6 m (15 ft) in either direction is called the "wire zone." Most vegetation in the wire zone is kept short except for the occasional clusters of red cedar (*Juniperus virginiana*) that are maintained for nesting habitat. The area from the edge of the wire zone to the outside edge of the right-of-way is called the "side zone." The side zone acts as a transition between the low structure of the wire zone and the forest. The side zone is maintained as a multi-layered habitat with low growing trees and shrubs.

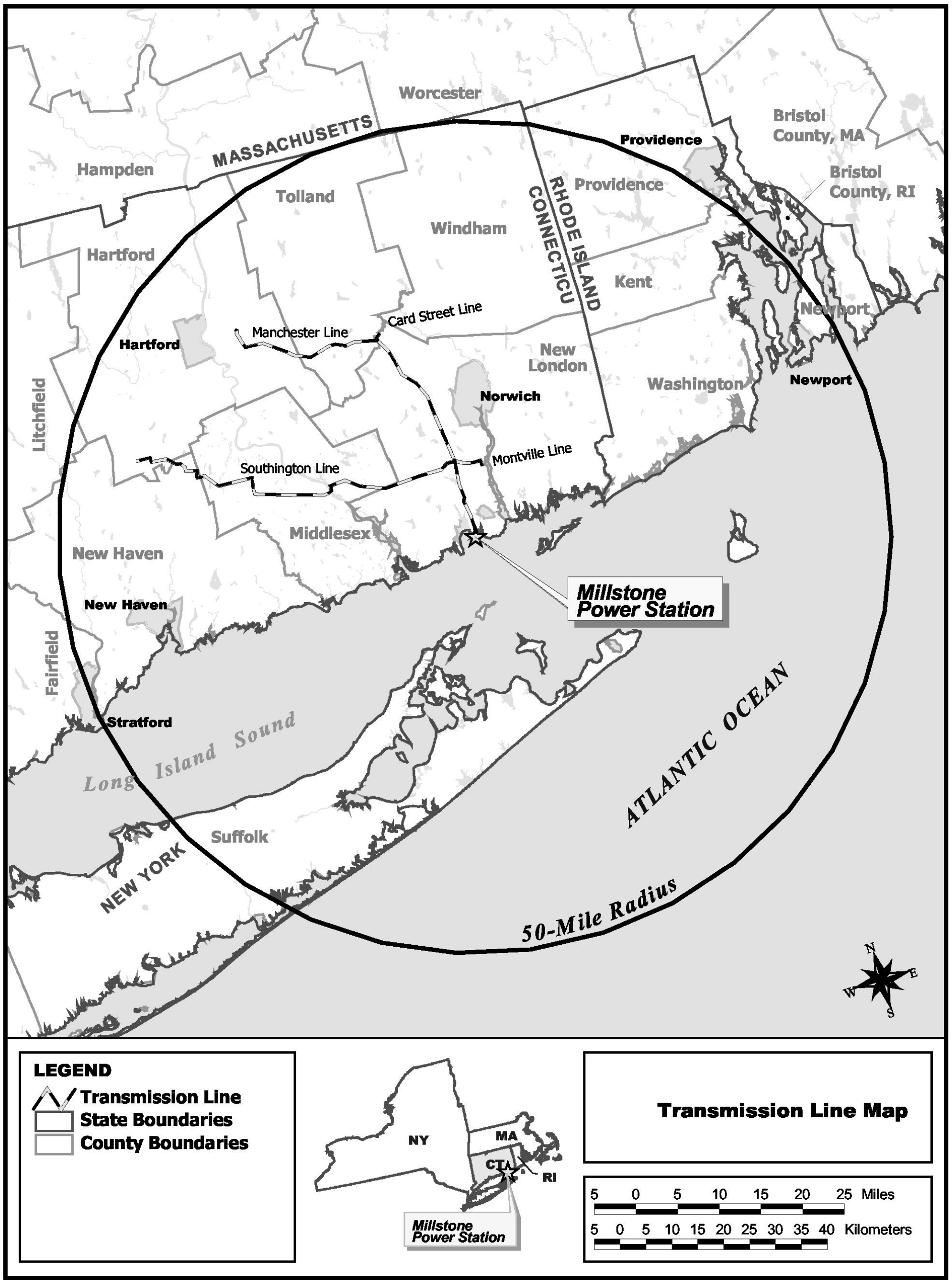


Figure 2-4. Millstone Transmission Lines

Vegetation is managed through a combination of mowing, trimming, and herbicide treatments. All personnel applying herbicides are required to process a valid applicator's license (NU 2004). Wetlands and other water bodies are protected from herbicides by a 3-m (10-ft) border (NU 2004). Mowing is conducted only between the months of November and April to minimize impacts to wet soils, nesting birds, and wildlife forage. CTDEP reviews all transmission right-of-way management plans to ensure protection of threatened and endangered species. CL&P personnel work closely with crews to ensure that transmission line maintenance is implemented properly.

CL&P encourages collaboration with conservation groups to use transmission rights-of-way for wildlife habitat improvement. CL&P has also developed a list of plant species and wildlife habitat types that it attempts to promote through its vegetation management actions (Ferrucci and Walicki 2002). Contractors are required to identify and target non-native, invasive plant species (Ferrucci and Walicki 2002).

2.2 Plant Interaction with the Environment

Sections 2.2.1 through 2.2.8 provide general descriptions of the environment near Millstone as background information. They also provide detailed descriptions when needed to support the analysis of potential environmental impacts of refurbishment and operation during the renewal term, as discussed in Chapters 3 and 4. Section 2.2.9 describes the historic and archaeological resources in the area, and Section 2.2.10 describes possible impacts associated with other Federal project activities.

2.2.1 Land Use

The Millstone site is approximately 212 ha (525 ac), including the developed area that is approximately 89 ha (220 ac). The lands at Millstone are designated as "public utility" on the 1996 *Existing Land Use* map for Waterford. They are within an industrial zone south of the Amtrak Northeast Corridor rail line, and are within an industrial park zoning district north of the rail lines. Waterford's *Future Land Use Plan* map calls out the Millstone site as an "electric generation facility." The plan specifies that this land use applies to "The area presently devoted to use by Millstone and associated facilities necessary for the generation and transmission of electricity." Also shown on the *Future Land Use Plan* map at Millstone are lands on the site designated for "natural resources." The plan notes that these are "areas that exhibit significant environmental constraints . . . and that represent the highest priorities for conservation. Use of these areas should be generally restricted or discouraged." These areas include wetlands and coastal resource areas. The entire shoreline of Millstone and of Waterford is considered a scenic area according to the Waterford Plan. The Coastal Boundary established by the 1982 Municipal Coastal Program (pursuant to Connecticut General Statutes Section 22a-94) encircles all of Millstone Point and includes offshore waters and lands within about 305 m (1000 ft) of the shore. Restoring freshwater wetlands at Millstone Point is encouraged by the plan. Adjacent land uses (existing and future) are shown for waterfront business development, residential, open space, and power transmission (Waterford 1998).

The current land uses on the land abutting the Millstone site are nearly exclusively single-family residential neighborhoods. A large undeveloped tract of forested private land that is also zoned for single-family residential uses abuts the site to the east of the recreation fields across Gardiners Wood Road. There is a small eighteenth century burial ground that abuts the site to the north and fronts Rope Ferry Road. A convalescent residential care center is located across from the main entrance to Millstone on the north side of Rope Ferry Road. The nearest commercial areas are found nearly 5 km (3 mi) away, where there are several small shopping centers and stand-alone retail establishments at Jordan Village, which is also the center for town government and the location of the high school. Maritime enterprises that cater to small fishing and pleasure craft are found at Mago Point about 1 km (0.6 mi) from Millstone.

Section 307(c)(3)(A) of the Coastal Zone Management Act [16 USC 1456(c)(3)(A)] requires that applicants for Federal licenses to conduct an activity in a coastal zone certify that the proposed activity is consistent with the enforceable policies of the State's coastal zone program. A copy of the certification is also to be provided to the State. The State is to notify the Federal agency whether the State concurs with or objects to the applicant's certification. This notification is to occur within 6 months of the State's receipt of the certification. The Millstone plant is within Connecticut's coastal zone for purposes of the Act. Following submission of the Dominion certification of consistency, the CTDEP waived a separate Federal coastal consistency review. CTDEP will evaluate consistency for the renewal of the OLs for Millstone in conjunction with the State's National Pollution Discharge and Elimination System (NPDES) permit review process (CTDEP 2004b). A copy of the letter is in Appendix E of this draft Supplemental Environmental Impact Statement (SEIS).

2.2.2 Water Use

Millstone receives water from the city of New London for potable and service uses at the plant. This freshwater is derived from the Lake Konomoc reservoir, located in Waterford and Montville on the mainland. Current plant usage averages approximately 1.3×10^6 L/day (3.3×10^5 gpd). The usage represents approximately 5.2 percent of the city of New London's daily capacity and 6 percent of the city's average daily use (Dominion 2004e). In the past, Millstone withdrew groundwater from three wells onsite for sanitary purposes, but no longer does so. However, registrations for these wells are maintained. Sanitary wastes generated at Millstone are discharged into the New London wastewater treatment facility.

Noncontact cooling water for Millstone Units 2 and 3 is withdrawn from Long Island Sound. Additional minor amounts of ocean water are used for fire protection and other systems. The water withdrawn from Long Island Sound represents about 3 percent of the mean tidal flow estimated for the Niantic Bay in the vicinity of Millstone (Dominion 2004a). The quantity of fresh water flow into Niantic Bay or Jordan Cove is not gauged (U.S. Geological Survey 2004), but is small relative to the estimated tidal exchange volumes. Dye tracer and modeling studies estimate that 20 percent of the Niantic River discharge goes through the plant (Dominion 2004f). After passing through the condensers and service water system, most of the Millstone cooling water is returned to Long Island Sound.

The Millstone site has several shallow wells near it, the nearest being 0.5 km (0.33 mi) from the station proper (Dominion 2004e). None of these wells provide water for domestic purposes, but two shallow wells in the northern part of the site were used to irrigate ball fields and supply concession stands at the field. In 2001, the concession stands were connected to a municipal water supply, and one of the two wells was filled in and abandoned. The remaining well is pumped seasonally. Because of its shallow depth of 6.7 m (22 ft) and pump size, Dominion has estimated its pumping capacity to be much less than 379 L per minute (100 gpm) (Dominion 2004a).

The ground-water environment at Millstone is characterized by generally impermeable bedrock (gneiss and granite) overlain by glacial tills and soil of varying permeabilities (Dominion 2004d). There appears to be little movement of water through fractures in the bedrock because the quarry did not fill with either fresh or salt water after its abandonment in 1960 (Dominion 2004e). A ground-water contour map of the site indicates that the ground-water table is highest in the northern part of the site and slopes gradually towards the shoreline (Dominion 2004e). Therefore, groundwater at the ball field area is hydraulically upgradient of the station proper.

2.2.3 Water Quality

In accordance with the Federal Water Pollution Control Act (also known as the Clean Water Act), the water quality of plant effluent discharges is regulated through the NPDES. CTDEP is the agency delegated by the EPA to issue discharge permits in Connecticut. Dominion holds an NPDES permit for cooling system discharges and several other plant and storm water discharges. The NPDES (CT0003263) permit sets limitations on water quality in effluent discharges and establishes specific monitoring requirements and the reporting frequency. The NPDES permit, which is renewed every five years, expired in 1997. Dominion filed a timely permit renewal application and is awaiting CTDEP issuance of a new NPDES permit. Until the new permit is issued, Dominion is operating under the requirements of the current permit.

The current permit requires monitoring of discharges from the circulating cooling water system, house service boiler blowdown system, the high-conductivity water tank discharge system (including steam generator blowdown), and the radiation waste holdup and treatment system. Discharge limitations vary with location, and include flow, maximum discharge temperature, incremental temperature difference, chlorine, boric acid, oil and grease, suspended solids, pH, iron, copper, zinc, and chromium. Impacts to Long Island Sound are also considered in the permit, for parameters such as odor, coliform bacteria, and dissolved oxygen. Recent monitoring results show that the discharge quality occasionally exceeds permit limits. In addition to requiring chemical specific testing, the NPDES permit also requires testing of discharges for biological toxicity. The testing has shown no significant biological toxicity.

At full discharge flow, water temperatures increase approximately 9 to 14 °C (17 to 26 °F) as it crosses the condensers. The NPDES permit for Millstone limits the discharge temperatures to 40 °C (105 °F) and the maximum increases in temperature at the quarry cut to 18 °C (32 °F) above intake temperatures at full flow. The discharge is not allowed to increase the temperature of Long Island Sound beyond an 2438-m (8000-ft) radius mixing zone by more than an average of 2.2 °C (4 °F) or above 28 °C (83 °F). Monitoring data indicates that the thermal plume is warmest in the immediate vicinity of the quarry cuts and the surface-oriented plume from three-unit operation was shown to cool to less than 2.2 °C (4 °F) above ambient temperatures within approximately 1100 m (3610 ft) of the quarry (Dominion 2004c).

Total residual chlorine concentrations in the discharge at the quarry cut must not exceed 0.1 mg/L, according to the NPDES permit. Detectable concentrations of free available chlorine may be present for no more than two hours in any one day. Millstone is expected to remain in compliance with the permitted chlorine concentrations.

2.2.4 Air Quality

Millstone has a continental climate modified by marine influences. The northeastern U.S. climate is influenced heavily by the upper level westerlies that prevail at the earth's middle latitudes. Large-scale air masses and storm systems normally approach the area from southwesterly through northwesterly directions, particularly in the colder seasons when the jet stream steers storms along preferred storm tracks that often cross New England. The influence of the ocean and Long Island Sound moderates the climate on more local scales. Temperatures along the coast tend to be less extreme than in inland areas, and the humidity tends to be higher. Warmer temperatures along the coast in winter contribute to snowstorms changing to rain before reaching the area. Differential heating of the ocean and land surfaces leads to localized, diurnal sea and land breezes, particularly in the warmer seasons. Proximity to the ocean sometimes contributes to two types of less frequent, but violent storms. Tropical storms or hurricanes, can occasionally make their way up the Atlantic seaboard from the south and deliver strong winds and heavy rains to New England coastal locations, in the summer and autumn months. Also, the relatively warm ocean waters off the east coast in winter can provide the energy for explosive growth of extratropical cyclones, many producing "northeasters" in New England, leading to strong winds and heavy snowfalls. Because of Millstone's proximity to the ocean, the National Weather Service observing station at Bridgeport, Connecticut can be expected to experience a climate very similar to Millstone and can be used to represent long-term weather statistics at Millstone. Bridgeport is also located near the coast, approximately 97 km (60 mi) west of Millstone.

Climatological records from 1971 to 2000 at Bridgeport (National Oceanic and Atmospheric Administration [NOAA] 2003) indicate that the normal daily maximum temperatures for the area range from 2.7 °C (36.9 °F) in January to 27.7 °C (81.9 °F) in July. Normal minimum temperatures range from −5.1 °C (22.9 °F) in January to 18.9 °C (66.0 °F) in July. The prevailing wind direction, based on a 15-year period of record (NOAA 2003), at Bridgeport for the months of November through January is from the west-northwest. The prevailing direction in February and March is from the northwest, while wind direction from April through October is mostly southwesterly.

Comparison of meteorological data collected at Millstone to data collected at Bridgeport during the years 1974 to1980 (Dominion 2004a), indicates that there are differences in the sea breeze characteristics between these two locations. Onshore flows at both sites tended to occur more frequently in the south-southwest to west direction than in the east-southeast to south direction. However, onshore winds from the east-southeast to south direction did occur more frequently at Millstone than at Bridgeport. Offshore flows from the west-northwest to north direction were recorded more frequently than winds from the north-northeast to east direction at both sites, with north-northeast to east winds occurring slightly more frequently at Bridgeport than at Millstone. In general, monthly average temperatures tended to be cooler at Millstone, particularly during the summer. Also, humidity tended to be lower at Millstone in the warmer months and was generally higher in the cooler months. This comparison is not rigorous and can only be used as a qualitative measure of relative difference between Millstone and the climate record at Bridgeport. The differences that exist in instrumentation type and height and frequency of observations, together with the short time frame of the comparisons (7 years) do not permit quantitative comparisons.

Precipitation in Connecticut is evenly distributed throughout the year and average annual snowfall is the lowest near the coast (Connecticut State Climate Center 2004). Normal annual precipitation at Bridgeport is 1120 mm (44.15 in.), with the lowest monthly mean of 74 mm (2.92 in.) in February, and the highest monthly mean of 105 mm (4.15 in.) in March (NOAA 2003). Normal annual snowfall at Bridgeport, is 64 mm (25.2 in.). Measurable snowfalls typically occur in the months of November through April.

Thunderstorms occur most often in the summer months with an average of 20.3 thunderstorms at Bridgeport, annually, based on a 40-year period of record (NOAA 2003). The probability of a tornado striking the site is 1.28×10^{-4} per year, based on statistics from the years 1955 through 1983 (Ramsdell and Andrews 1986). During the years between 1900 and 2000, there were eight direct-hitting hurricanes on the coast of Connecticut. Three of these were considered major hurricanes (Jarrell et al. 2001).

Wind energy potential along the coast of Connecticut is rated as wind Class 3 on a scale of 1 to 7 (Elliot et al. 1986). These ratings indicate that wind is potentially viable as an energy resource in this area.

Millstone is located in New London County, which is part of the Eastern Connecticut Intrastate Air Quality Control Region (40 CFR 81.183). The entire state of Connecticut has been designated as an attainment area for carbon monoxide, nitrogen dioxide, lead, and sulfur dioxide. New London County is also designated as in attainment for particulate matter with a diameter of 10 μm or less. New London County has been designated as serious nonattainment for the EPA 1 hour ozone standard (40 CFR 81.307, CTDEP 2002a).

Diesel generators, boilers, and other activities and facilities associated with Millstone emit various nonradioactive air pollutants to the atmosphere. Air emissions from these sources are subject to Connecticut General Statutes section 22a-174-33 of the Regulations of Connecticut State Agencies (Connecticut Legislature 2003). Emissions from these sources are regulated under permit number 199-0038-TV, which was issued January 29, 2003, and expires January 29, 2008.

2.2.5 Aquatic Resources

Millstone is located at Millstone Point, a small peninsula of land situated on the west shore of Long Island Sound near Waterford, Connecticut. The plant is bordered on the west by Niantic Bay, to the east by Jordan Cove, and to the south by the Twotree Island Channel (Dominion 2004f) (Figure 2-5). The plant is located approximately 1.6 km (1 mi) southeast of the mouth of the Niantic River and approximately (5.6 km) 3.5 mi west of the Thames River. Cooling water intake structures are located in Niantic Bay and are situated approximately 4.6 to 7.6 m (15.1 to 24.9 ft) below mean sea level. There are three separate intakes, one for each unit, that are located along a 200-m (656-ft) stretch of shoreline on the western boundary of Millstone Point. The Unit 1 intake is no longer used because the unit is undergoing decommissioning. Dye studies conducted by the Massachusetts Institute of Technology prior to the operation of Unit 3 and again in 1988 suggested that about 20 percent of the water discharged from the station from the Niantic River could be passed through the Millstone

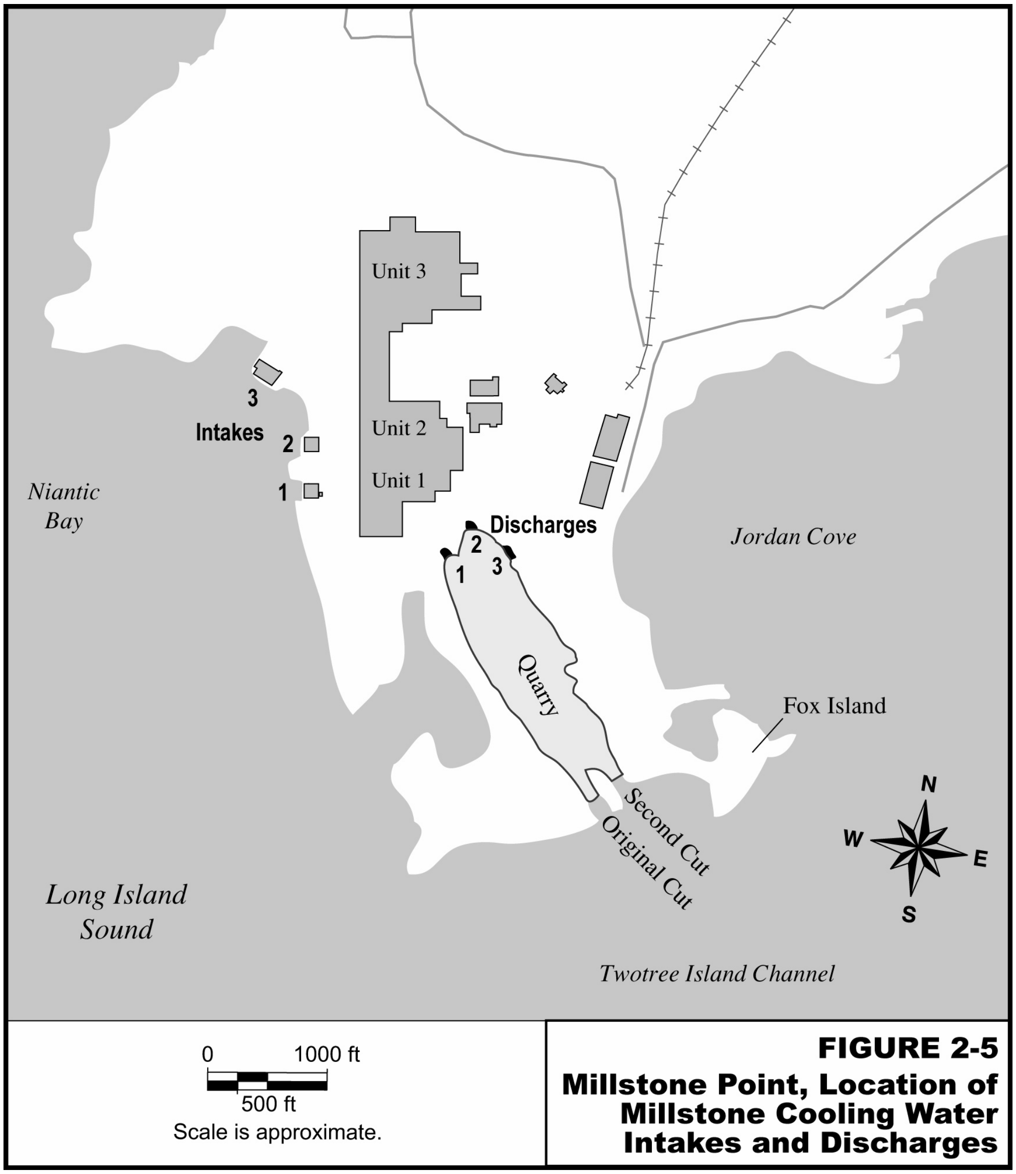


FIGURE 2-5
Millstone Point, Location of Millstone Cooling Water Intakes and Discharges

Figure 2-5. Millstone Point, Location of Millstone Cooling Water Intakes and Discharges

cooling water system under three-unit operation (Lorda et al. 2000; Dimou and Adams 1989). Once-through cooling water is discharged into an abandoned granite quarry located in approximately the center of Millstone Point. Water then flows into Long Island Sound near the Twotree Island Channel (see Figure 2-5). The maximum allowed daily flow of the discharges is 1.0×10^{10} L/d (2.7×10^{9} gpd). The current NPDES permit limits the maximum temperature of the discharge points at the quarry cut to 40.6 °C (105 °F), with a maximum temperature increase of 17.8 °C (32 °F) above the intake water temperature under normal conditions.

2.2.5.1 General Water Body Characteristics

Long Island Sound is a large water body, comprising 3419 km^2 (1320 mi^2), with 966 km (600 mi) of coastline. The drainage area associated with the water body is approximately 43,564 km^2 (16,820 mi^2). The average depth of the sound is 19 m (63 ft); and the approximate volume is 68 trillion L (18 trillion gallons). It is estimated that 20 million people live within 80 km (50 mi) of the sound (EPA 2004b).

Millstone Point lies on the western shore of Long Island Sound, near the mouth of the sound. This area of Long Island Sound experiences a salinity of approximately 23 parts per thousand. Salinity is influenced by the presence of three major rivers: the Thames, the Housatonic, and the Connecticut. These rivers flow into the Sound in the vicinity of the site. Ambient water near Millstone cooling water intakes can range from 1.0 to 22.0 °C (33.8 to 71.6 °F) over the course of a year. Linear regression performed on regional daily and annual seawater temperatures over a 25-year period revealed a significant increase in water temperature of 1.55 °C (2.8 °F) based on daily means and 1.01 °C (1.8 °F) based on annual means (Keser et al. 2003). Millstone Point is situated approximately 5.6 km (3.5 mi) west of the Thames River, in an area that experiences strong tidal currents that influence the nearshore ecosystem, which includes rocky coastlines and boulder and gravel substrate beaches. The ecosystem supports a variety of fish, invertebrate, and marine plant life. The average tidal flow through Twotree Island Channel is approximately 3400 m^3/s (1.2×10^5 ft^3/s) with a maximum flow of about 8500 m^3/s (3.0×10^5 ft^3/s). This translates into current velocities of about 1.8 to 3.3 km/hr (1 to 1.8 knots), with slightly lower velocities near the plant. Weak currents predominate in both the Niantic River and Jordan Cove. Tidal fluctuation in this area is not severe, with mean and maximum ranges of 0.8 and 1.0 m (2.6 and 3.3 ft), respectively (Dominion 2004f).

EPA Region 1 has identified Long Island Sound as “an estuary of national significance” and listed six problem areas of concern associated with water quality (EPA 2004c):

(1) Low dissolved oxygen (hypoxia)
(2) Toxic contamination
(3) Pathogen contamination
(4) Floatable debris
(5) Habitat degradation and loss and living resource health associated with items 1 to 4
(6) Land use and development resulting habitat loss and degradation of water quality

These environmental issues have resulted in a variety of long-term, integrated studies of Long Island Sound by both State and Federal agencies.

2.2.5.2 Chemical Contaminants Near Millstone

Specific chemical data associated with sediment, water, or biota near the Millstone study area were not available for review, but, in general, surficial sediment associated with the eastern portion of Long Island Sound exhibits lower levels of common contaminants (metals, polyaromatic hydrocarbons, polychlorinated biphenyls, pesticides) than western Long Island Sound. Recent U.S. Geological Survey data (Mecray et al. 2004) suggested that metal concentrations showed regional patterns of high concentrations in the western sound, with relatively low concentrations associated with the eastern sound in the vicinity of Millstone. Draft data provided by Battelle (1999) associated with surficial samples from the Thames River indicated that most metals were below NOAA effects-range-median (Long et al. 1998), and organic constituents were at or near analytical detection limits with the exception of the polyaromatic hydrocarbon, perylene, which was detected at concentrations ranging from approximately 20 to 1200 µg/kg dry weight. It is suspected that the source of this compound is biogenic rather than anthropogenic.

A citizens' group conducted limited chemical and radiological monitoring of bottom sediments in the vicinity of Millstone and reported possible elevated levels of hydrazine and uranium in the bottom sediments of Jordon Cove (CTDEP 2002c). The chemical compound 1,1-dimethylhydrazine (UMDH) was reported as detected in two sediment samples at low levels. It was postulated that the UMDH might be due to hydrazine used at Millstone for corrosion control. CTDEP reviewed available information and concluded that the detections likely were false positives because of questionable quality of the analytical procedures, and it was unlikely that hydrazine could accumulate in bottom sediments because it degrades rapidly into water and nitrogen. In addition, the particular chemical form of hydrazine used at Millstone is different than UMDH. There are also industrial facilities in the area that commonly use hydrazine. CTDEP also concluded that the types and levels of uranium measured in sediments near Millstone reflected naturally occurring background levels (CTDEP 2003c). Neither concern was judged by CTDEP to be sufficiently credible to warrant further investigation.

2.2.5.3 Expected Changes or Modifications to Water Body Over Life of Plant

Dredging near cooling water intakes was required during plant construction in the 1970s, and was permitted by the U.S. Army Corps of Engineers (USACE) under permit DACW33-71-C-0024 on February 6, 1970, for Unit 2, and under permit DACW33-75-C-0095 on June 10, 1975, for Unit 3. Dominion also informed USACE and the CTDEP on February 23, 1977, of its intent to maintain the existing 16.8-m (55-ft) wide quarry cut riprap and fish barrier structures associated with Units 1 and 2 and received permission from CTDEP to construct and maintain another 16.8-m (55-ft) wide quarry cut entering Jordan Cove on February 23, 1977, to support Unit 3 operation (Figure 2-3). If further maintenance dredging is required during the life of the plant, it is assumed Dominion will obtain the necessary permits from USACE and CTDEP as they have in the past.

Because the discharge of cooling water and other effluents associated with plant activities are permitted under the NPDES administered by the CTDEP, it is assumed future discharge during the life of the plant will be regulated under this system.

2.2.5.4 Important Fish and Shellfish Communities Near Millstone

A variety of commercially, recreationally, or environmentally important fish and shellfish live or spend a portion of their life cycle in the vicinity of Millstone and also commonly occur in Long Island Sound. Many of these species live in the waters near the Millstone, travel through the area during their seasonal migrations in and out of Long Island Sound, or pass close to the plant as they enter rivers adjacent to Millstone during their spawning seasons. Because of their proximity to Millstone, they may be susceptible to entrainment, impingement, or to other lethal or sublethal effects associated with plant operations. In order to assess relative species abundance near Millstone operations, a variety of collection and enumeration methods have been employed, including subsampling cooling water discharge using plankton nets to determine ichthyoplankton (fish eggs and larvae) abundance, shore zone seines to capture small fish, and bottom trawls to capture larger, demersal fish (Dominion 2004f). In general, assessments of fish and shellfish have included sampling stations in direct proximity to the plant (e.g., within a radius of approximately 3.2 km [2 mi]). Sampling stations have included a station located near the Unit 2 and 3 cooling water discharge, stations in the Niantic River and Bay, and stations in Jordan Cove. Far-field reference sites were not included in the fish and shellfish monitoring programs, nor were sampling grids located at varying distances from the area of interest to identify environmental gradient effects. The exception to this were plume dynamic studies and assessments of intertidal ecosystems.

2.2.5.5 Population Trends Associated with Important Fish and Shellfish Species

The following is a summary of the general population trends associated with the species that are considered important commercially, recreationally, or ecologically.

- **American Lobster**

The American lobster (*Homarus americanus*, family Nephropidae) is common in western and eastern Long Island Sound, with a range extending from Canada to Cape Hatteras. Lobsters represent an important fishery in New England, and the northern Atlantic cost of the U.S.

Lobsters can live up to 70 years; 6-year old individuals weigh approximately 0.5 kg (1 lb). Populations of American lobster near Millstone have been estimated from field studies since 1978 based on lobster pot deployments in the vicinity of Millstone. Lobster populations in eastern Long Island Sound have shown significant fluctuations in abundance over the past two decades, and the recent collapse of the fishery in 2000 caused the U.S. Secretary of Commerce to declare a failure of the commercial lobster fishery in Long Island Sound in January 2001 (Dominion 2004f; Sea Grant 2004a). Since that time, the lobster fishery has attracted the attention of both State and Federal agencies, resulting in regional scientific symposia, Sea Grant research initiatives, and increased environmental sampling at both state and local levels (Sea Grant 2004a). At present, it is believed some of the decline observed in the fishery can be attributed to the combined effects of disease and parasitism, but it also appears that the controlling factors might be attributed to physiological and biological stresses associated with the ecosystem change, including regional water temperature increases and the impacts of persistent environmental contaminants.

Populations associated with Millstone, expressed as the geometric mean catch per unit effort (CPUE), have been variable over the past two decades, but have not exhibited the significant population crash observed elsewhere in the fishery since 2002.

- **Winter Flounder**

The winter flounder (*Pseudopleuronectes americanus*, family Pleuronectidae) is the most common shoal water flounder occurring in the Gulf of Maine. Adults are typically 30 to 38 cm (12 to 15 in.) and weigh between 0.5 and 0.9 kg (1 and 2 lbs). It is an important commercial and recreational resource in New England (Bigelow and Schroeder 1953; NOAA 1998). Winter flounder tend to return to their natal estuaries in the late fall and early winter to breed and gradually migrate offshore in the spring and summer months to avoid increasing water temperatures. Individual females can produce up to 500,000 eggs. Commercial harvest is generally accomplished with trawls or seines. Winter flounder populations near Millstone and in Long Island Sound have shown an overall decrease over the past two decades (Figure 2-6).

The abundance of winter flounder peaked in the 1980s as a result of extraordinarily large year-classes produced during abnormally cold winters during the 1970s (Dominion 2004f). Comparison of abundance estimates from the Niantic River near Millstone with regional trends in Long Island Sound suggest similar regional decreases in abundance during concurrent reporting years (Figure 2-6) (NOAA 1998; MacLeod 2003; National Marine Fisheries Service [NMFS] 2003).

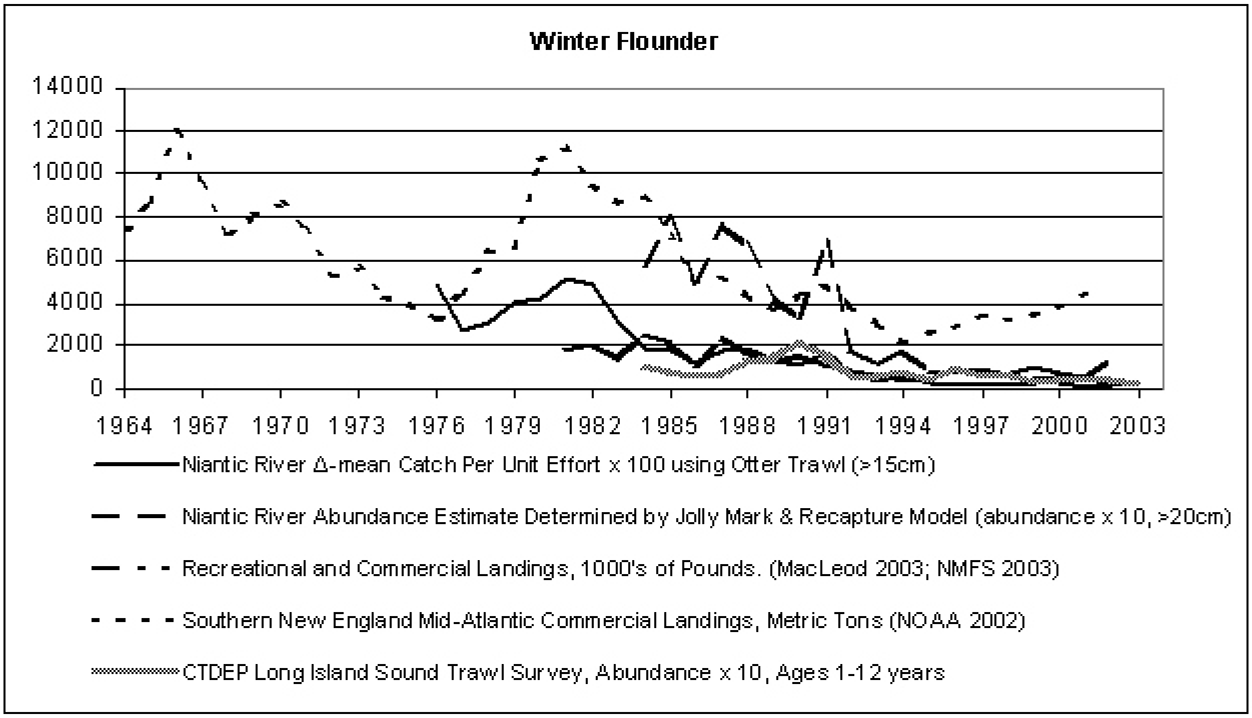


Figure 2-6. Comparison of Winter Flounder Population Trends in Niantic River and Long Island Sound

According to NOAA, “The continuing low level of landings, catch per unit effort indices, and survey indices suggest that winter flounder abundance in the Gulf of Maine has been reduced substantially. Future improvements in the condition of the stock will depend on decreases in exploitation in both the recreational and commercial fisheries, and on improved recruitment. The stock is at a low biomass level and is considered to be exploited” (NOAA 1998). It is possible that a variety of environmental factors may be responsible for decreasing flounder abundances in the Niantic River in addition to fishing mortality, including entrainment of larvae by Millstone, increasing water temperatures in the region, and habitat degradation associated with the Niantic River estuary associated with contaminant or nutrient inputs. Because winter flounder exhibit high fidelity to their natal stream, localized impacts to this species during spawning and larval growth can dramatically influence population dynamics. At present, it is not possible to quantify the importance of the various environmental stresses or evaluate their true influence on winter flounder survival associated with the Niantic River.

- **American Sand Lance**

The American sand lance (*Ammodytes americanus*, family Ammodytidae) is a schooling fish that is common to estuaries and coastal nearshore waters. Its geographic range extends from Labrador to Chesapeake Bay (Dominion 2004f). This fish reaches a size of approximately 10 to 15 cm (4 to 6 in.), and prefers sandy habitats in shallow water, and muddy bottoms in deeper water, where it burrows to a depth of several inches. Sand lance generally congregate in schools and provide a food source to many larger fish and marine mammals (Bigelow and Schroeder 1953).

Sand lance abundance near Millstone was determined by trawl, seine, and sampling of cooling water using fine-mesh nets. Because few fish were caught by trawl or net, abundance estimates are based on larval entrainment sampling of Millstone cooling water. The overall trends using this metric suggest a large population abundance in 1978, followed by a decline to a relatively stable but low abundance from approximately 1982 to present. Given the nature of fish distribution and population dynamics, it is difficult to assess regional trends. Population studies (Monteleone et al. 1987) suggest large variations in population densities in Long Island Sound between 1951 and 1983, with peak abundances occurring in the late 1970s as they did in the Millstone studies. Population variations may be due to a variety of environmental factors, including fluctuations in water temperatures and predator abundance.

- **Anchovy**

Anchovies (*Anchoa mitchelli/Anchoa hepsetus*, family Engaulidae) are common along the Atlantic coast and coastal New England. These species are an important component of the food web, and provide food to a variety of sport and commercial fishes (U.S. Fish and Wildlife Service and United States Army Corps of Engineers [FWS/USACE] 1989). The fish are generally silver in color and seldom exceed 8 cm (3 in.) in length. Although anchovies have historically been an important commercial fishery on the west coast, they are not considered an important commercial species in the mid-Atlantic region. They are, however, one of the most important species in the mid-Atlantic region as a primary forage item for many economically important predators and represent an important part of the regional food web (FWS/USACE 1989).

Anchovy abundance in the vicinity of Millstone was estimated based on larval entrainment associated with plant cooling water (Dominion 2004f). Based on these evaluations, anchovy abundance reached its highest level in 1981, dropped dramatically between 1981 and 1982, and has gradually decreased since that time. Entrainment estimates at Millstone from 2000 to 2002 were the lowest levels recorded since the study was initiated. The data associated with the Dominion studies for this species exhibit a large variation in larval density, with large confidence limits associated with the delta mean[(a)] estimates (Dominion 2004f). Quantitative anchovy biomass data is not available for Long Island Sound or the Mid-Atlantic region; thus, it is not possible to assess whether the decreasing abundance of this species near Millstone is a reflection of regional populations.

- **Atlantic Menhaden**

The Atlantic menhaden (*Brevoortia tyrannus*, family Clupeidae) is a common inhabitant of coastal waters extending from Nova Scotia to southeastern Florida (Bigelow and Schroeder 1953). Adults average 30 to 38 cm (12 to 15 in.) in length and generally weigh 0.5 kg (1 lb) or less. Menhaden feed primarily on diatoms and small crustaceans, and they are an important part of the food web in the coastal system, serving as food for larger fishes. Atlantic menhaden support the largest commercial fishery along the Atlantic coast. The species is primarily used for fish meal, oil, and emulsions (Dominion 2004f). The status of the fishery is considered to be healthy, with commercial harvests over the past seven years for the Atlantis seaboard ranging from approximately 259 to over 300 MT (286 to 331 tons) (Beal et al. 1998).

Atlantic menhaden were collected sporadically by trawl or seine near Millstone over the past 20 years; thus reliable abundance estimates were not possible. Estimations of menhaden abundance based on larval entrainment suggest an overall increase in larvae from approximately 1987 to present, with the highest entrainment abundances recorded in 2002.

- **Silverside**

The silverside (*Menidia menidia*, family Atherinidae) is a small schooling fish common to bays, estuaries, and salt marshes of New England. They are omnivorous, feeding primarily on copepods, juvenile mysids, small shrimp, amphipods, and the eggs of other fish. Silversides grow to a length of approximately 13 cm (5 in.) and are used as bait fish and are ecologically important as prey for larger fish, including bluefish, mackerel, and striped bass (Bigelow and Schroeder 1953). Silverside abundance near Millstone was assessed by trawl and seine sampling. Abundances varied from year to year in the vicinity of the Millstone site without apparent long-term trend. Regional abundance data are not available.

- **Grubby**

Grubby (*Myoxocephalus aenaeus, family Cottidae*) are demersal fish common to New England waters from the tide mark to a depth of approximately 30.5 m (100 ft). They are found on a

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(a) The delta mean is an abundance estimator that is used when data approximates a log-normal distribution and numerous zeros are present.

variety of bottom types; they are most abundantly among eelgrass. Grubby exhibit a high tolerance to both salinity and temperature changes (Bigelow and Schroeder 1953). Grubby feed primarily on annelid worms, shrimp, small crabs, and mollusks, and are of limited recreational and commercial value. Grubby populations at Millstone were assessed using trawls at three locations near the power plant (Niantic River, Jordan Cove, and cooling water intake). Grubby populations have varied without apparent long-term trend in the vicinity of the Millstone site. Regional abundance data are not available.

- **Cunner**

The cunner (*Tautogolabrus adspersus*, family Labridae) is a coastal fish occurring from Newfoundland to Chesapeake Bay in shallow waters. They are plentiful from just below the tideline downward, and often are associated with eelgrass, rocks, pilings, and mussel beds (Dominion 2004f, Bigelow and Schroeder 1953). Cunner tend to stay close to the bottom and are not known to school. Cunners are relatively small fish (15 to 25 cm [6 to 10 in.]) and currently have little recreational or commercial value. There is, however, a developing commercial interest in this species. Regional abundance data suggest that stocks have declined in Long Island Sound (Dominion 2004f). Abundance estimates using trawls have been conducted for 27 years near the Millstone intake and at Jordan Cove. Sampling near the intake revealed two population spikes in the mid to late 1970s followed by a decline to the current low abundance levels. Jordan Cove sampling showed a small population spike in 1988 followed by a larger one in 1999. Population abundance in Jordan Cove in 2002 was one of the lowest recorded in over 27 years.

- **Tautog**

The tautog (*Tautoga onitis*, family Labridae) is common in the waters of New England, with a geographic range from New Brunswick to South Carolina. Tautogs prefer rocky environments and are known to stay within a few miles of the coastline. Adults can reach a maximum length of about 1 m (3 ft), but are usually less than 0.6 m (2 ft) and weigh less than 4.5 kg (10 lb). When tautogs are not feeding, they are known to gather in holes or clefts in rocks where they lie inert, on their sides, until tidal fluctuations initiate feeding behavior (Bigelow and Schroeder 1953). Tautogs feed primarily on invertebrates, such as mollusks, mussels, and barnacles, and are long-lived, with reported maximum ages for males and females of 34 and 27 years, respectively (Dominion 2004f).

Tautog abundance near Millstone was assessed through trawl surveys near the Millstone cooling water intakes in the Niantic River and at Jordan Cove. Abundances at these locations appeared to vary without trend, although there appeared to be increases associated with sampling years 1999 to 2002. The recreational harvest for the state of Connecticut has varied considerably over time, with peak harvests of over one million fish occurring in 1987, 1989, and 1992 (Beal et al. 1998).

2.2.5.6 Other Important Aquatic Resources

Other important aquatic resources include eelgrass beds, rocky intertidal habitats, and benthic infaunal assemblages. These communities are an important component of the nearshore ecosystem associated with Millstone, and changes to these communities can directly affect the fish, shellfish, and bird communities they support.

- **Eelgrass**

Eelgrass (*Zostera marina*) is one of the dominant seagrasses in coastal regions of the northern hemisphere and is found in eastern Long Island Sound near the Millstone facility. This seagrass is important because of its significant influence on nearshore environment. Eelgrass beds provide habitat and cover for many larval and juvenile forms of fish and invertebrates, support significant primary and secondary production, and serve as a food source for numerous waterfowl and planktonic grazers (Keser et al. 2003). Eelgrass beds in the vicinity of Millstone have been monitored for many years to evaluate population dynamics and to document population changes over time. Sampling locations included areas associated with thermal plume discharge (Jordan Cove, White Point) and reference locations associated with the Niantic River (Dominion 2004f). Studies near Millstone and in Long Island Sound have shown considerable variation in the extent of eelgrass beds at all locations, probably due to multiple environmental factors, including water body temperature fluctuations, eutrophication, sedimentation, turbidity, the presence of nuisance organisms (mussels and green alga blooms), and possible changes associated with nearshore hydrodynamics.

- **Rocky Intertidal Communities**

A rich and varied rocky intertidal habitat exists in the region surrounding Millstone, and includes marine alga, polychaeteous annelids, crustaceans, and molluscs. All of these organisms are important contributors to the structure and function of the nearshore ecosystem. Environmental studies conducted by Dominion have included sample collection sites at Fox Island, Millstone Point, White Point, and a reference location near Giant's Neck. Monitoring studies have included qualitative assessments of attached flora at each site, abundance estimates of rocky intertidal organisms, and growth and mortality studies on algal species of interest. Cooling water discharge stations have included a location close to the quarry cuts, and one location approximately 200 m (656 ft) southeast of the quarry cut. Millstone monitoring programs have been in effect since 1979 and are intended to provide (1) an environmental baseline of abundance of important species and (2) a means to detect change in community structure and function near the Millstone facility.

Algal studies have been conducted since 1979 and have identified over 140 species that occur or have occurred in the area during the study duration. Dominion scientists have focused on classes of organisms that represent the more common marine flora or fauna, including barnacles, the algae *Fucus* spp., the red alga *Chondrus* spp., and the marine mussel *Mytilus edulis*.

- **Benthic Infauna**

Benthic infaunal communities near Millstone are consistent with soft bottom, nearshore environments associated with New England. These communities typically contain a diverse assemblage of species that collectively contribute to the stability of the nearshore food web. Subtidal communities in the vicinity of Millstone, and at a reference site located near Giant's Neck, have been sampled and studied since 1980. During the 2003 sampling, marine polychaetes were the most abundant taxa, followed by oligochaetes, arthropods, and molluscs (Dominion 2004f). The following infaunal taxa were selected as representative of sites affected by Millstone: oligochaetes, the polychaetes *Aricidea catherinae*, *Mediomastus ambiseta*, *Tharyx* spp., *Polycirrus eximius*, *Protodorvillea gaspeensis*, and *Parapionosyllis longicirrata,* and the bivalve mollusc *Nuculana annulata* (Dominion 2004f). Monitoring studies have been helpful in detecting changes in benthic infauna community structure, and linking the observed changes to both natural and anthropogenic disturbances.

2.2.5.7 Threatened or Endangered Aquatic Species

Aquatic species that are Federally protected under the Endangered Species Act and listed by the FWS and/or NOAA Fisheries (also known as NMFS) and that have the potential to occur in the vicinity of Millstone or along the transmission rights-of-way are presented in Table 2-2. Table 2-2 includes aquatic species listed by the state of Connecticut that are not listed Federally.

According to the Dominion Environmental Report (Dominion 2004a), endangered whale species pass south of Long Island during seasonal migrations and are occasionally observed in Long Island Sound. There have been no known observations of these species near the Millstone facility. Likewise, endangered or threatened sea turtle species have been observed in Long Island Sound and in the vicinity of Millstone; however, none have been impinged on the intake

Table 2-2. Aquatic Species Listed as Endangered or Threatened by the State of Connecticut, the FWS, or NOAA Fisheries and Proposed for Candidacy or that Are Known to Occur or Potentially Occur Within Millstone Site or the Associated Transmission Line Rights-of-Way

Scientific Name	Common Name	Federal Status[a]	State Status[a,b]
	FISH		
Acipenser brevirostrum	shortnose sturgeon	Endangered	Endangered
Acipenser oxyrhinchus	Atlantic sturgeon		Threatened
	REPTILES		
Caretta caretta	loggerhead	Endangered	Threatened
Chelonia mydas	green turtle	Threatened	Threatened
Dermochelys coriacea	leatherback turtle	Endangered	Endangered
Lepidochelys kempii	Kemp's ridley	Endangered	Endangered
	MAMMALS		
Balaena glacialis	right whale	Endangered	Not listed
Balaenoptera physalus	finback whale	Endangered	Not listed
Megaptera novaengliae	humpback whale	Endangered	Not listed

(a) Lists. U.S. Fish and Wildlife Service, December 21, 1999.
(b) CTDEP 2004 http://dep.state.ct.us/burnatr/wildlife/learn/esfact.htm (accessed April 27, 2004).

screens and none have been collected during trawl studies. Shortnose sturgeon (*Acipenser brevirostrum*), known from the Connecticut River could enter Long Island Sound. None have been impinged on the intake screens and none have been collected during trawl studies. Life history information suggests that it is unlikely that shortnose sturgeon would be present in the vicinity of Millstone.

Shortnose Sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon is Federally listed as endangered throughout its range (FWS 2004). Two populations of shortnose sturgeon are present in the Connecticut River. One of these is landlocked in the upper part of the river between the Holyoke and Turners Dams in Massachusetts, and the other population is located in the lower Connecticut River from the Holyoke Dam to Long Island Sound. An estimated 1200 to 1500 shortnose sturgeon are found in freshwater and estuarine portions of the Connecticut River and are presumed to occasionally range into adjacent areas of Long Island Sound (FWS 2001). No shortnose sturgeon have been impinged or captured in more than 30 years of sampling at Millstone (Dominion 2004a). The primary threats to this species are dam building, water pollution, and dredging (NatureServe 2004).

Atlantic Sturgeon (*Acipenser oxyrinchus*)

The Atlantic sturgeon is State-listed as threatened. Atlantic sturgeon are present in Long Island Sound, which may be an important feeding or resting area in transit to and from spawning areas (CTDEP 2004). Adult-sized (10 cm [6 or more in.]) sturgeon are occasionally seen in the rivers of Connecticut. Declines in Atlantic sturgeon populations are the result of overfishing, loss of habitat, limited access to spawning areas and water pollution (CTDEP 2004). The applicant reported that one Atlantic sturgeon specimen was captured and released alive during a trawl survey in 1980.

Loggerhead(*Caretta caretta)*

The loggerhead sea turtle is Federally listed as threatened throughout its range (FWS 2004). There are currently no critical habitats designated for this species, although the NMFS is currently working on a status review based on a 2002 petition to reclassify the Northern and Florida Panhandle subpopulations with endangered status and to designate critical habitat for both subpopulations (NMFS 2004a). The range for the Atlantic population of loggerheads extends from Newfoundland to Argentina, with primary nesting areas located in Florida, Georgia, and the Carolinas.

Green Turtle (*Chelonia mydas*)

The green sea turtle is Federally listed as endangered in the breeding colony populations in Florida and on the Pacific coast of Mexico and threatened for all other areas (FWS 2004). The western Atlantic population of green turtles ranges from Massachusetts south to the U.S. Virgin Islands and Puerto Rico, with important feeding grounds in Florida, and primary nesting sites on the east coast of Florida, the U.S. Virgin Islands and Puerto Rico (NMFS 2004b).

Leatherback Turtle (*Dermochelys coriacea*)

The leatherback sea turtle is Federally listed as endangered throughout its range (FWS 2004). The western Atlantic population of leatherback turtles ranges from Nova Scotia to Puerto Rico and the U.S. Virgin Islands. During the summer, leatherback turtles are typically found along the east coast of the U.S. from the Gulf of Maine to central Florida. Critical habitat designated in the area around the U.S. Virgin Islands, with nesting sites located from Georgia to the U.S.

Virgin Islands (NMFS 2004c). The primary threats to the survival of leatherback sea turtles include habitat destruction, incidental catch in commercial fisheries, and harvest of eggs and mea (NMFS 2004c).

Kemp's Ridley (*Lepidochelys kempii*)

The Kemp's ridley sea turtle is Federally listed as endangered throughout its range (FWS 2004). This species is found primarily in coastal areas of the Gulf of Mexico and the northwestern Atlantic, with a major nesting beach on the northeastern coast of Mexico (NMFS 2004d). Habitat degradation, pollution, and ingestion of floating debris are among the most significant threats to Kemp's ridley (NMFS 2004d).

Right Whale (*Eubalaena glacialis*)

The right whale is Federally listed as endangered throughout its range (FWS 2004). With a population estimated at 291 individuals in 1998, the North Atlantic right whale is considered to be one of the most critically endangered populations of large whales in the world (NMFS 2002). According to NMFS (2002), this population ranges from wintering and calving grounds in the coastal waters of the southeastern United States to summer feeding and nursery grounds in New England waters and northward. In 1994, the NMFS designated three critical habitats for the North Atlantic right whale: Cape Cod Bay/Massachusetts Bay, Great South Channel, and the Southeastern USA. At the present time, injuries and mortality caused by ship strikes are the primary source of human impacts to right whales, with some additional impacts from fishery entanglements. Right whales have been sighted near Long Island Sound (NMFS 2004), but are not known to move into the shallow waters immediately offshore of the Millstone site (Dominion 2004f).

Finback Whale (*Balaenoptera physalus*)

The finback (fin) whale is Federally listed as endangered throughout its range (FWS 2004). According to NMFS (2002), the current minimum population estimate from a 1999 survey for the western North Atlantic fin whale was 2362. Fin whales are found principally in waters from North Carolina north to Nova Scotia. New England waters provide an important feeding ground for this species. There are no critical habitats designated for the fin whale, although a recovery plan has been drafted. At the present time, injuries and mortality caused by ship strikes are the primary source of human impacts to fin whales. It is possible that fin whales could enter Long Island Sound, but they are not known to move into the shallow waters immediately offshore of the Millstone site (Dominion 2004f).

Humpback Whale (*Megaptera novaengliae*)

The humpback whale is Federally listed as endangered throughout its range (FWS 2004). According to NMFS (2002), the overall abundance for the North Atlantic humpback whale population was estimated in 1992/1993 at 11,570 individuals. North Atlantic humpback whales are found during the spring, summer, and fall over a range covering the eastern coast of the United States. New England waters are an important feeding ground for this species. A recovery plan for humpback whales is in effect. Injuries and mortality from fishery entanglements and ship strikes are the primary human impacts on humpback whales. Disturbance from whale watching traffic is also of concern, particularly in coastal New England waters. It is possible that humpback whales could enter Long Island Sound, but they are not known to move into the shallow waters immediately offshore of the Millstone site (Dominion 2004f).

2.2.6 Terrestrial Resources

The Millstone site supports flora and fauna common to the region. The Millstone site is located in the southern New England Coastal Plains and Hills of the Northeastern Coastal Zone ecoregion (EPA 2004). Presettlement vegetation would have consisted primarily of winter deciduous hardwood forests with some salt marsh and beach habitat types. Out of the approximately 212 ha (525 ac) that comprise the Millstone site, current land use includes approximately 89 ha (220 ac) of developed land, a 20 ha (50 ac) natural area, and a 12 ha (30 ac) ballpark licensed to the town of Waterford. Until 1960, the site was used as a granite quarry, in operation for some 200 years (Dominion 2004a).

2.2.6.1 Site Terrestrial Resources

The current terrestrial environment includes old field habitats dominated by eastern red cedar (*Juniperus virginiana*), scarlet oak (*Quercus coccinea*), black cherry (*Prunus serotina*), and blackberry (*Rubus* spp.) (Dominion 2004a). Common invasive exotics in this habitat include multiflora rose (*Rosa multiflora*) and Japanese honeysuckle (*Lonicera japonica*). Winter deciduous hardwood forest dominated by various species of oak (*Quercus* spp.), pignut hickory (*Carya glabra*), black birch (*Betula lenta*), red maple (*Acer rubrum*), and American beech (*Fagus grandifolia*), is the most common undisturbed habitat type. Along the coast, beach and coastal marsh habitats are dominated by beach grass (*Ammopila breviligulata*), toadflax (*Linaria vulgaris*), evening primrose (*Oenothera biennis*), seaside goldenrod (*Solidago sempervirens*), salt meadow grass (*Spartina patens*), salt grass (*Distichlis spicata*), Bigelow's glasswort (*Salicornia bigelovii*), and smooth cordgrass (*Spartina alterniflora*). Ponds and wetlands in the eastern portion of the site are managed as a wildlife refuge.

Terrestrial habitats on the Millstone site support common wildlife species such as white-tailed deer (*Odocoileus virginianus*), gray squirrel (*Sciurus carolinensis*), cottontail rabbits (*Sylvilagus floridanus*), red fox (*Vulpes vulpes*), woodchucks (*Marmota monax*), and wild turkey (*Meleagris gallopavo*). Coastal marshes and the wildlife refuge on the site contain habitat that supports waterfowl such as mallard ducks, wood ducks, Canada geese, common mergansers, black ducks, herons, and egrets. Osprey nest platforms have been maintained at Millstone for over 35 years and 173 fledglings have been produced over this period (Dominion 2004a).

2.2.6.2 Threatened and Endangered Terrestrial Species

There are 18 species listed by FWS or the state of Connecticut as being known to occur on the site. An additional 342 State-listed species are reported to occur in counties traversed by transmission line ROWs. Terrestrial species that are listed by the FWS or the state of Connecticut and are known to have the potential to occur in the vicinity of the Millstone site or along the transmission rights-of-way are presented in Table 2-3. Additional State-listed species that have the potential to occur in Hartford, Middlesex, New London, or Tolland counties are listed in Appendix G.

Puritan Tiger Beetle (*Cicindela puritana*)

The Puritan tiger beetle (*Cicindela puritana*) is known from two disjunct populations, one along Chesapeake Bay in Maryland and one along the Connecticut River, in northern Connecticut (CTDEP 2004). Although this species is reported to occur in Middlesex County (FWS 2004), CTDEP maps clearly show the Connecticut population to be primarily along the Connecticut River in Hartford County (CTDEP 2004). The Millstone ROW for the Manchester transmission line does not cross the Connecticut River in Hartford County. The Puritan tiger beetle is restricted to sandy habitats typically found along river banks. Habitat has been depleted through riverbank stabilization and flood control practices. There is no known habitat for this species near the Millstone site or associated transmission line ROWs. The Puritan tiger beetle is listed as threatened by the FWS and endangered by the state of Connecticut.

Cooper’s Hawk (*Accipiter cooperi*)

The Cooper’s hawk (*Accipiter cooperi*) is an accipiter that frequents deciduous and occasionally coniferous forests. This “chicken hawk” has been persecuted by farmers since the colonial times and suffered from pesticide contamination in the 1970s (CTDEP 2004a). It is listed as threatened by the state of Connecticut because of a small breeding population.

Table 2-3. Terrestrial Species Listed as Endangered or Threatened by the State of Connecticut or the FWS and Proposed for Candidacy or that Are Known to Occur or Potentially Occur Within Millstone Site or the Associated Transmission Line Rights-of-Way

Scientific Name	Common Name	Federal Status[a]	State Status[a,b]
	INSECTS		
Cicindela puritana	Puritan tiger beetle	Threatened	Endangered
	BIRDS		
Accipiter cooperi	Cooper's hawk		Threatened
Accipiter striatus	sharp-shinned hawk		Endangered
Ardea alba	great egret		Threatened
Charadrius melodus	piping plover	Threatened	Endangered
Circus cyaneus	northern harrier		Endangered
Egretta thula	snowy egret		Threatened
Falco peregrinus	peregrine falcon		Endangered
Haliaeetus leucocephalus	bald eagle	Threatened	Endangered
Icteria virens	yellow-breasted chat		Endangered
Pooecetes gramineus	vesper sparrow		Endangered
Podilymbus podiceps	pied-billed grebe		Endangered
Sterna antillarum	least tern		Threatened
Sterna dougallii	roseate tern	Endangered	Endangered
	MAMMALS		
Sylvilagus transitionalis	New England cottontail		Endangered
	PLANTS		
Honkenya peploides	seabeach sandwort		Endangered
Isotria medeoloides	small whorled pogonia	Threatened	Endangered
Scleria triglomerata	tall nut sedge		Endangered

(a) FWS 1999. Title 50, Wildlife and Fisheries, Part 17, Endangered and Threatened Wildlife and Plants, Subpart B Lists. U.S. Fish and Wildlife Service, December 21, 1999.
(b) CTDEP 2004a http://dep.state.ct.us/burnatr/wildlife/learn/esfact.htm (accessed April 27, 2004).

Sharp-shinned Hawk (*Accipiter striatus*)

The sharp-shinned hawk (*Accipiter striatus*) is a small accipiter found primarily in forested habitats. The sharp-shinned hawk is a relatively common fall migrant but has been listed as endangered because there is only a small breeding population in northern Connecticut (CTDEP 2004a). Population reduction is primarily a result of habitat degradation and past pesticide use. The sharp-shinned hawk is listed as endangered by the state of Connecticut.

Great Egret (*Ardea albus*)

The great egret (*Ardea albus*) is a large white heron that can be found in a variety of fresh and saltwater habitats. Great egrets were very rare in Connecticut by the mid-1800s, primarily due to market hunting for their aigrettes (plumes), used in women's apparel (CTDEP 2004a). Coastal development and disturbance of nesting colonies have hampered their recovery. The great egret is listed as threatened by the state of Connecticut.

Piping Plover (*Charadrius melodus*)

The piping plover (*Charadrius melodus*) is a shorebird that is found nesting in sandy beach habitats along seacoasts (CTDEP 2004). Piping plovers nest from North Carolina north to Nova Scotia. Nesting generally occurs from March through July. Historically, these birds were killed for consumption and the feathers used for adornment. Current threats include beach stabilization and development. The piping plover is listed as threatened by the FWS and the state of Connecticut. There have been no reported sightings of piping plover at the Millstone site. It is not likely that the necessary beach habitat for nesting is present in the vicinity of the site.

Northern Harrier (*Circus cyaneus*)

The northern harrier (*Circus cyaneus*), or marsh hawk, is a relatively large bird of prey that prefers open marshland and meadows. Once recorded as common in Connecticut, it is now listed as endangered. The population has been reduced by habitat degradation and past use of DDT (CTDEP 2004a). Northern harriers have been recorded at the Millstone site as an occasional migrant (Dominion 2004a). The northern harrier is listed as endangered by the state of Connecticut.

Snowy Egret (*Egretta thula*)

The snowy egret (*Egretta thula*) is a medium-sized white heron that is found in habitats similar to the habitats where the larger great egret is found. Because of their showy plumes, snowy egrets were hunted even more extensively than the great egret, and the species was virtually extirpated from Connecticut by the late 1800s (CTDEP 2004a). Snowy egrets have again been nesting in the State since 1961 but breeding populations remain low. The snowy egret is listed as threatened by the state of Connecticut.

Peregrine Falcon (*Falco peregrinus*)

The peregrine falcon (*Falco peregrinus*) has widespread distribution in open country from coastal areas to the mountains. Nesting peregrine falcons were relatively common in Connecticut though the early 1900s before egg collecting and later pesticide contamination nearly extirpated the species (CTDEP 2004a). The peregrine falcon is listed as endangered by the state of Connecticut.

Bald Eagle (*Haliaeetus leucocephalus*)

The bald eagle (*Haliaeetus leucocephalus*) is a large raptor that is found along the coastline and around lakes and rivers. There are reported to be up to 100 eagles wintering along major rivers and reservoirs in Connecticut (CTDEP 2004a). There are no known nesting pairs of eagles near the Millstone site or along the transmission line corridors. Individual eagles have been seen foraging in the area. Eagle populations have declined in the State due to loss of habitat, human disturbance, and pesticide contamination. The bald eagle is listed as threatened by the FWS and as endangered by the state of Connecticut.

Yellow-breasted Chat (*Icteria virens*)

The yellow-breasted chat (*Icteria virens*) is a songbird found in mid-successional shrubby habitats such as woodland edges, briar thickets, and old fields. Although once considered common in Connecticut, populations have declined due to the loss of farmlands and pastures (CTDEP 2004a). A few individuals were sighted in the Waterford area from 1986 to 1988 (CTDEP 2002b). The yellow-breasted chat is listed as endangered by the state of Connecticut.

Pied-billed Grebe (*Podilymbus podiceps*)

The pied-billed grebe (*Podilymbus podiceps*) is a small diving bird that is found in fresh and saltwater habitats. The species is declining throughout New England because of historically low numbers and wetland habitat loss and is listed as endangered by the state of Connecticut. It has apparently never been common in Connecticut and has been recorded breeding in only two isolated locations in the State (CTDEP 2004a). It has been recorded at the Millstone site as an occasional migrant (Dominion 2004a). The pied-billed grebe is listed as endangered by the state of Connecticut.

Vesper Sparrow (*Pooecetes gramineus*)

The vesper sparrow (*Pooecetes gramineus*) is a songbird found in open areas such as old fields, meadows, agricultural areas, and, occasionally, beach habitats. Apparently common in the mid-1800s, numbers have dropped in the past century with the decline in agriculture and increase in residential and commercial development (CTDEP 2004a). The vesper sparrow has not been confirmed nesting in the state of Connecticut since 1984 and is listed as endangered.

Least Tern (*Sterna antillarum*)

The least tern (*Sterna antillarum*) is a seabird that nests on beaches along coastlines, offshore islands, and large rivers. Similar to the roseate tern, least tern populations in Connecticut were decimated by market hunting by the early 1900s and continue to be impacted by shoreline development and predators that are often associated with human development (CTDEP 2004a). The least tern is listed as threatened by the state of Connecticut.

Roseate Tern (*Sterna dougallii*)

The roseate tern (*Sterna dougallii*) is a seabird that is found almost exclusively on saltwater coastlines. Roseate terns nest in colonies on coastal beaches and offshore islands. Historically, tern populations in Connecticut have been impacted by unrestricted market hunting and more recently by the expansion of predatory great black-backed and herring gull populations throughout their range in the State (CTDEP 2004a). Roseate terns are listed as endangered by both the FWS and the state of Connecticut. Fox Island, a small promontory extending off Millstone Point into Long Island Sound, is known to be used by roseate terns during the fall migration period. Roseate terns are not known to nest in the vicinity of the Millstone site (Dominion 2004a)

New England Cottontail Rabbit (*Sylvilagus transitionalis*)

The New England cottontail rabbit (*Sylvilagus transitionalis*) is found in brushy habitats associated with edges of fields and forests, fence lines, and, probably, transmission line rights-of-way. Populations in Connecticut were considered abundant through the mid-1930s but competition from introduced Eastern cottontails (*Sylvilagus floridanus*) and loss of agriculture-related habitat has led to a State listing of endangered (CTDEP 2004a); it is a proposed candidate for Federal listing. Vegetation management techniques used on the Millstone site and associated transmission line corridors maintain early successional habitat types the New England cottontail requires.

Seabeach Sandwort (*Honkenya peploides*)

The seabeach sandwort (*Honkenya peploides*) is an herbaceous succulent found near beaches. It is listed as a species of concern by the state of Connecticut. Individuals have been found in approximately six locations on the Millstone site (Dominion 2004a). The seabeach sandwort is listed as endangered by the state of Connecticut.

Small Whorled Pogonia (*Isotria medeoloides*)

The small whorled pogonia (*Isotria medeoloides*) occurs in isolated populations throughout the eastern United States. In Connecticut, it is reported to occur in New London, Middlesex, Tolland, Hartford, and New Haven counties. New England populations of this orchid are found almost exclusively on acidic, well-drained fragipan (a subsurface impermiable layer) soils (NatureServe 2004). Common plant associates include red maple, eastern hemlock (*Tsuga canadensis*), paper birch (*Betula papyrifera*), northern red oak (*Quercus rubra*), eastern white pine (*Pinus strobus*), and American beech. Isotria populations are found in second growth and mature forests. The major threats to this species are habitat destruction through development and forestry. The small whorled pogonia is listed as threatened by the FWS and endangered by the state of Connecticut. Habitat for the small whorled pogonia may exist at the Millstone site or along associated transmission line ROWs.

Tall Nut Sedge (*Scleria triglomerata)*

The tall nut sedge or nut rush (*Scleria triglomerata*) is a grass-like plant that favors wet habitats. A population of tall nut sedge has been found on the shared Card Street/Manchester transmission line right-of-way approximately 3.2 km (2 miles) north of the Hunts Brook Junction (Dominion 2004a; CTDEP 2002b). This species is listed as endangered by the state of Connecticut

2.2.7 Radiological Impacts

Millstone conducts an annual Radiological Environmental Monitoring Program (REMP) in and around the Millstone site and publishes an *Annual Radiological Environmental Operating Report* (Dominion 2003a). Through this program, radiological impacts to employees, the public, and the environment are monitored, documented, and compared to the appropriate standards. The objectives of the REMP are the following:

- provide representative measurements of radiation levels and radioactive materials in the exposure pathways and of the radionuclides that have the highest potential for radiation exposures to members of the public; and

- supplement the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of effluent measurements and the modeling of the environmental exposure pathways.

Radiological releases are summarized in two Millstone reports: *Annual Radiological Environmental Operating Report* (Dominion 2003a) and *Radioactive Effluent Release Report* (Dominion 2003b). The limits for all radiological releases are specified in the Millstone ODCM (Dominion 2004d), and these limits are used to meet Federal standards and requirements. The REMP includes monitoring of the aquatic environment (fish, invertebrates, and shoreline sediment); atmospheric environment (airborne radioiodine, gross beta, and gamma); terrestrial environment (vegetation); and direct radiation. The REMP found that

> No station effects were detected in terrestrial media. The predominant radioactivity, except for a few aquatic sample results, was that from outside sources, such as fallout from nuclear weapons tests and naturally occurring radionuclides. Monitoring of the aquatic environment in the area of the discharges indicated that presence of the following station related radionuclides: cobalt-60, cesium-137, silver-110m and tritium. Due to the decreasing trend in liquid effluent releases, a corresponding decrease is observed in measured levels of radionuclides in the environment. Doses from the 2003 measured levels are well below those required by each unit's safety technical specifications (Dominion 2003a).

Comparisons of zinc-65 and silver-110m discharges to uptakes in oysters in the quarry (on Dominion property) show a dependency between activity discharged and bioaccumulation in the oysters, as follows:

> The decreasing trend in effluent radioactive releases is apparent in both the curies released and the measured concentrations in oysters. (Dominion 2003a).

No measured radionuclides were observed in oysters beyond the station discharge area (outside the quarry).

Millstone's review of historical data on releases and the resultant dose calculations revealed that the calculated doses to maximally exposed individuals in the vicinity of Millstone were a small fraction of the limits specified in the Millstone ODCM (Dominion 2004b) to meet 10 CFR Part 50, Appendix I and EPA radiation standards in 40 CFR Part 190. For 2002, dose estimates were calculated based on actual liquid and gaseous effluent release data and conservative models to simulate the transport mechanisms. The results are described in the *Radioactive Effluent Release Reports* (Dominion 2003b). A second dose assessment method uses the actual measurements of the concentrations in various environmental media and dose consequences from the consumption of these foods (e.g., fish, shellfish), which are reported annually (Dominion 2003a). Dose estimates were performed by Millstone using the plant effluent release data, onsite meteorological data, and appropriate pathways identified in the ODCM. An assessment of doses to the maximally exposed individual from gaseous and liquid effluents was performed by Millstone for locations representing the maximum dose. In all cases, doses were well below the limits as defined in the ODCM (Millstone 2002d). A breakdown of the calculated maximum dose to an individual located at the Millstone boundary from liquid and gaseous effluents released during 2002 is summarized as follows (Dominion 2003b):

- The critical organ dose due to the liquid effluents at the site discharge was 1.48×10^{-4} mSv (1.48×10^{-2} mrem). This dose was about 0.15 percent of the 0.10 mSv (10 mrem) dose limit.

- The air dose due to noble gases in gaseous effluents was 1.89×10^{-4} mGy (1.89×10^{-2} mrad) or 0.189 percent of the 0.10 mGy (10 mrad) gamma dose limit and 6.91×10^{-4} mGy (6.91×10^{-2} mrad) beta or 0.346 percent of the 0.20 mGy (20 mrad) beta dose limit.

- The critical organ dose from gaseous effluents due to iodine-131, iodine-133, tritium, and particulates with half-lives greater than eight days was 2.99×10^{-4} mSv (2.99×10^{-2} mrem), which is 0.20 percent of the 0.15 mSv (15 mrem) dose limit.

The applicant does not anticipate any significant changes to the radioactive effluent releases or exposures from Millstone operations during the renewal period and, therefore, the impacts to the environment are not expected to change.

2.2.8 Socioeconomic Factors

The staff reviewed the Environmental Report (Dominion 2004a) and information obtained from meetings with local and regional agencies during a site visit to Waterford and the surrounding area from May 17 to 20, 2004. The following information describes the housing, public services, land use, demographics, and economy of the communities near Millstone.

2.2.8.1 Housing

Dominion employs a total nuclear-related permanent workforce of approximately 1550 to 1650 at Millstone. Of these, 1300 are Dominion employees and another 250 to 350 are long-term contractors. Approximately 73 percent of Millstone's employees live in New London County with about 140 employees living in Waterford, while another 200 live in Niantic and East Lime. Another 12 percent reside in Middlesex County, and about 14 percent are distributed across 14 other counties in Connecticut, Massachusetts, and Rhode Island with numbers ranging from 1 to 60 employees per county. Less than 1 percent of the workforce resides outside of these three states. Table 2-4 summarizes the information for the permanent workforce. Given the predominance of regular employees living in New London and Middlesex counties, and the absence of the likelihood of significant socioeconomic impacts in other counties, the focus of this analysis is the town of Waterford and 20 other municipalities in New London County that form an area that is generally referred to as the Southeastern Connecticut Planning Region.

Table 2-4. Millstone Employee Residence Information by County

County	Number of Personnel	Percent of Total
New London	1205	73
Middlesex	198	12
Other Counties	231	14
Outside of CT, RI, and MA	16	1
TOTAL	**1650**	**100**

Source: Dominion 2004a

The Millstone reactors are on an 18-month refueling cycle. During refueling outages, site employment increases substantially above the 1550 to 1650 Dominion workforce by as many as 700 to 800 workers for a period of 28 to 30 days. Most of these temporary workers are assumed to live in the same geographic areas as the permanent Millstone staff. These numbers are within the GEIS range of 200 to 900 additional contractor workers per reactor outage.

Table 2-5 provides the number of housing units and housing unit vacancies for New London and Middlesex counties for 1990 and 2000, derived from U.S. Census Bureau information.

New London County housing units numbered 110,674 and Middlesex County housing units numbered 67,285 in 2000. There were 10,839 vacant housing units in New London County and 5944 in Middlesex County in 2000, corresponding to a rate of 9.8 percent and 8.8 percent, respectively. There were a total of 444 vacant housing units in Waterford in 2000 which equates to a vacancy rate of 5.6 percent. Approximately half of these vacancies are seasonal homes. The vacancy rate in Connecticut in 2000 was 6.1 percent. Two-thirds of the housing units in New London and Middlesex counties are owner occupied compared to nearly 95 percent of the housing units in Waterford (USCB 2000).

Housing has become more of a regional concern in southeastern Connecticut since 2000. Several interacting factors impact housing demand, supply, and affordability. There have been fundamental shifts from a defense dependent economy to one dominated by gaming and tourism. There has been a reduction in the collective earning power of the employed labor force with the shift from manufacturing to service jobs and, consequently, there has been an increasing demand for affordable housing. The average median sales price for single-family homes within southeastern Connecticut increased by more than 50 percent between 2000 and 2003, and 40 percent for condominiums. While the net increase in southeastern Connecticut population between 1990 and 2000 was just 1 percent, the population also grew older, households got smaller, single-family homes dominated housing starts, and vacancy rates declined. These housing issues are being addressed through cooperative efforts of the municipalities, tribal nations, the state of Connecticut, private nonprofits, major employers, and the housing industry (Southeastern Connecticut Council of Governments. [SCCOG] 2002).

Table 2-5. Housing Units and Housing Units Vacant (Available) by County During 1990 and 2000

	1990	2000	Approximate Percentage Change
NEW LONDON COUNTY			
Housing Units	104,461	110,674	5.9
Occupied Units	93,245	99,835	7.1
Vacant Units	11,216	10,839	(3.4)
MIDDLESEX COUNTY			
Housing Units	61,593	67,285	9.2
Occupied Units	54,651	61,341	12.2
Vacant Units	6942	5944	(14.4)

Source: USCB 1990, 2000

According to Waterford's 1998 *Plan of Preservation, Conservation, and Development*, there is the theoretical potential for about 4000 additional housing units. The town had 7986 housing units in 2000 (USCB 2000) and could have 12,000 housing units when fully developed under existing zoning (Waterford 1998). The plan notes that Waterford is a suburban community consisting primarily of owner-occupied single-family dwellings on lots that range from 7500 ft^2 to 200,000 ft^2. Multiple-family dwellings are permitted with densities up to nine units per acre. The plan recommends that the Waterford continue to provide for a diversity of housing types and encourage the availability of housing for a variety of age and income groups. The plan promotes modifying some residential zoning designations and regulations to accomplish these goals, while protecting natural resources and retaining the rural character cherished by residents. The pattern and pace of growth in Waterford is determined by the availability and location of suitable urban infrastructure. There are no current proposals to institute a moratorium on development in Waterford.

2.2.8.2 Public Services

Public services include water supply, education, and transportation.

- **Water Supply**

Table 2-6 displays public water supply information for the entire county of New London. Most of the Millstone employees reside in New London County, and this discussion of public water supply systems will focus on the three municipalities in New London County where the greatest number of employees live—Waterford, East Lyme / Niantic, and Colchester—and the city of New London, which supplies water to Waterford and provides potable water to Millstone. The city of New London obtains water from the Lake Konomoc reservoir located in Waterford and Montville. Millstone's 2000 to 2001 potable water usage averaged 125.7×10^4 L per day (332.0×10^3 gpd). This usage represents approximately 5.2 percent of the city of New London's daily capacity and 6 percent of the city's average daily use.

Table 2-6. Major New London County Public Water Supplies and Capacities

Water Supplier[a]	Water Source	Average Daily Use (MGD[b])	Maximum Capacity (MGD)
Groton Water Department	surface water	9.31	12.6
Norwich Water Department	surface water	5.2	7.16
New London Water Division	surface water	5.5	6.4
East Lyme Water and Sewer Commission	groundwater	1.46	1.66
Waterford Water Pollution Control Authority	purchases water from New London Water Division	N/A	N/A
CT - American Water Co.—Mystic Valley Division	surface water and groundwater	1.56	1.5
Colchester Sewer and Water Commission	groundwater	0.48	0.74

(a) Dominion 20004a
(b) MGD - Mission gpd

State standards conclude that an adequate margin of safety exists when the safe yield is more than 125 percent of the average consumption, or average consumption is less than 80 percent of the safe yield. The Waterford water supply system may need to be expanded in the future because State standards indicate that there may not be an adequate margin of safety between average water consumption and the safe yield of the system. As a result, the city of New London is currently searching for additional supply sources for future consumption. An intermunicipal agreement with the city of New London provides that new Waterford customers may be denied service in times of water shortage (Waterford 1998).

A new water supply line was constructed in 2000 to supply Millstone, and this line replaced the use of two shallow low-yield wells that had been used to irrigate ballfields and supply concession stands on the Millstone site licensed to Waterford (Dominion 2004a).

Water availability may also be a more limiting factor for future growth in other New London County communities such as East Lyme and Colchester where Millstone workers prefer to reside. Aquifers provide the total current drinking water supply for East Lyme and will continue to do so for the foreseeable future. Although the town has the potential for developing new wells, the water supply is limited. Approximately 60 percent of the town is served by public water through the operation of seven wells located in four stratified drift aquifers. The remaining 40 percent is served by private wells in bedrock aquifers. In 1998, the town implemented a moratorium on new water connections for subdivisions and commercial establishments. Peak daily demands are currently being met. However, estimated future demand may compel the town to seek other sources of water, and water conservation is strongly encouraged (Dominion 2004a).

The recently approved Thames Basin Regional Water Interconnection Project will provide alternative water supply sources for Waterford by interconnecting the Norwich, Groton, and the New London/Waterford systems. This project provides a degree of redundancy to the Waterford water system while mitigating pressure deficiencies that have been a concern for fire fighting in the Quaker Hill neighborhood. Piping water from Groton will provide a less costly solution than developing new sources while increasing the safe yield available for present and future demands (Waterford 2002).

The Colchester Sewer and Water Commission and the Public Works Department manage the public water system in Colchester. Public water is derived exclusively from public wells and service is essentially limited to the center of Colchester where the majority of the commercial and community facilities in town are located. The commission serves a population of approximately 4500. Colchester has adequate water supply sources to meet current demand. However, future water consumption is expected to increase and an eventual need for additional water supplies is projected. Several alternatives including additional ground-water options and/or an interconnection with the Norwich Water Department (which accesses the Deep River Reservoir in Colchester) are being explored. Presently, water conservation is encouraged (Dominion 2004a).

- **Education**

In 2000, 85.7 percent of the population of the southeastern Connecticut region who were 25 years or older had completed high school, while 25.3 percent were college graduates as compared to 31.4 percent for the State as a whole. In Waterford, in 2000, 86.8 percent of the population over 18 had completed high school, and 28.1 percent had finished college. All municipalities in the region recorded improvements in educational levels compared to previous years. Elementary and high school enrollments have experienced an increase since 1990, while preschool and college enrollments have decreased uniformly throughout the region. One plausible explanation for this situation is a pattern of in-migration by families with children in this age bracket (SCCOG 2003b).

The Waterford Public Schools project a budget of $34,398,900 for the 2004 / 2005 school year to operate five elementary, one middle, and one high school. Previous approved budgets for the town of Waterford show that funding for the Waterford Public Schools increased from $27,866,712 for 1997 to1998 to $31,172,355 for 2001 to 2002. This increase reflects a change from 48.9 percent of the total general fund to 52.2 percent following deregulation of Millstone. The Board of Education budget is projected to increase to $41,222,367 in 2013 representing 57.3 percent of the total budget for Waterford. Total enrollment in February 2004 was 3119 students of which 1361 were in elementary, 776 in middle school, and 972 in high school. The capacity of all the schools is 3324. Two of the elementary schools are now slightly exceeding their capacity, but portable classrooms are used in all the elementary schools to address this situation. There has been an increase in overall enrollment during the past five years from 2981 students in 1999 / 2000 to 3119 in 2004 / 2005. Elementary enrollments peaked at 1441 in 2000 / 2001, while the middle school and high school population has increased since then. Overall enrollment for 2006 / 2007 is projected to be 3091 (Waterford Public Schools online, accessed April 8, 2004). Approximately 22.3 percent of the Waterford Public Schools budget is funded by revenues derived from Dominion operations at Millstone that are paid to the town of Waterford. This amounted to $7,373,494 in 2003.

The Waterford Public Schools were built between 1914 and 1958, initially, and have been remodeled and expanded over the decades many times. The seven schools comprise 557,221 square feet and 189 ac. The Board of Education is proceeding with plans to build or renovate-as-new three elementary schools. Waterford and New London have also received a $22 million grant from the State Department of Education to build an early childhood learning center for approximately 520 preschool and kindergarten aged children, half of whom will be from Waterford and half from New London. The building is to be located next to the Waterford High School. The project is scheduled to open in September 2005 (Waterford Public Schools 2004).

- **Transportation**

Waterford, New London County, and the southeastern Connecticut region have a well-developed transportation system. The area is served by an established roadway network of local, connector, arterial, and expressway routes. Rail lines operated by Amtrak provide local and long-distance high-speed train service connecting New London with Boston and New York. Intercity bus service is provided by Greyhound Lines with a stop in New London. Southeast Area Transit buses operate throughout New London County and provide local service into Waterford. The Groton / New London airport provides charter and commercial service. National air carriers serve Bradley International airport near Hartford and the T.F. Green airport in Providence, Rhode Island. Ferry service is offered from the consolidated inter-modal New London terminal seasonally and year-round to several Long Island destinations; Martha's Vineyard, Massachusetts; and Block Island, Rhode Island. The mouth of the Thames River is one of New England's finest natural harbors and provides direct access to major transatlantic and coastal sea lanes.

Road access to Millstone is via the Millstone Access Road, an onsite two-lane paved road with a north-south orientation. When nearing Millstone, all employees must use State Route 156 (Rope Ferry Road), which is a two- to four-lane highway classified as an arterial road. State Route 156 intersects with U.S. 1 (Boston Post Road), which has an east-west orientation in Connecticut. Employees traveling from the towns of New London and Waterford are most likely to use U.S. 1 and State Route 156. Employees traveling from East Lyme and other communities to the west are most likely to use State Route 161 or U.S. 1, and State Route 156. State Route 161 serves as a major feeder to and from Interstate (I)-95 south. Waterford's main roadways are I-95 and I-395, U.S. 1, and State Routes 85, 156, 161 and 32. Most Millstone workers commute in their own vehicles or in organized van pools. Parking for all vehicles is provided at the site.

The major transportation issues in Waterford involve the roadway circulation system and enhancing other modes of transportation, such as pedestrian ways and bicycle paths. Overall, the community wants to address traffic needs while maintaining community character and minimizing environmental impacts. One of Waterford's major transportation challenges is to preserve the capacity of existing roadways and to maintain adequate traffic service levels given the historic and anticipated growth of traffic volumes, congestion, and accidents. Since only half the land area in Waterford has been developed, future traffic volumes could increase when new development occurs.

There are some transportation projects being conducted by State and local authorities that may improve transportation and that could impact Millstone. These include intersection improvements on U.S. 1, widening westbound Route 156 to two lanes in the vicinity of U.S. 1 to minimize traffic merging conflicts, and eventual widening of I-95. The open space plan for Waterford recommends using power transmission line rights-of-way (outside of the Millstone traverse) for multimodal trails.

In order to meet 10-year transportation goals, the *East Lyme Plan for Preservation, Conservation and Development* proposes a number of transportation improvements to alleviate congestion on the 219 km (136 miles) of roads in the town (Dominion 2004a). Thirty-two miles of the roads are state owned and maintained including the two major east-west routes (U.S. 1 and Route 156) and the major north-south corridor (Route 161). The proposed improvement projects having the greatest potential to impact Millstone include the upgrades of Routes 161 and 156.

The *Regional Transportation Plan for Southeastern Connecticut* contains a number of recommendations to address transportation concerns that could affect Waterford and Millstone (SCCOG 2003a). The plan notes that New London will continue to function as the region's primary transportation hub with its confluence of water, rail, and highway systems, and it cites Millstone as being the eleventh largest regional nonresidential traffic generator, and that it is one of six high-security sites in southeastern Connecticut. The highest priority projects for southeastern Connecticut are the completion of Route 11 from Salem to I-95 and its intersection in Waterford, capacity improvements to I-95 from Branford to the Rhode Island state line, expansion of the regional bus system to address tourism and related employment demand, and improvements to Routes 2, 2A, and 32 to serve the casinos. These projects remain unfunded, except for transit improvements. Adequate public transportation for employment and other necessary travel was also identified as one of ten top priorities for southeastern Connecticut in 1999 (United Way of Southeastern Connecticut 1999).

The Connecticut Department of Transportation does not maintain level-of-service designations for the roads in the vicinity of Millstone (Dominion 2004a). Waterford strives to maintain a level-of-service standard of C or better for its roads, with exceptions made for certain commercial corridors provided that additional congestion occurs only on private driveways. Level-of-Service C means that vehicle traffic volumes are between 70 percent and 80 percent of the roadway capacity and that delays at traffic signals are between 15 and 20 seconds (Waterford 1998). In 2001, the segments of Route 156 passing by the Millstone access (at High Ridge Drive) had a volume to capacity ratio of 0.40 (SCCOG 2004). A new traffic signal will be installed at the intersection of Route 156 and Gardiners Wood Road, and recent changes to the intersection of Route 156 at Route 213 (Great Neck Road) should mitigate the congestion experienced there at certain times of the day. Table 2-7 lists roadways in the vicinity of Millstone and the annual average number of vehicles per day, as determined by the Connecticut Department of Transportation.

Table 2-7. Traffic Counts for Roads in the Vicinity of Millstone

	Roadway and Location	Annual Average Daily Traffic Volume[a]
(1)	Highway 156—Station Number 63 (just east of Millstone entrance near Gardiners Wood Road)	9600
(2)	Highway 156—Station Number 29 (west of Avery Road)	8900
(3)	Highway 156—Station Number 33 (east of Avery Road)	12,800
(4)	Highway 156—Station Number 44 (west of intersection with U.S.1)	14,700
(5)	Highway 156—Station Number 2190 (just west of Millstone entrance and west of High Ridge Road)	10,400
(6)	Highway 156—Station Number 2032 (west of River Street)	10,200
(7)	Highway 156—Station Number 25 (east of Highway 161)	10,300
(8)	Highway 156—Station Number 26 (west of Highway 161)	10,600
(9)	Highway 156—Station Number 27 (east of East Pattagansett Road)	9800
(10)	Highway 156—Station Number 18 (west of East Pattagansett Road)	9600
(11)	Highway 156—Station Number 33 (east of Rocky Neck Connector)	8900
(12)	Highway 161—Station Number 41 (northwest of Hope Street)	9300
(13)	Highway 16—Station Number 15 (north of Sleepy Hollow Road)	9900
(14)	Highway 161—Station Number 2010 (south of King Arthur Drive)	21,700
(15)	Highway 161—Station Number 8 (north of Boston Post Road)	11,900
(16)	Highway 161—Station Number 37 (north of Drabik Road)	6700
(17)	Highway 161—Station Number 38 (south of Walnut Hill Road)	5700
(18)	U.S. 1—Station Number 74 (east of Strosberg Road)	13,000
(19)	U.S. 1—Station Number 36 (west of Woodland Grove)	24,800
(20)	U.S. 1—Station Number 39 (southeast of Vivian Street)	25,200
(21)	U.S. 1—Station Number 35 (northwest of Vivian Street)	12,500
(22)	U.S. 1—Station Number 40 (northwest of Ellen Ward Road)	14,900
(23)	U.S. 1—Station Number 2051 (northwest of Cross Road)	9900
(24)	U.S. 1—Station Number 5034 (west of Oswegatchie Road)	9800

(a) Dominion 2004a

2.2.8.3 Offsite Land Use

Millstone is located in the town of Waterford, a suburban community that consists primarily of owner-occupied single-family dwellings. Waterford was settled in the late 1600s and originally was part of New London. It incorporated in 1801. Waterford is one of 21 municipalities that comprise New London County. Land use in Connecticut is regulated by municipalities and each municipality is an independent government. There are no unincorporated lands in Connecticut, and counties do not have government functions such as land use. The Connecticut General Assembly recently passed legislation enabling cooperation among municipalities. Intergovernmental projects are encouraged by allowing municipalities to engage jointly in any function that they are authorized to carry out independently. Towns in New London County have made efforts to work together to address regional planning issues, such as those presented by the presence of large American Indian casinos, economic development, transportation, water supply and availability, and housing. The forum for addressing regional and intermunicipal issues is the SCCOG. It is likely that this approach to intergovernmental planning and cooperation will continue in the region where Millstone is located (Vincent 2004).

Section 8-23 of the Connecticut General Statutes requires each town planning commission to prepare and adopt a plan of conservation and development, and to amend, update, or readopt such plan at least every 10 years. The *Waterford Plan of Preservation, Conservation and Development* provides a vision for the future of a desired community structure, and includes a future land-use plan. The plan provides for a variety of land uses and ensures an adequate supply of land for residential, open space, and business uses. The plan also includes and designates the lands devoted for use by Millstone and associated facilities. The town also has regulations governing lot sizes and places restrictions on multifamily development densities.

The Atomic Energy Commission, predecessor to the NRC, noted that the general character of land use at the time of Millstone construction during the 1970s was scattered villages and homes except for the towns of Groton, New London, and Norwich. In the southeastern Connecticut planning region, 86 percent of the land area was classified as undeveloped. In 1990, developed uses accounted for 20.5 percent of the total land area, and, in 2000, the developed area was 25 percent.

In the decade between 1990 and 2000, development grew at a rate of about 22 percent, which is comparable to the 1980s. Suburban towns like Waterford accommodated most of this growth in developed lands. Residential uses have historically been the dominant component of developed uses and this trend continued during the 1990s. While there was population growth in southeastern Connecticut of about 1 percent, there was a 39 percent increase in land area consumed for residential development. Decreasing household size may be a contributing factor, but other public policies and preferences result in low-density residential development being the predominant land use in southeastern Connecticut. While intensive industrial and commercial uses increased in geographic area, these remained fairly constant as a percentage of the total developed lands between 1980 and 2000. Lands used for transportation, communication, and utilities comprise approximately 21 percent of all developed lands in 2000, and total land used for this increased since 1990; however as a relative percentage to total developed lands in 2000, these lands decreased by 4 percent. Lands used for open space and active recreation, including agricultural uses, account for approximately 19.5 percent of the land area at the regional level, which represents a slight increase from 1990. The most common use (about 68 percent) within this category is public-private preserves and the holdings of water utilities, while agricultural lands comprise about 19 percent of this category. Undeveloped land (mostly vacant forests, fields, wetlands or bodies of water) covered 55.5 percent of the lands of southeastern Connecticut in 2000, compared to 61 percent in 1990. This equates to 1 percent of the total land area of the region being developed every two years, which implies major changes to land use in the coming decades (SCCOG 2002). Table 2-8 provides a summary of land use in southeastern Connecticut.

There are 610 farms in New London County comprising 27,500 ha (67,924 ac) or an average of 45 ha (111 ac). In contrast, there are 288 farms in Middlesex County totaling 7560 ha (18,682 ac) and averaging 26.3 ha (65 ac) (USDA 1997). Farms in New London County accounted for nearly 15 percent of all farms in the State, and they tended to be larger on average, while the farms in Middlesex County were about half the size on average of those in New London County. The number of farms reported in Connecticut remained at 4200, between 2001 and 2003. The average size of a Connecticut farm was 34.8 ha (86 ac) (USDA 2004).

Table 2-8. Land Use in Southeastern Connecticut

Land Use	km^2	mi^2	Percent of Total
Total Developed	361.2	139.5	24.9
Residential	222.0	85.7	15.3
Industrial	12.4	4.8	0.9
Commercial	15.0	5.8	1.0
Institutional	35.7	13.8	2.5
Transportation and Utilities	76.1	29.4	5.3
Open Space	191.7	74.0	13.2
Active Recreation	36.8	14.2	2.5
Agriculture	54.4	21.0	3.8
Native American	12.7	4.9	0.9
Undeveloped	295.6	305.4	54.6
Total	**656.8**	**559.5**	**100.0**

Source: SCCOG 2002.

2.2.8.4 Visual Aesthetics and Noise

Prior to development as a power facility, Millstone Point was the site of a granite quarry that operated for approximately two centuries, until 1960. Facility features include reactor containment buildings, auxiliary buildings, intake and discharge structures, turbine buildings, a radioactive waste facility, fuel handling buildings, the electrical switchyard and associated transmission lines, an environmental laboratory, and training facilities.

The Millstone site maintains a low profile when viewed from locations further inland and upland in Waterford. It is plainly visible from the waters of Long Island Sound, from the shoreline of the Pleasure Beach neighborhood, and from across Niantic Bay. The 114-m (375-ft) tall red and white stack and a meteorological tower are the most visible features when passing by the site on Rope Ferry Road. Loud noises are occasionally heard in Waterford from Millstone, but noise is generally not an issue because the actual facilities are located within an exclusion and buffer zone on a peninsula that is distant from houses.

2.2.8.5 Demography

- **Resident Population within 80 km (50 mi)**

Population was estimated within an 80-km (50-mi) radius of Millstone. Four states and all or parts of 15 counties fall within this radius. The city of Hartford, and sections of the Hartford and the New London-Norwich Metropolitan statistical areas are also located within 80 km (50 mi) of Millstone. There are eight counties in CT, four counties in Rhode Island, two counties in Massachusetts and one county in New York.

An estimated 2,868,207 people live within this area. This equates to a population density of 219 persons/km^2 (567 persons/mi^2). Applying the GEIS proximity measures, Millstone is classified as Category 4 (greater than or equal to 73 persons/km^2 (190 persons/mi^2 within 50 miles). According to the GEIS sparseness and proximity matrix, Millstone's rank of sparseness, Category 4, and proximity, Category 4, result in the conclusion that Millstone is located in a high-population area (Dominion 2004). Another estimate of population densities for 2000 reports that there are 168 persons/km^2 (434 persons/mi^2) within the southeastern Connecticut planning region, which falls within the 80-km (50-mi) radius from Millstone, while Waterford has a density of 221 persons/km^2 (573 persons/mi^2), compared with New London where 1802 persons occupy each square kilometer (4667 persons/mi^2) (SCCOG 2003b). Table 2-9 shows population growth rates and projections for New London County and Connecticut from 1980 to 2040. Table 2-10 provides more detail about the population growth in the vicinity of Millstone between 1980 and 2000.

Table 2-9. Population Growth and Trend in Connecticut and New London County 1980 to 2040

	Connecticut		New London County	
Year[a]	Number	Percent	Number	Percent
1970	3,031,709	--	230,348	--
1980	3,107,576	0.25	238,409	0.35
1990	3,287,116	0.58	254,957	0.70
2000	3,405,565	0.36	259,088	0.16
2010	3,533,269	0.37	271,393	0.47
2020	3,663,379	0.37	281,669	0.38
2030	3,793,490	0.36	291,946	0.36
2040	3,923,601	0.34	302,223	0.35

(a) Dominion 2004a

Table 2-10. Population Growth in Vicinity of Millstone 1980 to 2000

Region	1980	1990	2000	AAGR[a] 1980-2000
Connecticut	3,107,580	3,287,116	3,405,565	0.5%
County				
New London County	238,410	254,957	259,088	0.4%
Town				
Colchester	7761	10,980	14,551	3.2%
East Lyme	13,870	15,340	18,118	1.3%
Groton	41,072	45,144	39,907	–0.1%
Ledyard	13,725	14,913	14,687	0.3%
Montville	16,455	16,673	18,546	0.6%
New London	28,843	28,540	25,671	–0.6%
Waterford	17,843	17,930	19,152	0.4%

Source: Dominion 20004a
(a) AAGR: Annual Average Growth Rate.

The Hartford Metropolitan Service Area ranks 42[nd] in population size with 1,183,110 residents. The New London-Norwich Metropolitan Service Area, which contains New London County, has a total population of 293,566, making it the 134[th] largest Metropolitan Service Area in the United

States. Since 1980, New London County has had an annual average growth rate of only 0.4 percent. From a regional perspective, the population of southeastern Connecticut continues to move from the urban to the suburban and rural areas. The Waterford population growth rate is the same as the county's, 0.4 percent. Groton and New London have lost population, while Colchester, East Lyme, Ledyard, and Montville have gained population. The southeastern Connecticut region as a whole grew by 2327 persons between 1990 and 2000. The natural increase for this period was 14,160 persons while 11,833 person migrated out of the region. Waterford experienced a negative natural increase (more deaths than births), but there was a net in-migration that caused a total population gain. Waterford had a population of 19,152 in 2000, compared to 17,930 in 1990 (SCCOG 2003b)

- **Transient Population**

The population within a 16-km (10-mi) radius of Millstone increases seasonally as a result of an influx of approximately 10,500 summer residents (Dominion 2004a). Many of the beaches and recreation areas are popular regional and national tourist destinations, and during the summer months, they become sites inhabited by nonresidents, leading to a shift in population numbers. Some of these attractions are the Ocean Beach Park and boardwalk, Mystic Seaport and aquarium, the New London annual waterfront festival, evening summer concerts at Harkness State Park and the Coast Guard Academy. Other area establishments such as the Crystal Mall in Waterford, and the two nearby casinos—Foxwoods and Mohegan Sun—attract thousands of daily visitors throughout the year.

- **Migrant Labor**

Migrant farm workers are individuals whose employment requires travel to tend or harvest agricultural crops. Migrant workers travel, and they can temporarily spend a significant amount of time in an area without being actual residents. Therefore, they may be unavailable for census takers to count. If this occurs, migrant workers will be underrepresented in U.S. Census Bureau minority and low-income population counts. Migrant workers are typically members of minority or low-income populations. While there are not significant numbers of migrant agricultural workers in New London County and the region, according to the United Way of Southeastern Connecticut, there are large numbers of low-paid, mostly Asian, service workers who live in the Norwich area and who are employed at the casinos. Many of these workers became unemployed after September 11, 2000, and have come from New York City to take advantage of menial service jobs. They often occupy crowded households and share the same sleeping quarters.

2.2.8.6 Economy and Taxes

There have been structural changes to the economy of southeastern Connecticut during the past decade. The region has experienced a reduction of defense related and manufacturing employment and a boom in casino related development and employment that is altering the fundamental economics of southeastern Connecticut (SCCOG 1997).

The median household income for New London County was $50,646 in 1999 and lagged behind the State-wide median of $53,935 by 6.5 percent. However, the median household income gap between New London County and Connecticut was greater in 1989, when it lagged by 11 percent. Median household income in 1999 for towns in southeastern Connecticut ranged from a high of $58,750 in Salem to a low of $33,809 in New London. In Waterford, it was $56,047. There were 15,349 persons (6.3 percent of the population) classified as living below the poverty threshold in 1999 in southeastern Connecticut. This represented an increase of 2.6 percent from 14,954 persons in 1989 and contrasts with the decade between 1979 and 1989 when the number of persons classified as living below the poverty level threshold dropped by 18.2 percent. In 1999, 789 people living in Waterford were classified as living below the poverty threshold, an absolute increase of 206 people since 1989. In contrast, the actual total number of families that are living below the poverty threshold decreased in southeastern Connecticut from 3116 in 1989 to 2943 in 1999. The greatest concentration of low-income population is in the three urban towns of Groton, New London, and Norwich, which account for approximately two-thirds of the region's poverty population (SCCOG 2000b).

The 2000 U.S. Census reported that southeastern Connecticut had a combined civilian and military workforce of 128,677, which represents a labor force participation rate of 68 percent. The southeastern Connecticut employed labor force is similar to that of the State as a whole, with a few exceptions. There is a lower proportion of workers in the finance, insurance, and real estate category, 4.1 percent in southeastern Connecticut compared to 9.8 percent in the State; and the proportion of arts, entertainment, recreation, accommodation, and food service workers was twice that of the State, 15.9 percent compared to 6.7 percent. Unemployment statistics from the 2000 census indicate that 5192 individuals, or 4.3 percent of the total civilian labor force 16 years and older in the region, were unemployed, compared to 5.9 percent in 1990. The town of New London had the highest unemployment rate at 7.4 percent, while 3.6 percent were unemployed in Waterford (SCCOG 2000).

Casinos are now the largest employers in southeastern Connecticut, casino jobs having more than replaced in number the defense and manufacturing jobs lost during the 1990s. Defense and manufacturing still employ approximately 12,000 people in the New London labor market area, and more than 10,000 work at the U.S. Naval Submarine Base in Groton, and the pharmaceutical firm Pfizer had 6200 employees in 2000 (Southeastern Connecticut Enterprise Region Corporation 2000). Millstone is among the top ten corporate employers in the region and has a substantial economic impact on New London County. Table 2-11 lists major corporate employers in southeastern Connecticut.

Table 2-11. Major Employment Facilities in Southeastern Connecticut

Firm	Number of Employees
Foxwoods Resort Casino	11,500
U.S. Naval Submarine Base	10,119
Mohegan Sun Resort	10,000
Electric Boat	9000
Pfizer Pharmaceuticals	6200
Lawrence and Memorial Hospitals	2000
Millstone Power Station	**1650**
Backus Hospital	1500
U.S. Coast Guard Academy	1342
Connecticut College	900
Davis Standard—plastic extrusion equipment	650
Westerly Hospital	634
Computer Sciences Corporation	600
Franklin Mushroom Farms	595
Southern New England Telephone	528
Bess Eaton Donut Flour Company	405
S & S Worldwide—crafts, games, elderly aids	400
The Day Publishing Company—newspaper	395
Washington Trust	340
Mystic Seaport	330
Analysis and Technology—engineering and technical systems	325
Wyman-Gordon—casings	315
Ortronics—telecommunications	310
The Moore Company— fabrics	300
Sonalysts — sonar/film and audio studios	275

Source: Southeastern Connecticut Enterprise Region Corporation 2000: Area Survey of Employers April 2000 and May 2004

Millstone's economic contribution between April 2001 and April 2002 was $515.2 million in New London County. The main contribution of Millstone was salaries. Direct and indirect compensation accounted for $118.3 million paid to employees residing in New London County during this period. In 2004, the average salary with benefits for a permanent employee at Millstone is $100,256, which is 50-percent higher than the average for New London County. In 2001, Millstone purchases in New London County were $34 million (Nuclear Energy Institute 2004).

Millstone pays annual taxes to the towns of Waterford and East Lyme, both located in New London County. The majority of tax payments are made to Waterford ($13.5 million in 2002), but East Lyme receives a small tax payment for the plant's Information and Science Center ($5332 in 2002). Tax revenues fund Waterford's General Fund which supports programs such as the Waterford Public Schools, the library, public works, public health programs, emergency management services, the police and fire departments, parks and recreation, planning and land use commissions, the retirement commission, and others (Dominion 2004a).

For the assessment years 1996 to 1999, Millstone taxes averaged $34.8 million per year and represented 64 to 69 percent of Waterford's total tax revenues. The State enacted legislation in 1998 restructuring the electric power industry. One result of the legislation was that Millstone tax payments would be assessed using fair market value instead of net book value methodologies. Millstone property tax payments dropped to $11.7 million in 2000, representing approximately 36 percent of Waterford's tax revenues.

The State legislature passed a program called the Systems Benefit Charge, designed to reimburse affected towns such as Waterford for revenues lost by the change in assessment methodologies for electric power utilities. Eventually (as the program phases out after 2010), lost revenues will need to be recouped through millage rate increases and budget adjustments (Dominion 2004a). Table 2-12 compares Millstone's tax payments to Waterford's total tax revenues from 1996 to 2000.

Waterford commissioned and completed a study to investigate budget and service delivery options in 2000. The *Town of Waterford Long Range Financial Management Plan* provides a toolkit with over 140 recommendations to assist the town of Waterford and the Waterford Public Schools to control and reduce costs using service delivery strategies and methods implemented through aggressive management of organizational performance (Waterford 2000a).

Table 2-12. Millstone Tax Payments to Waterford 1996 to 2000

Year	Waterford Grand List Tax Revenues[a]	Tax Paid by Millstone Power Station	Percent of Waterford Tax Revenues
1996	$50,310,334	$34,768,749	69
1997	$50,436,903	$34,163,131	68
1998	$50,570,691	$33,495,022	66
1999	$52,548,808	$33,725,414	64
2000	$32,448,775[b]	$11,738,993	36

(a) Dominion 20004a. Note: Taxes collected after adjustments (such as abatements, etc.). Grand List includes real estate, personal property, and motor vehicle taxes.
(b) Assessment year 2000 revenue does not include the State program reimbursement.

2.2.9 Historic and Archaeological Resources

This section discusses the cultural background and the known historic and archaeological resources at the Millstone site and in the surrounding area. This section draws on information contained in the Environmental Report prepared by Dominion (Dominion 2004a), from archives and records stored at the Connecticut Historical Commission office in Hartford, as well as from published literature that treats the archaeology and history of Connecticut.

2.2.9.1 Cultural Background

The nearest established major cultural or historic park to Millstone is that of Ft. Trumbull State Park overlooking the Thames River about 8 km (5 mi) northwest of Millstone. Ft. Trumbull is the location of a series of coastal military forts dating back to the Revolutionary War.

As of May 2004, there are four Federally recognized Native American tribes in Connecticut and one in neighboring Rhode Island with possible historic ties to the general Millstone area. These include the Mohegan Tribe along the Thames River near Uncasville, approximately 14 km (9 mi) northeast of Millstone; the Mashantucket Pequot Tribal Nation in Ledyard, approximately 19 km (12 mi) north of Millstone; the Eastern Pequot Tribe in North Stonington, approximately 29 km (18 mi) northeast of Millstone; the Schaghticoke Tribal Nation in Kent, approximately 113 km (70 mi) northwest of Millstone; and the Narragansett Indian Tribe of Charlestown, Rhode Island, approximately 45 km (28 mi) east of Millstone. In addition to these Federally recognized tribes, there are several State-recognized tribes in Connecticut.

In the portions of the eastern coastline of Connecticut that are still largely undisturbed by historic and modern development, a rich heritage of prehistoric and early historic Native American resources and of historic Euroamerican resources is present (Van Dusen 1961;

Keegan and Keegan 1999; Kerbar 2002). Much of the information about Waterford is derived from Bachman (2000), while Millstone information is derived from a manuscript on the local quarrying industry (Reed 1994), and from a 1998 archaeological assessment survey of Waterford.

This area has an archaeological sequence that extends back at least 12,000 years before the present. The cultural history can be divided into four major periods: Paleoindian (10,000 B.C., and perhaps as early as 13,000 B.C., to around 7000 B.C.), Archaic (7000 to 700 B.C.), Woodland (700 B.C. to around A.D. 1650), and Historic (A.D. 1650 to the present). The Woodland period and the early portion of the Historic period are sometimes referred to as the Contact period.

During the Paleoindian period, the native peoples likely were organized into small mobile bands with a hunting and a fishing based economy. The Paleoindian climate was cooler than at present, with the presence of glaciers leading to much lower ocean levels. Thus, many of the archaeological sites along the coast dating from this time period would today be underwater, although a late Paleoindian site has been documented on Mashantucket Pequot tribal lands.

The Archaic period is typically divided into three components: Early, Middle, and Late Archaic, sometimes with a fourth component called Terminal Archaic. The greatest change came about during the Middle Archaic when ocean levels reached or even slightly exceeded current levels. Middle and Late Archaic archaeological sites typically exhibit greater evidence of sedentary economies, such as the presence of storage pits, extensive refuse middens, and large quantities of fire cracked rock. Habitation sites appear to have been divided into base camps used most of the year and smaller upland sites used during the fall.

In the Woodland period, Native American cultures reached their modern configurations, as noted at the time of initial European contact in the 1500s and 1600s. The increasing dependence on agriculture resulted in the development of increasingly complex trade networks and political systems and two major technological adaptions: use of ceramic containers and the bow and arrow. Woodland period archaeological sites are much more numerous throughout southern New England than are the earlier Archaic period sites. New England, for the most part, did not witness the complex Mississippian culture societies (e.g., Bense 1994) that developed immediately to the west and south of New England.

Prior to historic European contact, the ancestors of the modern southern New England Indians lived in a number of small distinct Algonquin-speaking Woodland culture societies. The Niantic occupied the area around Millstone. Around A.D. 1500, the Pequot, including the Mohegans, moved into eastern Connecticut, including the Millstone area, likely from the Hudson River Valley in New York, effectively dividing the Niantic into two bands, Eastern and Western Niantic. The Narragansett lived nearby in Rhode Island. In western Connecticut were the Mattabesic tribes, who spoke a dialect of Algonquin distinct from that of the Pequots, Mohegans, Niantics, and Narragansetts. The Pequot were aggressive and warlike and soon came to dominate much of Connecticut. The Algonquin word “quinnetukut” meant “on the long tidal river” in reference to the Connecticut River.

The Historic period for Connecticut can be roughly divided into eight subperiods: Contact (1614 to 1690), Colonial (1690 to 1764), Revolutionary War (1764 to 1783), Constitutional (1783 to 1850), Civil War Era (1850 to 1865), Reconstruction and Growth (1865 to 1917), World War I to World War II (1917 to 1945), and Modern (1945 to present).

The Historic period of Connecticut begins in 1614 with the exploration of the Connecticut River Valley by the Dutch explorer Adriaen Block. In 1633, the Dutch built a small fort in Hartford and the English founded the nearby city of Windsor. This marked the beginning of more than 100 years of population dislocation and cultural extirpation in Connecticut, ultimately resulting in amalgamations of native peoples previously distinct from one another and distributions that reflected the nature of European encroachment and economic systems, rather than the traditional patterns of the native populations.

In 1682, an amalgamation of Narragansetts and Eastern Niantics was allowed to settle and create the present Narragansett reservation in Charlestown, Rhode Island, and was given Federal recognition in 1983. An amalgamation of Mohegan Pequots together with the Western Niantics, lived variously in Connecticut and Wisconsin. In 1994, the surviving Mohegans were given Federal recognition. The Eastern Pequots were given Federal recognition in 2002. The Mattabesic tribes of western Connecticut were eventually largely amalgamated with the Mohegan, but a small surviving group composed of several Mattabesic tribes eventually became the Schaghticoke who received Federal recognition in 2004.

In the period between 1690 and 1764, all of the colonies, including Connecticut, witnessed growth as well as periodic boundary disputes with neighboring colonies. A population surge then occurred in Connecticut with the town of New London just east of Millstone increasing to a size of 5888 residents by 1774.

During the Revolutionary War, the British raided Danbury in 1777 and Greenwich in 1779, with major battles at Fort Trumbull and Fort Griswold. Connecticut primarily was involved by supplying troops and by provisioning the Continental Army during the Revolutionary War.

The period between 1790 and 1850 witnessed the dual processes of emigration from New England westward, and the growth of cotton and other manufacturing and banking industries in Connecticut. Connecticut once again became a provisioner during the Civil War, with the tiny port of Mystic being second only to Boston in terms of adding ships to the Federal Navy.

Between the Civil War and World War I, the communities around Millstone began to flourish and reached their modern configurations. During this entire period, Millstone served as a granite quarry for much of the construction in the surrounding cities.

In 1651, John Winthrop acquired more than 600 acres at Millstone Point. Winthrop did not live at the point, but instead used the land for pasturage. He gave the land to his daughter and son-in-law in 1655, and it remained in the family until approximately 1723. The new owner, Peter Buor, began quarrying operations at about that time. In 1788, the quarry was purchased by Benajah Gardiner, and it remained in the Gardiner family until purchased in 1951 by Northeast Utilities, Dominion's predecessor to power generation operations at Millstone Point. The Millstone quarry was one of seven quarries that were developed in the Waterford area. It remained the largest and most active of the seven, and was the last to cease operations.

Groundbreaking for the power facility at Millstone began in December 1965, with construction on Unit 1 commencing in 1966, at Unit 2 in 1970, and at Unit 3 in 1974. Actual power generation began in 1975. The old Millstone quarry, used for nearly two centuries, was opened to the ocean and converted into cooling area for water discharge.

2.2.9.2 Historic and Archaeological Resources at and near Millstone

As of 2002, a total of 181 properties in New London County was listed in the National Register of Historic Places, with 62 falling into a radius of 10 km (6 mi) of the Millstone facility (Dominion 2004a). None of these properties are on the Millstone site.

An archaeological records search was conducted through the use of the 1998 archaeological assessment survey for Waterford (Harper et al. 1998), and a general literature review was conducted at the Waterford Public Library. In addition, meetings were held with the Waterford town historian, Robert Nye, and with knowledgeable Millstone staff.

The earliest archaeological sites at Waterford date to the Late Archaic period, probably dating to around 4500 years to 3700 years ago. Middle Woodland (around 2000 to 1200 years ago) and Late Woodland (around 1200 to 400 years ago) were the most commonly represented pre-European time periods.

There are two areas within Millstone known to have been the locale of pre-European Native American village habitations, both of which have been largely destroyed by historic farming and construction activities. One was situated a few hundred meters inland from Niantic Bay immediately north of the railroad bed that transects Millstone. The other site is located adjacent to Jordan Cove, with possibly intact deposits being preserved within the 20-ha (50-ac) wildlife refuge maintained by Dominion.

Among known Historic period resources at Millstone are a stone lined, slab covered, circular well and a small stone slab bridge spanning a brook. The well is of an unknown date, but the bridge is located at the point depicted on a 1868 map, where an old trail or road intersects the historic Gardiners Wood Road, in the vicinity of a depicted house. Both of these properties were added to the State files at the Connecticut Historic Commission in 1998. Also present but not formally documented in undeveloped portions of Millstone are a number of historic stone boundary walls, many of which are depicted on current maps of Millstone along with a second stone lined, slab covered well north of the railroad bed on the western side of Millstone. An unstudied homestead site is located in the northwest corner of Millstone, not far from a small historic cemetery. Tombstones in the cemetery range in date between 1794 and 1862.

The most important archaeological site at Millstone is the Millstone granite quarry itself. Quarrying operations likely began sometime shortly after 1723, with millstones being produced for local use, but some also being shipped as far as the West Indies. By 1776, on postal route maps of Benjamin Franklin, the area was already referred to as Millstone Point. By the mid-1830s, quarrying activities shifted from the manufacture of millstones to the use of blocks for major construction projects. During the next 20 years, Millstone quarry granite was used for a number of coastal military forts including Adams, McAllister, Schuyler, Sumter, and Trumbull, along with the West Point Military Academy. By 1847, the Millstone quarry employed a workforce of 25 men and shipped some 30,000 tons of granite a year to cities such as New York, Philadelphia, and Charlestown. By the 1870s, the workforce had increased to more than 300 men. Millstone quarry granite was used for Mexico City's grand square, for Grand Central terminal, for the foundations of the Supreme Court building and the United Nations building, and for the base of the Statue of Liberty. Millstone quarry granite was also used for gravestones and for railroad construction.

In the late 1800s, a number of support facilities for the workers existed at the quarry, including offices, a boarding house, and a school. Virtually none of these facilities remain intact today, nor are their original locations well known. The wood framed school building still stands on Millstone property, and although removed from its original location and moved at least twice, it serves as a reminder of earlier quarrying operations at Millstone Point. The quarrying operations appear to have lasted until 1963. As previously mentioned, the southern wall of the quarry pit was subsequently breached to let in waters from Long Island Sound in order to serve as a water discharge cooling pond for the Millstone nuclear plant operations.

As previously mentioned, the Mohegan Tribe, located along the Thames River near Uncasville, is the closest Federally recognized tribe to Millstone. Its reservation land is approximately 14 km (9 mi) northeast of the facility. The Mashantucket Pequot Tribal Nation in Ledyard is approximately 19 km (12 mi) north of Millstone; the Eastern Pequot Tribe in North Stonington is approximately 29 km (18 mi) northeast of Millstone; the Schaghticoke Tribal Nation in Kent is approximately 113 km (70 mi) northwest of Millstone; and the Narragansett Indian Tribe of

Charlestown, Rhode Island, is approximately 45 km (28 mi) east of Millstone. With the possible exception of the Schaghticoke Tribal Nation, these tribes would all likely consider themselves culturally affiliated to the Millstone Area.

2.2.10 Related Federal Project Activities and Consultations

The staff reviewed the possibility that activities of other Federal agencies might impact the renewal of the operating licenses for Millstone. Any such activities could result in cumulative environmental impacts and the possible need for the Federal agency to become a cooperating agency for preparation of the SEIS.

There are several projects that have received or may receive Federal funding in the southeastern Connecticut planning region. A $2 billion upgrade to Amtrak's northeast corridor between Boston and New York City was completed recently to enable high-speed train travel. This rail line bisects the Millstone site but provides no access to or station within Waterford. The closest stop is in New London. Roadway improvements to connect Route 11 with I-95 in Waterford and to increase the capacity of I-95 in southeastern Connecticut would require Federal funding, but these roadway projects remain unfunded despite their high priority in the regional transportation plan. The recently approved Thames Basin Regional Water Interconnection Project will provide alternative water supply sources for Waterford by interconnecting the Norwich, Groton, and the New London/Waterford systems. This project is to be partially funded with Federal matching dollars. The State pier and foreign trade zone in New London was also Federally funded. This multimodal facility is intended to serve freight and passengers, as well as fishing and marine research. Cruise ships are now stopping in New London.

The next proposed round of Defense Department base realignment and closures could affect southeastern Connecticut if the submarine base were to be reduced in size or closed. This could result in the closing of related industries and have a magnified negative impact on businesses and the economy of the region. A comprehensive economic development strategy is being prepared to analyze options and scenarios for southeastern Connecticut.

The disposition of the old Norwich State Hospital is a State project. The State will sell the land to the bidder with the most desirable proposal for the 190-ha (470-ac) site. While not a Federal project or action, the ultimate reuse of this site could impact the region by addressing housing, transportation, and economic development issues.

NRC is required under Section 102(a) of the National Environmental Policy Act of 1969 to consult with and obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved. The staff has determined that there are no Federal projects or activities in the vicinity of Millstone that would result in cumulative impacts or would make it desirable for another Federal agency to become a cooperating agency for preparing this SEIS.

2.3 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy,* Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR Part 61. Code of Federal Regulations, Title 10, *Energy,* Part 6, "Licensing Requirements for Land Disposal of Radioactive Waste."

10 CFR Part 71. Code of Federal Regulations, Title 10, *Energy,* Part 71, "Packaging and Transportation of Radioactive Material."

40 CFR Part 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

49 CFR Parts 171–178. Code of Federal Regulations. Title 49, *Transportation, Subtitle B–Other Regulations Relating to Transportation*, Chapter 1, "Research and Special Programs Administration."

Bachman, R. 2000. *An Illustrated History of the Town of Waterford*, Waterford, Connecticut.

Battelle. 1999. *Draft Final Data Report for Thames River Vibratory Core Sampling at Uncasville, CT*. Submitted to Department of the Army, U.S. Army Corps of Engineers, North, August 9, 2004. Atlantic Division, New England District. Contract No. DACW33-96-D-005, Deliver Order No. 29. July 1999.

Beal, R. E., J. C. Desfosse, J. D. Field, A. M. Schick, and T. L. Berger. 1998. *Atlantic States Marine Fisheries Commission (ASMFC), Special report No. 66 of the Atlantic States Marine Fisheries Commission*. 1998 Annual Review of Interstate Fishery Management Plans.

Bense, J. A. 1994. *Archaeology of the Southeastern United States*. Academic Press, New York.

Bigelow, H. B. and W. C. Schroeder. 1953. “Fishes of the Gulf of Maine.” *Fishery Bulletin 74 of the Fish and Wildlife Service* 53: (Contribution 592), Woods Hole Oceanographic Institute. United States Government Printing Office, Washington D.C., 1953.

Connecticut Department of Environmental Protection (CTDEP). 2002a. *Attainment and Non-Attainment of National Ambient Air Quality Standards in Connecticut*. August 16, 2002. Accessed at: http://dep.state.ct.us/air2/attain2.htm on May 6, 2004.

Connecticut Department of Environmental Protection (CTDEP). 2002b. Letter, Environmental and Geographic Information Center Nancy Murray, to Anthony Johnson III, Northeast Utilities Service Company.

Connecticut Department of Environmental Protection (CTDEP). 2002c. Letter from Water Management Bureau, Robert L. Smith, Chief, to Scott M. Cullen, STAR Foundation.

Connecticut Department of Environmental Protection (CTDEP). 2004a. *Wildlife in Connecticut, Endangered and Threatened Species Series*. Accessed at: http://dep.state.ct.us/burnatr/wildlife/ factshts on April 27, 2004.

Connecticut Department of Environmental Protection (CTDEP). 2004b. Letter Office of Long Island Sound Programs, to NRC Environmental Project Manager and Dominion Vice President and Chief Environmental Officer. Subject: “Request to renew the operating license for Units 2 and 3 of the Millstone Power Station in Waterford Connecticut.” (April 27, 2004).

Connecticut Legislature. 2003. General Statutes of Connecticut. Title 22a, Environmental Protection, Chapter 446c "Air Pollution Control," Sec. 22a–174. (Formerly Sec. 19-508). *Powers of the Commissioner. Regulations. Fees. Exemptions. General permits. Appeal of Commissioner's Action re Permit Applications.* Accessed at: http://www.cga.state.ct.us/2003/pub/Chap446c.htm#Sec22a-174j.htm on August 5, 2004.

Connecticut State Climate Center (CSSC). 2004. Overview *of Climate in Connecticut*. Narrated from Weather America 2001, Grey House Publishing, Lakeville, Connecticut. Accessed at: http://www.canr.uconn.edu/nrme/cscc/CTweatherstationintroduction/CONNCTICUTINTRODUCTION.HTM on May 6, 2004.

Dimou, N. K. and E. E. Adams. 1989. *Application of a 2-D Particle Tracking Model to Simulate Entrainment of Winter Flounder Larvae at the Millstone Nuclear Power Station*. Energy Laboratory Report No. MIT-EL-89-002. November 1989.

Dominion Nuclear Connecticut (Dominion). 2002a. *Millstone Power Station, Annual Radiological Environmental Operating Report January 1, 2001 – December 31, 2001.* Waterford, Connecticut. April 30, 2002.

Dominion Nuclear Connecticut (Dominion). 2002b. *Millstone Power Station, 2001 Radioactive Effluent Release Report*. Volume 1, Waterford, Connecticut. April 30, 2002.

Dominion Nuclear Connecticut (Dominion). 2003a. *Millstone Power Station, Annual Radiological Environmental Operating Report January 1, 2002 – December 31, 2002.* Waterford, Connecticut. April 30, 2003.

Dominion Nuclear Connecticut (Dominion). 2003b. *Millstone Power Station, 2002 Radioactive Effluent Release Report*. Volume 1, Waterford, Connecticut. April 28, 2003.

Dominion Nuclear Connecticut, Inc. (Dominion). 2004a. *Applicant's Environmental Report—Operating License Renewal Stage Millstone Power Station, Units 2 and 3*. Waterford, Connecticut.

Dominion Nuclear Connecticut (Dominion). 2004b. *MP-22-REC-BAP-01, Radiological Effluent Monitoring and Offsite Dose Calculation Manual*, Revision 024-02. April 1,2004.

Dominion Nuclear Connecticut (Dominion). 2004c. *Millstone Power Station, Annual Radiological Environmental Operating Report January 1, 2003 – December 31, 2003.* Waterford, Connecticut. April 30, 2004.

Dominion Nuclear Connecticut (Dominion). 2004d. *Millstone Power Station, 2003 Radioactive Effluent Release Report*. Volume 1. Waterford, Connecticut. April 29, 2004

Dominion Nuclear Connecticut, Inc. (Dominion). 2004e. *Application for Renewed Operating Licenses, Millstone Power Station, Units 2 and 3.* Waterford, Connecticut, January 20, 2004.

Dominion Nuclear Connecticut (Dominion). 2004f. *Annual Report 2003, Monitoring the Marine Environment of Long Island Sound at Millstone Power Station*. Waterford, Connecticut.

Elliot, D. L., C. G. Holladay, W. R. Barchet, H. P. Foote, and W. F. Sandusky. 1986. *Wind Energy Resource Atlas of the United States*. DOE/CH 10093-4, U.S. Department of Energy, Washington, D.C. Accessed at: http://rredc.nrel.gov/wind/pubs/atlas on May 6, 2004.

Ferrucci and Walicki. 2002. *Northeast Utilities Wildlife Habitat Management Plan for Right-of-Way Areas*.

Harper, M. G., J. Martman-Brodur, B. Jones, and B. Clouette. 1998. *Report: Town-wide Archaeological Assessment Survey—Waterford*. Public Archaeology Survey Team, Inc. Manuscript in the possession of Robert Nye, Waterford Town Historian. Waterford, Connecticut.

Jarrell, J. D., M. Mayfield, E. N. Rappaport, and C. W. Landsea. 2001. *The Deadliest, Costliest, and Most Intense United States Hurricanes From 1900 to 2000 (and Other Frequently Requested Hurricane Facts).* NOAA Technical Memorandum NWS TPC-1, National Hurricane Center. Accessed at: http://www.aoml.noaa.gov/hrd/Landsea/deadly/ on May 6, 2004.

Keegan, W. F. and K. N. Keegan. 1999. *The Archaeology of Connecticut*. University Press of New England. Hanover, New Hampshire.

Kerber, J. E. 2002. *A Lasting Impression: Coastal, Lithic, and Ceramic Research in New England Archaeology.* Praeger. Westport, Connecticut.

Keser, M., J. T. Swenarton, J. M. Vozarik, and J. F. Foertch. 2003. “Decline in Eelgrass (Zostera marina L.) in Long Island Sound Near Millstone Point, Connecticut (USA) Unrelated to Thermal Input.” *Journal of Sea Research* 49: 11–26.

Kostiuk, L. K. 2004. E-mail from Connecticut Department of Environmental Protection to B. Gallaher, Los Alamos National Laboratory. Subject: “Millstone RCRA Status.” (June 28, 2004).

Long, E. R., L. J. Field, and D. D. MacDonald. 1998. “Predicting Toxicity in Marine Sediments with Numerical Sediment Quality Guidelines.” *Environmental Toxicology and Chemistry* 17(4): 714–727.

Lorda, E., D. J. Danila, and J. D. Miller. 2000. “Application of a Population Dynamics Model to the Probabilistic Assessment of Cooling Water Intake Effects on Millstone Nuclear Power Station (Waterford, CT) on a nearby winter flounder spawning stock.” *Environmental Science & Policy* 3: S471–482.

MacLeod, R. E. 2003. *Job 1: Marine Angler Survey*. Pages 1–38 in A Study of Recreational Fisheries in Connecticut. Connecticut Department of Environmental Protection, Bureau of Natural Resources, Fisheries Division.

Mecray, E. L., M. R. Buchholtz ten Brink, and S. Shah. 2004. *Metal Distributions in the Surface Sediments of Long Island Sound.* U.S. Geological Survey (USGS), USGS OFR 00-304: Chapter 6. Accessed at: http://pubs.usgs.gov/of/of00-304/htmldocs/chap06/index.htm on August 28, 2004.

Monteleone, D. M., W. T. Peterson, and G. C. Williams. 1987. "Interannual Fluctuations in the Density of Sand Lance, *Ammodytes americanus*, Larvae in Long Island Sound, 1951–1983." *Estuaries* 10 (3): 246–254.

National Environmental Policy Act of 1969 (NEPA), as amended. 42 USC 4321, et seq.

National Oceanic and Atmospheric Administration (NOAA). 1998. *Status of Fishery Resources off the Northeastern United States for 1998.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Region, Northeast Fisheries Science Center. Woods Hole, Massachusetts. September 1998.

National Oceanic and Atmospheric Administration (NOAA). 2002. *Assessment of 20 Northeast Groundfish Stocks through 2001. A Report of the Groundfish Assessment Review Meeting (GARM), Northeast Fisheries Science Center, Woods Hole, Massachusetts, October 8–11, 2002.* Northeast Fisheries Science Center Reference Document 02-16, October 2002. Accessed at: http://nefsc.noaa.gov/nefsc/publications/crd/drc0216/ on June 30, 2004.

National Oceanic and Atmospheric Administration (NOAA). 2003. *Local Climatological Data, 2003, Annual Summary with Comparative Data—Bridgeport, CT.* U.S. National Oceanic and Atmospheric Administration, National Climatic Data Center. Asheville, NC.

National Marine Fisheries Service (NMFS). 2002. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2002.* Available at http://www.nmfs.noaa.gov/prot_res/PR2/Stock_Assessment_Program/sars.html#Overview. On June 24, 2004.

National Marine Fisheries Service (NMFS). 2003. *Fisheries Statistics & Economics Division. Commercial Fishing Landings of Winter Flounder.* Accessed at: http://www.st.nmfs.gov/pls/webpls/mf_annual_landings.results on December 15, 2003.

National Marine Fisheries Service (NMFS). 2004a. *Loggerhead Sea Turtles* (*Caretta caretta*). Accessed at: http://www.nmfs.noaa.gov/prot_res/species/turtles/loggerhead.html on June 24, 2004.

National Marine Fisheries Service (NMFS). 2004b. *Green Sea Turtle* (*Chelonia mydas*). Accessed at: http://www.nmfs.noaa.gov/prot_res/species/turtles/green.html on June 24, 2004.

National Marine Fisheries Service (NMFS). 2004c. *Leatherback Sea Turtle* (*Dermochelys coriacea*). Accessed at: http://www.nmfs.noaa.gov/prot_res/species/turtles/leatherback.html on June 24, 2004.

National Marine Fisheries Service (NMFS). 2004d. *Kemp's Ridley Turtle* (*Lepidochelys kempii*). Accessed at: http://www.nmfs.noaa.gov/prot_res/species/turtles/kemps.html on June 24, 2004.

NatureServe 2004. *NatureServe Explorer: an Online Encyclopedia of Life*. Version 3.1, NatureServe, Arlington, Virginia. Accessed September 17-21, 2004 at http://www.natureserve.org on June 24, 2004.

Northeast Utilities Service Company (NU). 2004. *Specifications for Rights-of-Way Vegetation Management*. Section III, Technical Requirements.

Nuclear Energy Institute (NEI). 2004. *Economic Benefits of Millstone Power Station* Washington, DC.

Ramsdell, J. V. and G. L. Andrews. 1986. *Tornado Climatology of the Contiguous United States*. NUREG/CR 4461, U.S. Nuclear Regulatory Commission. Washington, DC.

Reed, W. A. III. 1994. *The Granite Industry of Waterford*. Report on file at the Waterford Public Library. Waterford, Connecticut.

Sea Grant 2004a. *Sea Grant's Long Island Sound Lobster Initiative. Sea Grant Program Response to Long Island Sound Mortality and Shell Disease, A Status Report.* Sea Grant New York. Accessed at: http://www.seagrant.sunysb.edu/LILobsters/Long Island SoundLI-ResearchResponse.pdf on August 28, 2004.

Southeastern Connecticut Council of Governments (SCCOG). 1997. *Regional Conservation and Development Policy Guide for Southeastern Connecticut*. Norwich, Connecticut.

Southeastern Connecticut Council of Governments (SCCOG). 2002. *Land Use - 2000 Southeastern Connecticut Region.* Norwich, Connecticut.

Southeastern Connecticut Council of Governments (SCCOG). 2003a. *Regional Transportation Plan for Southeastern Connecticut -— FY 2003–2004.* Norwich, Connecticut.

Southeastern Connecticut Council of Governments (SCCOG). 2003b. *Social Indicators —2000.* Norwich, Connecticut.

Southeastern Connecticut Council of Governments (SCCOG). 2004. *Housing a Region in Transition - An Analysis of Housing Needs in Southeastern Connecticut, 2000 — 2005 Summary Report.* Norwich, Connecticut.

Southeastern Connecticut Enterprise Region Corporation. 2000. *Southeastern Connecticut Almanac — A Factbook of Business Resources for New London County, Connecticut and Western Rhode Island.* New London, Connecticut.

United Way of Southeastern Connecticut. 1999. *Community Assessment.* Gales Ferry, Connecticut.

U.S. Census Bureau (USCB). 2000. *Highlights from the Census 2000 Demographic Profiles for Waterford town, New London County and Middlesex County*. Accessed at: http://factfinder.census.gov on April 30, 2004.

U.S. Department of Agriculture (USDA). 1997. *1997 Census of Agriculture*. National Agricultural Statistics Service. Washington, D.C.

U.S. Department of Agriculture (USDA). 2004. *Farms and Land in Farms*. National Agricultural Statistics Service. Washington D.C.

U.S. Environmental Protection Agency (EPA). 2004a. *Enforcement & Compliance History Online (ECHO).* Accessed at: http://www.epa.gov/echo/ on June 24, 2004.

U.S. Environmental Protection Agency (EPA). 2004b. *Long Island Sound: Facts, Figures, & Maps.* U.S. Environmental Protection Agency, Region 1: New England. Accessed at: http://www.epa.gov/region01/eco/lis/facts.html.

U.S. Environmental Protection Agency (EPA). 2004c. *Long Island Sound, An Estuary of National Significance.* U.S. Environmental Protection Agency, Region 1: New England. Accessed at: http://www.epa.gov/region01/eco/lis/ccmp.intro.html.

U.S. Fish and Wildlife Service (FWS) and United States Army Corps of Engineers (USACE). 1989. "Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic). Bay Anchovy." Biological Report 82(11.97). February 1989.

U.S. Fish and Wildlife Service (FWS). 1999. *Title 50 Wildlife and Fisheries, Part 17—Endangered and Threatened Wildlife and Plants, Subpart B—Lists.* U.S. Fish and Wildlife Service. December 21, 1999.

U.S. Fish and Wildlife Service (FWS). 2001. *Fish Facts - Shortnose Sturgeon*. Connecticut River Coordinator's Office website. Available at http://www.fws.gov/r5crc/fish/zf_acbr.html. Accessed June 24, 2004.

U.S. Fish and Wildlife Service (FWS). 2004. *Species Information, Threatened and Endangered Animals and Plants website*. Accessed at http://endangered.fws.gov/wildlife.html. Accessed August 2, 2004 through September 23, 2004.

U.S. Geological Survey. 2004. *Real Time Data for Connecticut*. Accessed at: http://waterdata.usgs.gov/ct/nwis/rt on August 9, 2004.

U.S. National Oceanic and Atmospheric Administration (NOAA). 2003. *Local Climatological Data, 2003 Annual Summary with Comparative Data—Bridgeport, CT.* U.S. National Oceanic and Atmospheric Administration, National Climatic Data Center, Asheville, NC.

Van Dusen, A. E. 1961. *Connecticut*. Random House, New York.

Vincent, J. 2004. *Inter-jurisdictional Planning Issues in Far Southeastern Connecticut*, Intergovernmental Affairs Newsletter. American Planning Association. Chicago, Illinois. March 2004.

Waterford. 1998. *Plan of Preservation, Conservation, and Development*. Adopted August 24, 1998.

Waterford. 2000a. *Town of Waterford Long Range Financial Management Plan,* 2000. Government Consulting Group, Inc. Waterford, Connecticut.

Waterford. 2000b. A Survey of Waterford Residents on Taxes, Town Services, and Dealing with the Loss of Revenue from Millstone. Center for Survey Research and Analysis, University of Connecticut. Waterford, Connecticut.

Waterford. 2002. *Thames Basin Regional Water Interconnection Project—Municipal Improvement Report to the Waterford Planning and Zoning Commission Pursuant to CGS 8-24.* Waterford, Connecticut.

Waterford. 2003. *Analysis of Impact of Collection Rate Changes Under De-Regulation.* Spread sheet provided by First Selectman Paul Eccard. Waterford, Connecticut.

Waterford Public Schools. 2004. Accessed at: http://www.waterfordschools.org on April 8, 2004.

3.0 Environmental Impacts of Refurbishment

Environmental issues associated with refurbishment activities are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[(a)] The GEIS includes a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required in this SEIS unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and, therefore, additional plant-specific review of these issues is required.

License renewal actions may require refurbishment activities for the extended plant life. These actions may have an impact on the environment that requires evaluation, depending on the type of action and the plant-specific design. Environmental issues associated with refurbishment that were determined to be Category 1 issues are listed in Table 3-1.

Environmental issues related to refurbishment considered in the GEIS for which conclusions could not be reached for the above criteria for all plants, or for specific classes of plants, are Category 2 issues. These are listed in Table 3-2.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

Table 3-1. Category 1 Issues for Refurbishment Evaluation

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
SURFACE-WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
Impacts of refurbishment on surface-water quality	3.4.1
Impacts of refurbishment on surface-water use	3.4.1
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Refurbishment	3.5
GROUND-WATER USE AND QUALITY	
Impacts of refurbishment on ground-water use and quality	3.4.2
LAND USE	
Onsite land use	3.2
HUMAN HEALTH	
Radiation exposures to the public during refurbishment	3.8.1
Occupational radiation exposures during refurbishment	3.8.2
SOCIOECONOMICS	
Public services: public safety, social services, and tourism and recreation	3.7.4; 3.7.4.3; 3.7.4.4; 3.7.4.6
Aesthetic impacts (refurbishment)	3.7.8

Category 1 and Category 2 issues related to refurbishment that are not applicable to the Millstone Power Station, Units 2 and 3 (Millstone) because they are related to plant design features or site characteristics not found at Millstone are listed in Appendix F.

The potential environmental effects of refurbishment actions would be identified, and the analysis would be summarized within this section, if such actions were planned. Dominion Nuclear Connecticut, Inc. (Dominion) indicated that it performed its integrated plant assessment, the evaluation of structures and components pursuant to 10 Code of Federal Regulations (CFR) 54.21, to identify activities that are necessary to continue operation of Millstone during the requested 20-year period of extended operation. These activities include replacement of certain components as well as new inspection activities and are described in the License Renewal Application (Dominion 2004). In its Environmental Report for Millstone, Dominion stated that it "has not identified the need to undertake any major refurbishment of replacement actions to maintain the functionality of important systems, structures, and components during the Millstone license renewal period" (Dominion 2004). Therefore, refurbishment is not considered in this supplemental environmental impact statement.

Table 3-2. Category 2 Issues for Refurbishment Evaluation

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53 (c)(3)(ii) Subparagraph
TERRESTRIAL RESOURCES		
Refurbishment impacts	3.6	E
THREATENED OR ENDANGERED SPECIES (FOR ALL PLANTS)		
Threatened or endangered species	3.9	E
AIR QUALITY		
Air quality during refurbishment (nonattainment and maintenance areas)	3.3	F
SOCIOECONOMICS		
Housing impacts	3.7.2	I
Public services: public utilities	3.7.4.5	I
Public services: education (refurbishment)	3.7.4.1	I
Offsite land use (refurbishment)	3.7.5	I
Public services, transportation	3.7.4.2	J
Historic and archaeological resources	3.7.7	K
ENVIRONMENTAL JUSTICE		
Environmental justice	Not addressed[(a)]	Not addressed[(a)]

(a) Guidance related to environmental justice was not in place at the time the GEIS and the associated revision to 10 CFR Part 51 were prepared. If an applicant plans to undertake refurbishment activities for license renewal, environmental justice must be addressed in the applicant's environmental report and the staff's environmental impact statement.

3.1 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

Dominion Nuclear Connecticut, Inc. (Dominion). 2004. *Applicant's Environmental Report – Operating License Renewal Stage Millstone Power Station, Units 2 and 3*. Waterford, Connecticut.

U.S. Atomic Energy Commission. 1973. *Final Environmental Statement Related to the Continuation of Construction of Unit 2 and the Operation of Units 1 and 2, Millstone Nuclear Power Station*. Docket Nos. 50-245 and 50-336. Washington, DC.

U.S. Nuclear Regulatory Commission (NRC). 1984. *Final Environmental Statement related to operation of Millstone Nuclear Power Station, Unit No. 3.* Docket No. 50-423. NUREG-1064. Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, *Section 6.3—Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report*. NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

4.0 Environmental Impacts of Operation

Environmental issues associated with operation of a nuclear power plant during the renewal term are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (U.S. Nuclear Regulatory Commission [NRC] 1996; 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, OR LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and therefore, additional plant-specific review of these issues is required.

This chapter addresses the issues related to operation during the renewal term that are listed in Table B-1 of 10 Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B and are applicable to the Millstone Power Station, Units 2 and 3 (Millstone). Section 4.1 addresses issues applicable to the Millstone cooling system. Section 4.2 addresses issues related to transmission lines and onsite land use. Section 4.3 addresses the radiological impacts of normal operation, and Section 4.4 addresses issues related to the socioeconomic impacts of normal operation during the renewal term. Section 4.5 addresses issues related to ground-water use and quality, while Section 4.6 discusses the impacts of renewal term operations on threatened and endangered species. Section 4.7 addresses potential new information that was raised during the scoping period, and Section 4.8 discusses cumulative

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

impacts. The results of the evaluation of environmental issues related to operation during the renewal term are summarized in Section 4.9. Finally, Section 4.10 lists the references for Chapter 4. Category 1 and Category 2 issues that are not applicable to Millstone because they are related to plant design features or site characteristics not found at Millstone are listed in Appendix F.

4.1 Cooling System

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, that are applicable to Millstone cooling system operation during the renewal term are listed in Table 4-1. Although

Table 4-1. Category 1 Issues Applicable to the Operation of the Millstone Cooling System During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
Altered current patterns at intake and discharge structures	4.2.1.2.1; 4.3.2.2; 4.4.2
Altered salinity gradients	4.2.1.2.2; 4.4.2.2
Scouring caused by discharged cooling water	4.2.1.2.3; 4.4.2.2
Discharge of chlorine or other biocides	4.2.1.2.4; 4.4.2.2
Discharge of sanitary wastes and minor chemical spills	4.2.1.2.4; 4.4.2.2
Discharge of other metals in waste water	4.2.1.2.4; 4.3.2.2; 4.4.2.2
Water use conflicts (plants with once-through cooling systems)	4.2.1.3
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Accumulation of contaminants in sediments or biota	4.2.1.2.4; 4.3.3; 4.4.3; 4.4.2.2
Entrainment of phytoplankton and zooplankton	4.2.2.1.1; 4.3.3; 4.4.3
Cold shock	4.2.2.1.5; 4.3.3; 4.4.3
Thermal plume barrier to migrating fish	4.2.2.1.6; 4.4.3
Distribution of aquatic organisms	4.2.2.1.6; 4.4.3
Gas supersaturation (gas bubble disease)	4.2.2.1.8; 4.4.3
Low dissolved oxygen in the discharge	4.2.2.1.9; 4.3.3; 4.4.3
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.2.2.1.10; 4.4.3
Stimulation of nuisance organisms	4.2.2.1.11; 4.4.3
HUMAN HEALTH	
Noise	4.3.7

the Dominion Nuclear Connecticut Inc. (Dominion) Environmental Report (ER) (Dominion 2004a) identified altered current patterns at intake and discharge structures (surface water) as a nonapplicable Category 1 issue, the staff determined that it is applicable. Dominion stated in its ER (Dominion 2004a) that it is not aware of any new and significant information associated with the renewal of the Millstone Power Station, Units 2 and 3 operating licenses (OLs). The staff has not identified any significant new information during its independent review of the Dominion ER (Dominion 2004a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of the issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows. (For each issue below, reference to the Dominion ER alludes to Dominion 2004a.)

- Altered current patterns at intake and discharge structures. Based on information in the GEIS, the Commission found that

  > Altered current patterns have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of altered current patterns at intake and discharge structures during the renewal term beyond those discussed in the GEIS.

- Altered salinity gradients. Based on information in the GEIS, the Commission found that

  > Salinity gradients have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of altered salinity gradients during the renewal term beyond those discussed in the GEIS.

- Scouring caused by discharged cooling water. Based on information in the GEIS, the Commission found that

  > Scouring has not been found to be a problem at most operating nuclear power plants and has caused only localized effects at a few plants. It is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of scouring caused by discharged cooling water during the renewal term beyond those discussed in the GEIS.

- Discharge of chlorine or other biocides. Based on information in the GEIS, the Commission found that

  > Effects are not a concern among regulatory and resource agencies, and are not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information including the National Pollutant Discharge Elimination System (NPDES) permit for Millstone, or discussion with the Connecticut Department of Environmental Protection (CTDEP). Therefore, the staff concludes that there are no impacts of discharge of chlorine or other biocides during the renewal term beyond those discussed in the GEIS.

- Discharge of sanitary wastes and minor chemical spills. Based on information in the GEIS, the Commission found that

  > Effects are readily controlled through NPDES permit and periodic modifications, if needed, and are not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information including the NPDES permit for Millstone, or discussion with the CTDEP. Therefore, the staff concludes that there are no impacts of discharges of sanitary wastes and minor chemical spills during the renewal term beyond those discussed in the GEIS.

- Discharge of other metals in waste water. Based on information in the GEIS, the Commission found that

  > These discharges have not been found to be a problem at operating nuclear power plants with cooling-tower-based heat dissipation systems and have been satisfactorily mitigated at other plants. They are not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information including the NPDES permit for Millstone or discussion with the CTDEP. Therefore, the staff concludes that there are no impacts of discharges of other metals in waste water during the renewal term beyond those discussed in the GEIS.

- Water use conflicts (plants with once-through cooling systems). Based on information in the GEIS, the Commission found that

  > These conflicts have not been found to be a problem at operating nuclear power plants with once-through heat dissipation systems.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of water use conflicts for plants with once-through cooling systems during the renewal term beyond those discussed in the GEIS.

- Accumulation of contaminants in sediments or biota. Based on information in the GEIS, the Commission found that

  > Accumulation of contaminants has been a concern at a few nuclear power plants but has been satisfactorily mitigated by replacing copper alloy condenser tubes with those of another metal. It is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of available information. Therefore, the staff concludes that there are no impacts of accumulation of contaminants in sediments or biota during the renewal term beyond those discussed in the GEIS.

- Entrainment of phytoplankton and zooplankton. Based on information in the GEIS, the Commission found that

  > Entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of entrainment of phytoplankton and zooplankton during the renewal term beyond those discussed in the GEIS.

- Cold shock. Based on information in the GEIS, the Commission found that

  > Cold shock has been satisfactorily mitigated at operating nuclear plants with once-through cooling systems, has not endangered fish populations or been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds, and is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of cold shock during the renewal term beyond those discussed in the GEIS.

- Thermal plume barrier to migrating fish. Based on information in the GEIS, the Commission found that

  > Thermal plumes have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of thermal plume barriers to migrating fish during the renewal term beyond those discussed in the GEIS.

- <u>Distribution of aquatic organisms</u>. Based on information in the GEIS, the Commission found that

  > Thermal discharge may have localized effects but is not expected to affect the larger geographical distribution of aquatic organisms.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on distribution of aquatic organisms during the renewal term beyond those discussed in the GEIS.

- <u>Premature emergence of aquatic insects</u>. Based on information in the GEIS, the Commission found that

  > Premature emergence has been found to be a localized effect at some operating nuclear power plants but has not been a problem and is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of premature emergence of aquatic insects during the renewal term beyond those discussed in the GEIS.

- <u>Gas supersaturation (gas bubble disease)</u>. Based on information in the GEIS, the Commission found that

  > Gas supersaturation was a concern at a small number of operating nuclear power plants with once-through cooling systems but has been satisfactorily mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  In 1972, the applicant reported a fish kill of Atlantic menhaden that might be attributed to gas bubble disease that occurred in the quarry. It is also possible that the fish kill was the result of heat stress or a combination of heat stress and gas bubble disease. In response to the event, the licensee installed a fish barrier at the quarry entrance to Long Island Sound. The barrier prevents fish from entering the quarry. Since installation of the fish barriers, the licensee has not observed any fish kills related to the station discharge.

The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of gas supersaturation during the renewal term beyond those discussed in the GEIS.

- Low dissolved oxygen in the discharge. Based on information in the GEIS, the Commission found that

  > Low dissolved oxygen has been a concern at one nuclear power plant with a once-through cooling system but has been effectively mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of low dissolved oxygen during the renewal term beyond those discussed in the GEIS.

- Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses. Based on information in the GEIS, the Commission found that

  > These types of losses have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of losses from predation, parasitism, and disease among organisms exposed to sublethal stresses during the renewal term beyond those discussed in the GEIS.

- Stimulation of nuisance organisms. Based on information in the GEIS, the Commission found that

  > Stimulation of nuisance organisms has been satisfactorily mitigated at the single nuclear power plant with a once-through cooling system where previously it was a problem. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of stimulation of nuisance organisms during the renewal term beyond those discussed in the GEIS.

- Noise. Based on information in the GEIS, the Commission found that

  > Noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of noise during the renewal term beyond those discussed in the GEIS.

The Category 2 issues related to cooling system operation during the renewal term and applicable to Millstone are discussed in the sections that follow and listed in Table 4-2.

Table 4-2. Category 2 Issues Applicable to the Operation of the Millstone Cooling System During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
AQUATIC ECOLOGY (FOR PLANTS WITH ONCE-THROUGH AND COOLING POND HEAT-DISSIPATION SYSTEMS)			
Entrainment of fish and shellfish in early life stages	4.2.2.1.2; 4.3.3	B	4.1.1
Impingement of fish and shellfish	4.2.2.1.3; 4.3.3	B	4.1.2
Heat shock	4.2.2.1.4; 4.3.3	B	4.1.3

4.1.1 Entrainment of Fish and Shellfish in Early Life Stages

For power plants with once-through heat-dissipation systems, the entrainment into nuclear and power plant associated cooling-water systems of fish and shellfish in early life stages is considered a Category 2 issue, requiring a site-specific assessment before license renewal.

The staff independently reviewed the Millstone Units 2 and 3 ER, visited the site, and reviewed the applicant's NPDES permit. The staff also reviewed relevant scientific articles and agency documents (CTDEP) and NOAA (National Oceanic and Atmospheric Administration) Fisheries (also known as National Marine Fisheries Service [NMFS]), interviewed agency staff, and interviewed a faculty member at the University of Connecticut who has conducted research on entrainment at Millstone.

Section 316(b) of the Clean Water Act (CWA) requires that the location, design, construction, and capacity of cooling-water intake structures reflect the best technology available for minimizing adverse environmental impacts (33 United States Code [USC] 1326). Entrainment of fish and shellfish into the cooling-water system is a potential adverse environmental impact.

On July 9, 2004, the U.S. Environmental Protection Agency (EPA) published a final rule in the Federal Register (69 FR 41575) addressing cooling-water intake structures at existing power plants whose flow levels exceed a minimum threshold value of 189 million L/d (50 million gpd). This rule is Phase II in EPA's development of 316(b) regulations establishing national requirements applicable, in existing facilities, to the location, design, construction, and capacity of cooling-water intake structures that exceed the threshold value for water withdrawals. The national requirements, which are implemented through NPDES permits, minimize the adverse environmental impacts associated with the continued use of the intake systems. Licensees are required to demonstrate compliance with the Phase II performance standards at the time of renewal of their NPDES permit. Licensees may be required as part of the NPDES renewal to alter the intake structure, redesign the cooling system, modify station operation, or take other mitigative measures as a result of this regulation. The new performance standards are designed to reduce significantly entrainment losses due to plant operation. Any required site-specific mitigation would result in less impact from entrainment during the license renewal period.

As a condition of the NPDES permit issued in 1992, the CTDEP required Dominion (as Northeast Utilities Service Company [NUSCO]) to conduct entrainment studies of winter flounder (*Pseudopleuronectes americanus*) and to submit a feasibility study on alternatives to reduce entrainment of larvae. The CTDEP approved the feasibility study, but required that Millstone " . . . continue efforts to schedule refueling outages to coincide with the period of high winter flounder abundance at the intake . . ." and "continue to monitor Niantic River winter flounder population characteristics, in accordance with [the terms of the NPDES permit]" (CTDEP 1994).

Millstone filed an NPDES permit renewal application in 1997. In 1999, the CTDEP notified Dominion that Millstone's once-through cooling might no longer represent the best technology available to minimize entrainment of aquatic eggs and larvae. Because of the possibility that Millstone is adversely impacting the local population of winter flounder, and the availability of new technologies to minimize entrainment, the CTDEP required that Millstone submit "a new evaluation of all measures available to eliminate or minimize the use of once-through cooling water" prior to reissuance of the Millstone NPDES permit (CTDEP 1999). At the request of the

CTDEP, the study scope included an assessment of winter flounder, tautog (*Tautoga onitis*), Atlantic menhaden (*Brevoortia tyrannus*), anchovies (*Anchoa* spp.), grubby (*Myoxocephalus aenaeus*), cunner (*Tautogolabrus adspersus*), and American sand lance (*Ammodytes americanus*). Dominion submitted the study (see Dominion 2001a) to CTDEP in August 2001. Dominion's NPDES permit application remains under review with the CTDEP, and the 1992 NPDES permit and 316(b) determination remain in effect until the State acts on Dominion's NPDES renewal application.

Entrainment of fish eggs and larvae through the Millstone cooling-water system has been monitored since 1976. During the most recent sampling periods, sampling frequency for eggs and larvae varied seasonally according to ichthyoplankton abundance, with day and night samples collected twice a week during June through August, once a week in September and February, and three times a week during March through May (Dominion 2002a; 2003a; 2004b). Only one daytime sample per week was collected during periods of low abundance (October through January). Samples were collected at the station discharges with a 1.0 × 3.6 m (3.3 × 11.8 ft) conical plankton net with 335 μm (0.013 in.) mesh deployed from a gantry system into the discharge water from each unit. Four flowmeters were positioned at the mouth of the net. Sample volume was determined by taking the average reading of the four flowmeters.

Tautog and cunner were the predominant species entrained at the egg stage (Tables 4-3 and 4-5). Anchovy, winter flounder, Atlantic menhaden, American sand lance, and grubby were the predominant species entrained as larvae from 1976 through 2003 (Tables 4-3 and 4-4). Winter flounder was the second most common species entrained by Millstone operations from 1976 through 2003 (Table 4-3), varying from 2.9×10^7 (1977) to just under 5.0×10^8 (1992) (Table 4-4). Dominion conservatively assumed 100-percent mortality for entrained organisms, which is consistent with EPA's entrainment mortality assumption (EPA 2004a).

Population abundances of important species (discussed in Section 2.2.5.7) subject to entrainment varied without trend or reflected regional patterns of abundance. Winter flounder populations in the vicinity of the plant also reflected regional abundance trends. However, winter flounder differ from other important species, in that winter flounder exhibit natal stream fidelity. Localized impacts to this species during spawning and larval growth could dramatically influence local population dynamics.

Since the 1970s, Dominion has examined many aspects of winter flounder population abundance and biology and attempted to determine the direct impacts associated with plant operations and compare the plant-related impacts to other adverse impacts to the species (Dominion 2002a; 2003a; 2004b). In addition to sampling larvae at the plant discharges, Dominion has conducted extensive surveys of adult, juvenile, and larval winter flounder abundance in the Niantic River and at areas near the Millstone site. Dominion's winter flounder monitoring program has identified a steady decline in adult winter flounder in the Niantic River since approximately 1982 (Dominion 2004b), but noted in the ER (Dominion 2004a) that this trend has also been observed in Long Island Sound in areas beyond the influence of Millstone operations.

Table 4-3. Percent Composition of Fish Larvae Collected at the Millstone Discharges from June 1976 Through May 2002, and Fish Eggs from 1979 Through 2001 (April Through September Inclusive), Compared to the Percent Composition of Fish Larvae Taken During June 2002 Through May 2003 and Fish Eggs During April Through September 2002 (From Dominion 2004b)

Species	Common Name	1976 to 2002 larvae (%)	2002 to 2003 larvae (%)	1979 to 2001 eggs (%)[a]	2002 eggs (%)[a]
Anchoa spp.	anchovies	44.5	1.5	4.7	<0.1
Pseudopleuronectes americanus	winter flounder	14.2	10.8	-	-
Brevoortia tyrannus	Atlantic menhaden	10.3	74.8	-	-
Ammodytes americanus	American sand lance	7.0	0.8	-	-
Myoxocephalus aenaeus	grubby	5.7	3.9	-	-
Pholis gunnellus	rock gunnel	2.7	1.7	-	-
Tautoga onitis	tautog	2.4	1.8	27.8	24.8
Tautogolabrus adspersus	cunner	2.4	0.3	53.7	52.3
Enchelyopus cimbrius	fourbeard rockling	1.5	0.2	-	-
Liparis spp.	snailfishes	1.1	0.1	-	-
Ulvaria subbifurcata	radiated shanny	1.1	<0.1	-	-
Clupea harengus	Atlantic herring	1.0	1.0	-	-
Syngnathus fuscus	northern pipefish	0.9	0.2	-	-
Scophthalmus aquosus	windowpane	0.7	0.2	-	-
Peprilus triacanthus	butterfish	0.7	0.1	-	-
Gobiidae	gobies	0.7	0.6	-	-
—	Other/not identified	3.1	2.0	13.8	22.9

(a) eggs were only positively identified for tautog, cunner, and anchovy; all other eggs went into the other/not identified category

Table 4-4. Estimated Number of Anchovy, Winter Flounder, American Sand Lance, and Grubby Larvae Entrained Each Year from 1976 Through 2002 at Millstone, and the Volume of Cooling Water on Which the Entrainment Estimates Were Based (From Dominion [2003a, 2004b].)

	Anchovy		Winter Flounder		American sand lance[a]		Grubby		Atlantic menhaden	
Year	No. entrained	Volume (m^3)[b]	No. entrained	Volume (m^3)[b]	No. entrained	Volume (m^3)[b]	No. entrained	Volume (m^3)[b]	No. entrained	Volume (m^3)[b]
1976	378	591	121	629	16	800	12	644	3	890
1977	414	549	29	443	90	888	31	667	2	857
1978	161	631	80	390	176	710	11	477	3	1035
1979	805	533	44	342	111	810	20	564	<1	895
1980	877	486	168	562	112	974	32	742	2	700
1981	1448	610	45	373	75	627	42	418	2	999
1982	449	525	164	638	27	927	48	650	4	859
1983	613	463	211	541	30	996	55	745	20	753
1984	167	581	84	508	18	877	39	673	4	989
1985	690	579	80	469	8	900	35	627	44	816
1986	1093	1206	123	1064	4	1766	54	1341	5	1776
1987	117	1114	165	1193	35	1962	52	1453	2	1785
1988	383	1284	184	1173	86	1813	112	1299	7	2009
1989	530	1158	167	889	44	1708	68	1198	208	1885
1990	978	1221	133	1174	45	2004	47	1415	37	1939
1991	451	754	116	750	7	1572	31	1090	56	1085
1992	151	979	492	1075	22	1526	73	1157	52	1601
1993	197	1050	42	1387	48	2011	52	1429	28	1800
1994	509	1193	173	920	65	1819	56	1203	70	1923
1995	175	1198	214	1006	89	1783	58	1221	91	1860
1996	24	133	51	472	18	1056	41	797	23	211
1997	17	125	76	173	3	227	28	180	5	213
1998	63	571	84	358	11	474	22	348	35	944
1999	136	905	146	748	14	1112	49	844	140	1532
2000	68	1008	331	1003	88	1613	47	1131	474	1647
2001	24	992	370	963	14	1513	178	1024	147	1610
2002	28	881	119	983	6	1612	33	1123	1454	1088
2003	-	-	-	-	-	-	153	890	-	-

(a) Includes data from December of the previous calendar year.

(b) Volume was determined from the condenser cooling water flow at Millstone during the season of occurrence for each taxon.

Table 4-5. Estimated Number of Cunner, Tautog, and Anchovy Eggs Entrained Each Year from 1979 through 2001 at Millstone, and the Volume of Cooling Water on Which the Entrainment Estimates Were Based (From Dominion 2003a)

	Cunner		Tautog		Anchovies	
Year	No. entrained ($\times 10^6$)	Volume (m^3)[a] ($\times 10^6$)	No. entrained ($\times 10^6$)	Volume (m^3)[a] ($\times 10^6$)	No. entrained ($\times 10^6$)	Volume (m^3)[a] ($\times 10^6$)
1979	1053	684	448	684	324	578
1980	1660	762	969	762	87	604
1981	1547	469	1398	769	287	673
1982	2078	808	1253	808	210	680
1983	1899	753	1019	753	371	601
1984	2135	449	1323	779	883	569
1985	2814	790	1720	790	27	675
1986	2855	1772	3750	1772	522	1484
1987	4090	1687	3597	1687	31	1402
1988	4294	1843	2693	1843	15	1558
1989	4307	1547	3002	1547	5	1327
1990	3634	1724	2101	1724	27	1465
1991	4117	1198	1521	1198	105	978
1992	2648	1484	1338	1484	18	1216
1993	5421	1655	2062	1655	228	1357
1994	6146	1627	2069	1627	177	1389
1995	5527	1536	2562	1536	30	1327
1996	872	264	313	264	4	168
1997	569	212	111	212	<1	161
1998	581	745	496	745	53	644
1999	1959	1200	1168	1200	<1	1004
2000	4802	1402	2149	1402	<1	1173
2001	4339	1448	3016	1448	8	121
2002	3340	1188	2040	1188	<1	750

(a) Volume was determined from the condenser cooling-water flow at Millstone during the season of occurrence for each taxon.

Dominion used mathematical models to place the Millstone entrainment monitoring data into the context of total Niantic River winter flounder larval production and population trends.

Dominion developed a mass-balance model to estimate the fraction of Niantic River winter flounder production that is entrained annually by Millstone operations. The results of the mass-balance model are then used as inputs to a stochastic population dynamics model, which is used to examine long-term impacts of Millstone operation on the Niantic River winter flounder stock. Dominion (2004b) estimated that Niantic River winter flounder entrainment ranged from 3.8 to 53 percent of larval production over the past 20 years that monitoring has occurred. Similarly, Dominion estimated that entrainment averaged 35 percent of winter flounder larval production between 1999 and 2003, with a range of 17.8 to 53 percent. Dominion (2004b) stated that the higher estimated entrainment of 53 percent is thought to be unreliable due to the lack of an estimate of natural larval mortality for that year. Because natural mortality for winter flounder larvae represents one of the ways in which the population is affected independently of Millstone operations, it is an important input in the mass-balance model.

To determine whether the Niantic River winter flounder larvae entrainment estimates from the mass-balance model were valid, Dominion determined the likely source populations (Niantic, Thames, and Connecticut rivers) of winter flounder larvae entrained at Millstone (Crivello 2003). Dominion then compared the model estimates to those derived by Crivello (2003), who used genetic identification techniques for two sample periods. During 2001, the mass-balance model predicted 19.7 percent entrainment of Niantic River winter flounder larvae; Crivello (2003) predicted 21.9 percent. In 2002, the model predicted 13.8 percent entrainment compared to Crivello's prediction of 12.3 percent. The close agreement of these independent estimates derived from different analyses suggests that, at least for the years examined, the mass-balance model entrainment estimates were valid.

The percentage of water entrained by Millstone operations also supports the validity of the mass-model estimates of the fraction of Niantic River winter flounder production entrained annually by Millstone operations. Millstone Units 2 and 3 have rated circulating water flows of 34.6 m^3/s (1220 ft^3/s) and 56.6 m^3/s (2000 ft^3/s), respectively, but cooling-water use is determined by plant operating conditions or the need to take units off line for scheduled or unscheduled maintenance. According to Dominion (2004a), mean tidal flows in Twotree Channel are approximately 3400 m^3/s (120,000 ft^3/s). Tidal flows in Niantic Bay are estimated to be 2830 m^3/s (100,000 ft^3/s). The percent of Twotree Channel and Niantic Bay tidal flows entrained by Millstone operations ranged from 1 to 4 percent, with the lowest water entrainment (less than 2 percent) associated with extended plant shutdowns in 1996 to 1999. Dominion (2004a) estimates that the fraction of Niantic River flow that passes through the plant is approximately 15 percent.

Dominion (2004b) interprets the relatively consistent larval abundance (based on monitoring and the mass-balance model) versus the trend of lower juvenile abundance as an indication that recruitment failure is probably related to high mortality associated with factors other than entrainment. Dominion (2004b) suggests that a "bottleneck" in the ecosystem is preventing nonentrained, late stage larvae from reaching reproductive maturity. This bottleneck may be attributable to the presence of predators at critical stages of winter flounder development, the impact of water temperature, the presence of aqueous constituents (anthropogenic or natural) that exert acute or sublethal toxic impacts, or by other unknown factors.

Using the entrainment estimates generated through the mass-balance model as inputs, Dominion (2004b) used a stochastic population dynamics model to predict the impacts of Millstone operation on the biomass of the Niantic River winter flounder population. The model was run under several scenarios that varied fishing rate (no fishing or current fishing rate) and entrainment levels (none, low, medium, and high). The predicted biomass in 2025 was about 58,000 kg (128,000 lb) under the scenario of no fishing and no entrainment. When fishing pressure was added (no entrainment), the predicted biomass dropped to 4900 kg (10,800 lb), which represents a reduction of 92 percent of the biomass under the no fishing / no entrainment scenario. When entrainment was added with fishing pressure, the predicted biomass in the year 2025 was reduced to 2800, 2300, and 1050 kg (6170, 5070, and 2310 lb) under low, medium, and high entrainment scenarios. This represents a 43 to 79 percent reduction in biomass compared to the fishing / no entrainment scenario.

Dominion (2004b) provided two additional theories to support the hypothesis that entrainment is not the primary cause of winter flounder decline. First, the extended shutdowns of Units 2 and 3 during 1997 to 1999 did not result in markedly stronger year classes or enhanced recruitment of adult winter flounder associated with the Niantic River. Second, regional winter flounder populations are declining.

Dominion attributes the high observed larval entrainment in recent years despite low abundance of Niantic River winter flounder spawners and eggs production to the presence of a compensatory mechanism. The applicant believes that the high abundance of newly hatched larvae could be due to increased egg survival from decreased predation on eggs or increased fecundity of spawner females at the lower population size. Higher abundance of later stage larvae could be due to lower mortality at both lower population density and decreased mortality associated with warmer spring temperatures.

Dominion (2004b) suggests that there are many factors adversely influencing winter flounder, including fishing pressure, regional water temperature increases, the presence or absence of predators at critical life stages, the acute or sublethal impacts caused by the presence of natural or anthropogenic constituents, and natural population fluctuations that may independently exist. Based on their monitoring and analyses and the 316(b) determination in the current NPDES permit, Dominion concluded that the impacts of entrainment "do not require mitigation beyond those measures that are required by the NPDES permit, as periodically amended" (Dominion 2004a).

The CTDEP has expressed an ongoing concern with entrainment impacts associated with Millstone operations, particularly for Niantic River winter flounder. The agency is in agreement with the applicant that multiple factors have contributed to the decline of the Niantic River winter flounder population, primarily overfishing, environmental changes related to regional temperature increases, and entrainment impacts from Millstone operations. The area of disagreement between the applicant and the CTDEP involves the extent to which each of these factors has contributed to the decline of Niantic River winter flounder. The CTDEP believes that Millstone is having a significant impact due to entrainment of winter flounder larvae. Crecco (2003) claims that although the one-year old age class and adult (ages 4+) Niantic River winter flounder stock sizes declined steadily from 1991 to 2001, similar declines have not occurred with the Long Island Sound winter flounder stocks, indicating that some factor specific to the Niantic River (i.e., entrainment) has resulted in recruitment failure in Niantic River winter flounder stock.

The CTDEP has noted that the recent high larval entrainment estimates for Niantic River winter flounder do not reflect the marked reduction in the number of female winter flounder that spawn in the Niantic River, and the correspondingly reduced estimates of Niantic River winter flounder egg production. CTDEP staff do not agree with the applicant's assertion that the apparent incongruence in entrainment estimates and population trends is due to a compensatory mechanism that results in increased survival of early life stages at low spawner abundance. A CTDEP contractor conducted a review and evaluation of the mass-balance model used by Dominion to estimate Niantic River winter flounder entrainment. Specifically, CTDEP staff were concerned that the high Niantic River winter flounder larval entrainment estimates were due to the violation of one or more of the model's assumptions (Greig et al. 2002).

The review concluded that the recent high-entrainment estimates for Niantic River winter flounder are the result of assessments of in-river larval abundance that are possibly inaccurate due to intrusion of non-Niantic River larvae into the river, and larval sampling in preferred spawning areas or areas where larvae are concentrated by currents (Greig et al. 2002). The study also concluded that additional overestimation of Niantic River winter flounder larval entrainment resulted from the approach used in the mass-balance model for estimating larval densities in Niantic Bay. In addition, Greig et al. (2002) examined current patterns in the Niantic Bay and suggested that assumptions in the model related to predicting entrainment based on transport of larvae through the zone of entrainment are incorrect. Based on these findings, Greig et al. (2002) questioned the utility of the mass-balance model input data for understanding the impact of entrainment on Niantic River winter flounder. Dominion responded to the report with detailed comments addressing these points and other issues raised in the review (Dominion 2002b; 2003b).

In a subsequent report written by CTDEP staff, Crecco (2003) asserts that the lack of relationship between late-stage larval and juvenile abundance indices in the river and future recruitment of Niantic River winter flounder supports the hypothesis that larval abundance indices for the Niantic River are highly biased due to the influx of non-Niantic River flounder larvae. Based on a Ricker-type stock recruitment model developed by CTDEP staff (Crecco 2003), entrainment levels for Niantic River winter flounder were estimated at 40 to 50 percent from 1977 to 1997 (compared to Millstone's estimate of 14 percent for the same time period). The licensee presented counter arguments by citing Crivello's work that relied on genetic markers to validate the origins of the larvae (Crivello 2003). Crecco (2003) further asserts that the persistently low recruitment levels during time periods in which Millstone was shut down are consistent with the presence of critical depensation, a situation in which the spawning stock size has fallen below some critical level and can no longer successfully recruit new fish to the population.

NOAA-NMFS staff concur with the applicant and CTDEP staff that Niantic River winter flounder are being impacted by overfishing, environmental changes related to regional temperature increases, and entrainment from Millstone operations. NOAA-NMFS staff believe that significant impacts from entrainment at Millstone are likely occurring due to the high volume of cooling water entrained through the cooling system, the number of eggs entrained, and the location of plant intakes in relation to current flowing out of the Niantic River. NOAA-NMFS staff emphasized that there is considerable uncertainty surrounding winter flounder life history, which has made it difficult to evaluate how the population is being impacted by various stressors. Nevertheless, NOAA-NMFS staff do not believe that the compensatory mechanism suggested by Millstone is likely to occur in prey species such as winter flounder. In addition, based on preliminary research conducted by NOAA-NMFS scientists, there is some evidence of offshore reproduction for winter flounder, which suggests that the assumption of natal stream fidelity might not always be true.

In order to assess the impacts of entrainment associated with Dominion activities, NRC staff reviewed the applicant's ER, annual monitoring data, and pertinent peer-reviewed journal articles written or co-authored by Dominion staff. NRC staff also consulted with CTDEP and NOAA-NMFS, and interviewed Dr. Joseph Crivello at the University of Connecticut concerning the fish genetics work he had performed as a consultant to Dominion. Dr. Crivello also provided peer-reviewed journal articles summarizing his work.

NRC staff adopted a weight-of-evidence approach consistent with Menzie et al. (1996) to evaluate the information. NRC staff identified the survival and sustainability of the Niantic River winter flounder population as the primary assessment endpoint (AE) of interest, with an AE defined by Menzie as an "explicit expression of the environmental value to be protected." NRC staff also identified five general categories of measurement endpoints (MEs), which Menzie defines as "lines of evidence used to evaluate the assessment endpoint." These MEs included studies of regional fish population trends (primarily as recreational or commercial catch data), local fish population assessments near the power plant, larval sampling near the power plant, genetic investigations of the origin of entrained larvae, and entrainment modeling. The identified MEs produced 10 relevant lines of evidence that addressed, to some extent, the impact of Dominion activities on winter flounder survival and sustainability. Each line of evidence was evaluated to determine its overall use and utility in supporting the primary AE, by considering 11 attributes that included the strength of association between the ME and AE, site specificity, impact specificity, ability of the ME to judge environmental harm, temporal and spatial representativeness, and other attributes described by Menzie et al. (1996). By evaluating each line of evidence relative to the attributes, it was possible to develop a semi-quantitative assessment of the overall use and utility of each ME relative to the primary AE. NRC staff then examined the different MEs for their level of agreement with and strength of support for the different positions presented by the applicant, regulatory agency staff, and independent research.

The CTDEP has based its assessment of Millstone's impacts primarily on a comparison of local (Niantic River) winter flounder stock trends to regional trends, with the assertion that the local decline has been more severe than the regional decline. In contrast, Dominion cites the similarity in local versus regional trends in winter flounder stock size as evidence that Millstone is not having a significant impact on the population (Dominion 2004b). NRC staff examined various data sources (see section 2.2.5), and did not detect enough difference between trends in the local and regional abundance data to conclude with certainty that there is a significant difference in population trends. NRC staff noted that the apparent differences in stock trends shown graphically in Crivello (2003) become much less discernable when data from the same time periods are compared, particularly for adult flounder (age 4+). Regulatory agencies concerned with the management of winter flounder have concluded that the resource is overfished and overexploited (NOAA 1998; NMFS 2003) and have instituted measures to reduce fishing pressure throughout Long Island Sound and the southern New England-middle Atlantic region. Thus, there is ample evidence to suggest that fishing pressure is directly contributing to the decline at both local and regional levels and may represent the major impact to this resource. The extent to which Dominion contributes to or exacerbates the problem in the Niantic River system is not elucidated by fish population studies reviewed in this SEIS.

Associations have also been made between the timing of Millstone operations and local trends in winter flounder stock. Greig et al. (2002) note that a shift occurred in the Niantic River winter flounder stock in or around 1991, approximately four years after the commissioning of Unit 3. The four-year time interval is relevant because it represents the lag between larval stages vulnerable to entrainment and reproductive maturity for females in a cohort. Dominion noted that Unit 3 went online in 1986, not four, but rather five years before 1991, which weakens the association somewhat. Dominion also pointed out that the fishing mortality rate increased substantially in 1983 and peaked in the early 1990s, and that spawner abundance in 1984 (two years before Unit 3 startup) was approximately half the levels seen from 1976 to 1983 (Dominion 2003b). Dominion (2001a) noted that there was no large change in the abundance of the adult stock of Niantic River winter flounder following the retirement of Unit 1 in 1995 or the larger, temporary shutdowns of Units 2 and 3 in 1996 to 1998. Crecco (2003) attributes the lack of positive response of the Niantic River winter flounder stock to reduced entrainment and reduced fishing pressure during the 1996 to1998 time period as further evidence of critical depensation. As discussed earlier, Dominion attributes recruitment failure to a “bottleneck” that reduces recruitment of postentrainment early life stages. NRC staff acknowledge that both compensatory and depensatory mechanisms are possible in the Niantic River winter flounder stock, but that the mechanisms are hypothesized rather than having been directly observed or measured. It also cannot be ruled out that depensatory and compensatory processes are occurring simultaneously at different life stages.

Entrainment models developed by Dominion and the CTDEP do not agree on the fraction of Niantic River winter flounder production that is entrained. However, the only recent entrainment estimates for Units 2 and 3 operation that are available for this review are based on the mass-balance model developed by Dominion. NRC staff reviewed the CTDEP critique of the model (Greig et al. 2002), and the subsequent response from Dominion (Dominion 2003b), and concluded that the model provided the best available estimate of entrainment, particularly considering the corroboration for two separate years provided by Crivello (2003). Although NRC staff acknowledges that CTDEP staff find the high entrainment estimates produced by the model to be implausible given low spawner abundance, NRC staff have not found sufficient evidence in this review to warrant eliminating from consideration the information provided by the model. NRC staff notes further that the mass-balance model is conservative in that it tends to overestimate larval entrainment.

The stochastic population dynamics model used by Dominion to predict Niantic River winter flounder biomass under various scenarios suggests that fishing has a much greater impact on the population than entrainment. However, the value chosen for the medium entrainment scenario (14.2 percent) was derived by averaging annual estimates of entrainment since 1986 (excluding 1996 to 1998 due to extended shut-down periods and 2000 due to incomplete data). NRC staff has noted that the average annual entrainment estimate for recent years under Units 2 and 3 operation (1999 to 2003, excluding 2000) was 30.6 percent, compared to 14.2 percent for earlier years under three-unit operation (1986 to 1995). Although increasing the input values for entrainment would increase the predicted impact from entrainment, the magnitude of the increase is unknown.

NRC staff sees no clear evidence of impact of entrainment on species other than winter flounder. Population trends for important fish species are either similar between the Millstone area and the region when the population trend was decreasing.

The staff’s evaluation of past impacts of entrainment on Niantic River winter flounder is inconclusive because unresolved questions remain about population dynamics, life history, and unknown factors that may be impacting the population. The available data do not allow us to unequivocally link or decouple population declines with Millstone operations. A better understanding of environmental factors that seem to be affecting the mortality rates in late stage larvae is needed. Until we can correlate spawning success with particular year classes, assignment of impact to various contributors is speculative.

The staff concludes that the impact of entrainment on species other than winter flounder is not detectable. However, regardless of cause, the Niantic River winter flounder spawning stock size appears to have reached critically low levels and to be highly vulnerable to collapse. Poor recruitment success due to unknown causes is a contributing factor in the stock decline but there is large uncertainty regarding the extent of the impact from Millstone operations. Because the spawning adult population is very low, and in consideration of the 20-year license renewal period, the staff's conclusion is that the impacts would be MODERATE.

During the course of the SEIS preparation, the staff considered mitigation measures for the continued operation of Millstone Units 2 and 3. Dominion and CTDEP are discussing mitigations as part of the NPDES permit application. Mitigation options being discussed include reducing intake flow during the winter flounder spawning season, performing regular inspection, maintenance, and refueling during the spawning season, importing fish into the Niantic Bay, installing fine mesh screens at the intake structures, and the installation of cooling towers. CTDEP is responsible for the review and issuance of NPDES permits in Connecticut and also responsible for implementation of the CWA in Connecticut. The NRC does not have authority over matters concerning discharge permits or compliance with the CWA. Therefore, the staff expects that the measures identified in the NPDES permitting process will provide mitigation for impacts related to entrainment. Any mitigation required by the state of Connecticut as a result of the ongoing NPDES permit review would reduce entrainment losses to winter flounder and lessen the impact of the plant on the Niantic winter flounder population.

4.1.2 Impingement of Fish and Shellfish

For power plants with once-through heat-dissipation systems, impingement of fish and shellfish on debris screens of cooling-water systems associated with nuclear power plants is considered a Category 2 issue, requiring a site-specific assessment before license renewal. The staff visited the site, consulted with regulatory agencies, and independently reviewed the applicant's ER, NPDES permit, and impingement studies submitted to the CTDEP.

Section 316(b) of the CWA requires that the location, design, construction, and capacity of cooling-water intake structures reflect the best technology available for minimizing adverse environmental impacts. Impingement of fish and shellfish on the debris screens of the cooling-water intake system is a potential adverse environmental impact that can be minimized by use of the best available technology.

reduced to once weekly from April to November, then increased to up to four times per week (February) from December to March.

Impingement rates at Unit 2 decreased significantly following the 1983 removal of a cofferdam that was in place during the construction of the Unit 3 cooling-water intake structure. Having documented this decrease in impingement for several years, NUSCO requested relief from routine impingement monitoring for Unit 2 from the CTDEP (NUSCO 1987a) and received concurrence that further quantification was unnecessary, with the exception of any impingement events where the daily total exceeded 300 organisms. Routine impingement monitoring for Unit 2 ceased in December 1987.

The six fish taxa that were most numerous in Millstone's impingement samples from 1976 to 1987 included winter flounder, anchovy (primarily bay anchovy), grubby, silverside [primarily Atlantic silverside (*Menidia menidia*)], Atlantic tomcod (*Microgadus tomcod*), threespine stickleback (*Gasterosteus aculeatus*), and blackspotted stickleback (*Gasterosteus wheatlandi*) (Table 4-6). Although the American sand lance had substantially higher impingement numbers than other species, approximately 480,000 American sand lance were impinged during the week of July 18, 1984. This represents approximately 98 percent of the total impingement for this species. Excluding the major impingement event, American sand lance impingement averaged about 600 individuals annually. Because of the extraordinary nature of that event and the otherwise relatively low impingement numbers, American sand lance was not considered to be among the most commonly impinged species. The six invertebrate taxa that were most abundant in impingement samples included Atlantic long-finned squid, lady crab, rock crab, green crab, blue crab, and American lobster.

In 1991, Millstone submitted an evaluation of winter flounder impingement to the CTDEP at that agency's request (NUSCO 1991). Because routine impingement monitoring for Unit 2 ceased in 1987, 1988 to 1990 estimates for Unit 2 were developed using a regression model that predicted impingement based on the catch of winter flounder at the Niantic Bay trawl station. Annual Unit 3 impingement was predicted by multiplying Unit 2 estimates by 1.74. This multiplier was based on a 1987 comparative impingement study for Units 2 and 3, which established the ratio of winter flounder impingement for Units 2 and 3 (NUSCO 1991). Limited impingement monitoring was conducted on Unit 3 for a short time as part of this study. Total annual impingement (Units 2 and 3 combined) ranged from 2446 in 1986 (highest annual impingement) to 1328 in 1990 (lowest annual impingement).

Table 4-6. Total and Range of Total Annual Impingement Estimates of Fishes and Macroinvertebrates at Millstone from 1976 through 1987 (Units 1 and 2 combined for 1976 to 1983 and Unit 2 alone for 1984 to 1987) (adapted from Dominion 2002a)

Species	Common Name	Smallest Annual Estimates	Largest Annual Estimates	Estimated Total (1976–87)	Percent of Total	Percent of Total Excluding 1984 American Sand Lance Impingement Event[a]
MACROINVERTEBRATES						
Loligo pealei	Atlantic long-finned squid	1491	24,109	142,495	37.5	-
Ovalipes ocellatus	lady crab	1343	31,952	120,460	31.7	-
Cancer productus	rock crab	633	7925	44,456	11.7	-
Carcinus maenas	green crab	656	6687	29,950	7.9	-
Callinectes sapidus	blue crab	437	1963	14,317	3.8	-
Homarus americanus	American lobster	501	1967	11,900	3.1	-
Libinia spp.	spider crabs	119	1598	8517	2.2	-
	Top seven taxa	8866	66,196	372,095	98.0	-
	Others	126	1721	7520	2.0	-
	Total	9946	67,290	379,615		-
FISHES						
Ammodytes americanus	American sand lance	8	485,411	487,089[a]	46.9	1.3
Pseudopleuronectes americanus	winter flounder	624	23,544	88,665	8.5	15.9
Anchoa spp.	anchovy	12	52,280	82,567	8.0	14.8
Myoxocephalus aenaeus	grubby	647	14,634	61,984	6.0	11.1
Menidia spp.	silverside	136	12,187	56,368	5.4	10.1
Microgadus tomcod	Atlantic tomcod	8	11,868	34,728	3.3	6.2
Gasterosteus spp.	sticklebacks[b]	0	9918	30,656	2.9	5.5
Gasterosteus aculeatus	threespine stickleback[b]	0	9472	22,640	2.1	4.1
Gasterosteus wheatlandi	blackspotted stickleback[b]	0	14,381	20,719	2.0	3.7
Tautogolabrus adspersus	cunner	57	3851	20,131	1.9	3.6
Syngnathus fuscus	northern pipefish	384	6572	17,478	1.7	3.1

Table 4-6. (contd)

Species	Common Name	Smallest Annual Estimates	Largest Annual Estimates	Estimated Total (1976–87)	Percent of Total	Percent of total Excluding 1984 American Sand Lance Impinge-ment Event[a]
			FISHES			
Peprilus triacanthus	butterfish	135	4061	17,415	1.7	3.1
Urophycis spp.	hake	41	9419	15,944	1.5	2.9
	Top thirteen taxa	6404	506,492	956,384	92.1	85.3
	Others	2039	20,992	82,086	2.0	14.7
	Total	8560	511,387	1,038,470		

(a) Approximately 480,000 American sand lance were estimated to have been impinged during the week of July 18, 1984 (98% of total sand lance impingement). This event was not included in percent of total impinged species. The event did not impact the percent of total values for macroinvertebrates.
(b) Threespine (*G. aculeatus*) and blackspotted (*G. wheatlandi*) sticklebacks were not identified as separate until 1981.

4.1.2.2 Impingement Mortality

A fish return sluiceway was completed at Unit 2 in 2000. Dominion (2001b) reported on a 1-year study of impingement survival for Unit 2. A similar 1-year study of impingement survival for Unit 3 was conducted in 1993 (NUSCO 1994), after several improvements had been made to the original fish return system design in order to comply with CTDEP requirements of at least a 70-percent rate of return sluiceway efficiency. These studies showed high survival for crustaceans (76 to 93 percent) in all water temperatures, and for demersal fishes (74 to 88 percent) in cool and cold water periods. Pelagic fish, such as Atlantic menhaden and butterfish, and Atlantic long-finned squid had relatively poor survival (0 to 14 percent). Pelagic fish were the most impinged species group with about 1300 fish impinged over one year compared to less than 400 for any other group.

Table 4-7 shows the survival rate for significant species in the Millstone vicinity. Survival rates for demersal fish were good, some at or approaching 100 percent.

Table 4-7. Impingement Survival of Significant Species Collected at the Millstone Units 2 and 3 Aquatic Returns. (Data for Unit 2 were collected biweekly from July 2000 to June 2001. Data for Unit 3 were collected biweekly from January to December 1993). (Adapted from NUSCO 1994 and Dominion 2001b).

Species	Common name	Body Type[a]	Total Impinged		Percent Survival			
					Initial		72 h	
			Unit 2	Unit 3	Unit 2	Unit 3	Unit 2	Unit 3
Pseudopleuronectes americanus	winter flounder	D	16	43	100	97	100	94
Homarus americanus	American lobster	C	10	26	100	100	100	100
Anchoa mitchilli	bay anchovy	P	5	15	0	0	0	0
Brevoortia tyrannus	Atlantic menhaden	P	915	16	14	50	0.3	0
Menidia menidia	silversides	P	13	160	70	63	23	0
Myoxocephalus aenaeus	grubby	D	49	42	94	100	78	86[b]
Tautogolabrus adspersus	cunner	D	32	3	69	67	56	67
Tautoga onitis	tautog	D	16	8	94	100	69	87

(a) D = demersal; C = crustacean; P = pelagic.
(b) typographic error in original document indicated 866% survival. We assume the number was intended to be 86%.

4.1.2.3 Assessment of Impact

Bay anchovy abundance in the vicinity of Millstone reached its highest level in 1981, dropped dramatically between 1981 and 1982, and has gradually decreased since that time. Due to lack of quantitative data for Long Island Sound or the mid-Atlantic region, it is not possible to evaluate whether the decrease in anchovy abundance near Millstone reflects regional population trends, although Dominion (2004b) reported that sharp drops in abundance have also occurred in the past decade in Narragansett Bay, Rhode Island, and in Chesapeake Bay. Dominion (2004b) describes bay anchovies as genetically homogeneous due to high levels of stock mixing and considerable movement. The species reaches maturity at approximately three months, spawns repeatedly during the summer, and has a high natural mortality rate.

Atlantic menhaden support the largest commercial fishery along the Atlantic coast (Dominion 2004b). The status of the Atlantic menhaden fishery is considered to be healthy, and abundance estimates in the Millstone vicinity suggest an overall increase in larval population size from 1987 until the present (Dominion 2004b). Silverside population abundance in the Millstone vicinity has varied from year to year without apparent trend. Due to lack of regional abundance data, it is not possible to compare the population trends in the Millstone area to the region. Cunner sampling near Millstone has shown a decline in the population since the late 1970s. This decline is similar to regional abundance estimates, which suggest that cunner stocks have also experienced a steady decline in Long Island Sound (Dominion 2004b).

Tautog abundance in the Millstone vicinity has varied without trend since the 1970s. The Connecticut recreational harvest of tautog has also varied considerably since the 1970s. Annual fishing mortality rates in the 1990s of 42 percent have potentially reduced the size of the stock, and the species is considered to be overfished (Dominion 2004b).

Fish stocks that have high or moderate impingement mortality at Millstone do not appear to have declined as a result of Millstone operations. Tautog and silverside populations have varied without trend in the vicinity of the plant, while Atlantic menhaden appear to have increased. Cunner declines near Millstone are similar to regional trends, and anchovy declines also appear to be reflecting a regional decline in the stock.

The staff has reviewed the available information, including reports provided by the applicant, information provided by regulatory agencies, public comments, and other public sources. Using this information, the staff evaluated the potential impacts due to impingement of fish and shellfish by continued operation and maintenance of Millstone. It is the staff's conclusion that the potential impacts due to impingement of fish and shellfish during the renewal term are SMALL.

During the course of the SEIS preparation, the staff considered mitigation measures for the continued operation of Millstone Units 2 and 3. Based on the assessment to date, the staff expects that the measures in place at Millstone Units 2 and 3 (i.e., aquatic organism return systems) provide mitigation for impacts related to impingement, and no new mitigation measures are warranted.

4.1.3 Heat Shock

For plants with once-through cooling systems, heat shock impacts is a Category 2 issue and requires plant-specific evaluation before license renewal. The NRC made impacts on fish and shellfish resources resulting from heat shock a Category 2 issue because of continuing concerns about thermal discharge impacts and the possible need to modify thermal discharges in the future in response to changing environmental conditions (NRC 1996).

Information to be considered includes (1) the type of cooling system (whether once-through or cooling pond) and (2) evidence of a CWA Section 316(a) variance or equivalent State documentation. To perform this evaluation, the staff reviewed the Dominion ER (Dominion 2004a), visited the Millstone site, and reviewed the applicant's NPDES permit (CT0003263), issued on December 14, 1992, and in force until the CTDEP acts on Millstone's 1997 application for NPDES permit renewal (Dominion 2004a). The staff also independently reviewed monitoring reports for the cooling-water discharge mixing zone.

Millstone has a once-through cooling system that withdraws water from Niantic Bay for condenser cooling and discharges it into Long Island Sound. Dominion also has Section 316(a) variance for thermal effluent limits. Section 316(a) of the CWA establishes a process whereby a thermal effluent discharger can demonstrate that thermal discharge limitations are more stringent than necessary to protect a balanced indigenous population of fish and wildlife and obtain alternative facility-specific thermal discharge limits. In renewing Millstone's NPDES permit in 1992, the CTDEP determined that thermal discharges from Millstone were sufficiently protective of fish and wildlife communities of Niantic Bay and eastern Long Island Sound to allow alternative thermal effluent limitations under Section 316(a) of the CWA. The NPDES permit also requires continued monitoring of the supplying and receiving waters, including studies of intertidal and subtidal benthic communities and finfish communities and "detailed studies" of lobster and winter flounder populations.

In 1972, a fish kill of Atlantic menhaden—attributed to heat shock or gas bubble disease—occurred in the quarry (NUSCO 1972). A fish barrier was installed later that year to prevent larger fishes from entering the quarry. When the second quarry cut was opened in 1982, a similar fish barrier was installed at that opening. Both barriers were replaced in 1999 and remain in place. Temperatures within the quarry occasionally exceed the lethal threshold temperatures for some species. However, Millstone has remained in compliance with the NPDES thermal and discharge volume limits at the quarry cut.

The current NPDES permit limits the maximum temperature of the discharge points at the quarry cut to 40.6 °C (105 °F), with a maximum temperature increase of 17.8 °C (32 °F) above the intake water temperature. Under unusual conditions, the temperature at the quarry cut can exceed the intake water temperature by 24.4°C (44 °F) for a period not exceeding 24 hours. In the event that the temperature differential exceeds 17.8°C (32 °F), the CTDEP requires notification. The average temperature of the receiving waters cannot be raised by more than 2.2 °C (4 °F), and discharge temperature cannot increase the normal temperature of the receiving water above 46.1 °C (83 °F). The boundary of the mixing zone cannot exceed a radius of 2438 m (8000 ft) from discharge outlet at the quarry cut. The maximum allowed daily flow of the discharges is 1.0×10^{10} L/d (2.7×10^{9} gpd).

Adams (2001) provides calculations of thermal plume extent. Thermal impacts associated with Millstone operations have been studied since 1979 and are reported in Dominion (2004b) and NUSCO (1987b). The impacts to rocky intertidal communities are limited to approximately 150 m (492 ft) of shoreline on the east side of the discharge to Long Island Sound and includes Fox Island. This area has been exposed to the thermal effluent since the opening of the second quarry cut in 1983 and has developed a resilient community of seaweeds and invertebrates. The intertidal community that developed under the thermal regimes in the discharge area is characterized by the absence or abbreviated season of occurrence for cold water species (*Chondrus* spp.*, Monostroma* spp.*, Dumontia concorta*), and the presence or extended season of occurrence for warm water species (*Codium gragile, Saragassum gilipendula, Gracilaria tikvahiae*, and more recently, *Hypnea musciformis*). Abundant growth of *Ascophyllum* spp. has also been noted during many study years and has been attributed to elevated temperatures from the Millstone discharge. However, high *abundance of Ascophyllum nodosum* has also occurred during growth seasons when all Millstone units were shut down. Increased abundance was not evident during the first year following Unit 3 restart, or from 2001 to 2003 when Units 2 and 3 were operating. It is possible that other factors such as ambient temperature conditions, nutrients, and light might be contributing to the *Ascophyllum* growth. Temperature monitoring at eelgrass beds in the vicinity of Millstone have not shown evidence of influence from plant discharges.

The staff has reviewed the available information, including that provided by the applicant, the staff's site visit, consultations with regulatory agencies, and other public sources. The staff evaluated the potential impacts to aquatic resources due to heat shock during continued operation. It is the staff's preliminary conclusion that the potential impacts to fish and shellfish due to heat shock during the renewal term are SMALL.

During the course of the draft SEIS preparation, the staff considered mitigation measures for the continued operation of Millstone during the license renewal period. Based on the assessment to date, measures in place at Millstone (e.g., fish barriers at the quarry cuts) provide mitigation of impacts related to heat shock, and no new mitigation measures are warranted.

4.2 Transmission Lines

The Millstone plant has four transmission lines (Figure 2-4), for the specific purpose of connecting Millstone to the transmission system (Dominion 2004a). The rights-of-way for the Montville, Card Street, Manchester, and Southington lines range in width from 76 to 152 m (250 to 500 ft) and in length from 21 to 85 km (13 to 53 mi), covering a total of approximately 1235 ha (3052 ac) (Section 2.1.7). The transmission rights-of-way are maintained by mowing, trimming, and herbicide application to undesirable vegetation. Vegetation within 4.5 m (15 ft) of the outermost conductor is kept short except for some red cedar thickets left for wildlife cover.

On July 9, 2004, EPA published a final rule in the Federal Register (69 FR 41575) addressing cooling-water intake structures at existing power plants whose flow levels exceed a minimum threshold value of 189 million L/d (50 million gpd) (EPA 2004b). The rule is Phase II in EPA's development of 316(b) regulations that establish national requirements applicable to the location, design, construction, and capacity of cooling-water intake structures at existing facilities that exceed the threshold value for water withdrawals. The national requirements, which are implemented through NPDES permits, minimize the adverse environmental impacts associated with the continued use of the intake systems. Licensees are required to demonstrate compliance with the Phase II performance standards at the time of renewal of their NPDES permit. Licensees may be required as part of the NPDES renewal to alter the intake structure, redesign the cooling system, modify station operation, or take other mitigative measures as a result of this regulation. The new performance standards are designed to significantly reduce impingement losses due to plant operation. Any required site-specific mitigation would result in less impact from impingement during the license renewal period.

As described by Dominion, routine impingement monitoring for Unit 2 began in 1975 at start-up and continued until 1987 (Dominion 2002a). Routine impingement monitoring has never been conducted for Unit 3 because that unit included a fish return system in its original design. Although Unit 1 has been permanently shut down and is not being considered in the current application for relicensing, monitoring reports from 1976 to 1983 present combined impingement data from Units 1 and 2. For that reason, Unit 1 data are included here for those years. For the purpose of identifying the most commonly impinged species, the staff assumed that the proportional representation of taxa impinged was similar between the two units.

Impingement survival is the most relevant issue for recent and future operations, since fish return systems are currently in place for Units 2 and 3. A discussion of the effectiveness of Units 2 and 3 fish return systems and impingement mortality is included below.

4.1.2.1 Impingement Monitoring

For Unit 2 routine impingement monitoring, from 1975 to 1977, all impinged organisms were collected, identified, and counted daily over a 24-hour period. In 1977, the collection frequency was reduced to three 24-hour samples per week. Monthly impingement rates were estimated using sample count data and actual water volumes entrained at Millstone. Impingement estimates for days not sampled were calculated by multiplying the average impingement density (number per unit volume of cooling water used on days sampled) by the volume of cooling water impinged. The actual and estimated daily counts were used to estimate monthly and annual impingement. Beginning in 1984, sampling effort was stratified to increase the precision of the estimates for periods of high impingement for winter flounder and other fishes that are prevalent in samples during late winter. Under this stratified sampling plan, sampling effort was

Vegetation from the 4.5-m (15-ft) edge to the outside of the transmission right-of-way is maintained as a structural transition to the habitat type outside of the right-of-way.

Special precautions are taken by Connecticut Light and Power (CL&P) to protect and promote quality habitat in transmission line rights-of-way (Dominion 2004a). All personnel applying herbicides are required to possess a valid applicators license (NUSCO 2004). Herbicides are not used within 3 m (10 ft) of wetlands or surface water. Vegetation is mowed only from November through April to protect saturated soils, to avoid disturbing nesting birds, and to minimize loss of fruits and seeds used by wildlife. The CTDEP reviews CL&P work plans for the presence of and potential impact to threatened or endangered species. If necessary, CL&P works with the CTDEP to design and implement transmission line maintenance procedures that protect the species.

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to transmission lines from the Millstone site are listed in Table 4-8. Dominion stated in its ER that it is not aware of any new and significant information associated with the license renewal of the Millstone site. The staff has not identified any significant new information during its independent review of the Dominion ER (Dominion 2004a), the staff site visit, the scoping process, or the evaluation of other information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-8. Category 1 Issues Applicable to the Millstone Transmission Lines During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
TERRESTRIAL RESOURCES	
Power line right-of-way management (cutting and herbicide application)	4.5.6.1
Bird collision with power lines	4.5.6.2
Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	4.5.6.3
Flood plains and wetland on power line right of way	4.5.7
AIR QUALITY	
Air quality effects of transmission lines	4.5.2
LAND USE	
Onsite land use	4.5.3
Power line right of way	4.5.3

A brief description of the staff's review and GEIS conclusions, as codified in Table B-1, for each of these issues follows. (For each issue below, reference to the Dominion ER alludes to Dominion 2004a.)

- Power line right-of-way management (cutting and herbicide application). Based on information in the GEIS, the Commission found that

  > The impacts of right-of-way maintenance on wildlife are expected to be of small significance at all sites.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, consultation with the U.S. Fish and Wildlife Service (FWS) and the CTDEP, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of power line right-of-way maintenance during the renewal term beyond those discussed in the GEIS.

- Bird collision with power lines. Based on information in the GEIS, the Commission found that

  > Impacts are expected to be of small significance at all sites.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, consultation with the FWS and the CTDEP, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of bird collisions with power lines during the renewal term beyond those discussed in the GEIS.

- Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock). Based on information in the GEIS, the Commission found that

  > No significant impacts of electromagnetic fields on terrestrial flora and fauna have been identified. Such effects are not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of electromagnetic fields on flora and fauna during the renewal term beyond those discussed in the GEIS.

- Flood plains and wetlands on power line right of way. Based on information in the GEIS, the Commission found that

  > Periodic vegetation control is necessary in forested wetlands underneath power lines and can be achieved with minimal damage to the wetland. No significant impact is expected at any nuclear power plant during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, consultation with the FWS and CTDEP, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of power line rights-of-way on flood plains and wetlands during the renewal term beyond those discussed in the GEIS.

- Air quality effects of transmission lines. Based on the information in the GEIS, the Commission found that

  > Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no air quality impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

- Onsite land use. Based on the information in the GEIS, the Commission found that

  > Projected onsite land use changes required during … the renewal period would be a small fraction of any nuclear power plant site and would involve land that is controlled by the applicant.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no onsite land use impacts during the renewal term beyond those discussed in the GEIS.

- Power line right of way. Based on information in the GEIS, the Commission found that

  > Ongoing use of power line right of ways would continue with no change in restrictions. The effects of these restrictions are of small significance.

> The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of power line rights-of-way on land use during the renewal term beyond those discussed in the GEIS.

There is one Category 2 issue related to transmission lines, and another issue related to transmission lines is being treated as a Category 2 issue. These issues are listed in Table 4-9 and are discussed in Sections 4.2.1 and 4.2.2.

Table 4-9. Category 2 and Uncategorized Issues Applicable to the Millstone Transmission Lines During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
HUMAN HEALTH			
Electromagnetic fields, acute effects (electric shock)	4.5.4.1	H	4.2.1
Electromagnetic fields, chronic effects	4.5.4.2	NA	4.2.2

4.2.1 Electromagnetic Fields—Acute Effects

In the GEIS (NRC 1996), the staff found that, without a review of the conformance of each nuclear plant transmission line with National Electrical Safety Code (NESC) criteria (NESC 1997), it was not possible to determine the significance of the electric shock potential. Evaluation of individual plant transmission lines is necessary because the issue of electric shock safety was not addressed in the licensing process for some plants. For other plants, land use in the vicinity of transmission lines may have changed, or power distribution companies may have chosen to upgrade line voltage. To comply with 10 CFR 51.53(c)(3)(ii)(H), the applicant must provide an assessment of the potential shock hazard if the transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the NESC for preventing electric shock from induced currents. According to the applicant

> . . . transmission lines were designed and constructed in accordance with the National Electrical Safety Code and industry guidance that was current when the lines were built. Ongoing right-of-way surveillance and maintenance of Millstone transmission facilities ensure continued conformance to design standards(Dominion 2004a).

In addition to compliance with the NESC limit of 5 mA electric-field-induced current, the transmission lines are phased to produce the lowest possible electromagnetic fields.

As described in the Appendix E (Section 3.1.3) of the ER, there are four 345-kV lines that were designed and constructed before the NESC promulgated the 5-mA rule on induced current. In 1987, a parking lot for the Cross Road Mall was constructed under the four transmission lines.

CL&P conducted extensive studies of the electric shock potential in the parking lot and has concluded that the lines in this location are constructed in accordance with NESC provisions for limiting induced current shock, including vehicles that use this area. (Dominion 2004a). Although Millstone has not conducted studies along the entire transmission line right-of-way, the Cross Road Mall is the most probable location for induced current shock.

The staff has reviewed the available information, including that provided by the applicant, the staff's site visit, the scoping process, and other public sources. Using this information, the staff evaluated the potential impacts for electric shock resulting from operation of Millstone and associated transmission lines. The staff considered the cumulative impacts of past, current, and foreseeable future actions at the site regardless of which agency (Federal or non-Federal) or person undertakes such other actions. It is the staff's conclusion that the potential impacts for electric shock during the renewal term are SMALL.

4.2.2 Electromagnetic Fields—Chronic Effects

In the GEIS, the chronic impacts of 60-Hz electromagnetic fields from power lines were not designated as Category 1 or 2, and will not be until a scientific consensus is reached on the health implications of these fields.

The potential for chronic impacts from these fields continues to be studied and is not known at this time. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy. A recent report (NIEHS 1999) contains the following conclusion:

> The NIEHS concludes that ELF-EMF [extremely low frequency-electromagnetic field] exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

This statement is not sufficient to cause the staff to change its position with respect to the chronic impacts of electromagnetic fields. The staff considers the GEIS finding of "not applicable" still appropriate and will continue to follow developments on this issue.

4.3 Radiological Impacts of Normal Operations

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to Millstone in regard to radiological impacts are listed in Table 4-10. Dominion stated in its ER that it is not aware of any new and significant information associated with the renewal of the Millstone OLs. The staff has not identified any significant new information during its independent review of the Dominion ER (Dominion 2004a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-10. Category 1 Issues Applicable to Radiological Impacts of Normal Operations During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
HUMAN HEALTH	
Radiation exposures to public (license renewal term)	4.6.2
Occupational radiation exposures (license renewal term)	4.6.3

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows. (For each issue, reference to the Dominion ER alludes to Dominion 2004a.)

- Radiation exposures to public (license renewal term). Based on information in the GEIS, the Commission found that

  > Radiation doses to the public will continue at current levels associated with normal operations.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of radiation exposures to the public during the renewal term beyond those discussed in the GEIS.

- Occupational radiation exposures (license renewal term). Based on information in the GEIS, the Commission found that

  > Projected maximum occupational doses during the license renewal term are within the range of doses experienced during normal operations and normal maintenance outages, and would be well below regulatory limits.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of occupational radiation exposures during the renewal term beyond those discussed in the GEIS.

There are no Category 2 issues related to radiological impacts of routine operations.

4.4 Socioeconomic Impacts of Plant Operations During the License Renewal Period

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to socioeconomic impacts during the renewal term are listed in Table 4-11. Dominion has stated in its ER that it was not aware of any new and significant information associated with the renewal of Millstone (Dominion 2004a). The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS (NRC 1996). For these issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-11. Category 1 Issues Applicable to Socioeconomics During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
SOCIOECONOMICS	
Public services: public safety, social services, and tourism and recreation	4.7.3; 4.7.3.3; 4.7.3.4; 4.7.3.6
Public services: education (license renewal term)	4.7.3.1
Aesthetic impacts (license renewal term)	4.7.6
Aesthetic impacts of transmission lines (license renewal term)	4.5.8

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows. (For each issue below, reference to the Dominion ER alludes to Dominion 2004a.)

- Public services: public safety, social services, and tourism and recreation. Based on information in the GEIS, the Commission found that

  > Impacts to public safety, social services, and tourism and recreation are expected to be of small significance at all sites.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on public safety, social services, and tourism and recreation during the renewal term beyond those discussed in the GEIS.

- Public services: education (license renewal term). Based on information in the GEIS, the Commission found that

  > Only impacts of small significance are expected.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on education during the renewal term beyond those discussed in the GEIS.

- Aesthetic impacts (license renewal term). Based on information in the GEIS, the Commission found that

  > No significant impacts are expected during the license renewal term.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no aesthetic impacts during the renewal term beyond those discussed in the GEIS.

- Aesthetic impacts of transmission lines (license renewal term). Based on information in the GEIS, the Commission found that

  > No significant impacts are expected during the license renewal term.

The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no aesthetic impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

Table 4-12 lists the Category 2 socioeconomic issues, which require plant-specific analysis, and environmental justice, which was not addressed in the GEIS.

Table 4-12. Environmental Justice and GEIS Category 2 Issues Applicable to Socioeconomics During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
SOCIOECONOMICS			
Housing impacts	4.7.1	I	4.4.1
Public services: public utilities	4.7.3.5	I	4.4.2
Offsite land use (license renewal term)	4.7.4	I	4.4.3
Public Services: transportation	4.7.3.2	J	4.4.4
Historic and archaeological resources	4.7.7	K	4.4.5
Environmental Justice	Not addressed[(a)]	Not addressed[(a)]	4.4.6

(a) Guidance related to environmental justice was not in place at the time the GEIS and the associated revision to 10 CFR Part 51 were prepared. Therefore, environmental justice must be addressed in the staff's environmental impact statement.

4.4.1 Housing Impacts During Operations

In determining housing impacts, the applicant chose to follow Appendix C of the GEIS (NRC 1996), which presents a population characterization method that is based on two factors, "sparseness" and "proximity" (GEIS Section C.1.4 [NRC 1996]). Sparseness measures population density within 32 km (20 mi) of the site, and proximity measures population density and city size within 80 km (50 mi). Each factor has categories of density and size (GEIS Table C.1), and a matrix is used to rank the population category as low, medium, or high (GEIS Figure C.1).

All or parts of 15 counties, the city of Hartford, and sections of the Hartford and the New London-Norwich Metropolitan Statistical Areas are located within 80 km (50 mi) of Millstone, and four states also fall within this radius. Approximately 73 percent of Millstone's employees live in New London County while another 12 percent reside in Middlesex County. Another 14 percent are distributed across 14 counties in Connecticut, Massachusetts, and Rhode Island with numbers ranging from 1 to 60 employees per county. As estimated from 2000 U.S. Census Bureau information, 2,868,207 people live within 50 miles of Millstone. This equates to a population density of 1469 persons/km^2 (567 persons/mi^2). Applying the GEIS proximity measures, Millstone is classified as Category 4 (greater than or equal to 190 persons per square mile within 50 miles). According to the GEIS sparseness and proximity matrix, the Millstone ranks of sparseness, Category 4, and proximity, Category 4, result in the conclusion that Millstone is located in a high-population area.

10 CFR Part 51, Subpart A, Appendix B, Table B-1 states that impacts on housing availability are expected to be of small significance at plants located in a high-population area where growth-control measures are not in effect. Millstone is located in a high-population area of southeastern Connecticut. Dominion plans to add no more than five additional permanent employees during the license renewal term. Dominion's analysis determined that some towns are applying growth control measures designed to guide but not preclude growth. There are no growth limits in Waterford, but the town regulates residential densities within zoning districts by establishing the maximum number of units allowed for any given parcel and by considering the most appropriate development pattern. The Dominion ER (Dominion 2004a) concluded that impacts to housing availability from a plant population growth of up to five employees would be SMALL and would not warrant mitigation during continued operations based on the NRC criteria.

SMALL impacts result when no discernible change in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and no housing construction or conversion is required to meet new demand (NRC 1996). The GEIS assumes that an additional staff of 60 permanent per-unit workers might be needed during the license renewal period to perform routine maintenance and other activities.

The U.S. Census Bureau (USCB) reported that there were 7986 housing units in Waterford in 2000, and a total of 110,674 in New London County. The vacancy rate in Waterford was 5.6 percent (444 units) while it was 9.8 percent (10,839) in New London County (USCB 2000). According to the 1998 *Plan of Preservation, Conservation & Development*, there is the theoretical potential for about 4000 additional housing units in Waterford. The plan recommends that Waterford continue to provide for a diversity of housing types, and encourage the availability of housing for a variety of age and income groups. While housing is a regional issue of concern in southeastern Connecticut, the focus of that concern is the provision of housing for the increasing numbers of service workers associated with the casino, tourism and service sector, and the provision of appropriate housing for the increasing numbers of single occupancy and elderly households (Southeastern Connecticut Council of Governments [SCCOG] 2004).

The staff reviewed the available information relative to housing impacts and Dominion's conclusions. Based on this review, the staff concludes that the impact on housing during the license renewal period would be SMALL, and additional mitigation would not be warranted.

4.4.2 Public Services: Public Utility Impacts During Operations

Impacts on public utility services are considered SMALL if there is little or no change in the ability of the system to respond to the level of demand, and thus there is no need to add capital facilities. Impacts are considered MODERATE if overtaxing of service capabilities occurs during periods of peak demand. Impacts are considered LARGE if existing levels of service (e.g., water or sewer services) are substantially degraded and additional capacity is needed to meet ongoing demands for services. The GEIS indicates that, in the absence of new and significant information to the contrary, the only impacts on public utilities that could be significant are impacts on public water supplies (NRC 1996).

Millstone acquires potable water from the city of New London through pipes owned by Waterford. Millstone's 2000 to 2001 potable water usage averaged 1.257×10^6 L/d (3.320×10^6 gpd). This usage represents approximately 5.2 percent of the city of New London's daily capacity and 6 percent of its average daily use. Impact on local water supplies is not expected to change during continuing operations at Millstone as a result of license renewal. Adding direct and indirect employees (as a result of five additional license renewal employees) would not significantly impact the capacity in the region's water supplies. Analysis of impacts on the public water supply system considered both plant demand and plant-related population growth. Millstone water usage is not expected to change during the license renewal and no refurbishment activities are planned for Millstone. Average daily water withdrawals are near authorized withdrawal limits (capacities) in some areas, and, while the region overall has excess capacity, it is expected to eventually experience water shortages in some areas. Although future water shortages are a concern for the region, their occurrence would be independent of the license renewal process. Dominion concluded that impacts to the public water supply from plant-related population growth and plant demand would be SMALL and mitigation would not be warranted (Dominion 2004a). The recently approved Thames Basin Regional Water Interconnection Project will provide alternative water supply sources for Waterford by interconnecting the Norwich, Groton, and the New London / Waterford systems. This project provides a degree of redundancy to the Waterford water system while mitigating pressure deficiencies that have been a concern for fire fighting in the Quaker Hill neighborhood. Piping water from Groton will provide a less costly solution than developing new sources, while increasing the safe yield available for present and future demands (City of Waterford 2002).

The staff has reviewed the available information, including the Dominion analysis discussed above. Based on this information, the staff concludes that the potential impacts of Millstone upon water use are SMALL, and that additional mitigation would not be warranted

4.4.3 Offsite Land Use During Operations

Offsite land use during the license renewal term is a Category 2 issue (10 CFR 51, Subpart A, Appendix B, Table B-1). Table B-1 of 10 CFR 51 Subpart A, Appendix B notes that "significant changes in land use may be associated with population and tax revenue changes resulting from license renewal."

Section 4.7.4 of the GEIS defines the magnitude of land-use changes as a result of plant operation during the license renewal term as follows:

SMALL—Little new development and minimal changes to an area's land-use pattern.

MODERATE—Considerable new development and some changes to the land-use pattern.

LARGE—Large-scale new development and major changes in the land-use pattern.

Dominion has identified a maximum of five additional permanent employees during the license renewal term (Dominion 2004a). Using this upper-bound employment assumption, the staff calculated that there could be an increase in total population of 15 people from continued operation of Millstone within southeastern Connecticut during the license renewal term. This represents about 0.006 percent of the current population of the area.

Section 3.7.5 of the GEIS (NRC 1996) states that if plant-related population growth is less than 5 percent of the study area's total population, offsite land-use changes would be small, especially if the study area has established patterns of residential and commercial development, a population density of at least 23 persons/km^2 (60 persons/mi^2), and at least one urban area with a population of 100,000 or more within 80 km (50 mi). Population growth related to Millstone license renewal will be less than 0.006 percent of the area's 2000 total population of 242,759; Waterford and the southeastern Connecticut region have established patterns of residential and commercial development, a population density of 219 persons/km^2 (567 persons/mi^2), and there are two cities (Hartford and New Haven) each with a population of about 123,000 in 2000 within a 80-km (50-mi) radius. Consequently, the staff concludes that population changes resulting from license renewal are likely to result in SMALL offsite land-use impacts.

Tax revenue can affect land use because it enables local jurisdictions to be able to provide the public services (e.g., transportation and utilities) necessary to support development. Section 4.7.4.1 of the GEIS states that the assessment of tax-driven land-use impacts during the license renewal term should consider (1) the size of the plant's payments relative to the community's total revenues, (2) the nature of the community's existing land-use pattern, and (3) the extent to which the community already has public services in place to support and guide development. If the plant's tax payments are projected to be small relative to the community's total revenue, tax-driven land-use changes during the plant's license renewal term would be SMALL, especially where the community has pre-established patterns of development and has provided adequate public services to support and guide development. Section 4.7.2.1 of the GEIS states that if tax payments by the plant owner are less than 10 percent of the taxing jurisdiction's revenue, the significance level would be SMALL. If the plant's tax payments are projected to be medium to large relative to the community's total revenue, new tax-driven land-use changes would be MODERATE. If the plant's tax payments are projected to be a dominant source of the community's total revenue, new tax-driven land-use changes would be LARGE. This would be especially true where the community has no pre-established pattern of development or has not provided adequate public services to support and guide development.

In 1999, prior to electric deregulation, property tax payments from Millstone accounted for 69 percent of Waterford tax revenues or $34.8 million. In 2000, after deregulation, Millstone taxes paid to Waterford represented 36 percent of the town's total annual property tax revenues or $11.7 million (Dominion 2004a). Based on an analysis by the town of Waterford (2003), tax payments from Millstone will continue to account for 25 to 30 percent of annual tax revenues.

The town of Waterford has anticipated the need to reduce its overall fiscal reliance on Millstone as a consequence of the change in assessment methodologies for electric power utilities. The *Waterford Long Range Financial Management Plan* provides a toolkit with over 140 recommendations to assist the town of Waterford and the Waterford Public Schools to control and reduce costs (City of Waterford 2000).

The nontax economic benefits of Millstone on New London County will continue to be substantial. Millstone's impact between April 2001 and April 2002, was $515.2 million in New London County. The main expenditure of Millstone is salaries. Direct and indirect compensation accounted for $118.3 million paid to employees residing in New London County during this period. In 2004, the average salary with benefits for a permanent employee at Millstone is $100,256, which is 50 percent higher than the average for New London County. In 2001, Millstone purchases in New London County were $34 million.

The criteria in the GEIS (Section C.4.1.5.2) result in the assignment of an impact level of MODERATE when tax levels are greater than 10 percent. However, the case study assumed a certain level of refurbishment. There are no major refurbishment activities planned at Millstone to support license renewal, and no new sources of plant-related tax payments are expected that could significantly affect land use in New London County. Millstone has been and likely will continue to be an important economic force for New London County. However, Millstone has not been the primary factor in land-use change in Waterford or New London County. Waterford's slow rate of population growth (0.4 percent since 1980) is the same as New London County. There is still a large amount of land that is zoned and suitable for residential, commercial, and industrial development in Waterford. Southeastern Connecticut has been addressing many planning issues including housing, water, transportation, and development patterns on a regional level. Land use patterns and trends are similar in Waterford and other suburban towns in southeastern Connecticut. In addition, continued operation of Millstone over the license renewal term would be important to maintaining the current level of development and public services in Waterford. Based on these considerations, it is the staff's conclusion that the tax-related land-use impacts are likely to be SMALL.

4.4.4 Public Services: Transportation Impacts During Operations

On October 4, 1999, 10 CFR 51.53(c)(3)(ii)(J) and 10 CFR Part 51, Subpart A, Appendix B, Table B-1 were revised to clearly state that "Public Services: Transportation Impacts During Operations" is a Category 2 issue (see NRC 1999 for more discussion of this clarification). The issue is treated as such in this draft SEIS.

There is no refurbishment planned at Millstone and, therefore, refurbishment impacts to the local transportation system are not anticipated, and further evaluation is not necessary. Dominion reports that there would be no more than five additional license renewal term employees (Dominion 2004). This is in addition to the station workforce of 1550 to 1650 employees and long-term contractors and a periodic outage workforce of as many as 800 additional workers.

Waterford, New London County and the southeastern Connecticut region have a well-developed transportation system. In 2001, the segments of Route 156 passing by the Millstone access (at High Ridge Drive) had a volume to capacity ratio of 0.40, which means that there is unused capacity (SCCOG 2004). A new traffic signal will be installed at the intersection of Route 156 and Gardiners Wood Road, and recent changes to the intersection of Route 156 at Route 213 (Great Neck Road) should mitigate the congestion experienced there at certain times of day. The regional transportation plan for southeastern Connecticut contains a number of recommendations to address transportation concerns that could affect Waterford and Millstone because Millstone is the eleventh largest regional nonresidential traffic generator, and one of six high-security sites in southeastern Connecticut. The highest priority projects for southeastern Connecticut that affect Millstone are the completion of Route 11, and capacity improvements to Interstate 95. These projects remain unfunded (SCCOG 2003).

The staff has reviewed the Dominion ER (Dominion 2004a) and other information made available during interviews with local officials and observation of the transportation conditions around Millstone and concludes that, based on the information available, increasing the current permanent workforce impacts of Millstone license renewal upon transportation would be SMALL, such that mitigation would not be warranted.

4.4.5 Historic and Archaeological Resources

The National Historic Preservation Act (NHPA) requires Federal agencies to take into account the impacts of their undertakings on historic properties. The historic preservation review process mandated by Section 106 of the NHPA is outlined in regulations issued by the Advisory Council on Historic Preservation at 36 CFR Part 800. Therefore, according to the NHPA, the NRC is to make a reasonable effort to identify historic properties in the areas of potential impact. If no historic properties are present or affected, the NRC is required to notify the State Historic Preservation Office before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve possible adverse impacts of the undertaking.

On August 5, 2003, the Connecticut deputy state historic preservation officer indicated that the license renewal of Units 2 and 3 at Millstone would have “no effect” on historic properties, “. . . conditional upon the understanding that no expansion, structural modification and / or ground disturbance will result from the license renewal operations” (Loether 2003). The staff concludes that this letter satisfies the determination of impacts under Section 106. However, the response from the State Historic Preservation Office indicated the need to restrict activities to existing developed areas and that any new use of previously undeveloped areas within Millstone would require evaluation and new consultation.

It is unlikely that significant historic resources are present in the previously developed portions of Millstone. However, provisions for dealing with the inadvertent discovery of significant subsurface archaeological deposits and human remains are part of the administrative control procedures in place at Millstone, in the unlikely event such deposits and remains are encountered during routine operations and maintenance. As described in Chapter 3, major refurbishment of Millstone is not required during the license renewal period, and it is anticipated that there will be no need to use the currently undeveloped portions of Millstone for operations during the renewal period. Millstone management is aware of the known cultural resources at Millstone and is committed to taking them into account during the license renewal period. Continued operation of Millstone would have a beneficial impact on these or any potential unknown or undiscovered historic or archaeological resources in undisturbed areas for the duration of the license renewal period by protecting the natural landscape and vegetation and by providing restricted access to the plant.

Based on the staff’s cultural resources analysis and consultation, the finding that Dominion did not identify any major refurbishment activities related to the renewal of the Millstone Units 2 and 3 OLs, and that operation will continue within the bounds of plant operations as evaluated in the Final Environmental Statement (U.S. Atomic Energy Commission 1973), it is the staff’s conclusion that the potential impacts on historic and archaeological resources are expected to be SMALL, and that mitigation is not warranted.

4.4.6 Environmental Justice

Environmental justice refers to a Federal policy that requires that Federal agencies identify and address, as appropriate, disproportionately high and adverse human health or environmental impacts of its actions on minority[a] or low-income populations. The memorandum accompanying Executive Order 12898 (59 FR 7629) directs Federal executive agencies to consider environmental justice under the National Environmental Policy Act of 1969. The Council on Environmental Quality has provided guidance for addressing environmental justice (Council on Environmental Quality 1997). Although the executive order is not mandatory for independent agencies, the NRC has voluntarily committed to undertake environmental justice reviews. Specific guidance is provided in NRC Office of Nuclear Reactor Regulation Office Instruction LIC-203, *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues* (NRC 2001). The Commission has since issued draft guidance on environmental justice in the *Federal Register* (68 FR 62642 [NRC 2003]).

The scope of the review as defined in NRC guidance (NRC 2001) includes identification of impacts on minority and low-income populations, the location and significance of any environmental impacts during operations on populations that are particularly sensitive, and information pertaining to mitigation. It also includes evaluation of whether these impacts are likely to be disproportionately high and adverse.

The staff looks for minority and low-income populations within the 80-km (50-mi) radius of the site. For the staff's review, a minority population exists in a census block group[b] if the percentage of each minority and aggregated minority category within the census block group exceeds the corresponding percentage of minorities in the state of which it is a part by 20 percent, or the corresponding percentage of minorities within the census block group is at least 50 percent. A low-income population exists if the percentage of low-income population within a census block group exceeds the corresponding percentage of low-income population in the state of which it is a part by 20 percent, or if the corresponding percentage of low-income population within a census block group is at least 50 percent.

(a) The NRC Guidance for performing environmental justice reviews defines "minority" as American Indian or Alaskan Native, Asian, Native Hawaiian or other Pacific Islander, Black races, or Hispanic ethnicity. "Other" races and multiracial individuals may be considered as separate minorities (NRC 2001).

(b) A census block group is a combination of census blocks, which are statistical subdivisions of a census tract. A census block is the smallest geographic entity for which the USCB collects and tabulates decennial census information. A census tract is a small, relatively permanent statistical subdivision of counties delineated by local committees of census data users in accordance with USCB guidelines for the purpose of collecting and presenting decennial census data. Census block groups are subsets of census tracts (USCB 2001).

The staff examined the geographic distribution of minority and low-income populations within 80 km (50 mi) of Millstone, using information derived from the 2000 Census for minority and low-income populations (Dominion 2004a). The analysis was supplemented by field inquiries to the Town of Waterford, the SCCOG and the United Way of New London County. Figures 4-1 and 4-2 show the distribution of census block groups for the minority and low-income populations, respectively.

The area within 80-km (50-mi) of Millstone includes parts of four states. USCB data characterize Connecticut as 0.3 percent American Indian or Alaskan Native, 2.4 percent Asian, 0.0 percent Native Hawaiian or other Pacific Islander, 9.1 percent Black races, 4.3 percent all other single minorities, 2.2 percent multiracial, 18.4 percent aggregate of minority races, and 9.4 percent Hispanic ethnicity. Rhode Island is 0.5 percent American Indian or Alaskan Native, 2.3 percent Asian, 0.1 percent Native Hawaiian or other Pacific Islander, 4.5 percent Black races, 5.0 percent all other single minorities, 2.7 percent multiracial, 15.0 percent aggregate of minority races, and 8.7 percent Hispanic ethnicity. New York was characterized as 0.4 percent American Indian or Alaskan Native, 5.5 percent Asian, 0.0 percent Native Hawaiian or other Pacific Islander, 15.9 percent Black races, 7.1 percent all other single minorities, 3.1 percent multiracial, 32.1 percent aggregate of minority races, and 15.1 percent Hispanic ethnicity. Massachusetts with 0.002 percent of the block groups is characterized as 0.2 percent American Indian or Alaskan Native, 3.8 percent Asian, 0.0 percent Native Hawaiian or other Pacific Islander, 5.4 percent Black races, 3.7 percent all other single minorities, 2.3 percent multiracial, 15.5 percent aggregate of minority races, and 6.8 percent Hispanic ethnicity.

Based on the “more than 20 percent” or the “exceeds 50 percent” criteria, there are no Native Hawaiian or other Pacific Islander or multiracial minorities within 80 km (50 mi) of Millstone. Based on the “more than 20 percent” criterion, American Indian or Alaskan Native minority populations exist in two block groups in Suffolk County, NY. Based on the “more than 20 percent” criterion, an Asian minority population exists in five block groups, and all of these block groups are in the state of Connecticut: three in New Haven, one in Hartford County and the fifth in Tolland County. Based on the “more than 20 percent” criterion, Black races minority populations exist in 193 block groups, 189 of which are located in the state of Connecticut. These block groups are distributed among five counties: New Haven with 103 block groups, Hartford with 80 block groups, New London with 4 block groups, and Tolland and Middlesex with 1 block group each. Two of the remaining four block groups are in Suffolk County, New York and the other two in Rhode Island: one in Newport and one in Providence County. Based on the “more than 20 percent” criterion, an “all other single minority races” population exists in 88 block groups that are all in Connecticut. These block groups are distributed among four

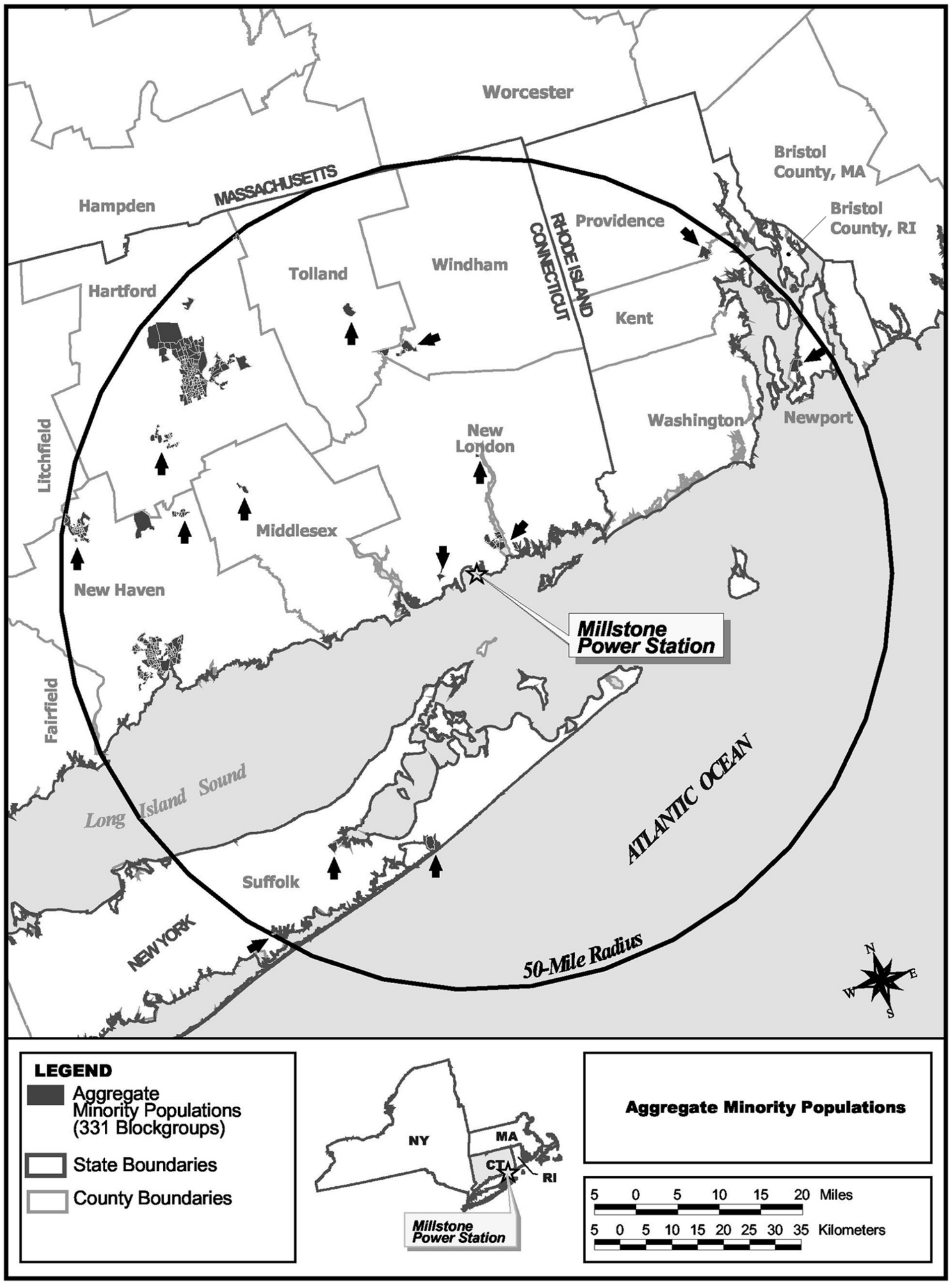

Figure 4-1. Geographic Distribution of Minority Populations (shown in shaded areas) Within 80 km (50 mi) of Millstone Based on Census Block Group Data[(a)]

(a) Note: Some of the census block groups extend into open water.

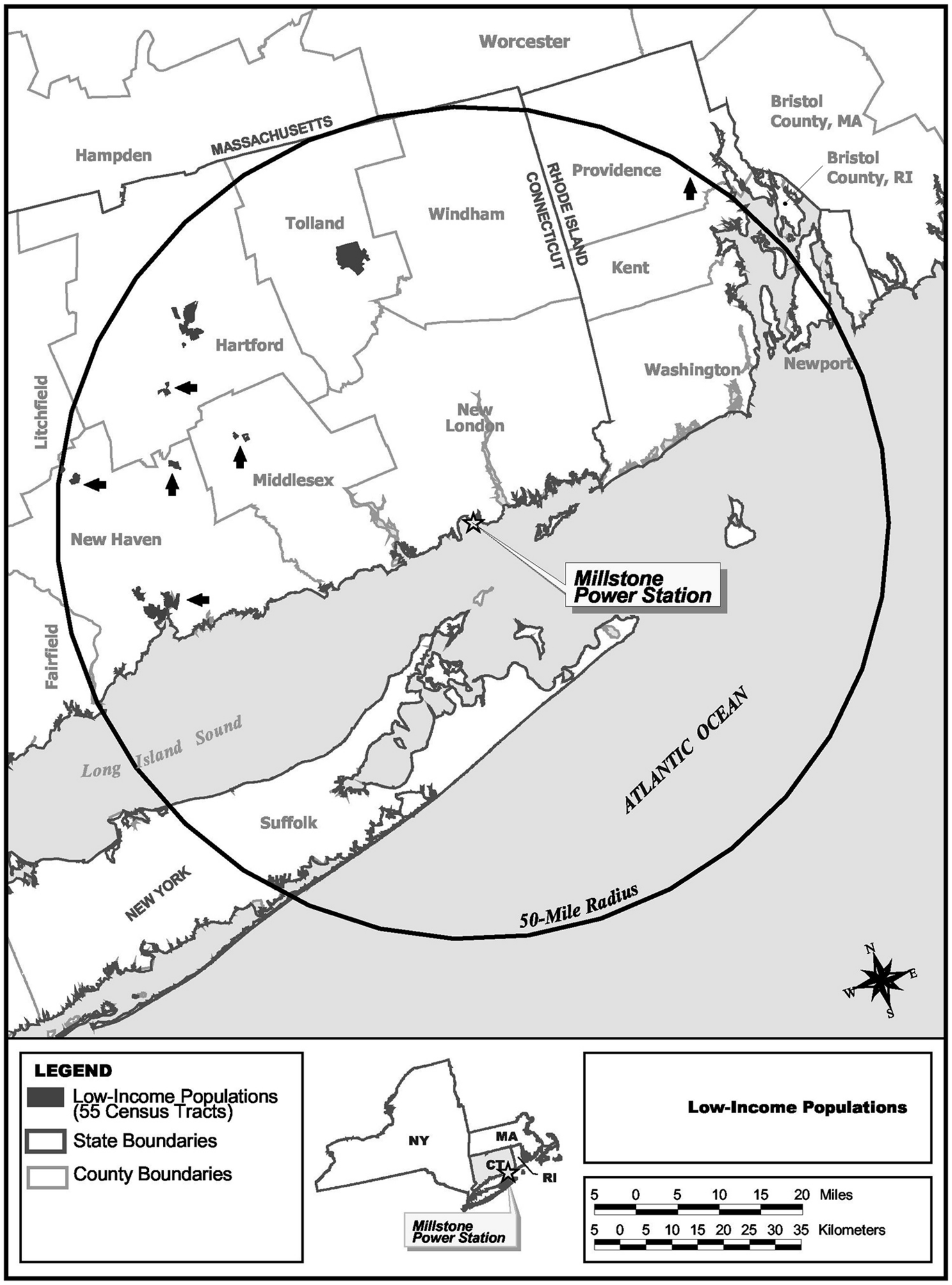

Figure 4-2. Geographic Distribution of Low-Income Populations (shown in shaded areas) Within 80 km (50 mi) of Millstone Based on Census Block Group Data [(a)]

(a) Note: Some of the census block groups extend into open water.

counties: Hartford with 52 block groups, New Haven with 31 block groups, Windham with 4 block groups, and New London with 1 block group. Based on the "more than 20 percent" criterion, aggregate of minority races populations exist in 331 block groups: Connecticut has 325 block groups, and New York and Rhode Island have 3 each. Based on the "more than 20 percent" criterion, Hispanic ethnicity minority populations exist in 169 block groups. Connecticut has 168 of the block groups distributed among 4 counties: Hartford (83 block groups), New Haven (76 block groups), Windham (6 block groups), and New London (3 block groups). The remaining block group is in Suffolk County, New York. The minority populations identified are predominantly in ethnic neighborhoods in Hartford and New Haven, approximately 64 km (40 mi) from Millstone.

Very few census blocks identified as minority populations under the environmental justice criteria, occur in closer proximity to Millstone. While there are not significant numbers of migrant agricultural workers in New London County and the region, according to the United Way of Southeastern Connecticut, there are large numbers of low-paid mostly Asian service workers employed at the casinos; most of these workers live in the Norwich area.

Dominion reported that the USCB characterized 8 percent of Connecticut, approximately 9 percent of all Massachusetts, 14 percent of New York, and 12 percent of Rhode Island households as "low income" in 2000. Based on the "more than 20 percent" criterion, 55 tracts contain low-income populations and 54 of these tracts are in Connecticut. The other one is in Rhode Island. These low-income households are predominantly in Hartford and New Haven, both approximately 64 (40 mi) from Millstone (Dominion 2004a).

With the locations of minority and low-income populations identified, the staff proceeded to evaluate whether any of the environmental impacts of the proposed action could affect these populations in a disproportionately large and adverse manner. Based on staff guidance (NRC 2001), air, land, and water resources within 80 km (50 mi) of Millstone were examined. Within that area, a few potential environmental impacts could affect human populations; all of these were considered SMALL for the general population.

The pathways through which the environmental impacts associated with Millstone license renewal could affect human populations are discussed throughout this SEIS. The staff evaluated whether minority and low-income populations could be disproportionately affected by these impacts. The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing through which the populations could be disproportionately high and adversely affected. In addition, the staff did not identify any location-dependent disproportionately high and adverse impacts affecting these minority and low-income populations. The staff concludes that offsite impacts from Millstone to minority and low-income populations would be SMALL, and no special mitigation actions would be warranted.

4.5 Ground-Water Use and Quality

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to Millstone Power Station Units 2 and 3 ground-water use and quality are listed in Table 4-13. Dominion stated in its ER that it is not aware of any new and significant information associated with the renewal of the Millstone Power Station, Units 2 and 3. The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the GEIS concluded that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-13. Category 1 Issues Applicable to Ground-water Use and Quality During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
GROUND-WATER USE AND QUALITY	
Ground-water use conflicts (potable and service water; plants that use <100 gpm).	4.8.1.1
Ground-water quality degradation (saltwater intrusion)	4.8.2.1

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, 10 CFR 51, follows. (For each issue below, reference to the Dominion ER alludes to Dominion 2004a.)

- Ground-water use conflicts (potable and service water; plants that use <100 gpm). Based on information in the GEIS, the Commission found that

  > Plants using less than 100 gpm are not expected to cause any ground-water use conflicts.

  As discussed in Section 2.2.2, Millstone ground-water use is less than 0.068 m^3/s (100 gpm). The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no ground-water use conflicts during the renewal term beyond those discussed in the GEIS.

- Ground-water quality degradation (saltwater intrusion). Based on information in the GEIS, the Commission found that

    Nuclear power plants do not contribute significantly to saltwater intrusion.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no ground-water quality degradation impacts associated with saltwater intrusion during the renewal term beyond those discussed in the GEIS.

  The staff has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no ground-water quality degradation impacts associated with cooling ponds in salt marshes during the renewal term beyond those discussed in the GEIS.

There are no Category 2 issues related to ground-water use and quality for Millstone.

4.6 Threatened or Endangered Species

Threatened or endangered species are listed as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue is listed in Table 4-14.

Table 4-14. Category 2 Issue Applicable to Threatened or Endangered Species During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
THREATENED OR ENDANGERED SPECIES (FOR ALL PLANTS)			
Threatened or endangered species	4.1	E	4.6

The issue of threatened or endangered species present at the Millstone site requires consultation with appropriate agencies to determine whether any such species are present and whether they would be adversely affected by continued operation of the nuclear plant during the license renewal term. The staff is currently consulting with the FWS under provisions of Section 7 of the Endangered Species Act concerning the potential impacts of an additional 20 years of operation and maintenance activities at Millstone on Federally listed species. The staff initiated consultation by requesting a list of threatened and endangered species (NRC 2004a, 2004b). FWS and NOAA Fisheries responded with a list of species that potentially occur in the project area (FWS 2004a; NOAA 2004). In November 2004, the staff sent a biological assessment (BA) to FWS and NOAA Fisheries and requested concurrence in the BA (NRC 2004c, 2004d). Copies of the letters to FWS and NOAA Fisheries are included in Appendix E.

4.6.1 Aquatic Species

The known range of eight Federally listed marine species include Long Island Sound. These include three species of whales—right whale (*Balaena glacialis*), finback whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), and four species of turtle—loggerhead sea turtle (*Caretta caretta*), green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Demochelys cariacea*), and Kemp's (Atlantic) ridley sea turtle (*Lepidochelys kempii*) (FWS 2004b). The shortnose sturgeon (*Acipenser brevirostrum*) is a Federally listed endangered species that is found in the Connecticut River and parts of Long Island Sound and is known to venture into salt water. The staff included the shortnose sturgeon in its impact analysis. The staff has evaluated the potential impact on these eight species from an additional 20 years of operation of Millstone and documented in its evaluation in a Biological Assessment (see Appendix E).

Based on the evaluation in the BA, the staff has preliminarily concluded that continued operation of the plant under license renewal will have no effect on the right whale, finback whale, humpback whale, loggerhead sea turtle, green sea turtle, leatherback sea turtle, Kemp's ridley sea turtle, and the shortnose sturgeon. Based on its evaluation, the staff's conclusion is that the potential impacts on threatened and endangered aquatic species from an additional 20 years of operation of Millstone would be SMALL.

4.6.2 Terrestrial Species

Six terrestrial species that are Federally protected under the endangered species act are known from counties in Connecticut that contain the Millstone site or are crossed by the Millstone transmission line ROWs. Two of the species, the piping plover (*Charadrius melodus*), and the Puritan tiger beetle (*Cicindela puritana*), are not known or not likely to be found in the future from the site or transmission ROWs. These two species are unlikely to be affected by station operation during the renewal period. Both the bald eagle (*Haliaeetus leucocephalus*) and the piping plover (*Charadrius melodus*) are known to occasionally use the Millstone site. The New England cottontail rabbit (*Sylvilagus transitionalis*), although not reported from the site or transmission ROWs, the habitat maintained by CL&P along the ROWs may be attractive to this species. Habitat for the small whorled pogonia (*Isotria medeoloides*) may exist at the Millstone site or along associated transmission line ROWs. Maintenance practices are unlikely to adversely impact specimens of this species if it, in fact, exists at the site or along the transmission line ROWs.

The staff has determined that license renewal for Millstone would have no effect on the Puritan tiger beetle and the piping plover and, may affect, but it is not likely to adversely affect, the bald eagle, the roseate tern, the New England cottontail, and the small whorled pogonia. The basis for the staff's conclusions are found in the BA enclosed with the staff's letters to FWS and NOAA Fisheries (NRC 2004c, 2004d). Copies of the letters to FWS and NOAA Fisheries are included in Appendix E. Therefore the staff concludes that the potential impacts of an additional 20 years of operation and maintenance of Millstone on Federal endangered, threatened, proposed, or candidate terrestrial species would be SMALL. During the course of its evaluation, the staff considered mitigation measures for continued operation of Millstone. Based on this evaluation, the staff expects that current mitigation measures are appropriate, and no additional mitigation is warranted.

4.7 Evaluation of Potential New and Significant Information on Impacts of Operations During the Renewal Term

During scoping, some commenters suggested that operation of Millstone resulted in excess cancers in the population around the plant site. Several reports were cited including *Elevated Childhood Cancer Incidents Proximate to U.S. Nuclear Power Plants* (Mangano et al. 2003), *2,500 Excess Cancer Cases in New London County Since 1970: Radioactive Emissions from Millstone May Be The Cause* (Mangano 1998), *Cancer in Populations Living Near Nuclear Facilities* (National Cancer Institute 1990), and *Cancer Incidence in Connecticut Counties, 1995-1999* (Connecticut Tumor Registry 2004). During scoping, other commenters suggested that there is no relationship between cancer incidence and nuclear power plants, citing a Connecticut Academy of Science and Engineering (CASE) study titled *Study of Radiation from the Connecticut Yankee Nuclear Power Plant* (CASE 2000) and *Cancer in Populations Living Near Nuclear Facilities* (National Cancer Institute 1990). These reports and referenced studies were based on data obtained from the Connecticut Tumor Registry and the Surveillance, Epidemiology, and End Result (SEER) reports, which are published by the National Cancer Institute.

Mangano (1998) provided summary information on cancer incidence and mortality rates in New London County and the four towns near Millstone before and after startup. The information summarized appears to be based on the Connecticut Tumor Registry data and a National Cancer Institute report (NCI 1990). Mangano (1998) suggested that the increase in cancer may be related to operations at Millstone; however, no evidence was provided to support a causal relationship between increased cancer incidence and Millstone operations.

Mangano et al. (2003) performed a more extensive review of cancer incidence and mortality for children living within 48 km (30 mi) of 14 nuclear power plants in the eastern U.S. (including Millstone) from 1970 through 1997. The cancer incidence and mortality rates were compared with data considered to be representative of the U.S. population. Mangano et al (2003) reported no significant difference in childhood cancer mortality rates between counties surrounding the nuclear power plants and the U.S. population. However, Mangano et al. (2003) referenced an NCI report (NCI 1990) that showed a significant excess of leukemia incidence in children ages 0 to 9 years who lived in five counties near four nuclear plants in Connecticut and Iowa. Similarly, the incidence rate for all cancers for children 0 to 9 years in counties near Millstone was 1.0 percent higher compared to the incidence estimate for the remainder of Connecticut and Rhode Island. The mortality rate for all cancers for children 0 to 9 years in counties near Millstone was 26.7 percent lower than the U.S. rate (Mangano et al. 2003).

The National Cancer Institute study (1990) reviewed 35 years of cancer incidence and mortality data for counties where 62 nuclear facilities are located. These data were compared with the cancer rates of comparable regional counties located away from nuclear facilities. The study reported that the relative risk of leukemia for New London County (location of Millstone) was significantly higher compared to the control counties for leukemia for children under 10 years (National Cancer Institute 1990). The relative risk was the highest of all sites reported (relative risk of 3.04, where 1.0 indicates the same relative risk compared to the control counties). The study stated that this high risk, in part, reflected the unusually low incidence of cancer in the control counties compared to the national rate. The report also noted that the incidence of leukemia in children under 10 in New London County was elevated before startup of Millstone. There were 30 cases of leukemia in children from 1961 to 1970 before Millstone startup (30 cases in 10 years is 3.00 cases per year) and 44 cases from 1971 to 1984 after Millstone startup (44 cases in 14 years is 3.15 cases per year before correction for population increase). The report (National Cancer Institute 1990) concluded:

> Comparisons of study and control counties exhibit substantial variation, as should be expected, because the matching cannot remove all variation due to demographic factors. Properly taking this into account, there is no evidence of systematically higher cancer risks in the study counties. Moreover, even the highest relative risks for individual facilities were compatible with the general level of variation seen....

The report also concluded:

> ... the survey has produced no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities.

The State of Connecticut Department of Public Health (CTDPH) reported cancer incidence rates for the period 1995 to 1999 for Connecticut towns (CTDPH 2002) and counties (CTDPH 2004). Both reports were based on data from the Connecticut Tumor Registry. The county report compared cancer incidence rates for various forms of cancer for each county with the average cancer incidence rate for the state. New London County had the highest incidence rate for all invasive tumors for females and for several forms of cancer for one or both genders.

The report for the towns compared the observed number of cancers for various forms of cancer for each town with the expected number of cancers based on the average incidence rates for the state and presented ratios of observed cases to expected cases. The town of Waterford did not have the highest ratio of observed cancers to expected cancers for any form of cancer analyzed. Waterford was in the highest ratio quartile for colorectal cancer in males, lung cancer in females, and melanomas (skin cancer) in females; however, for each of these cancer forms, several other towns had higher ratios.

The CASE study (2000) was initiated because of citizen concerns regarding the potential health impacts from nuclear power plants. The study focused on the Connecticut Yankee plant; however, the report included analyses of leukemia, thyroid cancer, and multiple myeloma from the Connecticut Tumor Registry from 1976 to 1995 for each of Connecticut's 169 towns. The maps in the report show the ratio of the observed cancer cases versus the expected cancer cases based on the state average incidence and the town population. The town of Waterford was not in the highest ratio category for any cancer except thyroid cancer, and at least three other towns had higher ratios for thyroid cancer. At least 30 towns had higher ratios for pediatric leukemia (ages 0 to 14) than Waterford.

As discussed in sections 2.1.4, 2.2.7, and 4.3 of this SEIS, the NRC staff and its contractors reviewed Millstone's radiological effluent and environmental monitoring data for the last several years. The effluent data shows (1) that Millstone's radiological effluents are well within the limits established by the NRC and EPA and (2) that the maximum dose to a member of the public exposed to Millstone's effluents is typically well less than 0.01 mSv (1 mrem) per year. The expected dose to a real person living or working near Millstone would be lower, and the expected dose to a real person living or working more than 1.6 km (1 mi) from Millstone would be much lower. There have been thousands of studies of health effects from radiation exposure; no credible study has reported health impacts from doses below 100 mSv (10,000 mrem).

A report by the state of Connecticut Department of Public Health (CTDPH 2002) analyzed cancer incidence by town from 1995 to 1999. The ratio of observed cancer cases to the expected cancer cases based on the State average and the town population was listed for each town. The town of Waterford did not have the highest ratio for any cancer analyzed. Waterford was in the highest ratio quartile for colorectal cancer in males, lung cancer in females, and melanoma in females; however, for each of these cancers, several other towns had higher ratios.

The NRC staff and its contractors discussed Millstone's history of radiological effluent and environmental monitoring with officials from CTDEP's Division of Radiation. The reports cited above by CTDPH, CASE, and the National Cancer Institute were also discussed. CTDEP conducts its own radiological environmental monitoring program around Millstone. CTDEP had also reviewed the reports by CTDPH, CASE, and the National Cancer Institute . CTDEP concluded that Millstone's radiological effluent and environmental monitoring data were accurate. CTDEP also concluded that the reports cited above by CTDPH, CASE, and the National Cancer Institute reports showed no evidence of a causal link between public exposure to Millstone's radiological effluents and cancer in Connecticut towns.

In the GEIS, radiation exposure to the public during the license renewal term was considered a Category 1 issue (see Chapter 1 and Section 4.3 for a discussion of Category 1 issues and radiological impacts from normal operations). The GEIS concluded that the risk to the public from continued operation of a nuclear plant would not increase during the license renewal term. Doses to members of the public from Millstone emissions were specifically evaluated in Appendix E of the GEIS and were found to be well within regulatory limits.

The staff concludes that the information provided during the scoping process was not new and significant with respect to the findings of the GEIS on the health effects to the public from radiological effluent releases due to the Millstone operations.

4.8 Cumulative Impacts of Operations During the Renewal Term

The staff considered potential cumulative impacts during the evaluation of information applicable to each of the potential impacts identified within the GEIS. The impacts of the proposed license renewal are combined with other past, present, and reasonably foreseeable actions to determine whether cumulative impacts exist. For the purposes of this analysis, past actions were those related to the resources at the time of the plant licensing and construction. Current actions are the operation of the power plant and future actions are considered to be those that are reasonably foreseeable through the end of plant operation. Therefore, the analysis considers potential impacts through the end of the current license term, as well as the 20-year renewal license term. The geographical area over which past, present, and future actions that could contribute to cumulative impacts is dependent on the type of action considered, and is described below for each impact area.

4.8.1 Cumulative Impacts Resulting from Operation of the Plant Cooling System

For the purposes of this analysis, the geographic area considered is the 80-km (50-mi) region surrounding Millstone. As described in Section 4.1, the staff found no new and significant information indicating that the conclusions regarding any of the cooling system-related Category 1 issues as related to Millstone are inconsistent with the conclusions in the GEIS. Additionally, the staff has determined that with the exception of entrainment, none of the cooling system-related Category 2 issues were likely to have greater than a SMALL impact on local water quality or aquatic resources. The staff has determined that entrainment would likely have a MODERATE impact on aquatic resources. Cumulative impacts to the water resources involve water-use conflicts and entrainment for winter flounder. As described in Section 2.1.3, Millstone uses the Niantic Bay as a source of cooling water for its condenser. The Niantic Bay is fed by the Niantic River and is connected hydrologically to Long Island Sound. The continuing low winter flounder population levels are likely a result of multiple impacts including fishing mortality, entrainment from Millstone water withdrawals, environmental changes associated with regional increases in water temperature, and predator-prey interactions. In addition, changes to water and sediment quality from runoff, urbanization, and industrial activities may also be stressors. Therefore, the cumulative impact is MODERATE. Dominion is involved in an ongoing review of impact from Millstone impingement and entrainment related to renewal of its NPDES permit. Additionally, new regulations promulgated by EPA related to intake structure performance standards will require further assessment of intake related impacts. Any additional mitigation related to the NPDES review and EPA's new performance requirements will result in less impact to the Long Island Sound fisheries.

4.8.2 Cumulative Impacts Resulting from Continued Operation of the Transmission Lines

The continued operation of the electrical transmission facilities connecting Millstone to the transmission grid was evaluated to determine if there is the potential for interactions with other past, present, and future actions that could result in adverse cumulative impacts—including both the acute and chronic effects of electromagnetic fields—to terrestrial resources, such as wildlife populations and the size and distribution of habitat areas, and to aquatic resources such as wetlands and floodplains. For the purposes of this analysis, the geographic area that encompasses the past, present and foreseeable future actions that could contribute to adverse cumulative impacts is the area within 80 km (50 mi) of the Millstone site, as depicted in Figure 2-1. As described in Section 4.2, the staff found no new and significant information indicating that the conclusions regarding any of the transmission line-related Category 1 issues related to Millstone are inconsistent with the conclusions in the GEIS. For the category 2 issue related to electromagnetic fields—acute impacts (electric shock)—the impact is small and the uncategorized issue of chronic impacts is still considered "not applicable." There are no known or planned activities within the 80-km (50-mi) radius area of consideration that could potentially produce additional impacts associated with transmission lines. Therefore, the cumulative impact is SMALL, and no mitigation measures are warranted.

4.8.3 Cumulative Radiological Impacts

The radiological dose limits for protection of the public and workers have been developed by EPA and NRC to address the cumulative impact of acute and long-term exposure to radiation and radioactive material. As described in Section 2.2.7, the public and occupational doses resulting from operation of Millstone are within regulatory limits, and as described in Section 4.3, the impacts of these doses are SMALL. For the purposes of this analysis, the area within an 80-km (50-mi) radius of the Millstone plant was included (see Figure 2-1). EPA regulation 40 CFR 190 limits the dose to members of the public from all sources in the nuclear fuel cycle in the United States, including all the nuclear power plants, fuel fabrication facilities, waste disposal facilities, and transport of fuel and waste. In addition, the radiological environmental monitoring program conducted by Dominion in the vicinity of Millstone measures radiation and radioactive material from all sources, including Millstone; therefore, the monitoring program measures cumulative radiological impacts. The NRC and the state of Connecticut would regulate any reasonably foreseeable future actions in the vicinity of Millstone that could contribute to cumulative radiological impacts. Therefore, the staff determined that the cumulative radiological impacts of continued operation of Millstone would be SMALL, and that no additional mitigation is warranted.

4.8.4 Cumulative Socioeconomic Impacts

Much of the analyses of socioeconomic impacts presented in Section 4.4 of this SEIS already incorporate cumulative impact analysis because the metrics used for quantification only make sense when placed in the total or cumulative context. For instance, the impact of the total number of additional housing units that may be needed can only be evaluated with respect to the total number that will be available in the impacted area. Therefore, the geographical area of the cumulative analysis varies depending on the particular impact considered, and may depend on specific boundaries, such as taxation jurisdictions, or may be distance related, as in the case of environmental justice.

The continued operation of Millstone is not likely to add to any cumulative socioeconomic impacts beyond those already evaluated in Section 4.4. In other words, the impacts of issues such as transportation or offsite land use are likely to be undetectable beyond the regions previously evaluated and will quickly decrease with increasing distance from the site. The staff has determined that the impacts on housing, public utilities, public services, and environmental justice would all be SMALL. The staff has determined that the impact on offsite land use is SMALL because, even though Millstone provides greater than 10 percent of the property tax revenue for the town of Waterford, there are no refurbishment actions planned at Millstone. There are no reasonably foreseeable scenarios that would alter these conclusions in regard to cumulative impacts.

Related to historic resources, there are no structures eligible for the inclusion in the National Register of Historic Places on the Millstone site or along the transmission lines. The staff has concluded that the impacts of license renewal would be SMALL. There is no reason to believe that the continued operation and maintenance of the Millstone site and transmission line rights-of-way would impact any properties beyond the site or right-of-way boundaries and, therefore, the contribution to a cumulative impact on historic resources would be negligible.

Based on these considerations, the staff concludes that continued operation of Millstone is not likely to make a detectable contribution to the cumulative impacts associated with any of the socioeconomic issues discussed in Section 4.4 and, therefore, that the cumulative impacts will be SMALL, and no additional mitigation measures are warranted.

4.8.5 Cumulative Impacts on Ground-water Use and Quality

There are no known or planned projects that would require withdrawal of groundwater that, if implemented in addition to license renewal, would potentially cause an adverse impact on groundwater. The Millstone ground-water use is less than 100 gpm. The current impact on the aquifer due to plant operations and current ground-water withdrawals is SMALL as discussed in Section 4.5. Therefore, the cumulative impact is SMALL, and no mitigation measures are warranted.

4.8.6 Cumulative Impacts on Threatened or Endangered Species

The geographic area considered in the analysis of cumulative impacts to threatened or endangered species includes the Millstone site and the associated transmission line rights-of-way. As discussed in Sections 2.2.5 and 2.2.6, there are several threatened or endangered species that occur within this area. However, the staff determined in Section 4.6 that continued operation of Millstone would have no impact or is not likely to adversely affect any of these species. Therefore, the continued operation of Millstone will not contribute to a regional cumulative impact to these species, regardless of whether or not other actions occur that could have adverse impacts.

Therefore, the staff has determined that the cumulative impacts to threatened or endangered species due to continued operation at the Millstone site and associated transmission line will be SMALL, and that additional mitigation measures would not be warranted.

4.9 Summary of Impacts of Operations During the Renewal Term

Neither Dominion nor the staff is aware of information that is both new and significant related to any of the applicable Category 1 issues associated with the Millstone operation during the renewal term. Consequently, the staff concludes that the environmental impacts associated with these issues are bounded by the impacts described in the GEIS. For each of these issues, the GEIS concluded that the impacts would be SMALL and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

In Chapter 4, plant-specific environmental evaluations were conducted for 10 Category 2 issues applicable to Millstone operation during the renewal term and for environmental justice and chronic impacts of electromagnetic fields. For nine issues and environmental justice, the staff concluded that the potential environmental impact of renewal term operations of Millstone would be of SMALL significance in the context of the standards set forth in the GEIS and that additional mitigation would not be warranted. For entrainment, the staff's preliminary conclusion is that the impact resulting from license renewal would be MODERATE and mitigations are warranted. In addition, the staff determined that a consensus has not been reached by appropriate Federal health agencies regarding chronic adverse impacts from electromagnetic fields. Therefore, the staff did not conduct an evaluation of this issue.

4.10 References

10 CFR Part 51. Code of Federal Regulations, Title 10*, Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property,* Part 800, "Advisory Council on Historic Preservation."

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

Clean Water Act. 33 USC 1326, et seq. (Also known as the Federal Water Pollution Control Act of 1977).

Adams, E.E. 2001. *Thermal plume analysis for Millstone Power Station*, Units 2-3. Massachusetts Institute of Technology, Cambridge, MA.

City of Waterford. 1998. *Plan of Preservation, Conservation and Development*. Adopted August 24, 1998.

City of Waterford. 2002. *Thames Basin Regional Water Interconnection Project — Municipal Improvement Report to the Waterford Planning and Zoning Commission Pursuant to CGS 8-24.* Waterford, Connecticut.

Connecticut Academy of Science and Engineering (CASE). 2000. *Study of Radiation from the Connecticut Yankee Nuclear Power Plant*.

Connecticut Department of Environmental Protection (CTDEP). 1994. Letter from CTDEP, E. C. Parker, to NNECO, D. Miller. (January 14, 1994)

Connecticut Department of Environmental Protection (CTDEP). 1999. Letter from CTDEP, M. J. Harder, to NNECO, F. C. Rothen. (November 15, 1999)

Connecticut Department of Environmental Protection (CTDEP). 2002. Letter from CTDEP, Nancy Murray, Biologist/Environmental Analyst III, CTDEP Environmental and Geographic Information Center, to Northeast Utilities Service Company, Anthony Johnson III. (April 23, 2002).

Connecticut Department of Public Health (CTDPH). 2002. *Incidence of Selected Cancers in Connecticut by Town 1995-1999*. Connecticut Tumor Registry. Hartford, CT. May 2002.

Connecticut Department of Public Health (CTDPH). 2004. *Incidence of Selected Cancers in Connecticut by Towns, 1995-99*. Connecticut Tumor Registry. Hartford, CT. May 2002

Council on Environmental Quality. 1997. *Environmental Justice: Guidance Under the National Environmental Policy Act*. Executive Office of the President, Washington, D.C.

Crecco, V. 2003. *Impact of Three Unit Operation at the Millstone Nuclear Power Station (NMPS) on Winter Flounder in the Niantic River*. Unpublished manuscript. Connecticut Department of Environmental Protection, Marine Fisheries Division, Old Lyme, Connecticut.

Crivello, J. 2003. *Characterization of winter flounder (Pseudopleurontectes americanus) larval genetic stock structure within eastern Long Island Sound: estimation of larval entrainment and recruitment*. Report made to the Millstone Environmental Laboratory, Millstone Power Station, Waterford, CT.

Dominion Nuclear Connecticut (Dominion). 2001a. *An evaluation of cooling-water system alternatives*. Attachment to letter No. D17249 from W. Matthews, Dominion, to M. Harder, CTDEP. (August 31, 2001)

Dominion Nuclear Connecticut (Dominion) 2001b. *Millstone Unit 2 aquatic organism return system survival study*. Enclosure to Letter D17240 from L. M. McMullin, Dominion, to M. Harder, CTDEP. (September 7, 2001)

Dominion Nuclear Connecticut (Dominion). 2002a. *Monitoring the Marine Environment of Long Island Sound at Millstone Power Station*. Annual Report 2001. Millstone Environmental Laboratory.

Dominion Nuclear Connecticut (Dominion) 2002b. Attachment to letter from Dominion to CTDEP and ESSA Technologies Ltd. Subject: The Scope of Study for Cooling Water System Alternatives to Reduce Entrainment at Millstone Power Station." (August 31, 2000).

Dominion Nuclear Connecticut (Dominion). 2003a. *Monitoring the Marine Environment of Long Island Sound at Millstone Power Station*. Annual Report 2002. Millstone Environmental Laboratory.

Dominion Nuclear Connecticut (Dominion). 2003b. Enclosure to letter from Dominion, G. Hicks, to CTDEP, J. Grier. Subject: "Assistance with the Evaluation of an NPDES Permit Application for Dominion's Millstone Power Station: Review of the Mass-Balance Model Used to Estimate the Number of Niantic River Winter Flounder Larvae Entrained by Millstone (1984 to 2001)"; Prepared by ESSA Technologies Limited for CTDEP. (February 5, 2003)

Dominion Nuclear Connecticut (Dominion). 2004a. *Applicants Environmental Report-Operating License Renewal Stage, Millstone Power Station, Units 2 and 3, Dominion Nuclear Connecticut*. Docket No. 50-336, License No. DPR-65; Docket No. 50-423, License No. NPF-49. January 2004.

Dominion Nuclear Connecticut (Dominion). 2004b. *Annual Report 2003. Monitoring the Marine Environment of Long Island Sound at Millstone Power Station, Waterford, Connecticut*. Millstone Environmental Laboratory, Dominion Nuclear Connecticut. April 2004.

Faggert, P. 2003. Letter from Dominion, Vice President and Chief Environmental Officer, to U.S. Fish and Wildlife Service, Threatened and Endangered Species Coordinator. Subject: "Millstone Power Stations Request for Information on Threatened or Endangered Species." (February 25, 2003)

Ferrucci and Walicki. 2002. *Northeast Utilities Wildlife Habitat Management Plan for Right-of-Way Areas*.

Greig, L., I. Parnell, and J.D. Meisner. 2002. *Assistance with the Evaluation of a National Pollutant Discharge Elimination System (NPDES) Permit Application for Dominion Nuclear Connecticut's Millstone Power Station: Review of the Mass-Balance Model Used to Estimate the Number of Niantic River Winter Flounder Larvae Entrained by Millstone Power Station (1984-2001)*. Prepared by ESSA Technologies Ltd., Toronto, ON, for Bureau of Water Management, CTDEP, Hartford, CT.

Loether, J. Paul. 2003. Letter from Deputy State Historic Preservation Officer, Connecticut Historical Commission, to Pamela F. Faggert, Dominion Nuclear Connecticut, Inc. (August 5, 2003)

Mangano, Joseph J. 1998. Letter from Radiation and Public Health Project to NRC. Subject: "2500 Excess Cancer Cases in New London County Since 1970: Radioactive emissions form Millstone May Be Cause." February 21, 1998.

Mangano, Joseph J., J. Sherman, C. Chang, A. Dave, E. Feinberg, and M. Frimer. 2003. "Elevated childhood cancer incidence proximate to U.S. nuclear power plants." *Archives of Environmental Health*. Vol 58, Issue 2, pp: 74-94.

Menzie, C. M. H. Henning, J. Cura, K. Finkelstein, J. Gentile, J. Maughan, D. Mitchell, S. Petron, C. Potocki, S. Svisrsky, and P. Tyler. 1996. “Special report of the Massachusetts Weight of Evidence Workshop: A Weight of Evidence Approach for Evaluating Ecological Risks.” *Human and Ecological Risk Assessment* 2(2): 277–304.

National Cancer Institute. 1990. *Cancer in Populations Living Near Nuclear Facilities*. NIH Publication No. 90-874. Washington, D.C.

National Electrical Safety Code (NESC) 1997. Institute of Electrical and Electronics Engineers, New York, New York.

National Environmental Policy Act of 1969, as amended. 42 USC 4321, et seq.

National Historic Preservation Act of 1966 (NHPA). 16 USC 470, et seq.

National Institute of Environmental Health Sciences (NIEHS). 1999. *NIESH Report on Health Effects from Exposure to Power Line Frequency and Electric and Magnetic Fields*. Publication No. 99-4493. Research Triangle Park, North Carolina.

National Marine Fisheries Service (NMFS). 2003. *Fisheries Statistics & Economics Division. Commercial fishing landings of winter flounder*. Accessed at: http://www.st.nmfs.gov/pls/webpls/mf_annual_landings.results on December 15, 2003.

National Oceanic and Atmospheric Administration (NOAA). 1998. *Status of fishery resources off the Northeastern United States for 1998*. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Region, Northeast Fisheries Science Center, Woods Hole, Massachusetts.

National Oceanic and Atmospheric Administration (NOAA). 2004. Letter from Assistant Regional Administrator for Protected Resources, Mary A. Colligan, to Division of Regulatory Improvement Programs, Office of Nuclear Reactor Regulation, Pao-Tsin Kuo, Program Director, License Renewal and Environmental Impacts. Subject: "Millstone Power Station Units 2 and 3 license renewal." September 21, 2004.

Northeast Utilities Service Company (NUSCO). 1972. Menhaden Incident at Millstone Point. Attachment to Letter dated October 11, 1972 from D. C. Switzer, The Millstone Point Company to the U.S. Atomic Energy Commission.

Northeast Utilities Service Company (NUSCO). 1987a. Enclosure 2 to letter from NUSCO, E. J. Mroczka, to CTDEP, L. Carruthers. Subject: “Justification for Discontinuing Impingement Monitoring at Millstone Unit 2.” (July 31, 1987)

Northeast Utilities Service Company (NUSCO). 1987b. Enclosure 3 to letter D17347 from Dominion, G. Hicks, to CTDEP, J. Grier. Subject: "Ecological Significance of Community Changes at Fox Island." (October 3, 2002)

Northeast Utilities Service Company (NUSCO) 1991. Enclosure 1 to Letter D04716 from NUSCO, E. J. Mroczka, to CTDEP, T. Keeney. Subject: "Reassessment of Impingement Effects on Winter Flounder at Millstone." (June 20, 1991)

Northeast Utilities Service Company (NUSCO). 1994. Enclosure 1 to letter D08071 from NUSCO, D. Miller, to CTDEP, T. Keeney. Subject: "Progress Report on the Millstone Fish Return Systems." (October 20, 1994)

Northeast Utilities Service Company (NUSCO). 2004. Section III, Technical Requirements. Specification for Rights-of-Way Vegetation Management.

Rose, K. A., J. H. Covan Jr., K. O. Winemiller, R. A. Myers, and R. Hilborn. 2001. "Compensatory Density Dependence in Fish Populations: Importance, Controversy, Understanding, and Prognosis." Fish and Fisheries 2: 293–327.

Southeastern Connecticut Council of Governments (SCCOG). 2003. *Regional Transportation Plan for Southeastern Connecticut—FY 2003-2004*. Norwich, Connecticut.

Southeastern Connecticut Council of Governments (SCCOG). 2004. *Housing a Region in Transition—An Analysis of Housing Needs in Southeastern Connecticut, 2000–2005 Summary Report*. Norwich, Connecticut.

U.S. Atomic Energy Commission. 1973. *Final Environmental Statement Related to the Continuation of Construction of Unit 2 and the Operation of Unit 1 Millstone Nuclear Power Station, Millstone Point Company Docket Nos. 50-245 and 50-336.* Washington, D.C.

U.S. Census Bureau (USCB) 2000. *Highlights from the Census 2000 Demographic Profiles for Waterford town, New London County and Middlesex County*. Accessed at http://factfinder.census.gov on April 30, 2004.

U.S. Census Bureau USCB). 2001. *Decennial Division Management Glossary*. Accessed at http//www.census.gov/dmd/www/glossary.html on July 26, 2004.

United States Environmental Protection Agency (EPA). 2004a. *Regional Analysis Document for the Final Section 316(b) Phase II Existing Facilities Rule*. Office of Water. EPA-821-R-02-003. Accessed at: www.epa.gov/waterscience/316b/casestudy/final on July 8, 2004.

U. S. Environmental Protection Agency (EPA). 2004b. "National Pollutant Discharge Elimination System—Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities." *Federal Register*, Vol. 69, No. 131, pp 41575–41624. Washington, D.C. July 9, 2004.

United States Fish and Wildlife Service (FWS). 2001. *Fish Facts - Shortnose Sturgeon*. Connecticut River Coordinator's Office website. Accessed at: http://www.fws.gov/r5crc/fish/zf_acbr.html on June 24, 2004.

United States Fish and Wildlife Service (FWS). 2004a. Letter from U.S. Fish and Wildlife Service (FWS), to NRC. Subject: "Response to the March 18, 2004, NRC staff letter requesting information regarding threatened and endangered species in the vicinity of Millstone." Accession No. ML04190230. (April 15, 2004)

United States Fish and Wildlife Service (FWS). 2004b. *Listings by State and Territory as of 04/13/2004*. Accessed at: http://ecos.fws.gov/tess_public/TESSWebpageUsaLists?state=CT on April 13, 2004.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report, Section 6.3 – Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report*. NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2001. *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues*. Appendix D to NRR Office Instruction LIC-203, June 21, 2001, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2003. "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions." Federal Register, Vol. 68, No. 214, pp 62642–62645. Washington, D.C. November 5, 2003.

U.S. Nuclear Regulatory Commission (NRC). 2004a. Letter from NRC, to Regional Administrator, National Marine Fisheries Service (NOAA Fisheries). Subject: "Request for List of Protected Species Within the Area Under Evaluation for Millstone, License Renewal." Accession No. ML040770760. (March 17, 2004)

U.S. Nuclear Regulatory Commission (NRC). 2004b. Letter from NRC, to Regional Director, U.S. Fish and Wildlife Service (FWS). Subject: “Request for List of Protected Species Within the Area Under Evaluation for Millstone, License Renewal.” Accession No. ML040780653. (March 18, 2004)

U.S. Nuclear Regulatory Commission (NRC). 2004c. Letter from NRC, to Regional Director, U.S. Fish and Wildlife Service (FWS). Subject: “Request for Concurrence - Biological Assessment for Millstone Power Station, Units 2 and 3 License Renewal.” Accession No. ML043170643. (November 9, 2004)

U.S. Nuclear Regulatory Commission (NRC). 2004d. Letter from NRC, to Regional Administrator, NOAA Fisheries. Subject: “Request for Concurrence - Biological Assessment for Millstone Power Station, Units 2 and 3 License Renewal.” Accession No. ML043170594. (November 9, 2004)

Waterford. 2003. *Analysis of Impact of Collection Rate Changes Under De-Regulation*. Spread sheet provided by First Selectman Paul Eccard. Waterford, Connecticut.

5.0 Environmental Impacts of Postulated Accidents

Environmental issues associated with postulated accidents are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[1] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) Single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1 and, therefore, additional plant-specific review of these issues is required.

This chapter describes the environmental impacts from postulated accidents that might occur during the license renewal term.

5.1 Postulated Plant Accidents

Two classes of accidents are evaluated in the GEIS. These are design-basis accidents (DBAs) and severe accidents, as discussed below.

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[1] The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the GEIS include the GEIS and its Addendum 1.

5.1.1 Design-Basis Accidents

In order to receive NRC approval to operate a nuclear power facility, an applicant for an initial operating license must submit a safety analysis report (SAR) as part of its application. The SAR presents the design criteria and design information for the proposed reactor and comprehensive data on the proposed site. The SAR also discusses various hypothetical accident situations and the safety features that are provided to prevent and mitigate accidents. The NRC staff reviews the application to determine whether the plant design meets the Commission's regulations and requirements and includes, in part, the nuclear plant design and its anticipated response to an accident.

DBAs are those accidents that both the licensee and the NRC staff evaluate to ensure that the plant can withstand normal and abnormal transients, and a broad spectrum of postulated accidents, without undue hazard to the health and safety of the public. A number of these postulated accidents are not expected to occur during the life of the plant, but are evaluated to establish the design basis for the preventive and mitigative safety systems of the facility. The acceptance criteria for DBAs are described in 10 CFR Part 50 and 10 CFR Part 100.

The environmental impacts of DBAs are evaluated during the initial licensing process, and the ability of the plant to withstand these accidents is demonstrated to be acceptable before issuance of the operating licenses (OLs). The results of these evaluations are found in license documentation such as the applicant's final safety analysis report (FSAR), the staff's safety evaluation report (SER), the final environmental statement (FES), and Section 5.1 of this draft supplemental environmental impact statement (SEIS). A licensee is required to maintain the acceptable design and performance criteria throughout the life of the plant, including any extended-life operation. The consequences for these events are evaluated for the hypothetical maximum exposed individual; as such, changes in the plant environment will not affect these evaluations. Because of the requirements that continuous acceptability of the consequences and aging management programs be in effect for license renewal, the environmental impacts as calculated for DBAs should not differ significantly from initial licensing assessments over the life of the plant, including the license renewal period. Accordingly, the design of the plant relative to DBAs during the extended period is considered to remain acceptable and the environmental impacts of those accidents were not examined further in the GEIS.

The Commission has determined that the environmental impacts of DBAs are of SMALL significance for all plants because the plants were designed to successfully withstand these accidents. Therefore, for the purposes of license renewal, DBAs are designated as a Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. The early resolution of the DBAs makes them a part of the current licensing basis of the plant; the current licensing basis of the plant is to be maintained by the licensee under its current license and, therefore, under the provisions of 10 CFR 54.30, is not subject to review under license renewal. This issue, applicable to Millstone, Units 2 and 3 (Millstone) , is listed in Table 5-1.

Table 5-1. Category 1 Issue Applicable to Postulated Accidents During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
POSTULATED ACCIDENTS	
Design basis accidents	5.3.2; 5.5.1

Based on information in the GEIS, the Commission found that:

> The NRC staff has concluded that the environmental impacts of design basis accidents are of small significance for all plants.

Dominion Nuclear Connecticut, Inc. (Dominion) stated in its Environmental Report (ER) (Dominion 2004) that it is not aware of any significant new and significant information associated with the renewal of the Millstone OLs. The staff has not identified any significant new information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to design basis accidents beyond those discussed in the GEIS.

5.1.2 Severe Accidents

Severe nuclear accidents are those that are more severe than DBAs because they could result in substantial damage to the reactor core, whether or not there are serious offsite consequences. In the GEIS, the staff assessed the impacts of severe accidents during the license renewal period, using the results of existing analyses and site-specific information to conservatively predict the environmental impacts of severe accidents for each plant during the renewal period.

Severe accidents initiated by external phenomena such as tornadoes, floods, earthquakes, fires, and sabotage have not traditionally been discussed in quantitative terms in FESs and were not specifically considered for the Millstone site in the GEIS (NRC 1996). However, in the GEIS the staff did evaluate existing impact assessments performed by NRC and by the industry at 44 nuclear plants in the United States and concluded that the risk from sabotage and beyond design basis earthquakes at existing nuclear power plants is SMALL. Additionally, the staff concluded that the risks from other external events are adequately addressed by a generic consideration of internally initiated severe accidents.

Based on information in the GEIS, the Commission found that:

> The probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives.

Therefore, the Commission has designated mitigation of severe accidents as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue, applicable to Millstone is listed in Table 5-2.

Table 5-2. Category 2 Issue Applicable to Postulated Accidents During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
	POSTULATED ACCIDENTS		
Severe accidents	5.3.3; 5.3.3.2; 5.3.3.3; 5.3.3.4; 5.3.3.5; 5.4; 5.5.2	L	5.2

The staff has not identified any significant new information with regard to the consequences from severe accidents during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of severe accidents beyond those discussed in the GEIS. However, in accordance with 10 CFR 51.53(c)(3)(ii)(L), the staff has reviewed severe accident mitigation alternatives (SAMAs) for Millstone. The results of its review are discussed in Section 5.2.

5.2 Severe Accident Mitigation Alternatives

Section 51.53(c)(3)(ii)(L) requires that license renewal applicants consider alternatives to mitigate severe accidents if the staff has not previously evaluated SAMAs for the applicant's plant in an environmental impact statement (EIS) or related supplement or in an environmental assessment. The purpose of this consideration is to ensure that plant changes (i.e., hardware, procedures, and training) with the potential for improving severe accident safety performance are identified and evaluated. SAMAs have not been previously considered for Millstone; therefore, the remainder of Chapter 5 addresses those alternatives.

5.2.1 Introduction

This section presents a summary of the SAMA evaluations for Millstone conducted by Dominion and described in the ER and the NRC's review of those evaluations. The details of the review are described in the NRC staff evaluations that were prepared with contract assistance from Information Systems Laboratories, Inc. The entire evaluation for Millstone, Unit 2 is presented in Appendix H; the entire evaluation for Millstone, Unit 3 is presented in Appendix I.

The SAMA evaluations for Millstone were conducted with a four-step approach. In the first step Dominion quantified the level of risk associated with potential reactor accidents using plant-specific probabilistic risk assessments (PRAs) and other risk models.

In the second step Dominion examined the major risk contributors and identified possible ways (SAMAs) of reducing that risk. Common ways of reducing risk are changes to components, systems, procedures, and training. Dominion initially identified 196 potential SAMAs for Millstone, Unit 2 and 185 potential SAMAs for Millstone, Unit 3. Dominion screened out SAMAs that were not applicable to Millstone, had already been implemented at Millstone (or the Millstone design met the intent of the SAMA), or were related to reactor coolant pump (RCP) seal vulnerability stemming from charging pump dependency on the component cooling water (CCW) system. The Millstone units do not rely on component cooling water systems for RCP seal injection. This screening reduced the list of potential SAMAs to 44 for Unit 2 and 52 for Unit 3 .

In the third step Dominion estimated the benefits and the costs associated with each of the remaining SAMAs. Estimates were made of how much each SAMA could reduce risk. Those estimates were developed in terms of dollars in accordance with NRC guidance for performing regulatory analyses (NRC 1997b). The cost of implementing the proposed SAMAs was also estimated.

Finally, in the fourth step, the costs and benefits of each of the remaining SAMAs were compared to determine whether the SAMA was cost-beneficial, meaning the benefits of the SAMA were greater than the cost (a positive cost-benefit). For Unit 2, Dominion determined in its ER that SAMA 3 would be cost-beneficial. For Unit 3, Dominion determined that none of the SAMAs would be cost-beneficial (Dominion 2004a).

The NRC reviewed Dominion's SAMA analyses. In response to an RAI (NRC 2004), Dominion assessed the applicability and feasibility of several SAMAs for Unit 2 that were considered by another CE plant. As a result, Dominion eliminated all of the SAMAs questioned except one – adding a capability to flash the field on the emergency diesel generator using a portable generator to enhance SBO event recovery. Dominion stated that this SAMA is not expected to be cost-beneficial because it would likely require a plant modification to install a disconnect to allow the connection of a portable (temporary) generator, as well as development of a new severe accident management guideline (SAMG). However, Dominion stated that if this SAMA can be accomplished via a SAMG without a hardware modification, the SAMA would be cost-beneficial and will be implemented prior to the period of extended operation (Dominion 2004b).

The staff questioned Dominion about lower cost alternatives to some of the SAMAs evaluated for Unit 3 (NRC 2004). As originally proposed, SAMA 112 involved physical modifications to provide steam generator level indication in a station blackout (SBO) scenario, as well as the development of an emergency operating procedure that would direct the manual control of the turbine-driven auxiliary feedwater (AFW) pump. This SAMA was estimated not to be cost-beneficial. However, as an alternative to SAMA 112, Dominion considered the development of a SAMG without the hardware modification. This improvement could be effective in a more limited number of sequences in which AFW control power is lost, but steam generator level indications are not. The estimated benefit of this modification is greater than the expected cost after consideration of uncertainties; therefore, it is potentially cost-beneficial. As indicated in its RAI response, Dominion plans to complete its evaluation of this SAMA and, if it is cost-beneficial, will develop a SAMG addressing manual control of the turbine-driven AFW pump prior to the period of extended operation (Dominion 2004b).

None of these SAMAs relate to adequately managing the effects of aging during the period of extended operation; therefore, they need not be implemented as part of license renewal pursuant to 10 CFR Part 54. Dominion's SAMA analyses and the NRC's review are discussed in more detail below.

5.2.2 Estimate of Risk

Dominion submitted an assessment of SAMAs for Millstone as part of the ER (Dominion 2004a). This assessment was based on the most recent Millstone PRA available at that time, a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System 2 (MACCS2) computer program, and insights from the Millstone Individual Plant Examinations (IPE) for Unit 2 (NNECO 1993) and for Unit 3 (NNECO 1990) and Individual Plant Examination of External Events (IPEEE) for Unit 2 (NNECO 1995) and for Unit 3 (NNECO 1991).

The baseline core damage frequency (CDF) for the purpose of the SAMA evaluation is approximately 7.17 x 10^{-5} per year for Unit 2 and approximately 2.57 x 10^{-5} per year for Unit 3 . These CDFs are based on the risk assessment for internally initiated events. Dominion did not include the contribution to risk from external events within the Millstone risk estimates; however, it did account for the potential risk reduction benefits associated with external events by increasing the estimated benefits for internal events by a factor of 1.3 for Unit 2 and a factor of 1.6 for Unit 3. The breakdown of CDF by initiating event for Units 2 and 3 is provided in Tables 5-3 and 5-4, respectively.

As shown in Table 5-3, loss-of-coolant accidents (LOCAs), loss of cooling water to the primary side components (COOL) including service water (SW) and reactor building closed cooling water (RBCCW), loss of DC power, and transients including anticipated transients without scram (ATWS) are dominant contributors to the CDF for Unit 2. LOCAs are dominated by small-break LOCAs, which make up about 36 percent of the total CDF. Bypass events [i.e., steam generator tube rupture (SGTR) and interfacing systems loss of coolant accident (ISLOCA)] contribute less than four percent to the total internal events CDF.

Table 5-3. Core Damage Frequency for Unit 2

Initiating Event or Accident Class	CDF (Per Year)	% Contribution to CDF
LOCA	2.66×10^{-5}	37.1
COOL	1.44×10^{-5}	20.1
Loss of DC power	1.03×10^{-5}	14.4
ATWS	8.68×10^{-6}	12.1
Transients	4.66×10^{-6}	6.5
SGTR	2.22×10^{-6}	3.1
SBO	2.15×10^{-6}	3.0
Steamline and main feed line breaks	1.72×10^{-6}	2.4
Loss of offsite power (LOOP)	8.60×10^{-7}	1.2
ISLOCA	1.43×10^{-7}	0.2
Total CDF	7.17×10^{-5}	100

As shown in Table 5-4, LOCAs, RCP seal LOCAs, transients including ATWS, and LOOP are dominant contributors to the CDF for Unit 3. Bypass events (i.e., SGTR and ISLOCA) contribute less than five percent to the total internal events CDF.

In the ER, Dominion estimated the dose to the population within 80 km (50 mi) of the Millstone site from severe accidents to be approximately 0.174 person-Sv (17.4 person-rem) per year for Unit 2 and approximately 0.128 person-Sv (12.8 person-rem) per year for Unit 3. The breakdown of the total population dose by containment release mode is summarized for Units 2 and 3 in Tables 5-5 and 5-6, respectively.

Intermediate containment failures dominate the population dose risk at Unit 2, followed by SGTR and late containment failures. Early containment failures and ISLOCAs make relatively small contributions, each being less than three percent of the total. Containment isolation and basemat failures are each indicated to be zero contributors to risk. As indicted in the response to an RAI, these release modes are incorporated into other release modes with similar characteristics (Dominion 2004b).

Table 5-4. Core Damage Frequency for Unit 3

Initiating Event or Accident Class	CDF (Per Year)	% Contribution to CDF
RCP Seal LOCA	5.66×10^{-6}	22.0
Transients	4.04×10^{-6}	15.7
LOCAs	3.42×10^{-6}	13.3
LOOP	2.77×10^{-6}	10.8
ATWS	2.39×10^{-6}	9.3
Steamline break inside containment	2.31×10^{-6}	9.0
SBO	1.78×10^{-6}	6.9
Total loss of service water	1.28×10^{-6}	5.0
SGTR	1.00×10^{-6}	3.9
Loss of one vital DC bus	4.18×10^{-7}	1.6
Steamline break outside containment	3.79×10^{-7}	1.5
ISLOCA	2.21×10^{-7}	0.9
Instrument tube LOCA	5.04×10^{-8}	0.2
Total CDF	2.57×10^{-5}	100

Late containment failures dominate the population dose risk at Unit 3, followed by SGTR and ISLOCAs. Early failures and containment isolation failures are each indicated to be zero contributors to risk. As indicated in the response to an RAI, these release modes were deleted from the IPE model because of low contribution (i.e., <0.1 percent) (Dominion 2004b).

The NRC staff has reviewed Dominion's data and evaluation methods and concludes that the quality of the risk analyses is adequate to support an assessment of the risk reduction potential for candidate SAMAs. Accordingly, the staff based its assessment of offsite risk on the CDFs and offsite doses reported by Dominion.

Table 5-5. Breakdown of Population Dose by Containment Release Mode (Unit 2)

Containment Release Mode	Population Dose (Person-rem[1] Per Year)	% Contribution
Intermediate failure	12.4	71
SGTR	2.5	14.4
Late failure	1.63	9.4
Early failure	0.48	3
ISLOCA	0.42	2.4
Containment isolation failure	0	0
Basemat failure	0	0
Total Population Dose	17.4	100

[1]One person-rem = 0.01 person-Sv

Table 5-6. Breakdown of Population Dose by Containment Release Mode (Unit 3)

Containment Release Mode	Population Dose (Person-rem[1] Per Year)	% Contribution
Late failure	6.60	51.5
SGTR	2.77	21.6
ISLOCA	2.23	17.4
Intermediate failure	0.93	7.2
No containment failure	0.24	1.9
Basemat failure	0.05	0.4
Early failure	0	0
Containment isolation failure	0	0
Total Population Dose	12.8	100

[1]One person-rem = 0.01 person-Sv

5.2.3 Potential Plant Improvements

Once the dominant contributors to plant risk were identified, Dominion searched for ways to reduce that risk. In identifying and evaluating potential SAMAs, Dominion considered SAMA analyses performed for other operating plants that have submitted license renewal applications, as well as industry and NRC documents that discuss potential plant improvements, such as NUREG-1560 (NRC 1997a). Dominion identified 196 potential risk-reducing improvements (SAMAs) to plant components, systems, procedures and training for Unit 2 and 185 for Unit 3.

For Unit 2, all but 44 of the the SAMAs were removed from further consideration because they were not applicable to Millstone, they had already been implemented at Millstone (or the Millstone design met the intent of the SAMA), or they were related to reactor coolant pump seal vulnerability stemming from charging pump dependency on the component cooling water system. The Millstone units do not rely on component cooling water systems for reactor coolant pump seal injection. Unit 2 relies on the RBCCW rather than CCW for RCP seal injection and, in Unit 3, the charging pumps do not rely on CCW for RCP seal injection. For Unit 3, all but 52 of the SAMAs were removed from further consideration based on the same criteria.

The staff concludes that Dominion used a systematic and comprehensive process for identifying potential plant improvements for Millstone, and that the set of potential plant improvements identified by Dominion is reasonably comprehensive and, therefore, acceptable.

5.2.4 Evaluation of Risk Reduction and Costs of Improvements

Dominion evaluated the risk-reduction potential of the remaining 44 SAMAs that were applicable to Unit 2 and the remaining 52 SAMAs that were applicable to Unit 3. A majority of the SAMA evaluations were performed in a bounding fashion in that the SAMA was assumed to completely eliminate the risk associated with the proposed enhancement. Such bounding calculations overestimate the benefit of the risk reduction and are conservative.

Dominion estimated the potential benefits for each SAMA by generating a revised set of plant damage state frequencies. Using these revised frequencies, a revised Level 3 (dollars averted) calculation was performed. The benefits were increased by a factor of 1.3 for Unit 2 and by a factor of 1.6 for Unit 3 to account for benefits in external events.

The staff has reviewed Dominion's bases for calculating the risk reduction for the various plant improvements and concludes that the rationale and assumptions for estimating risk reduction are reasonable and generally conservative (i.e., the estimated risk reduction is higher than what would actually be realized). Accordingly, the staff based its estimates of averted risk for the various SAMAs on Dominion's risk reduction estimates.

Dominion personnel experienced in estimating the cost of performing work at a nuclear plant estimated the costs of the remaining 44 SAMAs that were applicable to Unit 2 and the remaining 52 SAMAs that were applicable to Unit 3. For some of SAMAs considered, the cost estimates were sufficiently greater than the benefits calculated that it was not necessary to perform a detailed cost estimate. Cost estimates typically included procedures, engineering analysis, training, and documentation, in addition to any hardware.

The staff reviewed the bases for the applicant's cost estimates (presented in Section F.3 of Appendix F to the ER). For certain improvements, the staff also compared the cost estimates to estimates developed elsewhere for similar improvements, including estimates developed as part of other licensees' analyses of SAMAs for operating reactors and advanced light-water reactors. The cost estimates provided were in the form of ranges. For purposes of evaluating specific SAMAs, the staff selected the low end values from the range to represent the costs. For some SAMAs, the costs appeared to be over-estimated. Therefore, the staff asked the applicant to justify the costs for those SAMAs that had significant benefits (NRC 2004). In response to the staff's request, Dominion provided a discussion of the components and activities that were considered in estimating the costs of those SAMAs for which the benefit was determined to be $50,000 or more. The discussion included a description of the modification, if any procedure changes and training would be required, and if any new instrumentation and maintenance would be required (Dominion 2004b). The staff reviewed the costs and subsequent explanations and found them to be reasonable and generally consistent with estimates provided in support of other plants' analyses.

The staff concludes that the cost estimates provided by Dominion are sufficient and adequate for use in the SAMA evaluation.

5.2.5 Cost-Benefit Comparison

The cost-benefit analysis performed by Dominion was based primarily on NUREG/BR-0184 (NRC 1997b) and was executed consistent with this guidance. Sensitivity calculations were conducted to examine the potential impact of uncertainties, discount rates other than seven percent, and several parameters and assumptions involved in the severe accident dose calculations. None of these sensitivity calculations altered the results of the cost-benefit comparisons.

For Unit 2, Dominion identified one cost-beneficial SAMA:

SAMA 3: Enhance loss of RBCCW procedure to ensure cool down of RCS prior to seal LOCA. The resolution of this issue is expected to be either a new procedure or a procedure modification that will require actions to prevent or mitigate a seal LOCA upon loss of RBCCW.

As stated in the ER, Dominion is addressing SAMA 3 as part of a comprehensive industry initiative in response to Generic Safety Issue 23, "Reactor Coolant Pump Seal Failure." The SAMA is being addressed as a current operating license issue and is anticipated to be implemented before the period of extended operation (Dominion 2004a).

In response to an RAI, Dominion assessed the applicability and feasibility for Unit 2 of several SAMAs considered by another Combustion Engineering plant. As a result, Dominion eliminated all of the SAMAs questioned except one – adding a capability to flash the field on the emergency diesel generator (EDG) using a portable generator to enhance SBO event recovery. Dominion stated that this SAMA is not expected to be cost-beneficial because it would likely require a plant modification to install a disconnect to allow the connection of a portable generator, as well as development of a new SAMG. However, Dominion stated that if this

SAMA can be accomplished via a SAMG without a hardware modification, the SAMA could be cost-beneficial and will be implemented prior to the period of extended operation (Dominion 2004b).

For Unit 3, Dominion identified no cost-beneficial SAMAs. In response to an RAI regarding the costs of SAMA 112 (proceduralize local manual operation of AFW when control power is lost), Dominion assessed the applicability and feasibility of a procedure for manual operation of the turbine-driven AFW pump when control power is lost. Dominion stated that this SAMA would likely require a plant modification to provide the level indication that would be necessary during SBO, in addition to a new procedure. However, Dominion stated that if this SAMA can be accomplished via a SAMG, without a hardware modification, then the SAMA could be cost-beneficial and will be implemented prior to the period of extended operation (Dominion 2004b).

The staff concludes that, with the exception of the one cost-beneficial SAMA (SAMA 3 for Unit 2) and the two SAMAs that would be cost-beneficial if they can be implemented by SAMG changes without hardware modifications, the costs of the SAMAs would be higher than the associated benefits. This conclusion is supported by uncertainty assessment and sensitivity analysis.

5.2.6 Conclusions

The staff reviewed the Dominion analyses and concluded that the methods used and the implementation of those methods were sound. The treatment of SAMA benefits and costs, the generally large negative net benefits, and the inherently small baseline risks support the general conclusion that the SAMA evaluations performed by Dominion are reasonable and sufficient for the license renewal submittal.

Based on its review of the Dominion SAMA analysis, the staff concludes that none of the candidate SAMAs are cost-beneficial, except for SAMA 3 for Unit 2. Two additional SAMAs, one SAMA involving adding a capability to flash the field on the EDG using a portable generator to enhance SBO event recovery on Unit 2 and SAMA 112 (proceduralize local manual operation of AFW when control power is lost) on Unit 3, are potentially cost-beneficial if they can be implemented by a SAMG without hardware modifications. This is based on conservative treatment of costs and benefits. This conclusion is consistent with the low residual level of risk indicated in the PRA for both units and the fact that Millstone has already implemented many of the plant improvements identified from the IPE and IPEEE processes.

Dominion plans to implement SAMA 3 on Unit 2 before the period of extended operation (Dominion 2004a). The other two SAMAs will be implemented prior to the period of extended operation if they can be accomplished as discussed above (Dominion 2004b). None of these SAMAs relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of the license renewal pursuant to 10 CFR Part 54.

5.3 References

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, "Reactor Site Criteria."

Dominion Nuclear Connecticut, Inc. (Dominion). 2004a. *Applicant's Environmental Report–Operating License Renewal Stage, Millstone Power Station Units 2 and 3.* Dominion Nuclear Connecticut, Inc., Richmond, Virginia. January 2004.

Dominion Nuclear Connecticut, Inc. (Dominion). 2004b. Letter from Leslie N. Hartz, Dominion, to United States Nuclear Regulatory Commission Document Control Desk. Subject: Dominion Nuclear Connecticut, Inc., Millstone Power Sation Units 2 and 3, Response to Request for Additional Information, License Renewal Applications. August 13, 2004.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1997a. *Individual Plant Examination Program: Perspectives on Reactor Safety and Plant Performance*. NUREG-1560, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1997b. *Regulatory Analysis Technical Evaluation Handbook*. NUREG/BR-0184, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, Section 6.3—Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants. NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2004. Letter from Richard L. Emch, Jr., NRC, to David A. Christian, Dominion. Subject: Request for Additional Information (RAI) Regarding Severe Accident Mitigation Alternatives for the Millstone Power Station, Units 2 and 3 (TAC NOS. MC1827 and MC1828), June 22, 2004.

6.0 Environmental Impacts of the Uranium Fuel Cycle and Solid-Waste Management

Environmental issues associated with the uranium fuel cycle and solid-waste management are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (U.S. Nuclear Regulatory Commission [NRC] 1996; 1999.)[a] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste [HLW] and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1 and, therefore, additional plant-specific review of these issues is required.

This chapter addresses the issues that are related to the uranium fuel cycle and solid-waste management during the license renewal term, which are listed in Table B-1 of 10 Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B, and are applicable to Millstone Power Station Units 2 and 3 (Millstone). The generic potential impacts of the radiological and nonradiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes are described in detail in the GEIS based, in part, on the generic impacts provided in 10 CFR 51.51(b), Table S-3, "Table of Uranium Fuel Cycle Environmental Data," and in 10 CFR 51.52(c), Table S-4, "Environmental Impact of Transportation of Fuel and Waste

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

to and from One Light-Water-Cooled Nuclear Power Reactor." The staff also addresses the impacts from radon-222 and technetium-99 in the GEIS.

6.1 The Uranium Fuel Cycle

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to Millstone from the uranium fuel cycle and solid-waste management are listed in Table 6-1.

Table 6-1. Category 1 Issues Applicable to the Uranium Fuel Cycle and Solid-Waste Management During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
URANIUM FUEL CYCLE AND WASTE MANAGEMENT	
Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high-level waste)	6.1; 6.2.1; 6.2.2.1; 6.2.2.3; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (collective effects)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (spent fuel and high-level waste disposal)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Nonradiological impacts of the uranium fuel cycle	6.1; 6.2.2.6; 6.2.2.7; 6.2.2.8; 6.2.2.9; 6.2.3; 6.2.4; 6.6
Low-level waste storage and disposal	6.1; 6.2.2.2;6.4.2; 6.4.3; 6.4.3.1; 6.4.3.2; 6.4.3.3; 6.4.4; 6.4.4.1; 6.4.4.2; 6.4.4.3; 6.4.4.4; 6.4.4.5; 6.4.4.5.1; 6.4.4.5.2; 6.4.4.5.3; 6.4.4.5.4; 6.4.4.6; 6.6
Mixed waste storage and disposal	6.4.5.1; 6.4.5.2; 6.4.5.3; 6.4.5.4; 6.4.5.5; 6.4.5.6; 6.4.5.6.1; 6.4.5.6.2; 6.4.5.6.3; 6.4.5.6.4; 6.6
Onsite spent fuel	6.1; 6.4.6; 6.4.6.1; 6.4.6.2; 6.4.6.3; 6.4.6.4; 6.4.6.5; 6.4.6.6; 6.4.6.7; 6.6
Nonradiological waste	6.1; 6.5; 6.5.1; 6.5.2; 6.5.3; 6.6
Transportation	6.1; 6.3.1; 6.3.2.3; 6.3.3; 6.3.4; 6.6, Addendum 1

Dominion Nuclear Connecticut, Inc. (Dominion) stated in its Environmental Report (ER) (Dominion 2004) that it is not aware of any new and significant information associated with the renewal of the Millstone operating licenses. The staff has not identified any significant new information on these issues during its independent review of the Millstone ER (Dominion 2004), its site visit, public comments, or staff evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the staff concluded in the GEIS that the impacts are SMALL except for the collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, as discussed below, and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the staff review and the GEIS conclusions, as codified in Table B-1, 10 CFR Part 51, for each of these issues follows:

- <u>Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high-level waste</u>). Based on information in the GEIS, the Commission found that

    > Off-site impacts of the uranium fuel cycle have been considered by the Commission in Table S-3 of this part [10 CFR 51.51(b)]. Based on information in the GEIS, impacts on individuals from radioactive gaseous and liquid releases including radon-222 and technetium-99 are small.

    The staff has not identified any new and significant information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no offsite radiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- <u>Offsite radiological impacts (collective effects)</u>. Based on information in the GEIS, the Commission found that

    > The 100-year environment dose commitment to the U.S. population from the fuel cycle, high-level waste and spent fuel disposal excepted, is calculated to be about 14,800 person rem (148 person Sv), or 12 cancer fatalities, for each additional 20-year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consisted of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the U.S. The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny doses have some statistical adverse health effect which will not ever be mitigated (for example no cancer cure in the next thousand years), and that these doses projected over thousands of years are meaningful. However, these assumptions are questionable. In particular,

> science cannot rule out the possibility that there will be no cancer fatalities from these tiny doses. For perspective, the doses are very small fractions of regulatory limits and even smaller fractions of natural background exposure to the same populations.
>
> Nevertheless, despite all the uncertainty, some judgement as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective effects of the fuel cycle, this issue is considered Category 1.

The staff has not identified any new and significant information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no offsite radiological impacts (collective effects) from the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- <u>Offsite radiological impacts (spent fuel and high-level waste disposal)</u>. Based on information in the GEIS, the Commission found that

> For the high-level waste and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for offsite releases of radionuclides for the current candidate repository site. However, if we assume that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, "Technical Bases for Yucca Mountain Standards," and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site which will comply with such limits, peak doses to virtually all individuals will be 100 millirem (1 mSv) per year or less. However, while the Commission has reasonable confidence that these assumptions will prove correct, there is considerable uncertainty since the limits are yet to be developed, no repository application has been completed or reviewed, and uncertainty is inherent in the models used to evaluate possible pathways to the human environment. The NAS report indicated that 100 millirem (1 mSv) per year should be considered as a starting point for limits for individual doses, but notes that some measure of consensus exists among national and international bodies that the limits

should be a fraction of the 100 millirem (1 mSv) per year. The lifetime individual risk from 100 millirem (1 mSv) annual dose limit is about is about 3×10^{-3}.

Estimating cumulative doses to populations over thousands of years is more problematic. The likelihood and consequences of events that could seriously compromise the integrity of a deep geologic repository were evaluated by the Department of Energy in the "Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste," October 1980 [DOE 1980]. The evaluation estimated the 70-year whole-body dose commitment to the maximum individual and to the regional population resulting from several modes of breaching a reference repository in the year of closure, after 1,000 years, after 100,000 years, and after 100,000,000 years. Subsequently, the NRC and other federal agencies have expended considerable effort to develop models for the design and for the licensing of a high level waste repository, especially for the candidate repository at Yucca Mountain. More meaningful estimates of doses to population may be possible in the future as more is understood about the performance of the proposed Yucca Mountain repository. Such estimates would involve very great uncertainty, especially with respect to cumulative population doses over thousands of years. The standard proposed by the NAS is a limit on maximum individual dose. The relationship of potential new regulatory requirements, based on the NAS report, and cumulative population impacts has not been determined, although the report articulates the view that protection of individuals will adequately protect the population for a repository at Yucca Mountain. However, Environmental Protection Agency's (EPA) generic repository standards in 40 CFR part 191 generally provide an indication of the order of magnitude of cumulative risk to population that could result from the licensing of a Yucca Mountain repository, assuming the ultimate standards will be within the range of standards now under consideration. The standards in 40 CFR part 191 protect the population by imposing "containment requirements" that limit the cumulative amount of radioactive material released over 10,000 years. Reporting performance standards that will be required by EPA are expected to result in releases and associated health consequences in the range between 10 and 100 premature cancer deaths with an upper limit of 1,000 premature cancer deaths
world-wide for a 100,000 metric tonne (MTHM) repository.

Nevertheless, despite all the uncertainty, some judgement as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into

> account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and high level waste disposal, this issue is considered Category 1.

On February 15, 2002, based on a recommendation by the Secretary of the Department of Energy, the President recommended the Yucca Mountain site for the development of a repository for the geologic disposal of spent nuclear fuel and high-level nuclear waste. The U.S. Congress approved this recommendation on July 9, 2002, in Joint Resolution 87, which designated Yucca Mountain as the repository for spent nuclear waste. On July 23, 2002, the President signed Joint Resolution 87 into law; Public Law 107-200, 116 Stat. 735 (2002) designates Yucca Mountain as the repository for spent nuclear waste. This development does not represent new and significant information with respect to the offsite radiological impacts from license renewal related to disposal of spent nuclear fuel and high-level nuclear waste.

EPA developed Yucca Mountain-specific repository standards, which were subsequently adopted by the NRC in 10 CFR Part 63. In an opinion, issued July 9, 2004, the U.S. Court of Appeals for the District of Columbia Circuit (the Court) vacated EPA's radiation protection standards for the candidate repository, which required compliance with certain dose limits over a 10,000 year period. The Court's decision also vacated the compliance period in NRC's licensing criteria for the candidate repository in 10 CFR Part 63.

Therefore, for the high-level waste and spent fuel disposal component of the fuel cycle, there is some uncertainty with respect to regulatory limits for offsite releases of radioactive nuclides for the current candidate repository site. However, prior to promulgation of the affected provisions of the Commission's regulations, we assumed that limits would be developed along the lines of the 1995 National Academy of Sciences report, "Technical Bases for Yucca Mountain Standards," and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository that would comply with such limits could and likely would be developed at some site. Peak doses to virtually all individuals will be 1mSv (100 mrem) per year or less.

Despite the current uncertainty with respect to these rules, some judgment as to the regulatory NEPA implications of offsite radiological impacts of spent fuel and high-level waste disposal should be made. The staff concludes that these impacts are acceptable in that the impacts would not be sufficiently large to require the NEPA conclusion that the option of extended operation under 10 CFR Part 54 should be eliminated.

The staff has not identified any new and significant information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no offsite radiological impacts related to spent fuel and HLW disposal during the renewal term beyond those discussed in the GEIS.

- Nonradiological impacts of the uranium fuel cycle. Based on information in the GEIS, the Commission found that

  > The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant are found to be small.

  The staff has not identified any new and significant information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no nonradiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Low-level waste storage and disposal. Based on information in the GEIS, the Commission found that

  > The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment will remain small during the term of a renewed license. The maximum additional on-site land that may be required for low-level waste storage during the term of a renewed license and associated impacts will be small. Nonradiological impacts on air and water will be negligible. The radiological and nonradiological environmental impacts of long-term disposal of low-level waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient low-level waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

  The staff has not identified any new and significant information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of low-level waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- Mixed waste storage and disposal. Based on information in the GEIS, the Commission found that

> The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient mixed waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

The staff has not identified any new and significant information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of mixed waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- <u>Onsite spent fuel</u>. Based on information in the GEIS, the Commission found that

> The expected increase in the volume of spent fuel from an additional 20 years of operation can be safely accommodated on site with small environmental effects through dry or pool storage at all plants if a permanent repository or monitored retrievable storage is not available.

The staff has not identified any new and significant information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of onsite spent fuel associated with license renewal beyond those discussed in the GEIS.

- <u>Nonradiological waste</u>. Based on information in the GEIS, the Commission found that

> No changes to generating systems are anticipated for license renewal. Facilities and procedures are in place to ensure continued proper handling and disposal at all plants.

The staff has not identified any new and significant information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no nonradiological waste impacts during the renewal term beyond those discussed in the GEIS.

- Transportation. Based on information contained in the GEIS, the Commission found that

> The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with average burnup for the peak rod to current levels approved by NRC up to 62,000 MWd/MTU and the cumulative impacts of transporting high-level waste to a single repository, such as Yucca Mountain, Nevada are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S-4—Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor. If fuel enrichment or burnup conditions are not met, the applicant must submit an assessment of the implications for the environmental impact values reported in § 51.52.

  Millstone meets the fuel-enrichment and burnup conditions set forth in Addendum 1 to the GEIS. The staff has not identified any new and significant information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of transportation associated with license renewal beyond those discussed in the GEIS.

There are no Category 2 issues for the uranium fuel cycle and solid-waste management.

6.2 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR Part 63. Code of Federal Regulations, Title 10, *Energy,* Part 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada."

40 CFR Part 191. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste."

40 CFR Part 197. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 197, "Public Health and Environmental Radiation Protection Standards for Management and Disposal for Yucca Mountain, Nevada."

Dominion Nuclear Connecticut, Inc. (Dominion). 2004. *Applicant's Environmental Report—Operating License Renewal Stage Millstone Power Station, Units 2 and 3*. Waterford, Connecticut.

Energy Policy Act of 1992. 42 USC 10101, et seq.

National Academy of Sciences (NAS). 1995. *Technical Bases for Yucca Mountain Standards*. Washington, D.C.

National Environmental Policy Act (NEPA) of 1969, as amended, 42 USC 4321, et. seq.

Nuclear Energy Institute, Inc. v. EPA. 2004. No. 01-1258. U.S. Court of Appeals for the District of Columbia Circuit.

U.S. Department of Energy (DOE). 1980. *Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste*. DOE/EIS-0046F. Washington, D.C.

U.S. Environmental Protection Agency (EPA). 2001. "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV." *Federal Register*, Vol. 66, No. 114, pp. 32074-32135. Washington, D.C. June 13, 2001.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, "Section 6.3 – Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report." NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2001. "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada." *Federal Register.* Vol. 66, No. 213, pp.55792–55815. November 2, 2001.

7.0 Environmental Impacts of Decommissioning

Environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license are evaluated in the *Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities*, NUREG-0586, Supplement 1 (NRC 2002). The staff's evaluation of the environmental impacts of decommissioning presented in Supplement 1 resulted in a range of impacts for each environmental issue. These results may be used by licensees as a starting point for a plant-specific evaluation of the decommissioning impacts at their facilities.

The incremental environmental impacts associated with decommissioning activities resulting from continued plant operation during the renewal term are evaluated in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (U. S. Nuclear Regulatory Commission [NRC] 1996; 1999).[a] The evaluation in NUREG-1437 includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1 and, therefore, additional plant-specific review of these issues is required. There are no Category 2 issues related to decommissioning.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

7.1 Decommissioning

Category 1 issues in Table B-1 of 10 Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B that are applicable to Millstone Units 2 and 3 decommissioning following the renewal term are listed in Table 7-1. Dominion Nuclear Connecticut (Dominion) stated in its Environmental Report (ER) (Dominion 2004) that it is aware of no new and significant information regarding the environmental impacts of Millstone Units 2 and 3 license renewal. The staff has not identified any significant new information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of these issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 7-1. Category 1 Issues Applicable to the Decommissioning of Millstone Units 2 and 3 Following the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
DECOMMISSIONING	
Radiation Doses	7.3.1; 7.4
Waste Management	7.3.2; 7.4
Air Quality	7.3.3; 7.4
Water Quality	7.3.4; 7.4
Ecological Resources	7.3.5; 7.4
Socioeconomic Impacts	7.3.7; 7.4

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of the issues follows:

- <u>Radiation doses</u>. Based on information in the GEIS, the Commission found that

> Doses to the public will be well below applicable regulatory standards regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem [0.01 person-Sv] caused by buildup of long-lived radionuclides during the license renewal term.

The staff has not identified any new and significant information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no radiation dose impacts associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Waste management. Based on information in the GEIS, the Commission found that

> Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected.

The staff has not identified any new and significant information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts from solid waste associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Air quality. Based on information in the GEIS, the Commission found that

> Air quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term.

The staff has not identified any new and significant information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on air quality associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Water quality. Based on information in the GEIS, the Commission found that

> The potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts.

The staff has not identified any new and significant information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on water quality associated with decommissioning following the license renewal term beyond those discussed in the GEIS

- Ecological resources. Based on information in the GEIS, the Commission found that

> Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts.

The staff has not identified any new and significant information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on ecological resources associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Socioeconomic Impacts. Based on information in the GEIS, the Commission found that

> Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth.

The staff has not identified any new and significant information during its independent review of the Dominion ER (Dominion 2004), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no socioeconomic impacts associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

7.2 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

Dominion Nuclear Connecticut (Dominion). 2004. *Applicant's Environmental Report—Operating License Renewal Stage Millstone Units 2 and 3*. Waterford, Connecticut.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report, Section 6.3—Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report*. NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2002. *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors*. NUREG-0586, Supplement 1, Volumes 1 and 2, Washington, D.C.

8.0 Environmental Impacts of Alternatives to License Renewal

This chapter examines the potential environmental impacts associated with denying the renewal of an operating license (OL) (i.e., the no-action alternative); the potential environmental impacts from electric generating sources other than Millstone Power Station, Units 2 and 3 (Millstone); the possibility of purchasing electric power from other sources to replace power generated by Millstone and the associated environmental impacts; the potential environmental impacts from a combination of generating and conservation measures; and other generation alternatives that were deemed unsuitable for replacement of power generated by Millstone. The environmental impacts are evaluated using the U.S. Nuclear Regulatory Commission's (NRC's) three-level standard of significance—SMALL, MODERATE, or LARGE—developed using the Council on Environmental Quality guidelines and set forth in the footnotes to Table B-1 of 10 Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B:

> SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize important attributes of the resource.
>
> LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The impact categories evaluated in this chapter are the same as those used in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999)[(a)] with the additional impact category of environmental justice.

8.1 No-Action Alternative

The NRC's regulations implementing the National Environmental Policy Act of 1969 specify that the no-action alternative be discussed in an NRC environmental impact statement (EIS) (see 10 CFR Part 51, Subpart A, Appendix A[4]). For license renewal, the no-action alternative refers to a scenario in which the NRC would not renew the Millstone OLs and Dominion Nuclear

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

Connecticut (Dominion) would then cease plant operations by the end of the current licenses and initiate the decommissioning of the plants.

Dominion will be required to shut down Millstone and to comply with NRC decommissioning requirements in 10 CFR 50.82 whether or not the OLs are renewed. If the Millstone OLs are renewed, shutdown of the units and decommissioning activities will not be avoided, but will be postponed for up to an additional 20 years.

The environmental impacts associated with decommissioning following a license renewal period of up to 20 years or following the no-action alternative would be bounded by the discussion of impacts in Chapter 7 of the license renewal GEIS (NRC 1996), Chapter 7 of this supplemental environmental impact statement (SEIS), and the *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586, Supplement 1 (NRC 2002). The impacts of decommissioning after 60 years of operation are not expected to be significantly different from those occurring after 40 years of operation.

Impacts from the decision to permanently cease operations are not considered in NUREG-0586, Supplement 1[a]. Therefore, immediate impacts that occur between plant shutdown and the beginning of decommissioning are considered here. These impacts will occur when the units shut down regardless of whether the licenses are renewed or not and are discussed below, with the results presented in Table 8-1. Plant shutdown will result in a net reduction in power production capacity. The power not generated by Millstone during the license renewal term would likely be replaced by (1) power purchased from other electricity providers, (2) generating alternatives other than Millstone, (3) demand-side management and energy conservation, or (4) some combination of these options. The environmental impacts of these options are discussed in Section 8.2.

- **Land Use**

  In Chapter 4, the staff concluded that the impacts of continued plant operation on land use would be SMALL. Onsite land use will not be affected immediately by the cessation of operations. Plant structures and other facilities are likely to remain in place until decommissioning. The transmission lines associated with the project are expected to remain in service after the plants stop operating. As a result, maintenance of the rights-of-way will continue as before. Therefore, the staff concludes that the impacts on land use from plant shutdown would be SMALL.

(a) Appendix J of NUREG-0586 Supplement 1 discusses the socioeconomic impacts of plant closure, but the results of the analysis in Appendix J are not incorporated in the analysis presented in the main body of the NUREG.

Table 8-1. Summary of Environmental Impacts of the No-Action Alternative

Impact Category	Impact	Comment
Land Use	SMALL	Impacts are expected to be SMALL because plant shutdown is not expected to result in changes in onsite or offsite land use.
Ecology	SMALL	Impacts are expected to be SMALL because aquatic impacts are generally positive and terrestrial impacts are not expected because there will not be any land use changes.
Water Use and Quality—Surface Water	SMALL	Impacts are expected to be SMALL because surface water intake and discharges will decrease.
Water Use and Quality—Groundwater	SMALL	Impacts are expected to be SMALL because groundwater use will decrease.
Air Quality	SMALL	Impacts are expected to be SMALL because discharges related to plant operation and worker transportation will decrease.
Waste	SMALL	Impacts are expected to be SMALL because generation of high-level waste will stop, and generation of low-level and mixed waste will decrease.
Human Health	SMALL	Impacts are expected to be small because radiological doses to workers and members of the public, which are within regulatory limits, will be reduced.
Socioeconomics	SMALL to MODERATE	Impacts are expected to be SMALL to MODERATE because of a decrease in employment and tax revenues.
Socioeconomics (Transportation)	SMALL	Impacts are expected to be SMALL because of the decrease in employment would reduce traffic.
Aesthetics	SMALL	Impacts are expected to SMALL because plant structures will remain in place.
Historic and Archaeological Resources	SMALL	Impacts are expected to be SMALL because shutdown of the plant will not change land use.
Environmental Justice	SMALL	Impacts are expected to be SMALL because very few minority / low-income persons live in the immediate vicinity of Millstone. Economic offset likely is due to the general size and availability of other employment opportunities in the region.

- **Ecology**

  In Chapter 4 of this SEIS, the NRC staff concluded that the terrestrial and aquatic resource impacts of plant operation were SMALL, with the exception of entrainment, which would likely be MODERATE. Cessation of operations will be accompanied by a significant reduction in cooling water flow, elimination of any impact due to impingement, entrainment, and the thermal plume. The environmental impacts to aquatic species, including threatened and endangered species, associated with these changes are generally positive. The impact of plant closure would be to cease the impacts due to entrainment. The impact of plant closure on the terrestrial ecosystem will be negligible because the transmission lines to the plant will be maintained and remain energized. Therefore, the staff concludes that ecological impacts from shutdown of the plant would be SMALL.

- **Water Use and Quality—Surface Water**

  In Chapter 4 of this SEIS, the NRC staff concluded that impacts of plant operation on surface water use and quality were SMALL. When the plant stops operating, there will be an immediate reduction in the consumptive use of water because of reduction in cooling water flow and in the amount of heat rejected to the Niantic Bay. There will also be a significant reduction in biocide use. Therefore, the staff concludes that the impacts on surface water use and quality from plant shutdown would be SMALL.

- **Water Use and Quality—Groundwater**

  In Chapter 4, the staff concluded that impacts of plant ground-water use on ground-water availability and quality were SMALL. When the plant stops operating, there will be a reduction in use of groundwater. Therefore, the staff concludes that ground-water use and quality impacts from shutdown of the plant would be SMALL.

- **Air Quality**

  In Chapter 4, the staff found the impacts of plant operation on air quality to be SMALL. When the plant stops operating, there will be a reduction in emissions from activities related to plant operation such as use of diesel generators and workers' transportation. Therefore, the staff concludes that the impact on air quality from shutdown of the plant would be SMALL.

- **Waste**

  The impacts of waste generated by plant operation are discussed in Chapter 6. The impacts of low-level and mixed waste from plant operation are characterized as SMALL.

When the plant stops operating, the plant will stop generating high-level waste, and generation of low-level and mixed waste associated with plant operation and maintenance will be reduced. Therefore, the staff concludes that the impact of waste generated after shutdown of the plant would be SMALL.

- **Human Health**

In Chapter 4 of this SEIS, the NRC staff concluded that the impacts of plant operation on human health were SMALL. After the cessation of operations, the amount of radioactive material released to the environment in gaseous and liquid forms will be reduced. Therefore, the staff concludes that the impact of shutdown of the plant on human health will be SMALL. In addition, the variety of potential accidents at the plant will be reduced to a limited set associated with shutdown events and fuel handling. In Chapter 5 of this SEIS, the NRC staff concluded that the impacts of accidents during operation were SMALL. Therefore, the staff concludes that the impacts of potential accidents following shutdown of the plant would be SMALL.

- **Socioeconomics**

In Chapter 4, the NRC staff concluded that the socioeconomic impacts of continued plant operation would be SMALL. There would be immediate socioeconomic impacts associated with the shutdown of the plant because of the reduction in the staff at the plant. There may also be an immediate reduction in property tax revenues for the county. The NRC staff concludes that the socioeconomic impacts of plant shutdown would range from SMALL to MODERATE. Some of these impacts could be offset if new power generating facilities are built at or near the current site. See Appendix J to NUREG-0586, Supplement 1 (NRC 2002), for additional discussion of the potential impacts of plant shutdown.

- **Socioeconomics (Transportation)**

In Chapter 4, the staff concluded that the impacts of continued plant operation on transportation would be SMALL. Cessation of operations will be accompanied by a reduction in traffic in the vicinity of the plant. Most of the reduction will be associated with a reduction in the plant workforce, but there will also be a reduction in shipment of material to and from the plant. Therefore, the staff concludes that the impacts of plant closure on transportation would be SMALL.

- **Aesthetics**

In Chapter 4, the staff concluded that the aesthetic impacts of continued plant operation would be SMALL. Cessation of plant operations would probably result in the dismantlement of buildings and structures at the site, resulting in a positive aesthetic impact. Operational noise would be reduced or eliminated. Decommissioning would result in the eventual dismantlement of buildings and structures at the site, resulting in a positive aesthetic impact. Noise would be generated during decommissioning operations that may be detectable off site; however, the impact is unlikely to be of large significance and can normally be mitigated. Thus, the aesthetic impacts associated with the no-action alternative and decommissioning are considered SMALL.

- **Historic and Archaeological Resources**

In Chapter 4, the staff concluded that the impacts of continued plant operation on historic and archaeological resources would be SMALL. Onsite land use will not be affected immediately by the cessation of operations. Plant structures and other facilities are likely to remain in place until decommissioning. The transmission lines associated with the project are expected to remain in service after the plants stop operating. As a result, maintenance of transmission line rights-of-way will continue as before. Therefore, the staff concludes that the impacts on historic and archaeological resources from plant shutdown would be SMALL.

- **Environmental Justice**

In Chapter 4, the staff concluded that the environmental justice impact of continued operation of the plant would be SMALL because continued operation of the plant would not have a disproportionately high and adverse impact on minority and low-income populations. Shutdown of the plant could have disproportionately high and adverse impacts on minority and low-income populations because of the loss of employment opportunities at the site and because of secondary socioeconomic impacts (e.g., loss of patronage at local businesses). The staff concludes that the environmental justice impacts of plant shutdown would be SMALL. Some of these impacts could be offset if new power generating facilities are built at or near the current site. See Appendix J to NUREG-0586, Supplement 1 (NRC 2002), for additional discussion of these impacts.

8.2 Alternative Energy Sources

This section discusses the environmental impacts associated with alternative sources of electric power to replace the power generated by Millstone, assuming that the OLs for Units 2 and 3 are not renewed. The order of presentation of alternative energy sources in Section 8.2 does not imply which alternative would be most likely to occur or to have the least environmental impacts.

The following generation alternatives are considered in detail:

- coal-fired generation at the Millstone site and an alternate retired oil-fired plant site (Section 8.2.1);

- natural gas-fired generation at the Millstone site and an alternate retired oil-fired plant site (Section 8.2.2); and

- nuclear generation at the Millstone site and an alternate retired oil-fired plant site (Section 8.2.3).

The alternative of purchasing power from other sources to replace power generated at Millstone is discussed in Section 8.2.4. Other power-generation alternatives and conservation alternatives considered by the staff and found not to be reasonable replacements for Units 2 and 3 are discussed in Section 8.2.5. Section 8.2.6 discusses the environmental impacts of a combination of generation and conservation alternatives.

Each year the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an Annual Energy Outlook. In its Annual Energy Outlook 2004, with Projections to 2025, EIA projects that combined-cycle[a] or combustion turbine technology fueled by natural gas is likely to account for approximately 62 percent of new electric generating capacity between the years 2011 and 2025 (DOE/EIA 2004a). Both technologies are designed primarily to supply peak and intermediate capacity, but combined-cycle technology can also be used to meet base-load[b] requirements. Coal-fired plants are projected by EIA to account for approximately 33 percent of new capacity during this period. Coal-fired plants are generally used to meet base-load requirements. Renewable energy sources, primarily wind and biomass units, are projected by EIA to account for the remaining 5 percent of capacity additions. EIA's projections are based on the assumption that providers of new generating capacity will seek to minimize cost while meeting applicable environmental requirements. Combined-cycle plants are projected by EIA to have the lowest generation cost in 2010, followed by wind generation and then coal-fired plants (DOE/EIA 2004a). By 2025, coal-fired plants are projected by EIA to have the lowest generation cost, followed by combined-cycle plants and then wind generation (DOE/EIA 2004a).

(a) In a combined-cycle unit, hot combustion gas in a combustion turbine rotates the turbine to generate electricity. The hot exhaust from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

(b) A base-load plant normally operates to supply all or part of the minimum continuous load of a system and, consequently, produces electricity at an essentially constant rate. Nuclear power plants are commonly used for base-load generation; i.e., these units generally run near full load.

EIA projects that oil-fired plants will account for very little of new generation capacity in the United States during the 2002 to 2025 time period because of higher fuel costs and lower efficiencies (DOE/EIA 2004a).

EIA also projects that new nuclear power plants will not account for any new generation capacity in the United States during the 2002 to 2025 time period because natural gas and coal-fired plants are projected to be more economical (DOE/EIA 2004a). In spite of this projection, a new nuclear plant alternative for replacing power generated by Millstone is considered for reasons stated in Section 8.2.3. NRC established a new reactor licensing program organization in 2001 to prepare for and manage future reactor and site licensing applications (NRC 2001).

Millstone Units 2 and 3 have a combined net calculated electrical output of approximately 2024 megawatts electric (MW[e]). The staff assumed construction of four 500-MW(e) units for the coal alternative and five 400-MW(e) units for the natural gas alternative, for a combined capacity of 2000 MW(e), which is consistent with Dominion's Environmental Report (ER) (Dominion 2004). For the nuclear alternative, the staff assumed construction of two 1000-MW(e) plants. This assumption will understate the environmental impacts of replacing the 2024 MW(e) from Millstone by roughly 1.2 percent.

The Dominion ER (Dominion 2004) identified the potential availability of retired oil-fired plant sites in Connecticut as locations for alternative energy production plants. A previously used site would not require construction of transmission lines or other support facilities and may not require construction of a rail spur. In addition, greenfield sites may not be a reasonable alternative because of the high population and limited amount of open space for this type of development. Therefore, greenfield sites are not considered in this analysis.

8.2.1 Coal-Fired Generation

The coal-fired alternative is analyzed for both the Millstone site and an alternate retired oil-fired plant site in Connecticut. Existing transmission lines, cooling systems, and support facilities would be used (Dominion 2004). Millstone has an existing rail spur, although it may require some improvement if used for a coal-fired facility. The alternate sites may have rail access in place.

Unless otherwise indicated, the assumptions and numerical values used in Section 8.2.1 are from the Dominion ER (Dominion 2004). The staff reviewed this information and compared it to environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating the coal-fired alternative for 40 years is considered (as a reasonable projection of the operating life of a coal-fired plant).

The coal-fired plant would consume approximately 5.4 million metric tons (MT) (5.9 million tons) per year of pulverized bituminous coal with an ash content of approximately 4.85 percent (Dominion 2004). Dominion assumes a heat rate[(a)] of 9700 joules (J) of fuel /J of electricity (10,200 BTU/kWh) and a capacity factor[(b)] of 0.85 in its ER (Dominion 2004). After combustion, 99.9 percent of the ash would be collected and disposed of at the plant site. In addition, approximately 170.5 × 10^3 MT (188.0 × 10^3 tons) of scrubber sludge would be disposed of at the plant site based on annual lime usage of approximately 58,000 MT (64,000 tons). Lime is used in the scrubbing process for control of sulfur dioxide (SO_2) emissions.

Coal and lime or limestone for a coal-fired plant sited at Millstone most likely would be delivered via rail line. Lime[(c)] or limestone is used in the scrubbing process for control of sulfur dioxide (SO_2) emissions. Rail delivery also would be the most likely option for delivering coal and lime/limestone to an alternative site for the coal-fired plant. Construction at an alternative site could necessitate the construction of a rail spur to the plant. This would require construction of docking and loading facilities onsite.

8.2.1.1 Closed-Cycle Cooling System

The overall impacts at either the Millstone or at an alternate site of the coal-fired generating system using a closed-cycle cooling system with cooling towers are discussed in the following sections and summarized in Table 8-2. The magnitude of impacts for the alternate site (retired oil-fired plant site) will depend on the location of the particular site selected. The Millstone plant currently uses a once-through cooling system. For the purposes of comparison with an alternate site, however, it is assumed that the replacement coal-fired plant sited on the Millstone site would use a closed-cycle cooling system, which would most likely require the acquisition of additional land adjacent to the site. For completeness, the staff also considered the impacts of a once-through cooling system, which are discussed in Section 8.2.1.2.

(a) Heat rate is a measure of generating station thermal efficiency. In English units, it is generally expressed in British thermal units (BTUs) per net kilowatt-hour (kWh). It is computed by dividing the total BTU content of the fuel burned for electric generation by the resulting kWh generation. The corresponding metric unit for energy is the Joule (J).

(b) The capacity factor is the ratio of electricity generated, for the period of time considered, to the energy that could have been generated at continuous full-power operation during the same period.

(c) In a typical wet scrubber, lime (calcium hydroxide) or limestone (calcium carbonate) is injected as a slurry into the hot effluent combustion gases to remove entrained sulfur dioxide. The lime based scrubbing solution reacts with sulfur dioxide to form calcium sulfite which precipitates and is removed in sludge form.

Table 8-2. Summary of Environmental Impacts of Coal-Fired Generation at Millstone Site and an Alternate Site Using Once-Through Cooling

	Millstone Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	Uses approximately 164 ha (406 ac) for plant and waste disposal. Additional land may be required at Millstone. Additional offsite land impacts for coal and limestone mining. Additional impacts would occur for rail spur and closed-cycle cooling system towers.	SMALL to MODERATE	Uses approximately 700 ha (1700 ac), for plant, offices, parking, and rail spur. Additional land impacts for coal and limestone mining and cooling-water system.
Ecology	SMALL to MODERATE	Uses undeveloped areas at current Millstone site, additional land adjacent to Millstone site, plus rail corridor. Impacts to terrestrial ecology from cooling tower drift.	SMALL to MODERATE	Impact depends on location and ecology of the site and need for rail or barge facilities, Impacts to terrestrial ecology from cooling tower drift; impact to aquatic resources from surface water body used for intake and discharge.
Water Use and Quality—Surface Water	SMALL	Partial use of existing cooling system (e.g., intake and discharge structures). Operational impacts similar or less than Millstone Units 2 and 3.	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the surface water body.
Water Use and Quality—Groundwater	SMALL	Groundwater use is limited.	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the aquifers.
Air Quality	MODERATE	Sulfur oxides • 12,500 MT/yr (13,780 tons/yr) Nitrogen oxides • 4045 MT/yr (4459 tons/yr) Particulates • 131 MT/yr (144 tons/yr) of total PM_{10} particulates • 30 MT/yr (33 tons/yr)	MODERATE	Potentially same impacts as the Millstone site, although pollution-control standards may vary.

Table 8-2. (contd)

	Millstone Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Air Quality (contd)		Carbon monoxide • 1348 MT/yr (1486 tons/yr) Small amounts of mercury and other hazardous air pollutants and naturally occurring radioactive materials–mainly uranium and thorium		
Waste	MODERATE	Total waste volume would be approximately 2.63 × 10^5 MT/yr (2.90 × 10^5 tons/yr) of ash and scrubber sludge requiring approximately 43 ha (106 ac) for disposal during the 40-year life of the plant.	MODERATE	Same impacts as Millstone site; waste disposal constraints may vary.
Human Health	SMALL	Impacts are uncertain, but considered SMALL in the absence of more quantitative data.	SMALL	Same impact as the Millstone site.
Socioeconomics	SMALL to MODERATE	During construction, impacts would be visible. Up to 2500 workers during the peak period of the five-year construction period, followed by reduction from current Millstone workforce of 1650 to 400; tax base preserved. Impacts during operation would be negligible.	SMALL to LARGE	Construction impacts depend on location, but could be significant if plant is located in an area that is more rural than the Millstone site. City of Waterford would experience loss of tax base and employment, potentially offset by possible economic growth.
Socioeconomics (Transportation)	SMALL to LARGE	Transportation impacts associated with construction workers could be noticeable to significant. Impacts could be slight to noticeable during operations. For rail transportation of coal and lime, the impact is considered noticeable to significant.	SMALL to LARGE	Transportation impacts associated with construction workers could be noticeable to significant. Impacts could be slight to noticeable during operation. For rail transportation of coal and lime, the impact is considered noticeable to significant.

Table 8-2. (contd)

	Millstone Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Aesthetics	MODERATE	MODERATE aesthetic impact due to visual impact of cooling towers, exhaust stacks, and rail on environment. Noise impact would be SMALL to MODERATE due to proximity of houses.	SMALL to MODERATE	Impacts would depend on characteristics of alternate location.
Historic and Archeological Resources	SMALL to MODERATE	Some construction would affect previously developed parts of Millstone site; cultural resource inventory should minimize any impacts on undeveloped lands.	SMALL to MODERATE	Alternate location would necessitate cultural resource studies.
Environmental Justice	SMALL to MODERATE	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Loss of 1250 operating jobs could reduce employment prospects for minority and low-income populations. Impacts could be offset by possible economic growth and the ability of affected workers to commute to other jobs.	SMALL to MODERATE	Impacts will vary depending on population distribution and make-up at the site.

- **Land Use**

The existing facilities and infrastructure at the Millstone site would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the staff assumed that the coal-fired replacement plant alternative would use the once-through system, switchyard, offices, and transmission line rights-of-way. Much of the land that would be used has been previously disturbed.

The coal-fired generation alternative would necessitate converting roughly an additional 164 ha (406 ac) of the Millstone site for the plant, coal storage, and ash and scrubber sludge disposal. Additional land may be needed since the Millstone site is only 212 ha (525 ac) in size. Although the Millstone site has an existing once-through cooling system, it is likely that the system would need to be significantly modified to accommodate a coal plant with a closed-cycle cooling system (e.g., addition of cooling towers). Additional land-use changes would occur off site in an undetermined coal-mining area to supply coal for the plant.

In the GEIS, the staff estimated that approximately 8900 ha (22,000 ac) would be affected for mining the coal and disposing of the waste to support a 1000 MW(e) coal plant during its operational life. Partially offsetting this offsite land use would be the elimination of the need for uranium mining to supply fuel for Millstone. In the GEIS, the staff estimated that approximately 400 ha (1000 ac) would be affected for mining the uranium and processing it during the operating life of a nuclear power plant.

The impact of a coal-fired generating unit on land use at the existing Millstone site is best characterized as SMALL to MODERATE. The impact would be greater than the OL renewal alternative.

Construction of the coal-fired plant at an alternate site could impact up to 700 ha (1700 ac) (NRC 1996). While transmission facilities would be available, additional land may be disturbed if a rail spur is needed for coal and lime delivery. This alternative would result in SMALL to MODERATE land-use impacts.

- **Ecology**

Locating a coal-fired plant at the Millstone site would alter ecological resources because of the need to convert roughly 164 ha (406 ac) of land to industrial use (plant, coal storage, ash and scrubber sludge disposal). Additional land may be needed since the Millstone site is only 212 ha (525 acres) in size. However, some of the land on Millstone and surrounding area would have been previously disturbed. Therefore, the impacts to terrestrial resources would be considered inconsequential to detectable but not destabilizing. Impacts to aquatic resources would likely be less than the current Millstone operations even if the existing intake and discharge structures are used.

Locating a coal-fired plant at an alternate site would alter ecological resources because of the need to convert roughly up to 700 ha (1700 ac) (NRC 1996) of land to industrial use (plant, coal storage, ash and scrubber sludge disposal). Additional land may be disturbed if a rail spur is needed for coal and lime delivery. Impacts could include wildlife habitat loss, reduced productivity, and a local reduction in biological diversity. Cooling tower drift from the closed-cycle cooling system could impact terrestrial resources. If needed, construction and maintenance of a rail spur would have ecological impacts. Overall, the ecological impacts at an alternate site would be SMALL to MODERATE.

- **Water Use and Quality—Surface Water**

Coal-fired generation at the Millstone site would likely use water from Niantic Bay for cooling. It is possible that some of the existing intake and discharge structures could be used, but the construction of additional cooling infrastructure would be needed to accommodate a closed-cycle cooling system. Plant discharges would consist mostly of cooling tower blowdown, characterized primarily by an increased temperature and concentration of dissolved solids relative to the receiving water body and intermittent, low concentrations of biocides (e.g., chlorine). Sanitary waste would likely continue to be discharged into the water treatment system of the city of New London. Treated process waste streams and sanitary wastewater may also be discharged. All discharges would be regulated by the Connecticut Department of Environmental Protection (CTDEP) through a National Pollution Discharge Elimination System permit. There would be a consumptive use of water due to evaporation from the cooling towers. Some erosion and sedimentation would likely occur during construction (NRC 1996). The staff considers the impacts to surface-water use and quality of a new coal-fired plant with a closed-cycle cooling system located at the Millstone site to be SMALL.

Cooling water at an alternate site would likely be withdrawn from a surface-water body and would be regulated by permit. Depending on the source water body, the impacts of water use for cooling system make-up water and the impacts on water quality due to cooling tower blowdown could have noticeable impacts. Therefore, the staff considers the impacts of a new coal-fired plant utilizing a closed-cycle cooling system at an alternate site to be SMALL to MODERATE. Water quality impact from sedimentation during construction was characterized in the GEIS as SMALL. The staff also noted in the GEIS that operational water-quality impacts would be similar to or less than those from other generating technologies. Sedimentation impacts from construction of a coal-fired plant at the Millstone site or at an alternate would be short-term and easily mitigated.

- **Water Use and Quality—Groundwater**

The staff assumed that the groundwater wells would continue to be used for non-Millstone related activities (e.g., watering of baseball fields) located adjacent to Millstone. Ground-water withdrawals would be equal to or less than the no-action and license renewal alternatives. Hence, impacts are considered SMALL. Use of groundwater for a coal-fired plant located at an alternative site is a possibility. Ground-water withdrawals at an alternate site would likely require a permit from the state of Connecticut. The impacts will depend on the characteristics of the site and the amount of groundwater used. Therefore, the impacts are considered SMALL to MODERATE.

- **Air Quality**

The air-quality impacts of coal-fired generation vary considerably from those of nuclear generation due to emissions of sulfur oxides (SO_x), nitrogen oxides (NO_x), particulates, carbon monoxide, hazardous air pollutants such as mercury, and naturally occurring radioactive materials.

Millstone is located in New London County, which is part of the Eastern Connecticut Intrastate Air Quality Control Region (40 CFR 81.183). The entire state of Connecticut has been designated as an attainment area for carbon monoxide, nitrogen dioxide, lead, and sulfur dioxide. New London County is also designated as in attainment for particulate matter with a diameter of 10 μm or less. New London County has been designated as serious nonattainment for the U.S. Environmental Protection Agency (EPA) one-hour ozone standard (40 CFR 81.307; CTDEP 2002a).

A new coal-fired generating plant located in Connecticut would need an operating permit under the Clean Air Act and would have to offset its emissions of NO_x and SO_x through the purchase of allowances (Dominion 2004). The plant would need to comply with the new source performance standards for such plants set forth in 40 CFR Part 60, Subpart D(a). The standards establish limits for particulate matter and opacity (40 CFR 60.42[a]), SO_2 (40 CFR 60.43[a]), and NO_x (40 CFR 60.44[a]).

The EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified under the Clean Air Act. All of Connecticut is classified as attainment for criteria pollutants (40 CFR 81.310).

Section 169A of the Clean Air Act (42 United States Code [USC] 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from human made air pollution. EPA issued a new regional haze rule on July 1, 1999 (64 *Federal Register* (FR) 35714 [EPA 1999]). The rule specifies that for each mandatory Class I Federal area located within a state, the state must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most-impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period [40 CFR 51.308(d)(1)]. If a coal-fired plant were located close to a mandatory Class I Federal area, additional air pollution control requirements could be imposed. There are no Class I areas in Connecticut.

In 1998, EPA issued a rule requiring 22 eastern states, including Connecticut, to revise their state implementation plans to reduce nitrogen oxide emissions. Nitrogen oxide emissions contribute to violations of the national ambient air quality standard for ozone. The total amount of nitrogen oxides that can be emitted by each of the 22 states in the year 2007 ozone season (May 1 to September 30) is set out at 40 CFR 51.121(e). For Connecticut, the amount is 38,870 MT (42,850 tons).

Impacts for particular pollutants are as follows:

<u>Sulfur oxides emissions</u>. Dominion states in its ER that an alternative coal-fired plant would use wet scubber-lime for flue gas desulfurization (Dominion 2004).

A new coal-fired power plant would be subject to the requirements in Title IV of the Clean Air Act. Title IV was enacted to reduce emissions of SO_2 and NO_x, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_2 emissions and imposes controls on SO_2 emissions through a system of marketable allowances. EPA issues one allowance for each ton of SO_2 that a unit is allowed to emit. New units do not receive allowances, but are required to have allowances to cover their SO_2 emissions. Owners of new units must therefore acquire allowances from owners of other power plants by purchase or reduce SO_2 emissions at other power plants they own. Allowances can be banked for use in future years. Thus, a new coal-fired power plant would not add to net regional SO_2 emissions, although it might do so locally.

Regardless, SO_2 emissions would be greater for the coal alternative than the OL renewal alternative.

Dominion estimates that, by using the best technology to minimize SO_x emissions, the total annual stack emissions would be approximately as high as 12,500 MT (13,780 tons) of SO_x (Dominion 2004).

<u>Nitrogen oxides emissions</u>. Section 407 of the Clean Air Act establishes technology-based emission limitations for NO_x emissions. The market-based allowance system used for SO_2 emissions is not used for NO_x emissions. A new coal-fired power plant would be subject to the new source performance standards for such plants at 40 CFR 60.44a(d)(1). This regulation, issued on September 16, 1998 (63 FR 49453 [EPA 1998]), limits the discharge of any gases that contain nitrogen oxides (expressed as NO_2) in excess of 200 ng/J (1.6 lb/MWh) of gross energy output, based on a 30-day rolling average.

Dominion estimates that, by using NO_x burners with overfire air and selective catalytic reduction, the total annual NO_x emissions for a new coal-fired power plant would be approximately as high as 4045 MT (4459 tons) (Dominion 2004). This level of NO_x emissions would be greater than the level for the OL renewal alternative.

Particulate emissions. Dominion estimates that the total annual stack emissions would include 131 MT (144 tons) of filterable total suspended particulates and 30 MT (33 tons) of particulate matter having an aerodynamic diameter less than or equal to 10 µm (PM_{10}) (40 CFR 50.6). Fabric filters or electrostatic precipitators would be used for control. In addition, coal-handling equipment would introduce fugitive particulate emissions. Particulate emissions would be greater under the coal alternative than the OL renewal alternative.

During the construction of a coal-fired plant, fugitive dust would be generated. In addition, exhaust emissions would come from vehicles and motorized equipment used during the construction process.

Carbon monoxide emissions. Dominion estimates that the total carbon monoxide emissions would be approximately 1348 MT (1486 tons) per year. This level of emissions is greater than the level for the OL renewal alternative.

Hazardous air pollutants including mercury. In December 2000, EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam generating units (EPA 2000a). EPA determined that coal- and oil-fired electric utility steam generating units are significant emitters of hazardous air pollutants. Coal-fired power plants were found by EPA to emit arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (EPA 2000a). EPA concluded that mercury is the hazardous air pollutant of greatest concern. EPA found that (1) there is a link between coal consumption and mercury emissions; (2) electric utility, steam generating units are the largest domestic source of mercury emissions; and (3) certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health impacts due to mercury exposures resulting from consumption of contaminated fish (EPA 2000a). Accordingly, EPA added coal- and oil-fired, electric utility, steam generating units to the list of source categories under Section 112(c) of the Clean Air Act for which emission standards for hazardous air pollutants will be issued (EPA 2000a).

Uranium and thorium. Coal contains uranium and thorium. Uranium concentrations are generally in the range of 1 to 10 parts per million. Thorium concentrations are generally about 2.5 times greater than uranium concentrations (Gabbard 1993). One estimate is that a typical coal-fired plant released roughly 4.7 MT (5.2 tons) of uranium and 11.6 MT (12.8 tons) of thorium in 1982 (Gabbard 1993). The population dose equivalent from the uranium and thorium releases and daughter products produced by the decay of these isotopes has been calculated to be significantly higher than that from nuclear power plants (Gabbard 1993).

Carbon dioxide. A coal-fired plant would also have unregulated carbon dioxide emissions that could contribute to global warming. The level of emissions from a coal-fired plant would be greater than the OL renewal alternative.

Summary. The GEIS analysis did not quantify emissions from coal-fired power plants, but implied that air impacts would be substantial. The GEIS also mentioned global warming from unregulated carbon dioxide emissions and acid rain from SO_x and NO_x emissions as potential impacts (NRC 1996). Adverse human health impacts such as cancer and emphysema have been associated with the products of coal combustion. The appropriate characterization of air impacts from coal-fired generation would be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

Siting a coal-fired generation plant at a site other than Millstone would not significantly change air-quality impacts, although it could result in installing more or less stringent pollution-control equipment to meet applicable local requirements. Therefore, the impacts would be MODERATE.

- **Waste**

Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash and scrubber sludge. Four 500-MW(e) coal-fired plants would generate approximately 2.63×10^5 MT (2.90×10^5 tons) of this waste annually for 40 years. The waste would be disposed of onsite, accounting for approximately 43 ha (106 ac) of land area over the 40-year plant life. Waste impacts to groundwater and surface water could extend beyond the operating life of the plant if leachate and runoff from the waste storage area occurs. Disposal of the waste could noticeably affect land use and ground-water quality, but with appropriate management and monitoring, it would not destabilize any resources. After closure of the waste site and revegetation, the land could be available for other uses. Debris would be generated during construction activities.

In May 2000, EPA issued a “Notice of Regulatory Determination on Wastes From the Combustion of Fossil Fuels” (EPA 2000b). EPA concluded that some form of national regulation is warranted to address coal combustion waste products because of the following: (a) the composition of these wastes could present danger to human health and the environment under certain conditions; (b) EPA has identified 11 documented cases of proven damages to human health and the environment by improper management of these wastes in landfills and surface impoundments; (c) present disposal practices are such that, in 1995, these wastes were being managed in 40 percent to 70 percent of landfills and surface impoundments without reasonable controls in place, particularly in the area of ground-water monitoring; and (d) EPA identified gaps in state oversight of coal combustion wastes. Accordingly, EPA announced its intention to issue regulations for disposal of coal combustion waste under subtitle D of the Resource Conservation and Recovery Act.

For all of the preceding reasons, the appropriate characterization of impacts from waste generated from burning coal at the Millstone site is MODERATE; the impacts would be clearly noticeable, but would not destabilize any important resource.

Siting the facility at a site other than Millstone would not alter waste generation, although other sites might have more constraints on disposal locations. Therefore, the impacts would also be MODERATE.

- **Human Health**

Coal-fired power generation introduces worker risks from fuel and limestone mining, from fuel and lime / limestone transportation, and from disposal of coal combustion waste. In addition, there are public risks from inhalation of stack emissions. Emission impacts can be widespread and health risks difficult to quantify. The coal alternative also introduces the risk of coal-pile fires and attendant inhalation risks.

In the GEIS, the staff stated that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates, but it did not identify the significance of these impacts (NRC 1996). In addition, the discharges of uranium and thorium from coal-fired plants can potentially produce radiological doses in excess of those arising from nuclear power plant operations (Gabbard 1993).

Regulatory agencies, including EPA and state agencies, set air emission standards and requirements based on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. As discussed previously, EPA has recently noted that certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health impacts due to mercury exposures from sources such as coal-fired power plants. However, in the absence of more quantitative data, human health impacts from radiological doses and inhaling toxins and particulates generated by burning coal are characterized as SMALL.

Siting the facility at this site other than Millstone would not change the impact on human health. Therefore, the impacts would be SMALL.

- **Socioeconomics**

Construction of the coal-fired alternative would take approximately five years. The staff assumed that construction would take place while Millstone continues operation and would be completed by the time Millstone permanently ceases operations. The workforce would be expected to vary between 1200 and 2500 workers during the five-year construction period (NRC 1996). These workers would be in addition to the approximately 1650 workers currently employed at Millstone. During construction, the surrounding communities would experience demands on housing and public services that could have noticeable impacts. These impacts would be tempered by construction workers commuting to the site from other counties. After construction, the communities would be impacted by the loss of the construction jobs, although this loss would be possibly offset by other growth occurring in the region.

If the coal-fired replacement plant were constructed at the Millstone site and Units 2 and 3 were decommissioned, there would be approximately 1250 fewer permanent high-paying jobs, with a commensurate reduction in demand on socioeconomic resources and contribution to the regional economy. However, as discussed previously, projected economic growth in southeastern Connecticut could temper or offset the projected loss of jobs from the closure of Millstone. The coal-fired plants would provide a new tax base to offset the loss of tax base associated with decommissioning of the nuclear units. For all these reasons, the appropriate characterization of nontransportation socioeconomic impacts for a coal-fired plant constructed at the Millstone site would be SMALL.

Construction of a replacement coal-fired power plant at an alternate site would relocate some socioeconomic impacts, but would not eliminate them. The communities around Millstone would still experience the impact of Millstone operational job loss (although potentially tempered by projected economic growth), and the communities around the new site would have to absorb the impacts of a large, temporary workforce (up to 2500 workers at the peak of construction) and a permanent workforce of approximately 400 workers. In the GEIS, the staff stated that socioeconomic impacts at an urban site would be smaller than at a rural site, because less of the peak construction workforce would need to move to the area to work. The Millstone site is within commuting distance of the Hartford metropolitan area and is therefore not considered a rural site. Alternate sites would need to be analyzed on a case-by-case basis. Socioeconomic impacts at a rural site could be LARGE.

- **Socioeconomics (Transportation)**

  During the five-year construction period of replacement coal-fired units, up to 2500 construction workers would be working at the site in addition to the 1650 workers at Millstone. The addition of these workers could place significant traffic loads on existing highways. Such impacts could be noticeable but are not expected to be overwhelming.

  For transportation related to commuting of plant operating personnel, the impacts are minor. The maximum number of plant operating personnel would be approximately 400. The current Millstone workforce is approximately 1650. Therefore, traffic impacts associated with plant personnel commuting to a coal-fired plant would be expected to be negligible compared to the current impacts from Millstone operations.

  For rail transportation related to coal and lime delivery to the Millstone site, the impacts are noticeable to significant. Each train would have approximately 100 open-top rail cars, each holding about 90 MT (100 tons) of coal or lime. Approximately 600 trains per year would be needed to deliver the coal and lime for the four coal-fired units. A total of 12 train trips is expected per week, or nearly 4 trips per day, because, for each full train delivery, there would be an empty train.

  Transportation-related impacts associated with commuting construction workers at an alternate site are site-dependent, but could range from MODERATE to LARGE. Transportation impacts related to the commuting of plant operating personnel would also be site-dependent, but can be characterized as SMALL to MODERATE.

  At an alternate site, coal and lime would likely be delivered by rail. Transportation impacts would depend upon the site location. Socioeconomic impacts associated with rail transportation would likely be MODERATE to LARGE.

- **Aesthetics**

  If sited at Millstone, the four coal-fired power plant units could be as much as 60 m (200 ft) tall and be visible in daylight hours over many miles. The four exhaust stacks would be somewhere in the range of 120 to 185 m (400 to 600 ft) high. The units and associated stacks would also be visible at night because of outside lighting. Visual impacts of a new coal-fired plant could be mitigated by landscaping and by color selection for buildings that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. Overall, the addition of a coal-fired unit and the associated stack at the Millstone site would likely have a MODERATE aesthetic impact.

Coal-fired generation would introduce mechanical sources of noise that would be audible off site. Sources contributing to the total noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the equipment related to coal handling, solid-waste disposal, transportation related to coal and lime delivery, use of outside loudspeakers, and the commuting of plant employees. Noise impacts associated with rail delivery of coal and lime to a plant at Millstone would be most significant for residents living in the vicinity of the facility and along the rail route. Although noise from passing trains significantly raises noise levels near the rail corridor, the short duration of the noise reduces the impact. Nevertheless, given the frequency of train transport and the many residents likely to be within hearing distance of the rail route, the impacts of noise on residents in the vicinity of the facility and the rail line would be noticeable. Overall, the aesthetic impacts at Millstone due to noise are detectable. The incremental noise impacts of a coal-fired plant compared to existing Millstone operations would likely be SMALL to MODERATE.

At an alternate site, there would be a visual aesthetic impact from the buildings, exhaust stacks, and power-generation buildings. Noise and light from the plant would be detectable off site. Aesthetic impacts at the plant site would be mitigated because the site was the former location of a retired oil-fired plant. Noise impacts from a rail spur would be similar to the impacts at the existing site. Overall, the visual and noise aesthetic impacts associated with locating at an alternate site can be categorized as SMALL to MODERATE.

- **Historic and Archaeological Resources**

At the Millstone site or an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse impacts from subsequent ground-disturbing actions related to physical expansion of the plant site.

Before construction at the Millstone site or an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-way). Historic and archaeological resource impacts need to be evaluated on a site-specific basis. The impacts can generally be effectively mitigated, and, as such, impacts would range from SMALL to MODERATE, depending on the historic and archaeologic resources that may be present, and whether mitigation is necessary.

- **Environmental Justice**

  No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement coal-fired plant were built at the Millstone site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Closure of Millstone would result in employment of approximately 1250 fewer operating employees, possibly offset by growth in the southeastern Connecticut area. Following construction of the replacement coal-fired plant, it is possible that the ability of local government to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for minority or low-income populations. Overall, impacts would be SMALL to MODERATE, and would depend on both the extent to which projected economic growth is realized and also on the ability of minority or low-income populations to commute to other jobs outside the southeastern Connecticut area.

  Impacts at other sites would depend upon the site chosen and the nearby population distribution, but are likely to also be SMALL to MODERATE.

8.2.1.2 Once-Through Cooling System

This section discusses the environmental impacts of constructing a coal-fired generation system at the Millstone site using once-through cooling. The impacts (SMALL, MODERATE, or LARGE) of this option are the same as the impacts for a coal-fired plant using the closed-cycle system. However, there are minor environmental differences between the closed-cycle and once-through cooling systems. Table 8-3 summarizes the incremental differences.

Table 8-3. Summary of Environmental Impacts of Coal-Fired Generation at the Millstone Site with Once-Through Cooling

Impact Category	Change in Impacts from Once-Through Cooling System
Land Use	Impacts may be less (e.g., through elimination of cooling towers).
Ecology	Impacts would be greater on aquatic ecology at the site; potential impacts associated with entrainment of fish and shellfish in early life stages, impingement of fish and shellfish, and heat shock.

Table 8-3. (contd)

Impact Category	Change in Impacts from Once-Through Cooling System
Water Use and Quality—Surface Water	Increased water withdrawal; thermal load higher than with closed-cycle cooling.
Water Use and Quality—Groundwater	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Socioeconomics (Transportation)	No change
Aesthetics	Elimination of cooling towers
Historic and Archaeological Resources	No change
Environmental Justice	No change

8.2.2 Natural Gas-Fired Generation

The environmental impacts of the natural gas-fired alternative are examined in this section for both the Millstone site and an alternate site (retired oil-fired plant site). The staff assumed that the plant would use a closed-cycle cooling system. In Section 8.2.2.1, the staff also evaluated the impacts of using the existing open-cycle cooling system at the Millstone site.

The Millstone site and an alternate site would need a 41-cm (16-in) diameter natural gas pipeline constructed from the plant site to a supply point where a reliable supply of natural gas would be available.

The staff assumed that a replacement natural gas-fired plant would use combined-cycle technology (Dominion 2004). In a combined-cycle unit, hot combustion gases in a combustion turbine rotate the turbine to generate electricity. Waste combustion heat from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity. The staff assumed that a replacement natural gas-fired plant would use combined-cycle combustion turbines as described by Dominion (Dominion 2004). Dominion estimates that the plant would consume approximately 2.4 million m^3 (85.7 billion ft^3) of natural gas annually (Dominion 2004).

Unless otherwise indicated, the assumptions and numerical values used in Section 8.2.2 are from the Dominion ER (Dominion 2004). The staff reviewed this information and compared it to environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating the natural gas-fired alternative for 40 years is considered (as a reasonable projection of the operating life of a natural gas-fired plant).

8.2.2.1 Closed-Cycle Cooling System

The overall impacts of the natural gas-generating system are discussed in the following sections and summarized in Table 8-4. The extent of impacts at an alternate site (retired oil-fired plant) will depend on the location of the particular site selected.

- **Land Use**

  For siting at Millstone, existing facilities and infrastructure would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the staff assumed that the natural gas-fired replacement plant alternative would need to modify and use the existing cooling system, switchyard, offices, and transmission line right(s)-of-way. Much of the land that would be used has been previously disturbed. At Millstone, the staff assumed that approximately 45 ha (110 ac) would be needed for the plant and associated infrastructure. There would be an additional impact for construction of a gas pipeline.

Table 8-4. Summary of Environmental Impacts of Natural Gas-Fired Generation at Millstone and an Alternate Site Using Closed-Cycle Cooling

	Millstone Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	45 ha (110 ac) for power-block, offices, roads, and parking areas. Additional impact for construction of an underground gas pipeline.	SMALL to MODERATE	45 ha (110 ac) for power-block, offices, roads, and parking areas. Additional impact for construction and/or upgrade of an underground gas pipeline.
Ecology	SMALL to MODERATE	Would use undeveloped areas at current Millstone site, plus gas pipeline. Small impacts to aquatic resources because less cooling water required.	SMALL to MODERATE	Impact depends on location and ecology of the site, surface-water body used for intake and discharge, and pipeline routes; potential habitat loss and fragmentation, reduced productivity and biological diversity. Likely plant sites already have power-generation facilities.

Table 8-4. (contd)

	Millstone Site		Alternate Site	
Impact Category	Impact	Comments	Impact	Comments
Water Use and Quality—Surface Water	SMALL	Would use existing intake and discharge structures. Less water use because closed-cycle replaces once-through cooling system.	SMALL to MODERATE	Impact depends on volume of water withdrawal and discharge and characteristics of surface water body.
Water Use and Quality—Groundwater	SMALL	Millstone site would use little groundwater.	SMALL to MODERATE	Impact would depend on volume of water withdrawal.
Air Quality	MODERATE	Sulfur oxides • 136 MT/yr (150 tons/yr) Nitrogen oxides • 511 MT/yr (564 tons/yr) Carbon monoxide • 671 MT/yr (740 tons/yr) PM_{10} particulates • 200 MT/yr (220 tons/yr) Some hazardous air pollutants	MODERATE	Same emissions as Millstone site.
Waste	SMALL	Small amount of ash produced.	SMALL	Same waste produced as if produced at the Millstone site.
Human Health	SMALL	Impacts considered to be minor.	SMALL	Impacts considered to be minor.
Socioeconomics	SMALL to MODERATE	During construction, impacts would be noticeable. Up to 1200 additional workers during the peak of the three-year construction period, followed by reduction from current Millstone workforce of 1650 to 55; tax base preserved. Impacts during operation would be minor.	SMALL to MODERATE	During construction, impacts would be noticeable. Up to 1200 additional workers during the peak of the three-year construction period. City of Waterford would experience loss of tax base and employment, potentially offset by possible economic growth.
Socioeconomics (Transportation)	SMALL to MODERATE	Transportation impacts likely would be noticeable during construction and slight for operations.	SMALL to MODERATE	Transportation impacts likely would be noticeable during construction and slight for operations.

Table 8-4. (contd)

	Millstone Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Aesthetics	SMALL to MODERATE	Visual aesthetic impact due to plant units and stacks could be mitigated by landscaping and appropriate color selection for buildings. Visual impact at night could be mitigated by reduced use of lighting and appropriate shielding. Noise impacts would be relatively small and could be mitigated.	SMALL to MODERATE	Impact would depend on location of site. Similar to Millstone if located on retired oil-fired plant site.
Historic and Archeological Resources	SMALL to MODERATE	Any potential impacts can likely be effectively mitigated.	SMALL to MODERATE	Same as Millstone; any potential impacts can likely be effectively mitigated.
Environmental Justice	SMALL to MODERATE	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction; loss of 1595 operating jobs at Millstone. Plant could reduce employment prospects for minority and low-income populations. Impacts could be offset by possible economic growth and the ability of affected workers to commute.	SMALL to MODERATE	Impacts vary, depending on population distribution and make-up at site.

For construction at an alternate site, the staff assumed that 20 ha (50 ac) would be needed for the plant and associated infrastructure for a 1000-MW(e) plant (NRC 1996). Therefore, the staff assumed about 45 ha (110 ac) would be needed to replace the over 2000 MW(e) Millstone power generation. In addition, construction and/or upgrade of an underground pipeline would result in additional land disturbance at an alternate site.

Regardless of where the gas-fired plant is built, additional land would be required for natural gas wells and collection stations. Partially offsetting these offsite land requirements would be the elimination of the need for uranium mining to supply fuel for Millstone. In the GEIS (NRC 1996), the staff estimated that approximately 400 ha (1000 ac) would be affected for mining the uranium and processing it during the operating life of a nuclear power plant. Overall, land-use impacts would be SMALL to MODERATE.

- **Ecology**

At the Millstone site, there would be minor ecological impacts due to changes land use resulting from siting of the gas-fired plant. There would also be ecological impacts associated with bringing a new underground gas pipeline to the Millstone site. Additionally, there may be some impact on terrestrial ecology from saltwater drift from the cooling towers. Impacts to aquatic resources would likely be less than the current Millstone operations even if the existing intake and discharge structures are used. Ecological impacts at an alternate site would depend on the nature of the land converted for the plant and the possible need for a new gas pipeline. Construction of the transmission line and construction and/or upgrading of the gas pipeline to serve the plant would be expected to have temporary ecological impacts. Ecological impacts to the plant site and utility easements could include impacts on threatened or endangered species, wildlife habitat loss and reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Depending on the location of an alternate site, the cooling make-up water intake and discharge could impact aquatic resources. Overall, the ecological impacts are considered SMALL to MODERATE at either location.

- **Water Use and Quality—Surface Water**

Each of the gas-fired units would include a heat-recovery boiler from which steam would turn an electric generator. Steam would be condensed and circulated back to the boiler for reuse. A natural gas-fired plant sited at Millstone is assumed to use a closed-cycle cooling system. Existing intake and discharges would be used; however, cooling towers and other cooling system components would be constructed, replacing the existing once-through cooling system. Surface-water impacts at the Millstone site are expected to be SMALL; the impacts would be sufficiently minor that they would not noticeably alter any important attribute of the resource.

A natural gas-fired plant at an alternate site is assumed to use a closed-cycle cooling system with cooling towers. The staff assumed that surface water would be used for cooling make-up water and discharge. Intake and discharge would involve relatively small quantities of water compared to the coal alternative. The impact on the surface water would depend on the volume of water needed for make-up water, the discharge volume, and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water would be regulated by the state of Connecticut. The impacts would be SMALL to MODERATE.

The issue of water-quality impact from sedimentation during construction was characterized in the GEIS as SMALL. The staff also noted in the GEIS that operational water quality impacts would be similar to, or less than, those from other generating technologies.

Sedimentation impacts from construction of a natural gas-fired plant at the Millstone site or at an alternate site would be short-term and easily mitigated.

- **Water Use and Quality—Groundwater**

The staff assumed that the ground-water wells would continue to be used for non-Millstone related activities (e.g., watering of baseball fields) located adjacent to Millstone. Ground-water withdrawals for a natural gas-fired plant at the Millstone site would be equal to or less than the withdrawals for the no-action and license renewal alternatives. Hence, impacts are considered SMALL. Use of groundwater for a gas-fired plant located at an alternate site is a possibility. Ground-water withdrawals at an alternate site would likely require a permit from the state of Connecticut. The impacts will depend on the characteristics of the site and the amount of groundwater used. Therefore, the impacts are considered SMALL to MODERATE.

- **Air Quality**

Natural gas is a relatively clean-burning fuel. The gas-fired alternative would release similar types of emissions, but in lesser quantities than the coal-fired alternative.

A new gas-fired generating plant located in Connecticut would likely need a prevention of significant deterioration permit and an operating permit under the Clean Air Act. A new combined-cycle natural gas power plant would also be subject to the new source performance standards for such units at 40 CFR Part 60, Subparts Da and GG. These regulations establish emission limits for particulates, opacity, SO_2, and NO_x.

Section 169A of the Clean Air Act (42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from human made air pollution. EPA issued a new regional haze rule on July 1, 1999 (64 *Federal Register* [FR] 35714 [EPA 1999]). The rule specifies that for each mandatory Class I Federal area located within a state, the state must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most-impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period [40 CFR 51.308(d)(1)]. If a coal-fired plant were located close to a mandatory Class I Federal area, additional air pollution control requirements could be imposed. There are no Class I areas in Connecticut.

In 1998, EPA issued a rule requiring 22 eastern states, including Connecticut, to revise their state implementation plans to reduce nitrogen oxide emissions. Nitrogen oxide emissions contribute to violations of the national ambient air quality standard for ozone. The total amount of nitrogen oxides that can be emitted by each of the 22 states in the year 2007 ozone season (May 1 to September 30) is set out at 40 CFR 51.121(e). For Connecticut, the amount is 38,873 MT (42,850 tons).

EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated attainment or unclassified under the Clean Air Act. The entire state of Connecticut has been designated as an attainment area for carbon monoxide, nitrogen dioxide, lead, and sulfur dioxide. New London County is also designated as in attainment for particulate matter with a diameter of 10 μm or less. New London County has been designated as serious nonattainment for the EPA one-hour ozone standard (40 CFR 81.307; CTDEP 2002a).

Dominion projects the following emissions for the natural gas-fired alternative (Dominion 2004):

Sulfur oxides — 136 MT/yr (150 tons/yr)
Nitrogen oxides — 511 MT/yr (564 tons/yr)
Carbon monoxide — 671 MT/yr (740 tons/yr)
PM_{10} particulates — 200 MT/yr (220 tons/yr)

A natural gas-fired plant would also have unregulated carbon dioxide emissions that could contribute to global warming.

In December 2000, EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000a). Natural gas-fired power plants were found by EPA to emit arsenic, formaldehyde, and nickel (EPA 2000a). Unlike coal and oil-fired plants, EPA did not determine that emissions of hazardous air pollutants from natural gas-fired power plants should be regulated under Section 112 of the Clean Air Act.

Construction activities would result in temporary fugitive dust. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process.

The preceding emissions would likely be the same at Millstone or at an alternate site. Impacts from the above emissions would be clearly noticeable, but would not be sufficient to destabilize air resources as a whole.

The overall air-quality impact for a new natural gas-fired plant sited at Millstone or at an alternate site is considered MODERATE.

- **Waste**

  There will be spent selective catalytic reduction catalyst from NO_x emissions control and small amounts of solid-waste products (i.e., ash) from burning natural gas fuel. In the GEIS, the staff concluded that waste generation from gas-fired technology would be minimal (NRC 1996). Gas firing results in very few combustion by-products because of the clean nature of the fuel. Waste-generation impacts would be so minor that they would not noticeably alter any important resource attribute. Construction-related debris would be generated during construction activities. Overall, the waste impacts would be SMALL for a natural gas-fired plant sited at Millstone or at an alternate site.

- **Human Health**

  In Table 8-2 of the GEIS, the staff identifies cancer and emphysema as potential health risks from gas-fired plants (NRC 1996). The risk may be attributable to NO_x emissions that contribute to ozone formation, which, in turn, contributes to health risks. NO_x emissions from any gas-fired plant would be regulated. For a plant sited in Connecticut, NO_x emissions would be regulated by the CTDEP. Human health impacts would not be detectable or would be sufficiently minor. Overall, the impacts on human health of the natural gas-fired alternative sited at Millstone or at an alternate site are considered SMALL.

- **Socioeconomics**

  Construction of a natural gas-fired plant would take approximately three years. Peak employment would be approximately 1200 workers (NRC 1996). The staff assumed that construction would take place while Millstone continues operation and would be completed by the time it permanently ceases operations. During construction, the communities surrounding the Millstone site would experience demands on housing and public services that could have noticeable impact. These impacts would be tempered by construction workers commuting to the site from other parts of New London County or from other counties. After construction, the communities would be impacted by the loss of jobs. The current Millstone workforce (1650 workers) would decline through a decommissioning period to a minimal maintenance size. The gas-fired plant would introduce a replacement tax base at Millstone or an alternate site and approximately 55 new permanent jobs. For siting at an alternate site, impacts in New London County resulting from decommissioning of Millstone may be offset by economic growth projected to occur in the county.

  In the GEIS (NRC 1996), the staff concluded that socioeconomic impacts from constructing a natural gas-fired plant would not be very noticeable and that the small operational workforce would have the lowest socioeconomic impacts of any nonrenewable technology. Compared to the coal-fired and nuclear alternatives, the smaller size of the construction workforce, the shorter construction time frame, and the smaller size of the operations workforce would mitigate socioeconomic impacts. For these reasons, socioeconomic impacts associated with construction and operation of a natural gas-fired power plant at Millstone or at an alternate site would be SMALL to MODERATE. Depending on other growth in the area, socioeconomic impacts could be noticed, but they would not destabilize any important socioeconomic attribute.

- **Socioeconomics (Transportation)**

Transportation impacts associated with construction and operating personnel commuting to the plant site would depend on the population density and transportation infrastructure in the vicinity of the site. The impacts can be classified as SMALL to MODERATE for siting at Millstone or at an alternate site.

- **Aesthetics**

The turbine buildings, exhaust stacks [approximately 61 m (200 ft) tall], cooling towers, and the plume from the cooling towers would be visible from off site during daylight hours. Visual impacts could be mitigated by landscaping and selecting a color for buildings that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. The gas pipeline compressors also would be visible. Noise and light from the plant would be detectable off site. Overall, the aesthetic impacts associated with constructing and operating a natural gas-fired plant at the Millstone site are categorized as SMALL to MODERATE.

At an alternate site, the buildings, cooling towers, cooling tower plumes, and the associated gas pipeline compressors would be visible off site. Aesthetic impacts would be mitigated by location of the plant at a retired oil-fired plant site. Overall, the aesthetic impacts associated with constructing and operating a natural gas-fired plant at the Millstone site are categorized as SMALL to MODERATE.

- **Historic and Archaeological Resources**

At both Millstone and an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other land, if any, acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse impacts from subsequent ground-disturbing actions related to physical expansion of the plant site.

Before construction at Millstone or an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission and pipeline corridors, or other rights-of-way). Impacts to historic and archaeological resources can be managed and mitigated to a certain extent under current laws and regulations. Therefore, impacts to historic and archaeological resources from a natural gas-fired plant are considered to be SMALL to MODERATE, depending on the resources that may be present and whether mitigation is necessary.

- **Environmental Justice**

No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement natural gas-fired plant were built at the Millstone site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Closure of Millstone would result in a decrease in employment of approximately 1595 operating employees, possibly offset by general growth in the southeastern Connecticut area. Following construction, the local government's ability to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for minority or low-income populations. Overall, impacts are expected to be SMALL to MODERATE, especially since minority and low-income populations are not in the immediate vicinity of the Millstone site. Projected economic growth in southeastern Connecticut and the ability of minority and low-income populations to commute to other jobs outside the Waterford area could mitigate any adverse impacts.

Impacts at an alternate site would depend upon the site chosen and the nearby population distribution, but are likely to also be SMALL to MODERATE.

8.2.2.2 Once-Through Cooling System

This section discusses the environmental impacts of constructing a natural gas-fired generation system at the Millstone site using once-through cooling. The impacts (SMALL, MODERATE, or LARGE) of this option are the same as the impacts for a natural gas-fired plant using the closed-cycle system. However, there are minor environmental differences between the closed-cycle and once-through cooling systems. Table 8.5 summarizes the incremental differences.

Table 8-5. Summary of Environmental Impacts of Natural Gas-Fired Generation at the Millstone Site with Once-Through Cooling

Impact Category	Change in Impacts from Once-Through Cooling System
Land Use	Impacts may be less (e.g., through elimination of cooling towers).
Ecology	Impact would be greater on aquatic ecology at the site. Potential impacts associated with entrainment of fish and shellfish in early life stages, impingement of fish and shellfish, and heat shock.
Water Use and Quality—Surface Water	Increased water withdrawal; thermal load higher than with closed-cycle cooling.
Water Use and Quality—Groundwater	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Transportation	No change
Aesthetics	Elimination of cooling towers
Historic and Archaeological Resources	No change
Environmental Justice	No change

8.2.3 Nuclear Power Generation

Since 1997, the NRC has certified three new standard designs for nuclear power plants under 10 CFR Part 52, Subpart B. These designs are the 1300 MW(e) U.S. Advanced Boiling Water Reactor (10 CFR Part 52, Appendix A), the 1300 MW(e) System 80+ Design (10 CFR 52, Appendix B), and the 600 MW(e) AP600 Design (10 CFR Part 52, Appendix C). All of these plants are light-water reactors. Although no applications for a construction permit or a combined license based on these certified designs have been submitted to NRC, the submission of the design certification applications indicates continuing interest in the possibility of licensing new nuclear power plants. In addition, recent escalation in prices of natural gas and electricity have made new nuclear power plant construction more attractive from a cost standpoint.

Consequently, construction of a new nuclear power plant at both the Millstone site and an alternate is considered in this section. The staff assumed that the new nuclear plant would have a 40-year lifetime. Consideration of a new nuclear generating plant to replace Millstone was not included in the Dominion ER.

NRC has summarized environmental data associated with the uranium fuel cycle in Table S-3 of 10 CFR 51.51. The impacts shown in Table S-3 are representative of the impacts that would be associated with a replacement nuclear power plant built to one of the certified designs and sited at Millstone or an alternate site. The impacts shown in Table S-3 are for a 1000-MW(e) reactor and would need to be adjusted to reflect impacts of 2024-MW(e) of new nuclear power. The environmental impacts associated with transporting fuel and waste to and from a light-water cooled nuclear power reactor are summarized in Table S-4 of 10 CFR 51.52. The summary of NRC's findings on National Environmental Policy Act issues for license renewal of nuclear power plants in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, is also relevant, although not directly applicable, for consideration of environmental impacts associated with the operation of a replacement nuclear power plant. Additional environmental impact information for a replacement nuclear power plant using closed-cycle cooling is presented in Section 8.2.3.1, and using open-cycle cooling in Section 8.2.3.2.

8.2.3.1 Closed-Cycle Cooling System

The overall impacts of the nuclear generating system are discussed in the following sections. The impacts are summarized in Table 8-6. The magnitude of impacts at an alternate site would depend on the location of the particular site selected.

Table 8-6. Summary of Environmental Impacts of New Nuclear Power Generation at the Millstone Site and an Alternate Site Using Closed-Cycle Cooling

	Millstone Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	MODERATE	Would require approximately 200 to 400 ha (500 to 1000 ac) for the plant. Additional area would need to be purchased.	MODERATE to LARGE	Same as Millstone site, except may need to construct rail spur for construction.

Table 8-6. (contd)

	Millstone Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Ecology	SMALL to MODERATE	Would use undeveloped and previously disturbed areas at current Millstone site and adjacent property. Use of closed-cycle system would have negligible impact on aquatic resources.	SMALL to MODERATE	Impact depends on location and ecology of the site, surface-water body used for intake and discharge, and potential rail spur route; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Water Use and Quality—Surface Water	SMALL	Would use existing intake and discharge structures with new closed-cycle system. Less water use compared to existing system.	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the surface-water body.
Water Use and Quality—Groundwater	SMALL	Millstone uses little groundwater.	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the surface-water body.
Air Quality	SMALL	Fugitive emissions and emissions from vehicles and equipment during construction; small amount of emissions from diesel generators and possibly other sources during operation.	SMALL	Same impacts as Millstone site
Waste	SMALL	Waste impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B-1. Debris would be generated and removed during construction.	SMALL	Same impacts as Millstone site
Human Health	SMALL	Human health impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B-1.	SMALL	Same impacts as Millstone site

Table 8-6. (contd)

	Millstone Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Socioeconomics	SMALL to MODERATE	During construction, impacts would be noticeable. Up to 2500 workers during peak period of the six-year construction period. Operating workforce assumed to be similar to Millstone; tax base preserved. Impacts during operation would be negligible.	SMALL to LARGE	Construction impacts depend on location. City of Waterford would experience loss of tax base and employment, possibly offset by economic growth.
Socioeconomics (Transportation)	SMALL to LARGE	Transportation impacts associated with construction workers could be noticeable to significant. Transportation impacts of commuting plant personnel would be slight.	SMALL to LARGE	Transportation impacts of construction workers could be noticeable to significant. Transportation impacts of commuting plant personnel could be slight to noticeable.
Aesthetics	MODERATE	Visual aesthetic impact due to impact of plant units and stacks on local area. Daytime visual impact could be mitigated by landscaping and appropriate color selection for buildings. Visual impact at night could be mitigated by reduced use of lighting and appropriate shielding. Noise impacts would be relatively small and could be mitigated.	SMALL to MODERATE	Dependent on location of site; however, likely similar to Millstone site.
Historic and Archeological Resources	SMALL to MODERATE	Any potential impacts can likely be effectively managed.	SMALL to MODERATE	Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction.	SMALL to MODERATE	Impacts will vary, depending on population distribution and make-up at the site. Impacts to minority and low-income residents of New London County associated with closure of Millstone could be significant, but could also be mitigated by projected economic growth for the area.

- **Land Use**

The existing facilities and infrastructure at the Millstone site would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the staff assumed that a replacement nuclear power plant would need to construct a new closed-cycle system including cooling towers; however, the existing intake and discharge structures would be used. In addition, the staff assumed other existing structures would be used, including the switchyard, offices, and transmission line rights-of-way. Much of the land that would be used has been previously disturbed.

A replacement nuclear power plant at the Millstone site would alter approximately 200 to 400 ha (500 to 1000 ac) of land to industrial use. Additional land may need to be purchased because the Millstone site is only 212 ha (525 ac). There would be no net change in land needed for uranium mining because land needed for the new nuclear plant would offset land needed to supply uranium for fuel for Millstone.

The impact of a replacement nuclear generating plant on land use at the existing Millstone site is best characterized as MODERATE. The impact would be greater than the OL renewal alternative.

Land-use impacts at an alternate site (site of a retired oil-fired generation plant) would be similar to siting at Millstone. A closed-cycle cooling system including cooling towers may be needed. In addition, it may be necessary to construct a rail spur to an alternate site to bring in equipment during construction. The staff assumed that existing transmission line, switchyard, and other existing facility would be used. Siting a new nuclear plant at an alternate site would result in MODERATE to LARGE land-use impacts.

- **Ecology**

Locating a replacement nuclear power plant at the Millstone site would alter ecological resources because of the need to convert roughly 200 to 400 ha (500 to 1000 ac) of land to industrial use. Additional land would be needed because the Millstone site is only 212 ha (525 acres) in size. Some of this land, however, would have been previously disturbed. Use of a closed-cycle cooling system would result in minor impact on aquatic resources. Siting at Millstone would have a SMALL to MODERATE ecological impact and would be greater than renewal of the Millstones OLs.

At an alternate site, there would be construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts would alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of cooling make-up water from a nearby surface water body could have adverse aquatic resource impacts. Construction of a rail spur, if needed, would have ecological impacts. Overall, the ecological impacts at an alternate site would be SMALL to MODERATE.

- **Water Use and Quality—Surface Water**

The replacement nuclear plant alternative at the Millstone site is assumed to use a new closed-cycle cooling system (including cooling towers) and the existing intake and discharge structures. This would minimize incremental water use and quality impacts. Surface-water impacts are expected to be SMALL; the impacts would be sufficiently minor that they would not noticeably alter any important attribute of the resource.

Cooling towers would also likely be used at an alternate site. For an alternate site, the impact on the surface water would depend on the volume of water needed for make-up water, the discharge volume, and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water would be regulated by the state of Connecticut. The impacts would be SMALL to MODERATE.

Water quality impact from sedimentation during construction was characterized in the GEIS as SMALL. The staff also noted in the GEIS that operational water-quality impacts would be similar to or less than those from other generating technologies. Sedimentation impacts from construction of a new nuclear power plant at the Millstone site or at an alternate site would be short-term and easily mitigated.

- **Water Use and Quality—Groundwater**

No groundwater is currently used for the operation of Millstone. It is unlikely that groundwater would be used for an alternative nuclear power plant sited at Millstone. Use of groundwater for a nuclear power plant sited at an alternate site is a possibility. Any ground-water withdrawal would require a permit from the local permitting authority. Therefore, impact to groundwater would be SMALL at the Millstone site and SMALL to MODERATE at an alternate site.

- **Air Quality**

Construction of a new nuclear plant sited at Millstone or an alternate site would result in fugitive emissions during the construction process. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process. An operating nuclear plant would have minor air emissions associated with diesel generators and other minor intermittent sources. These emissions are regulated. Emissions for a plant sited at

Millstone or elsewhere in Connecticut would be regulated by the CTDEP. Overall, emissions and associated impacts would be SMALL.

- **Waste**

The waste impacts associated with operation of a nuclear power plant are set out in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. Construction-related debris would be generated during construction activities and removed to an appropriate disposal site. Overall, waste impacts for a replacement nuclear unit at Millstone would be SMALL.

Siting the replacement nuclear power plant at a site other than the Millstone site would not alter waste generation. Therefore, the impacts would be SMALL.

- **Human Health**

Human health impacts for an operating nuclear power plant are set out in 10 CFR Part 51 Subpart A, Appendix B, Table B-1. Overall, human health impacts from siting the replacement nuclear power plant at Millstone or another site would result in negligible human health impacts. Therefore, the impacts would be SMALL.

- **Socioeconomics**

The construction period and the peak workforce associated with construction of a new nuclear power plant are currently unquantified (NRC 1996). In the absence of quantitative data, staff assumed a construction period of six years and a peak workforce of 2500. The staff assumed that construction would take place while the existing nuclear units continue operation and would be completed by the time Millstone permanently ceases operations. During construction, the communities surrounding the Millstone site would experience demands on housing and public services that could have noticeable impacts. These impacts would be tempered by construction workers commuting to the site from other parts of southeastern Connecticut. After construction, the communities would be impacted by the loss of the construction jobs, although this loss would be possibly offset by other growth in the area.

The replacement nuclear units are assumed to have an operating workforce comparable to the 1650 workers currently working at Millstone. The replacement nuclear units would provide a new tax base to offset the loss of tax base associated with decommissioning of Millstone. For all of these reasons, the appropriate characterization of nontransportation socioeconomic impacts for replacement nuclear units constructed at Millstone would be SMALL to MODERATE; the socioeconomic impacts would be noticeable, but would be unlikely to destabilize the area’s economy.

Construction of a replacement nuclear power plant at an alternate site would relocate some socioeconomic impacts, but would not eliminate them. The communities around the Millstone site would still experience the impact of Millstone operational job loss (although potentially tempered by projected economic growth). The communities around the new site would have to absorb the impacts of a large, temporary workforce (up to 2500 workers at the peak of construction) and a permanent workforce of approximately 1650 workers. In the GEIS (NRC 1996), the staff indicated that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction workforce would need to move to the area to work. The Millstone site is within commuting distance of the metropolitan areas and is therefore not considered a rural site. Alternate sites would need to be analyzed on a case-by-case basis. Socioeconomic impacts at a rural site could be SMALL to LARGE.

- **Socioeconomics (Transportation)**

During the six-year construction period, up to 2500 construction workers would be working at the Millstone site in addition to the 1650 workers at Millstone. The addition of the construction workers could place significant traffic loads on existing highways, particularly those leading to the Millstone site. Such impacts would be noticeable to significant. Transportation impacts related to commuting of plant operating personnel would be similar to current impacts associated with operation of Millstone and are considered SMALL. Transportation-related impacts associated with commuting construction workers at an alternate site are site-dependent, but could be noticeable to significant. Transportation impacts related to commuting of plant operating personnel would also be site-dependent, but can be characterized as slight to noticeable.

- **Aesthetics**

The containment buildings for a replacement nuclear power plant sited at Millstone and other associated buildings would likely be visible in daylight hours over many miles. The replacement nuclear units would also likely be visible at night because of outside lighting. Visual impacts could be mitigated by landscaping and selecting a color for buildings that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. No exhaust stacks would be needed. Cooling towers constructed for the closed-cycle system would be visible. Noise impacts from a new nuclear plant at the Millstone site would be similar to those from the existing Millstone Units 2 and 3. Mitigation measures, such as reduced or no use of outside loudspeakers, can be employed to reduce noise levels. Overall, the aesthetic impact associated with siting a replacement nuclear unit at Millstone are considered MODERATE.

At an alternate site, there would be aesthetic impacts from the buildings, cooling towers, and the plume associated with the cooling towers. Noise and light from the plant would be detectable off site. The impact of noise and light could be mitigated if the plant is located in an industrial area adjacent to other power plants. Overall the aesthetic impacts associated with locating at an alternative site would depend on the location of the site and can be categorized as SMALL to MODERATE.

- **Historic and Archaeological Resources**

At both Millstone and an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other land, if any, acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse impacts from subsequent ground-disturbing actions related to physical expansion of the plant site.

Before construction at Millstone or another site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-way). Historic and archaeological resource impacts can generally be effectively mitigated and, therefore, are considered SMALL to MODERATE whether at Millstone or at an alternate site.

- **Environmental Justice**

No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement nuclear plant were built at the Millstone site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect the minority and low-income populations. After completion of construction, it is possible that the ability of the local government to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for the minority and low-income populations. Overall, impacts are expected to be SMALL. Economic growth in southeastern Connecticut and the ability of minority and low-income populations to commute to other jobs area could mitigate any adverse impacts.

Impacts at other sites would depend upon the site chosen and the nearby population distribution, but are likely to be SMALL to MODERATE. Impacts associated with closure of Millstone that could affect minority and low-income residents of southeastern Connecticut could be mitigated by projected economic growth for the area.

8.2.3.2 Once-Through Cooling System

This section discusses the environmental impacts of constructing a nuclear power plant at the Millstone site using once-through cooling. The impacts (SMALL, MODERATE, or LARGE) of this option are the same as the impacts for a nuclear power plant using a closed-cycle system. However, there are minor environmental differences between the closed-cycle and once-through cooling systems. Table 8.7 summarizes the incremental differences.

8.2.4 Purchased Electrical Power

If available, purchased power from other sources could obviate the need to renew the Millstone OLs. It is unlikely, however, that sufficient base-load, firm power supply would be available to replace the Millstone capacity.

Connecticut is a net importer of power. Purchased power accounted for approximately 19.2 terawatt-hours of electricity in 1999, in Connecticut (Dominion 2004). In addition, there is demand for increased power in the region, including Long Island Sound. Therefore, purchased power is reasonable; however, replacing the 2024 MW(e) of power generated by Millstone solely with purchased power and no new generation capacity may not be reasonable in the long term.

Imported power from Canada or Mexico is unlikely to be available for replacement of Millstone capacity. In Canada, 60 percent of the country's electrical generation capacity is derived from renewable energy sources, principally hydropower (DOE/EIA 2004b). Canada has plans to continue developing hydroelectric power with more than 6000 MW of hydroelectric capacity either under construction or planned (DOE/EIA 2004b). Canada's nuclear generation is projected to increase by 23 percent by 2025, by bringing four units of Ontario Province's Pickering reactors back into operation over the next several years to assist in replacing coal-fired generation (DOE/EIA 2004b). EIA projects that total gross U.S. imports of electricity from Canada and Mexico will gradually increase from 38.4 billion kWh in year 2001, to 48.9 billion kWh in year 2005, and then gradually decrease to 15.2 billion kWh, in year 2025 (DOE/EIA 2004a). Consequently, it is unlikely that electricity imported from Canada or Mexico would be able to replace Millstone capacity.

If power to replace Millstone capacity were to be purchased from sources within the United States or a foreign country, the generating technology would likely be one of those described in this SEIS and in the GEIS (probably coal, natural gas, or nuclear). The description of the environmental impacts of other technologies in Chapter 8 of the GEIS is representative of the purchased electrical power alternative to renewal of the Millstone OLs. Thus, the environmental

Table 8-7. Summary of Environmental Impacts of a New Nuclear Power Plant Sited at the Millstone Site with Once-Through Cooling

Impact Category	Change in Impacts from Once-Through Cooling System
Land Use	Impacts may be less (e.g., through elimination of cooling towers).
Ecology	Impacts would be greater on aquatic ecology at site; potential impacts associated with entrainment of fish and shellfish in early life stages, impingement of fish and shellfish, and heat shock.
Water Use and Quality-Surface Water	Increased water withdrawal leading to possible water use conflicts; thermal load higher than with closed-cycle cooling.
Water Use and Quality-Groundwater	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Transportation	No change
Aesthetics	Elimination of cooling towers
Historic and Archaeological Resources	No change
Environmental Justice	No change

impacts of imported power would still occur but would be located elsewhere within the region, nation, or another country.

8.2.5 Other Alternatives

Other generation technologies considered by NRC are discussed in the following paragraphs.

8.2.5.1 Wind Power

Wind power, by itself, is not suitable for large base-load electrical generation. As discussed in Section 8.3.1 of the GEIS, wind has a high degree of intermittency, and average annual capacity factors for wind plants are relatively low (less than 30 percent). Wind power, in conjunction with energy storage mechanisms, might serve as a means of providing base-load power. However, current energy storage technologies are too expensive for wind power to serve as a large base-load generator.

The State of Connecticut is in a wind power Class 2 region (average wind speeds at 10-m [30-ft]) elevation of 5.6 to 6.4 m/s [18 to 21 ft/s]). On the coast, Connecticut is in a wind power Class 3 region (average wind speeds at 10-m (30-ft) elevation of 6.4 to 7.0 m/s [21 to 23 ft/s]) (DOE 2004a). In wind power Class 2 areas wind turbines are economically marginal for development, but in Class 3 areas may be suitable with future technology (DOE 2004a).

There are active wind power facilities in the region, and others are proposed. As of January 2003, there were approximately 48 MW of grid-connected wind power facilities in New York State, with an additional 410 MW of additional capacity in various stages of planning (American Wind Energy Association 2003). In addition, the U.S. Army Corps of Engineers (USACE) is preparing an environmental impact statement for a proposed wind farm to generate 420 MW(e) using 170 turbines off the coast of Massachusetts (USACE 2004).

Access to many of the best land-based wind power sites near the coast likely would require extensive road building, as well as clearing (for towers and blades) and leveling (for the tower bases and associated facilities) in steep terrain. Also, many of the best quality wind sites are on ridges and hilltops that could have greater archaeological sensitivity than surrounding areas. For these reasons, development of large-scale, land-based wind-power facilities are not only likely to be costly, but could also have MODERATE to LARGE impacts on aesthetics, archaeological resources, land use, and terrestrial ecology.

The offshore wind speeds are higher than those onshore and could thus support greater energy production than onshore facilities. Ten offshore wind power projects are currently operating in Europe, but none have been developed in the United States. The European plants together provide approximately 250 MW(e), which is significantly less than the electrical output of Millstone (British Wind Energy Association 2003). For the preceding reasons, the staff concludes that locating a wind-energy facility on or near the Millstone site, or offshore as a replacement for Millstone generating capacity, is not only likely to be costly, but could also have MODERATE to LARGE impacts on aesthetics, aquatic ecology, and shipping lanes.

8.2.5.2 Solar Power

Solar technologies use the sun's energy and light to provide heat and cooling, light, hot water, and electricity for homes, businesses, and industry. In the GEIS, the staff noted that by its nature, solar power is intermittent. Therefore, solar power by itself is not suitable for base-load capacity and is not a feasible alternative to license renewal of Millstone. The average capacity factor of photovoltaic cells is about 25 percent, and the capacity factor for solar thermal systems is about 25 percent to 40 percent (NRC 1996). Solar power, in conjunction with energy storage mechanisms, might serve as a means of providing base-load power. However, current energy storage technologies are too expensive to permit solar power to serve as a large base-load generator. Therefore, solar power technologies (photovoltaic and thermal) cannot currently compete with conventional fossil-fueled technologies in grid-connected applications, due to high costs per kilowatt of capacity. (NRC 1996).

There are substantial impacts to natural resources (wildlife habitat, land-use, and aesthetic impacts) from construction of solar-generating facilities. As stated in the GEIS, land requirements are high—14,000 ha (35,000 ac) per 1000 MW(e) for photovoltaic and approximately 5700 ha (14,000 ac) per 1000 MW(e) for solar thermal systems. Neither type of solar electric system would fit at the Millstone site, and both would have large environmental impacts at an alternate site.

The Millstone site receives approximately 3 to 3.5 kWh of solar radiation per square meter per day (Dominion 2004), compared to 6 to 8 kWh of solar radiation per square meter per day in areas of the western United States, such as California, which are most promising for solar technologies (DOE/EIA 2000). Because of the natural resource impacts (land and ecological), the area’s relatively low rate of solar radiation, and high cost, solar power is not deemed a feasible base-load alternative to renewal of the Millstone OLs. Some solar power may substitute for electric power in rooftop and building applications. Implementation of nonrooftop solar generation on a scale large enough to replace Millstone would likely result in LARGE environmental impacts.

8.2.5.3 Hydropower

Connecticut has an estimated 43.5 MW(e) of undeveloped hydroelectric resources (Idaho National Environmental and Engineering Laboratory 1995). This amount is far less than would be needed to replace the 2024 MW(e) capacity of Millstone. In Section 8.3.4 of the GEIS, the staff points out that hydropower’s percentage of U.S. generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern about flooding, destruction of natural habitat, and alteration of natural river courses.

In the GEIS, the staff estimated that land requirements for hydroelectric power are approximately 4.0×10^5 ha (1.0×10^6 ac) per 1000 MW(e). Replacement of Millstone generating capacity would require flooding more than this amount of land. Due to the relatively low amount of undeveloped hydropower resource in Connecticut, and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to replace Millstone, the staff concludes that, on its own, local hydropower is not a feasible alternative to Millstone OLs renewal. Siting hydroelectric facilities large enough to replace Millstone would result in LARGE environmental impacts.

8.2.5.4 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for base-load power where available. However, geothermal technology is not widely used as base-load electrical generation due to the limited geographical availability of the resource and immature status of the technology (NRC 1996). As illustrated by Figure 8.4 in the GEIS, geothermal plants are most likely to be sited in the western continental United States, Alaska, and Hawaii where hydrothermal reservoirs are prevalent. There is no feasible eastern location for geothermal capacity to serve as an alternative to Millstone. The staff concludes that geothermal energy is not a feasible alternative to renewal of the Millstone OLs.

8.2.5.5 Wood Waste

The use of wood waste to generate electricity is largely limited to those states with significant wood resources, such as California, Maine, Georgia, Minnesota, Oregon, Washington, and Michigan. Electric power is generated in these states by the pulp, paper, and paperboard industries, which burn wood and wood waste for electrical power generation, benefitting from the use of waste materials that could otherwise represent a disposal problem.

A wood-burning facility can provide base-load power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent efficiency (NRC 1996). The fuels required are variable and site-specific. A significant barrier to the use of wood waste to generate electricity is the high delivered-fuel cost and high construction cost per MW of generating capacity. The larger wood-waste power plants are only 40 to 50 MW(e) in size. Estimates in the GEIS suggest that the overall level of construction impact per MW of installed capacity should be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at smaller scales. Like coal-fired plants, wood-waste plants require large areas for fuel storage and waste disposal and involve the same type of combustion equipment.

Due to uncertainties associated with obtaining sufficient wood and wood waste to fuel a base-load generating facility, ecological impacts of large-scale timber cutting (e.g., soil erosion and loss of wildlife habitat), and low efficiency, the staff has determined that wood waste is not a feasible alternative to renewing the Millstone OLs.

8.2.5.6 Municipal Solid Waste

Municipal waste combustors incinerate the waste and use the resultant heat to generate steam, hot water, or electricity. The combustion process can reduce the volume of waste by up to 90 percent and the weight of the waste by up to 75 percent (EPA 2001). Municipal waste combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel (DOE/EIA 2001). Mass burning technologies are most commonly used in the United States. This group of technologies processes raw municipal solid waste "as is," with little or no sizing, shredding, or separation before combustion.

Growth in the municipal waste combustion industry slowed dramatically during the 1990s after rapid growth during the 1980s. The slower growth was due to three primary factors: (1) the Tax Reform Act of 1986, which made capital-intensive projects such as municipal waste combustion facilities more expensive relative to less capital-intensive waste disposal alternatives such as landfills; (2) the 1994 Supreme Court decision *(C&A Carbone, Inc. v. Town of Clarkstown*), which struck down local flow control ordinances that required waste to be delivered to specific municipal waste combustion facilities rather than the potentially lower-cost (lower fee) landfills; and (3) increasingly stringent environmental regulations that increased the capital cost necessary to construct and maintain municipal waste combustion facilities (DOE/EIA 2001).

The decision to burn municipal waste to generate energy is usually driven by the need for an alternative to landfills rather than by energy considerations. The use of landfills as a waste disposal option is likely to increase in the near term; however, it is unlikely that many landfills will begin converting waste to energy because of unfavorable economics, particularly with electricity prices declining in real terms. EIA projects that between 1999 and 2020, the average price of electricity in real 1999 dollars will decline by an average of 0.5 percent per year as a result of competition among electricity suppliers (DOE/EIA 2001).

Municipal solid waste combustors generate an ash residue that is buried in landfills. The ash residue is composed of bottom ash and fly ash. Bottom ash refers to that portion of the unburned waste that falls to the bottom of the grate or furnace. Fly ash represents the small particles that rise from the furnace during the combustion process. Fly ash is generally removed from flue-gases using fabric filters and/or scrubbers (DOE/EIA 2001).

Currently there are approximately 102 waste-to-energy plants operating in the United States. These plants generate approximately 2800 MW(e), or an average of approximately 28 MW(e) per plant (Integrated Waste Services Association 2001), much less than needed to replace the 2024 MW(e) of Millstone.

The initial capital costs for municipal solid-waste plants are greater than for comparable steam-turbine technology at wood-waste facilities. This is due to the need for specialized waste-separation and -handling equipment for municipal solid waste (NRC 1996). Furthermore, estimates in the GEIS suggest that the overall level of construction impact from a waste-fired plant should be approximately the same as that for a coal-fired plant. Additionally, waste-fired plants have the same or greater operational impacts (including impacts on the aquatic environment, air, and waste disposal). Some of these impacts would be moderate, but still larger than the environmental impacts of license renewal of Millstone. Therefore, municipal solid waste would not be a feasible alternative to renewal of the Millstone OLs, particularly at the scale required.

8.2.5.7 Other Biomass-Derived Fuels

In addition to wood and municipal solid-waste fuels, there are several other concepts for fueling electric generators, including burning crops, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste). In the GEIS, the staff points out that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a base-load plant such as Millstone. For these reasons, such fuels do not offer a feasible alternative to renewal of the Millstone OLs.

8.2.5.8 Fuel Cells

Fuel cells work without combustion and its environmental side effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode and air over a cathode and separating the two by an electrolyte. The only by-products are heat, water, and carbon dioxide. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Natural gas is typically used as the source of hydrogen.

Phosphoric acid fuel cells are generally considered first-generation technologies. These fuel cells are commercially available at a cost of approximately $4500 per kW of installed capacity (DOE 2004b). Higher-temperature, second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute to improved efficiencies and give the second-generation fuel cells the capability to generate steam for cogeneration and combined-cycle operations.

DOE has a new initiative to reduce costs to as low as $400 per kW by the end of the decade (DOE 2004b). For comparison, the installed capacity cost for a natural gas-fired, combined-cycle plant is about $456 per kW (DOE/EIA 2004a). As market acceptance and manufacturing capacity increase, natural gas-fueled fuel cell plants in the 50- to 100-MW range are projected to become available. At the present time, however, fuel cells are not economically or technologically competitive with other alternatives for base-load electricity generation. Fuel cells are, consequently, not a feasible alternative to renewal of the Millstone OLs.

8.2.5.9 Delayed Retirement

Dominion has no current plans to retire any existing generating units. For this reason, delayed retirement of other Dominion generating units would not be a feasible alternative to renewal of the Millstone OLs.

8.2.5.10 Utility-Sponsored Conservation

Dominion participates in State-wide residential, commercial, and industrial programs to reduce both peak demands and daily energy consumption. These programs are commonly referred to as demand-side management. State-wide, these demand-side management programs through 2001 have resulted in peak demand reduction of approximately 63 MW in 2000 (Connecticut State Legislature 2001). These demand-side management induced load reductions are acknowledged in load forecasts; therefore they cannot be used as credits to offset the power generated by Millstone. An additional 1961 MW(e) of savings would be required to offset the power generated by Millstone. Therefore, the conservation option by itself is not considered a reasonable replacement for the Millstone OLs renewal alternative.

8.2.6 Combination of Alternatives

Even though individual alternatives to Millstone might not be sufficient on their own to replace Millstone generating capacity due to the small size of the resource or lack of cost-effective technologies, it is conceivable that a combination of alternatives might be cost effective.

As discussed in Section 8.2, Millstone Units 2 and 3 have a combined net summer rating of 2024 MW(e). For the coal and natural gas alternatives, the Dominion ER assumes four and five standard 400-MW(e) units, respectively, as potential replacements for Units 2 and 3. This approach is evaluated in Sections 8.2.1 and 8.2.2 of this SEIS; although it results in some environmental impacts that are somewhat lower than the impacts for full replacement capacity.

There are many possible combinations of alternatives. Some alternatives could include renewable energy sources, such as wind power. Table 8-8 contains a summary of the environmental impacts of one assumed combination of alternatives consisting of 1000 MW(e) of combined-cycle natural gas-fired generation using once-through cooling, an additional 524 MW(e) from purchased power, and 500 MW(e) gained from additional demand-side management measures. The impacts are based on the gas-fired generation impact assumptions discussed in Section 8.2.2, adjusted for the reduced generating capacity. While the demand-side management measures would have few environmental impacts, operation of the new gas-fired plant would result in increased emissions and environmental impacts. The staff concludes that it is very unlikely that the environmental impacts of any reasonable combination of generating and conservation options could be reduced to the level of impacts associated with renewal of the Millstone OLs.

8.3 Summary of Alternatives Considered

The environmental impacts of the proposed action, license renewal, are SMALL for all impact categories except entrainment, which is MODERATE (other exceptions include collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal, for which a single significance level was not assigned). The alternative actions, i.e., no-action alternative (discussed in Section 8.1), new generation alternatives (from coal, natural gas, and nuclear discussed in Sections 8.2.1 through 8.2.3, respectively), purchased electrical power (discussed in Section 8.2.4), alternative technologies (discussed in Section 8.2.5), and the combination of alternatives (discussed in Section 8.2.6) were considered.

The no-action alternative would require the replacement of electrical generating capacity by (1) demand-side management and energy conservation, (2) power purchased from other electricity providers, (3) generating alternatives other than Millstone, or (4) some combination of these options. For each of the new generation alternatives (coal, natural gas, and nuclear), the environmental impacts would not be less than the impacts of license renewal. For example, the land-disturbance impacts resulting from construction of any new facility would be greater than the impacts of continued operation of Millstone. The impacts of purchased electrical power (imported power) would still occur, but would occur elsewhere. Alternative technologies are not considered feasible at this time, and it is very unlikely that the environmental impacts of any reasonable combination of generation and conservation options could be reduced to the level of impacts associated with renewal of the Millstone OLs.

The staff concludes that the alternative actions, including the no-action alternative, may have environmental impacts in at least some impact categories that reach MODERATE or LARGE significance.

Table 8-8. Summary of Environmental Impacts of 1000 MW(e) of Natural Gas-Fired Generation, 524 MW(e) from Purchased Power and 500 MW(e) from Demand-Side Management Measures

	Millstone Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	22 ha (55 ac) for power-block, offices, roads, and parking areas. Additional impact for construction of an underground gas pipeline.	SMALL to MODERATE	22 ha (55 ac) for power-block, offices, roads, and parking areas. Additional impact for construction and/or upgrade of an underground gas pipeline.
Ecology	SMALL to MODERATE	Uses undeveloped areas at current Millstone site, plus gas pipeline. Small impacts to aquatic resources since less cooling water required.	SMALL to MODERATE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity. Likely plant sites already have power-generation facilities.
Water Use and Quality—Surface Water	SMALL	Uses existing intake and discharge structures. Less water use, since closed-cycle cooling system replaces once-through system.	SMALL to MODERATE	Impact depends on volume of water withdrawal and discharge and characteristics of surface-water body.
Water Use and Quality—Groundwater	SMALL	Millstone uses little groundwater.	SMALL to MODERATE	Impact depends on volume of water withdrawal and discharge.
Air Quality	MODERATE	Natural Gas-Fired Units Sulfur oxides • 68 MT/yr (75 tons/yr) Nitrogen oxides • 256 MT/yr (282 tons/yr) Carbon monoxide • 336 MT/yr (370 tons/yr) PM_{10} particulates • 100 MT/yr (110 tons/yr) Some hazardous air pollutants Some hazardous air pollutants. Additional emissions from producers of purchased power.	MODERATE	Same as siting at Millstone

Table 8-8. (contd)

	Millstone Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Waste	SMALL	Small amount of ash produced from gas-fired plan.	SMALL	Same as siting at Millstone.
Human Health	SMALL	Impacts considered to be minor.	SMALL	Impacts considered to be minor.
Socioeconomics	SMALL to MODERATE	During construction, impacts would be MODERATE. Up to 1000 additional workers during the peak of the three-year construction period, followed by reduction from current Millstone workforce of 1650 to 55; tax base preserved. Impacts during operation would be SMALL.	SMALL to MODERATE	Construction impacts depend on location, but could be significant if location is in a more rural area than Millstone. City of Waterford would experience loss of tax base and employment, potentially offset by possible economic growth.
Transportation	MODERATE	Transportation impacts associated with construction workers would be MODERATE.	MODERATE	Transportation impacts associated with construction workers would be MODERATE.
Aesthetics	MODERATE	MODERATE aesthetic impacts due to plant units and stacks.	SMALL to MODERATE	Impact would depend on location. Similar to Millstone if sited on retired oil-fired plant site.
Historic and Archeological Resources	SMALL	Studies would likely be needed to identify, evaluate, and address mitigations of the potential impacts from construction and operation. Any potential impacts can likely be effectively managed.	SMALL	Same as Millstone.

Table 8-8. (contd)

	Millstone Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Environmental Justice	SMALL to MODERATE	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction; loss of 1595 operating jobs at Millstone could reduce employment prospects for minority and low-income populations. Impacts could be offset by potential economic growth and the ability of affected workers to commute to other jobs.	SMALL to MODERATE	Impacts vary depending on population distribution and make-up at site.

8.4 References

10 CFR Part 50. Code of Federal Regulations, Title 10*, Energy,* Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy,* Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

40 CFR Part 51. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

40 CFR Part 60. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 60, "Standards of Performance for New Stationary Sources."

40 CFR Part 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

Clean Air Act (CAA) of 1970, as amended. 42 USC. 7401, et seq.

C & A Carbone, Inc. v. Town of Clarkstown, New York, 511 U.S. 383, (U.S. Supreme Court 1994).

American Wind Energy Association. 2003. *Wind Project Data Base*. Accessed at: http://www.awea.org/projects/newyork.html on August 3, 2004.

British Wind Energy Association. 2003. Accessed at http://www.offshorewindfarms.co.uk/else.html on August 3, 2004.

Connecticut Department of Environmental Protection (CTDEP). 2002a. *Attainment and Non-Attainment of National Ambient Air Quality Standards in Connecticut*. August 16, 2002. Accessed at: http://dep.state.ct.us/air2/attain2.htm on May 6, 2004.

Connecticut State Legislature. 2001. *Report of the Energy Conservation Management Board Year 2000–2001 Programs and Operations*. Energy & Technology Committee and Environment Committee. January 31, 2001. Accessed at: http://www.state.ct.us/dpuc/ecmb/LegRep-Elec.pdf on August 3, 2004.

Dominion Nuclear Connecticut, Inc. (Dominion). 2004. *Applicant's Environmental Report – Operating License Renewal Stage Millstone Power Station, Units 2 and 3*. Waterford, Connecticut.

Gabbard, Alex. 1993. "Coal Combustion: Nuclear Resource or Danger," *Oak Ridge National Laboratory Review*. Oak Ridge National Laboratory: Oak Ridge, Tennessee. Summer/Fall 1993. Accessed at: http://www.ornl.gov/ORNLReview/rev26-34/text/colmain.html on August 3, 2004.

Idaho National Engineering and Environmental Laboratory (INEEL). 1995. *U.S. Hydropower Resource Assessment for Connecticut*. DOE/ID-10430(CT). Idaho Falls, Idaho. July 1995. Accessed at: http://hydropower.inel.gov/resourceassessment/ct/ct.pdf on August 3, 2004.

Integrated Waste Services Association. 2001. *About Waste to Energy*. Accessed at http://www.wte.org/waste.html on August 3, 2004.

National Environmental Policy Act of 1969 (NEPA), as amended. 42 USC 4321, et seq.

U.S. Army Corps of Engineers (USACE). 2004. *Cape Cod Wind Farm Permit Application*. Accessed at: http://www.nae.usace.army.mil/projects/ma/ccwf/windfarm.htm on August 3, 2004.

U.S. Department of Energy, Energy Information Administration (DOE/EIA). 2000. *Energy Consumption and Renewable Energy Development Potential on Indian Lands*. SR/CNEAF/2000-01. Washington, D.C. Accessed at: http://www.eia.doe.gov/cneaf/solar.renewables/ilands/ilands.pdf on August 3, 2004.

U.S. Department of Energy, Energy Information Administration (DOE/EIA). 2001. *Renewable Energy 2000: Issues and Trends*. DOE/EIA-0628(2000), Washington, D.C. Accessed at: http://www.eia.doe.gov/cneaf/solar.renewables/rea_issues/062800.pdf on August 3, 2004.

U.S. Department of Energy, Energy Information Administration (DOE/EIA). 2004a. *Annual Energy Outlook 2004 With Projections to 2025*. DOE/EIA-0383(2004). Washington, D.C. Accessed at: http://www.eia.doe.gov/oiaf/aeo/index.html/ on June 21, 2004.

U.S. Department of Energy, Energy Information Administration (DOE/EIA). 2004b. *International Energy Outlook 2004*. DOE/EIA-0484(2004). Washington, D.C. Accessed at: http://www.eia.doe.gov/oiaf/ieo/ on June 21, 2004.

U.S. Department of Energy (DOE). 2004a. *Map of Connecticut, Massachusetts, and Rhode Island Annual Average Wind Power*. Accessed at: http://www.eere.energy.gov/windandhydro/wind_potential.html and http://rredc.nrel.gov/wind/pubs/atlas/maps/chap3/3-21m.html on August 3, 2004.

U.S. Department of Energy (DOE). 2004b. *Future Fuel Cells R&D*. Accessed at: http://www.fossil.energy.gov/programs/powersystems/fuelcells/index.html on August 3, 2004.

U.S. Environmental Protection Agency (EPA). 1998. "Revision of Standards of Performance for Nitrogen Oxide Emissions From New Fossil-Fuel Fired Steam Generating Units; Revisions to Reporting Requirements for Standards of Performance for New Fossil-Fuel Fired Steam Generating Units, Final Rule." *Federal Register* Vol. 63, No. 179, pp. 49442–49455. Washington, D.C. September 16, 1998.

U.S. Environmental Protection Agency (EPA). 1999. "Regional Haze Regulations, Final Rule." *Federal Register* Vol. 64, No. 126, pp. 35714–3577. Washington, D.C. July 1, 1999.

U.S. Environmental Protection Agency (EPA). 2000a. "Regulatory Finding on the Emissions of Hazardous Air Pollutants from Electric Utility Steam Generating Units." *Federal Register,* Vol. 65, No. 245, pp. 79825–79831. Washington, D.C. December 20, 2000.

U.S. Environmental Protection Agency (EPA). 2000b. "Notice of Regulatory Determination on Wastes From the Combustion of Fossil Fuels." *Federal Register,* Vol. 65, No. 99, pp. 32214–32237. Washington, D.C. May 22, 2000.

U.S. Environmental Protection Agency (EPA). 2001. "Municipal Solid Waste Disposal." Accessed at http://www.epa.gov/epaoswer/non-hw/muncpl/dosposal.htm on February 19, 2002.

U.S. Nuclear Regulatory Commission (NRC). 1988. *Final Generic Impact Statement on Decommissioning of Nuclear Facilities*. NUREG-0586, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report, Section 6.3—Transportation*, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report. NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2001. *NRC Organizes Future Licensing Project Organization*. Press Release No. 01-035, March 30, 2001. Accessed at http://www.nrc.gov/reading-rm/doc-collections/news/2001/01-035.html on August 3, 2004.

U.S. Nuclear Regulatory Commission (NRC). 2002. *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors*. NUREG-0586, Supplement 1, Volumes 1 and 2. Washington, D.C.

9.0 Summary and Conclusions

By letter dated January 20, 2004, the Dominion Nuclear Connecticut, Inc. (Dominion) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating licenses (OLs) for Millstone Power Station, Units 2 and 3 (Millstone), for an additional 20-year period (Dominion 2004a). If the OLs are renewed, State regulatory agencies and Dominion will ultimately decide whether the plant will continue to operate, based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners. If the OLs are not renewed, then the plants must be shut down at or before the expiration of the current OLs, which expire in July 2015 for Unit 2 and November 2025 for Unit 3.

Section 102 of the National Environmental Policy Act (NEPA) (42 United States Code [USC] 4321) directs that an environmental impact statement (EIS) is required for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in 10 Code of Federal Regulations (CFR) Part 51. Part 51 identifies licensing and regulatory actions that require an EIS. In 10 CFR 51.20(b)(2), the Commission requires preparation of an EIS or a supplement to an EIS for renewal of a reactor OL; 10 CFR 51.95(c) states that the EIS prepared at the OL renewal stage will be a supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plant*s (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[a]

Upon acceptance of the Dominion application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing a notice of intent to prepare an EIS and conduct scoping (69 FR 18409 [NRC 2004a]) on April 7, 2004. The staff visited the Millstone site in May 2004 and held public scoping meetings on May 18, 2004, in Waterford, Connecticut (NRC 2004b). The staff reviewed the Dominion Environmental Report (ER; Dominion 2004b) and compared it to the GEIS, consulted with other agencies, and conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1, the *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC 2000). The staff also considered the public comments received during the scoping process for preparation of this draft Supplemental Environmental Impact Statement (SEIS) for Millstone. The public comments received during the scoping process that were considered to be within the scope of the environmental review are provided in Appendix A, Part 1, of this SEIS.

The staff will hold two public meetings in Waterford, Connecticut, in January 2005, to describe the preliminary results of the NRC environmental review and to answer questions, in order to provide members of the public with information to assist them in formulating their comments on

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

this draft SEIS. When the comment period ends, the staff will consider and address all of the comments received. These comments will be addressed in Appendix A, Part 2, of the final SEIS.

This draft SEIS includes the NRC staff's preliminary analysis, which considers and weighs the environmental impacts of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's preliminary recommendation regarding the proposed action.

The NRC has adopted the following statement of purpose and need for license renewal from the GEIS:

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decisionmakers.

The goal of the staff's environmental review, as defined in 10 CFR 51.95(c)(4) and the GEIS, is to determine

> . . . whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

Both the statement of purpose and need and the evaluation criterion implicitly acknowledge that there are factors, in addition to license renewal, that will ultimately determine whether an existing nuclear power plant continues to operate beyond the period of the current OL.

NRC regulations [10 CFR 51.95(c)(2)] contain the following statement regarding the content of SEISs prepared at the license renewal stage:

> The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed

action and the alternatives, or any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) and in accordance with § 51.23(b).[(a)]

The GEIS contains the results of a systematic evaluation of the consequences of renewing an OL and operating a nuclear power plant for an additional 20 years. It evaluates 92 environmental issues using the NRC's three-level standard of significance—SMALL, MODERATE, or LARGE—developed using the Council on Environmental Quality guidelines. The following definitions of the three significance levels are set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

> SMALL — Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE — Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> LARGE — Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

For 69 of the 92 issues considered in the GEIS, the staff analysis in the GEIS shows the following:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

(a) The title of 10 CFR 51.23 is "Temporary storage of spent fuel after cessation of reactor operations–generic determination of no significant environmental impact.

These 69 issues were identified in the GEIS as Category 1 issues. In the absence of new and significant information, the staff relied on conclusions as amplified by supporting information in the GEIS for issues designated Category 1 in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

Of the 23 issues that do not meet the criteria set forth above, 21 are classified as Category 2 issues requiring analysis in a plant-specific supplement to the GEIS. The remaining two issues, environmental justice and chronic effects of electromagnetic fields, were not categorized. Environmental justice was not evaluated on a generic basis and must also be addressed in a plant-specific supplement to the GEIS. Information on the chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared.

This draft SEIS documents the staff's consideration of all 92 environmental issues identified in the GEIS. The staff considered the environmental impacts associated with alternatives to license renewal and compared the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that were considered include the no-action alternative (not renewing the OLs for Millstone) and alternative methods of power generation. These alternatives were evaluated assuming that the replacement power generation plant is located at either the Millstone site or some other unspecified greenfield location.

9.1 Environmental Impacts of the Proposed Action—License Renewal

Dominion and the staff have established independent processes for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. Neither Dominion nor the staff has identified information that is both new and significant related to Category 1 issues that would call into question the conclusions in the GEIS. Similarly, neither the scoping process, Dominion, nor the staff has identified any new issue, applicable to Millstone, that has a significant environmental impact. Therefore, the staff relies upon the conclusions of the GEIS for all Category 1 issues that are applicable to Millstone.

Dominion's license renewal application presents an analysis of the Category 2 issues that are applicable to Millstone, plus environmental justice and chronic effects from electromagnetic fields. The staff has reviewed the Dominion analysis for each issue and has conducted an independent review of each issue plus environmental justice and chronic effects from electromagnetic fields. Six Category 2 issues are not applicable because they are related to plant design features or site characteristics not found at Millstone. Four Category 2 issues are not discussed in this draft SEIS because they are specifically related to refurbishment. Dominion (Dominion 2004b) has stated that its evaluation of structures and components, as required by 10 CFR 54.21, did not identify any major plant refurbishment activities or modifications as necessary to support the continued operation of Millstone for the license renewal period. In addition, any replacement of components or additional inspection activities are within the bounds of normal plant component replacement and, therefore, are not expected to affect the environment outside the bounds of the plant operations evaluated in the U.S. Atomic Energy Commission's 1973 *Final Environmental Statement Related to the Continuation of Construction of Unit 2 and the Operation of Units 1 and 2, Millstone Nuclear Power Station* and in the NRC's 1984 *Final Environmental Statement related to operation of Millstone Nuclear Power Station, Unit No. 3*.

Eleven Category 2 issues related to operational impacts and postulated accidents during the renewal term, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this draft SEIS. Five of the Category 2 issues and environmental justice apply to both refurbishment and to operation during the renewal term and are only discussed in this draft SEIS in relation to operation during the renewal term. For 10 Category 2 issues and environmental justice, the staff concludes that the potential environmental impacts are of SMALL significance in the context of the standards set forth in the GEIS. For entrainment, the staff concludes that the potential environmental impacts are of MODERATE significance in the context of the standards set forth in the GEIS. In addition, the staff determined that appropriate Federal health agencies have not reached a consensus on the existence of chronic adverse effects from electromagnetic fields. Therefore, no further evaluation of this issue is required. For severe accident mitigation alternatives (SAMAs), the staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for Millstone and the plant improvements already made, the staff concludes that one of the candidate SAMAs is cost-beneficial for Unit 2. One additional SAMA for each unit could be cost-beneficial if it can be implemented by severe accident management guidelines without hardware modifications.

Mitigation measures were considered for each Category 2 issue. Current measures to mitigate the environmental impacts of plant operation were found to be adequate, and no additional mitigation measures were deemed sufficiently beneficial to be warranted. The Connecticut Department of Environmental Protection is currently reviewing Dominion's National Pollution Discharge Elimination System permit application. The Connecticut Department of Environmental Protection may identify mitigations to further minimize entrainment as a condition of the permit.

The following sections discuss unavoidable adverse impacts, irreversible or irretrievable commitments of resources, and the relationship between local short-term use of the environment and long-term productivity.

9.1.1 Unavoidable Adverse Impacts

An environmental review conducted at the license renewal stage differs from the review conducted in support of a construction permit because the plant is in existence at the license renewal stage and has operated for a number of years. As a result, adverse impacts associated with the initial construction have been avoided, have been mitigated, or have already occurred. The environmental impacts to be evaluated for license renewal are those associated with refurbishment and continued operation during the renewal term.

The adverse impacts of continued operation identified are considered to be of SMALL significance with the exception of a MODERATE impact for entrainment, and none warrants implementation of additional mitigation measures. The adverse impacts of likely alternatives if Millstone Units 2 and 3 cease operation at or before the expiration of the current OLs will not be smaller than those associated with continued operation of these units, and they may be greater for some impact categories in some locations.

9.1.2 Irreversible or Irretrievable Resource Commitments

The commitment of resources related to construction and operation of the Millstone Units 2 and 3 during the current license period was made when the plants were built. The resource commitments to be considered in this draft SEIS are associated with continued operation of the plants for an additional 20 years. These resources include materials and equipment required for plant maintenance and operation, the nuclear fuel used by the reactors, and ultimately, permanent offsite storage space for the spent fuel assemblies.

The most significant resource commitments related to operation during the renewal term are the fuel and the permanent storage space. Dominion replaces approximately one-third of the fuel assemblies in each of the two units during every refueling outage, which occurs on an 18-month cycle.

The likely power generation alternatives if Millstone ceases operation on or before the expiration of the current OLs will require a commitment of resources for construction of replacement plants as well as for fuel to run those plants.

9.1.3 Short-Term Use Versus Long-Term Productivity

An initial balance between short-term use and long-term productivity of the environment at the Millstone site was set when the plants were approved and construction began. That balance is now well established. Renewal of the OLs for Millstone Units 2 and 3 and continued operation of the plants will not alter the existing balance but may postpone the availability of the site for other uses. Denial of the application to renew the OLs will lead to shutdown of the plants and will alter the balance in a manner that depends on subsequent uses of the site. For example, the environmental consequences of turning the Millstone site into a park or an industrial facility are quite different.

9.2 Relative Significance of the Environmental Impacts of License Renewal and Alternatives

The proposed action is renewal of the OLs for Millstone. Chapter 2 describes the site, power plants, and interactions of the plants with the environment. As noted in Chapter 3, no refurbishment and no refurbishment impacts are expected at Millstone. Chapters 4 through 7 discuss environmental issues associated with renewal of the OLs. Environmental issues associated with the no-action alternative and alternatives involving power generation and use reduction are discussed in Chapter 8.

The significance of the environmental impacts from the proposed action (approval of the application for renewal of the OLs), the no-action alternative (denial of the application), alternatives involving coal, gas, or nuclear generation of power at the Millstone site and an unspecified “greenfield site”— and a combination of alternatives—are compared in Table 9-1. Continued use of a closed-cycle cooling system for Millstone is assumed for Table 9-1.

Substitution of once-through cooling for the recirculating cooling system in the evaluation of the nuclear, gas-, and coal-fired generation alternatives would result in somewhat greater environmental impacts in some impact categories.

Table 9-1 shows that the significance of the environmental impacts of the proposed action are SMALL for all impact categories except for entrainment, which is MODERATE, and for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal, for which a single significance level was not assigned (see Chapter 6). The alternative actions, including the no-action alternative, may have environmental impacts in at least some impact categories that reach MODERATE or LARGE significance.

Table 9-1. Summary of Environmental Significance of License Renewal, the No-Action Alternative, and Alternative Methods of Generation Using Once-Through Cooling

	Proposed Action	No-Action Alternative	Coal-Fired Generation		Natural-Gas-Fired Generation		New Nuclear Generation		Combination of Alternatives	
Impact Category	**License Renewal**	**Denial of Renewal**	**Millstone Site**	**Alternate Site**	**Millstone Site**	**Alternate Site**	**Millstone Site**	**Alternate Site**	**Millstone Site**	**Alternate Site**
Land Use	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	MODERATE	MODERATE to LARGE	SMALL to MODERATE	SMALL to MODERATE
Ecology	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Water Use and Quality—Surface Water	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Water Use and Quality—Groundwater	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Air Quality	SMALL	SMALL	MODERATE	MODERATE	MODERATE	MODERATE	SMALL	SMALL	MODERATE	MODERATE
Waste	SMALL	SMALL	MODERATE	MODERATE	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Human Health	SMALL[(a)]	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Socioeconomics	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE
Socioeconomics (Transportation)	SMALL	SMALL	SMALL to LARGE	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE	SMALL to LARGE	MODERATE	MODERATE
Aesthetics	SMALL	SMALL	MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	MODERATE	SMALL to MODERATE	MODERATE	SMALL to MODERATE
Historic and Archaeological Resources	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL
Environmental Justice	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE

(a) Except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal, for which a significance level was not assigned. See Section 6 for details.

9.3 Staff Conclusions and Recommendations

Based on (1) the analysis and findings in the GEIS (NRC 1996; 1999), (2) the ER submitted by Dominion (Dominion 2004b), (3) consultation with Federal, State, and local agencies, (4) the staff's own independent review, and (5) the staff's consideration of public comments received during the scoping process, the preliminary recommendation of the staff is that the Commission determine that the adverse environmental impacts of license renewal for Millstone are not so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

9.4 References

10 CFR Part 51. Code of Federal Regulations, *Title 10, Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, *Title 10, Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

Dominion Nuclear Connecticut, Inc. (Dominion). 2004a. *Application for Renewed Operating Licenses, Millstone Power Station, Units 2 and 3*. Waterford, Connecticut.

Dominion Nuclear Connecticut, Inc. (Dominion). 2004b. *Applicant's Environmental Report – Operating License Renewal Stage Millstone Power Station, Units 2 and 3*. Waterford, Connecticut.

National Environmental Policy Act of 1969 (NEPA). 42 USC 4321, et seq.

U.S. Atomic Energy Commission. 1973. *Final Environmental Statement Related to the Continuation of Construction of Unit 2 and the Operation of Units 1 and 2, Millstone Nuclear Power Station*. Docket Nos. 50-245 and 50-336, Washington D.C.

U.S. Nuclear Regulatory Commission (NRC). 1984. *Final Environmental Statement Related to the Operation of Millstone Power Station, Unit No. 3.* Docket No. 50-423, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Main Report*, *Section 6.3, Transportation, Table 9.1,* *Summary of findings on NEPA issues for license renewal of nuclear power plants*, *Final Report*. NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*. NUREG-1555, Supplement 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2004a. "Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register*, Vol 69, No 67, pp 18409–18410, Washington, D.C. (April 7, 2004).

U.S. Nuclear Regulatory Commission (NRC). 2004b. *Environmental Impact Statement Scoping Process: Summary Report – Millstone Power Station, Units 2 and 3, New London County, Connecticut*. Washington, D.C. August 27, 2004.

Appendix A

Comments Received on the Environmental Review

Appendix A

Comments Received on the Environmental Review

Part I - Comments Received During Scoping

On April 7, 2004, the U.S. Nuclear Regulatory Commission (NRC) published a Notice of Intent in the Federal Register (69 FR 18409), to notify the public of the staff's intent to prepare a plant-specific supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2, to support the renewal application for the Millstone operating licenses and to conduct scoping. The plant-specific supplement to the GEIS has been prepared in accordance with the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) guidance, and 10 CFR Part 51. As outlined by NEPA, the NRC initiated the scoping process with the issuance of the Federal Register Notice. The NRC invited the applicant; Federal, State, and local government agencies; Native American tribal organizations; local organizations; and individuals to participate in the scoping process by providing oral comments at the scheduled public meetings and/or submitting written suggestions and comments no later than June 4, 2004.

The scoping process included two public scoping meetings, which were held at the Town Hall in Waterford, Connecticut on May 18, 2004. Approximately 95 members of the public attended the meetings. Both sessions began with NRC staff members providing a brief overview of the license renewal process and the NEPA process. After the NRC's prepared statements, the meetings were open for public comments. Thirty-three attendees provided oral statements that were recorded and transcribed by a certified court reporter and written statements that were appended to the transcript. The meeting transcripts are an attachment to the Scoping Meeting Summary dated June 24, 2004. In addition to the comments received during the public meetings, eight comment letters or e-mail messages were received by the NRC in response to the Notice of Intent.

The NRC received an email dated September 7, 2004, from Mr. Michael Steinberg providing clarification to comments made during the scoping meeting. Because this comment was received well after the scoping process had ended, it was not included in the scoping summary report. However, the staff did consider the comment in the preparation of this supplemental environmental impact statement (SEIS).

At the conclusion of the scoping period, the NRC staff and its contractor(s) reviewed the transcripts and all written material to identify specific comments and issues. Each set of comments from a given commenter was given a unique identifier (Commenter ID), so that each set of comments from a commenter could be traced back to the transcript or letter by which the comments were submitted. Specific comments were numbered sequentially within each comment set. Several commenters submitted comments through multiple sources (e.g., afternoon and evening scoping meetings). All of the comments received and the staff responses are included in the Millstone Scoping Summary Report dated August 27, 2004.

Table A.1 identifies the individuals who provided comments applicable to the environmental review and the Commenter ID associated with each person's set(s) of comments. The individuals are listed in the order in which they spoke at the public meeting, and in alphabetical order for the comments received by letter or e-mail. To maintain consistency with the Scoping Summary Report, the unique identifier used in that report for each set of comments is retained in this appendix.

Specific comments were categorized and consolidated by topic. Comments with similar specific objectives were combined to capture the common essential issues raised by the commenters. The comments fall into one of the following general groups:

- Specific comments that address environmental issues within the purview of the NRC environmental regulations related to license renewal. These comments address Category 1 or Category 2 issues or issues that were not addressed in the GEIS. They also address alternatives and related Federal actions.

- General comments (1) in support of or opposed to nuclear power or license renewal or (2) on the renewal process, the NRC's regulations, and the regulatory process. These comments may or may not be specifically related to the Millstone license renewal application.

- Questions that do not provide new information.

- Specific comments that address issues that do not fall within or are specifically excluded from the purview of NRC environmental regulations related to license renewal. These comments typically address issues such as the need for power, emergency preparedness, security, current operational safety issues, and safety issues related to operation during the renewal period.

Table A.1. Individuals Providing Comments During Scoping Comment Period

Commenters ID	Commenter	Affiliation (If Stated)	Comment Source and ADAMS Accession Number[(a)]
MS-A	Gerald Gaynor Jr.	Mayor, City of New London	Afternoon Scoping Meeting
MS-B	Mr. Fraser	First Selectman, Town of East Lyme	Afternoon Scoping Meeting
MS-C	Melodie Peters	CT State Senator	Afternoon Scoping Meeting
MS-D	Andrea Stillman	CT State Representative	Afternoon Scoping Meeting
MS-E	Richard Brown	City Manager, City of New London	Afternoon Scoping Meeting
MS-F	Steve Scace	Director of Safety and Licensing, Millstone	Afternoon Scoping Meeting
MS-G	Mr. Medeiros	Commercial Fisherman	Afternoon Scoping Meeting
MS-H	Mr. Maderia	Commercial Fisherman	Afternoon Scoping Meeting
MS-I	Nancy Burton	Spokesperson for the Connecticut Coalition Against Millstone	Afternoon Scoping Meeting
MS-J	Don Klepper-Smith	Data Core Partners, LLC	Afternoon Scoping Meeting
MS-K	Stephen Negri	Local Resident	Afternoon Scoping Meeting
MS-L	Brigadier General Zembrzuski	Deputy General, Connecticut National Guard	Afternoon Scoping Meeting
MS-M	John Markowicz	Executive Director, Southeastern CT Enterprise Region	Afternoon Scoping Meeting
MS-N	Susan McNamara	Executive Director, Long Island Sound Foundation	Afternoon Scoping Meeting
MS-O	Tony Sheridan	President, Chamber of Commerce of Eastern CT	Afternoon Scoping Meeting
MS-P	Evan Woollacott	Co-Chairman, CT Nuclear Energy Advisory Council	Afternoon Scoping Meeting
MS-Q	Paul Eccard	First Selectman, Town of Waterford	Evening Scoping Meeting
MS-R	Janet Dinkel Pearce	President, United Way of Southeastern CT	Evening Scoping Meeting
MS-S	James Butler	Executive Director, Southeastern CT Council of Government	Evening Scoping Meeting
MS-T	Steve Scace	Director of Safety and Licensing, Millstone	Evening Scoping Meeting
MS-U	Marvin Berger	Local resident	Evening Scoping Meeting
MS-V	Geraldine Winslow	Local resident	Evening Scoping Meeting
MS-W	Pete Reynolds	Local resident	Evening Scoping Meeting

Commenters ID	Commenter	Affiliation (If Stated)	Comment Source and ADAMS Accession Number[(a)]
MS-X	Michael Steinberg	Local resident	Evening Scoping Meeting
MS-Y	Mr. Schwartz	Local resident	Evening Scoping Meeting
MS-Z	John “Bill” Sheehan	Vice Chairman, CT Nuclear Energy Advisory Council	Evening Scoping Meeting
MS-AA	Tony Sheridan	President, Chamber of Commerce of Eastern CT	Evening Scoping Meeting
MS-AB	George Kee	Local resident	Evening Scoping Meeting
MS-AC	JQ	Local resident	Evening Scoping Meeting
MS-AD	John Markowicz	Executive Director, Southeastern CT Enterprise Region & Co-Chairman, CT Nuclear Energy Advisory Council	Evening Scoping Meeting
MS-AE	Fred W. Thiele, Jr.	Member, Assembly of the State of New York	Letter (ML041620373)
MS-AF	Lucille C. Malouche	Local resident	Letter (ML041620380)
MS-AG	Hortense and Ralph Carpentier	Local resident	Letter (ML041770288)
MS-AH	Charles D. Stephani	Local resident	Letter (ML041770290)
MS-AI	Douglas Schwartz	Local resident	Letter (ML041770175)
MS-AJ	Kelly L. Streich	Local resident	Letter (ML041770177)
MS-AK	Michael Steinberg	Local resident	Letter (ML041770179)
MS-AL	Nancy Burton	Spokesperson for the Connecticut Coalition Against Millstone	Letter (ML041770182)

(a) The accession number for the afternoon transcript is ML041740756
The accession number for the evening transcript is ML041740767
The accession number for the attachments to the evening transcript is ML041750500

Comments applicable to this environmental review and the staff’s responses are summarized in this appendix. The parenthetical alpha-numeric identifier after each comment refers to the comment set (Commenter ID) and the comment number. This information, which was extracted from the Millstone Scoping Summary Report, is provided for the convenience of those interested in the scoping comments applicable to this environmental review. The comments that are general or outside the scope of the environmental review for Millstone are not included here. More detail regarding the disposition of general or inapplicable comments can be found in the summary report. The ADAMS accession number for the Scoping Summary Report is

ML041830272.

This accession number is provided to facilitate access to the document through the Public Electronic Reading Room (ADAMS) http://www.nrc.gov/reading-rm.html.

Comments in this section are grouped in the following categories:

1. Surface Water Quality and Use
1. Aquatic Ecology
2. Air Quality
3. Socioeconomics
4. Land Use
5. Human Health
6. Uranium Fuel Cycle and Waste Management
7. Postulated Accidents
8. Alternatives

Part I. Comments Received During Scoping

1. Surface Water Quality and Use

Comment: They've been operating with an invalid permit that expired in 1997 to discharge these chemicals. If they were to go to a closed system which they know about, they would not be killing these fish and other things that are going in there and they wouldn't have to use this chemical to clean it either.
(MS-G-3)

Comment: I want to briefly discuss the issue of the Clean Water Act. Under the Federal Clean Water Act, this facility requires a valid permit to take in the billions of gallons of water per day that it needs to keep the reactors from melting down and to flush out chemicals into the sea. The organization that I'm affiliated with has brought this issue to various legal public fora. We have demonstrated without any doubt that the permit is not valid. Not only that, the information that Dominion has submitted to the NRC is incorrect. It relies upon submission of materials suggesting that the company has obtained lawful permits to do what it has been doing to the environment which, as you have heard, has been devastating to the indigenous winter flounder.
(MS-I-5)

Comment: Second, the fact that the Millstone Point Station has not received a renewal of the discharge permit from the Department of Environmental Protection is of considerable concern. (MS-Q-4)

Comment: It is essential that the approval by the Department of Environmental Protection of the NPDES renewal application occur prior to granting the application for relicensing in my view. This concern is further reinforced by the fact that the plant operates at variance with the Clean Water Act as approved by the Commission of the Connecticut Department of Environmental Protection.
(MS-Q-6)

Comment: Eighth, the license renewal process concerns me in that it fails to include a description of the changes that have occurred since the initial license was issued; things like the harvesting of shellfish from Jordan Cove, which has been conditionally open, and the impact of the installation of a new water line to the site and the result in changing consumption rates. I anticipate that both of these changes and conditions will be carefully explored during this process.
(MS-Q-13)

Comment: The discharge permit, it's been an issue since 1993. It was brought up in 1997. It's been brought up at several meetings of the EPUC, the City Council, the Environmental Protection Agency. They are still operating under emergency discharge.
(MS-W-7)

Comment: These facts require the U.S. Nuclear Regulatory Commission to consider the prospect of its relicensing of Millstone nuclear reactors when the reactors are being operated in continuing flagrant violation of the federal Clean Water Act.
(MS-AL-1)

Response: *The comments are related to the status of Dominion's application for a revised National Pollutant Discharge Elimination System (NPDES) permit for Millstone and Millstone's compliance with the Clean Water Act. The Department of Environmental Protection (DEP) is responsible for the review and issuance of NPDES permits in Connecticut. DEP is also responsible for implementation of the Clean Water Act in Connecticut. The NRC does not have authority over matters concerning discharge permits or compliance with the Clean Water Act. The comments provide no significant, new information; therefore, the comments will not be evaluated further. The status of Dominion's NPDES permit application will be discussed in Chapters 2 and 4 of the SEIS.*

Comment: Dominion also has been exploring ideas for creative ways to deal with watershed management aside from the obligations that they are going to be held to in the reissuing of their permit.
(MS-C-5)

Comment: The other thing is when the cooling system when they discharge, they discharge hydrazine which is cancer-causing chemical that causes cancer in fish and probably humans too.
(MS-G-2)

Comment: Seventh, does Millstone Point Station sample the sediments in Jordan Cove? Are there radioactive deposits identified in these sediments? What are they and in what quantity do they exist?
(MS-Q-12)

Comment: Those plants contribute to global warming and it increases the temperature of the water used in the cooling. One million gallons per minute of Long Island Sound are sucked in and out of that power, each plant, so that would be times two for Millstone. Many compounds, radiological and industrial chemicals like hydrazine, are discharged routinely.
(MS-V-3)

Comment: The potential accumulation of Hydrazine and Uranium in our local waters and marine life is deeply troubling and presents a serious hazard to public health. It is critical to the protection of our natural resources and the public health that we investigate the extent of the pollution and, most importantly, target the source to eliminate further discharge of these deadly toxins into our waters.
(MS-AE-3)

Comment: I encourage you to request further information from me as will assist your environmental analysis. For example, the Connecticut Coalition Against Millstone presented testimony of an expert in chemistry in a Connecticut Superior Court proceeding in which the expert testified about the synergistic effects of toxic chemical and radioactive waste byproduct releases to the Millstone environment.
(MS-AL-3)

Response: *The comments are related to water quality issues. Water quality, water use, and other water issues were evaluated in the GEIS and determined to be Category 1 issues. The comments provide no significant, new information on water quality; therefore, the comments will not be evaluated further. Water quality will be discussed in Chapters 2 and 4 of the SEIS.*

2. Aquatic Ecology

Comment: ... I was hoping that the present environment could be with the algae surrounding the power plant and other things could be studied more thoroughly in the upcoming weeks and months ahead.
(MS-AC-1)

Response: *The comment is related to aquatic ecology issues. Aquatic ecology issues such as stimulation of nuisance organisms, such as algae, were evaluated in the GEIS and determined to be Category 1 issues. The comments provide no significant, new information on aquatic ecology; therefore, the comments will not be evaluated further. Aquatic ecology will be discussed in Chapters 2 and 4 of the SEIS.*

Comment: And more recently, we've heard about the depletion of winter flounder and some of the other fisheries with respect to the watershed. And I have been involved in discussions with the Department of Environmental Protection in the State and Dominion in trying to move forward with an appropriate approach to how the reactors are being cooled and its impact on the fisheries. That, I understand, from one of your colleagues has something that has been somewhat unresolved since the late `90s in that is as much as a problem or more of a problem with the state environmental protection and their scheduling.
(MS-C-4)

Comment: In the past few years, we haven't been able to go there and that's mainly because there is no fish there anymore. Now the reason for that is because of the cooling system that Millstone uses to cool their reactors. They have an entrainment where they take in millions and millions and billions of little baby fish and whatever else there is and they kill them. The result is we have no fish anymore.
(MS-G-1)

Comment: You're really talking about livelihood of people, maybe people's lives or you're talking about some monetary figure that could take care of this whole problem. I think the only way to do this is to shut them down and make them change their system over to a closed system and that would be the only way that I would agree to renewing the permit.
(MS-G-4)

Comment: We have both have a lawsuit that's in the works against Millstone against this killing of winter flounder.
(MS-H-1)

Comment: We did a test there in the middle of May last year at the peak of the flounder season. We used to do seven bushels there so the tow that we towed, we had seven fish in

count. That's not a tribute to the mesh size in the new Federal laws. That's a tribute to the lack of fish there. I'd like to see a closed system go because I want to get to this problem before they are depleted. The way we're going, they will be totally extinct in Niantic Bay. It's not overfishing. I've heard this for years. And we stopped fishing there approximately seven years ago and it's worse now than it was before. I don't want to hear "all the fishing." I'm sick of it. We get blamed for a lot. We don't do it. It's time that the public realizes that maybe now the Government should start looking at other things besides the fishing, pollution, this hydrazine, everything. ... Let's go to a closed system. The money that it's cost us, the fishermen and resources, that money could have been well spent to put a closed system in.
(MS-H-2)

Comment: When Northeast Utilities applied to the NRC, initially to the Atomic Energy Commission, to operate, it made certain predictions of the effects that the operations would have over time in the community but never predicted, at least on paper to the NRC, that it would have the devastating effect that it has had which is to drive the indigenous fish to a point of near extinction.
(MS-I-6)

Comment: The outstanding issue on renewal of the discharge permit is not limited to thermal discharge. Although not described in Section 4, the issue of the impact of the plant on the Flounder population is the focus of a disagreement between Dominion Nuclear Connecticut and the Department of Environmental Protection.
(MS-Q-7)

Comment: The long-term impacts of discharging two billion gallons of water daily into the Long Island Sound cannot yet be determined and such discharge should cease until a proper and thorough examination of its effects can be measured before the facility is permitted to operate into the future. Such as examination of the power station's impacts should include, but not be limited to, aquatic organisms and the larger marine ecosystem. An analysis must also consider the cumulative impact of the facility upon Long Island.
(MS-AE-2)

Comment: The EIS should present a comprehensive evaluation of the impact of Millstone's water intake (used for cooling purposes) from Niantic Bay on both nektonic and planktonic species. As well as a consideration of economically important species (ie. winter flounder), the EIS should assess the mortality of species that support ecosystem functions (i.e. trophic dynamics). Such species may be significant to the life cycle of other economically important species.
(MS-AJ-1)

Comment: An evaluation of abotic and biotic interactions may be appropriate if the water intake results in modification of the hydrodynamics of Niantic Bay.
(MS-AJ-2)

Comment: The intake structures of the Millstone reactors are recognized as a significant, if not predominant, contributor to the collapse of the indigenous winter flounder population in the Niantic River-Bay. I encourage you to enquire of the Marine Fisheries Division of the Connecticut Department of Environmental Protection, located in Old Lyme, as to its analysis of this phenomenon.
(MS-AL-2)

Response: *The comments are related to aquatic ecology issues. Aquatic ecology will be discussed in Chapters 2 and 4 of the SEIS.*

3. Air Quality

Comment: ... Connecticut and especially, I would venture to say the shore line, Connecticut unfortunately receives the air quality from the Midwest and we don't need fossil fuel plants adding to the problems here in Connecticut in terms of air quality. Nuclear power is a cleaner source of electricity and I would state that it is something that if it is working well, we should continue to promote it here in this region and I believe it is working well.
(MS-D-5)

Comment: Millstone produces all of this electricity using nuclear fuel which does not generate the emissions to the air that are typical to other sources of electricity.
(MS-T-1)

Response: *The comments are related to air quality issues. Air quality issues were evaluated in the GEIS and determined to be Category 1 issues. The comments provide no significant, new information on air quality; therefore, the comments will not be evaluated further*.

4. Socioeconomics

Comment: Dominion has been at the table problem-solving looking for new ways to make this community feel as though they're protected and they're comfortable. They've made huge financial contributions as the Mayor suggested, often times, often times unsolicited with respect to education foundations, the Lion's Club, the children's museum. There's a host of contributions that they've made to improve the quality of life in our region.
(MS-C-6)

Response: *The comment is related to public services impacts in education, social services, and recreation. Public services involving education, social services, and recreation were evaluated in the GEIS and were determined to be Category 1 issues. The comment provides no significant, new information on these public service issues: therefore, the comment will not be evaluated further.*

Comment: ... I am here because this plant is a regional asset whose benefits are received by all of us in Southeastern Connecticut and New England for that matter.
(MS-A-2)

Comment: The construction and the operation of this plant have been a huge part of regional economy for more than 40 years and one that we need to protect for the planned license extension of another 20 years.
(MS-A-3)

Comment: I really feel that the business to provide electricity in Southeastern Connecticut is so important because it's such a major part of the State of Connecticut that the economic concerns that I can draw to right here, as the Mayor of New London also said, is huge to our area as they try their best to support our local businesses with purchases of goods and materials and that their commitment and their word is excellent.
(MS-B-4)

Comment: Electricity is becoming a rare commodity and the fact that we have Dominion supplying as much of the electricity as they have has kept our lights on in this state, a case in point in the recent brownouts that were triggered from someplace off in Ohio. We in Southwestern Connecticut lost our lights. We have transmission problems in south and we have congestion problems, but if it weren't for the fact that Dominion was up and generating in a safe manner our lights would have gone down all over the state and we would have been down the sinkhole as much as New York was in.
(MS-C-2)

Comment: This plant provides a large part of not only Waterford's tax base - I venture to say less than it did because of the of the electric restructuring, but it also provides to the tax base for the State of Connecticut.
(MS-D-2)

Comment: When you look at the fact as was mentioned that more than 45 percent of the electricity that's generated here supports the State of Connecticut, we all know what that means for business.
(MS-D-3)

Comment: We cannot forget what an important part of the economy Millstone is. (MS-D-4)

Comment: ... not only contributes to the regional economy, but is a major supplier of power in Connecticut and the Northeast. Dominion Resources through Millstone Power Station is a major employer with over 460 persons employed within Southeastern Connecticut. Additionally, Millstone supports the local economy by purchasing as many goods and services locally as possible. The total economic impact of Millstone Power Station in New London County is estimated to exceed $500 million.
(MS-E-2)

Comment: Renewal of the Millstone operating licenses will continue the benefits our employees provide for our local community. Millstone has approximately 1,300 full-time employees. The annual payroll, including benefits, is over $150 million. More 250 local contractors work at Millstone and live in our community. During our regularly scheduled refueling outages, the number of contractors increases by about 800. Each reactor is refueled every 18 months. During the past two years, Millstone spent over $170 million on operations and capital projects, making vital investments in the future of our state.
(MS-F-1)

Comment: As our economy and the population grow, reliable sources of electricity including Millstone will be vital to our prosperity and our way of life. License renewal will help ensure Millstone remains available to meet these future needs.
(MS-F-3)

Comment: We have incentive within the State of Connecticut to keep the costs of doing business down. Clearly cost effective nuclear power has a role to play in keeping the cost of doing business under control. Our study pointed out, when we looked at production costs for electricity by fuel generation type, that nuclear power was clean. It was safe, and it was the most cost effective alternative. It was 30 percent cheaper than gas, 33 percent cheaper than oil, and actually less than coal without the environmental issues. A key point from our study was that Millstone Station provides cost effective power which in turn is essential to the state's long-term economic competitiveness.
(MS-J-1)

Comment: ... our study concluded that Millstone Station had positive and substantial economic benefits for the local area economy. Our study showed that there were 1,497 direct jobs

associated with Millstone Station generating $231.3 million in annualized direct spending. Accounting for multiplier effects, the level of spending, both direct and indirect, was about $500 million. So again, looking at these dollar volumes and the jobs generated, the economic impact was substantial and very, very clearly beneficial.
(MS-J-2)

Comment: Our bottom line conclusions were that Millstone Station provides cost effective and reliable electricity to the region's commercial, industrial, and residential users enhancing Connecticut's economic competitiveness.
(MS-J-3)

Comment: Millstone also contributes to the state's economy through direct job creation and spending on goods and services as well as the indirect multiplier effects.
(MS-J-4)

Comment: I cannot emphasize enough the economic importance of importance of Millstone for the town and region. Millstone provides good paying jobs and spends money at local businesses. It pays a very large portion of Waterford's taxes and contributes voluntarily to many community activities and charities. Personal spending by Millstone employees contributes greatly to the economic base of Southeastern Connecticut. In short, Millstone is one of the economic engines that keep our local economy on an upward track.
(MS-K-2)

Comment: The Millstone Nuclear Power Station, worth one percent of the workforce in Southeastern Connecticut, contributes a half a billion dollars to that $10 billion gross domestic product.... Roughly 1,500 employees are onsite. As has been indicated earlier, to use a conservative multiple, that leads to around 2,500 direct and indirect jobs in Southeastern Connecticut. Roughly two percent of our workforce is in one way, shape, or fashion connected to the Millstone Nuclear Power Station. The pay salaries at the nuclear power station are roughly 50 percent above the average in New London. As far as its expenditure within the region, as far as compensation of employees, it's around $75 million. If you add to that other parts of the state, you are roughly around $100 million annually. Direct and indirect compensation, if you want to play the multiple game, you are now talking about probably $150 million to $200 million. Millstone Point makes substantial purchases in New London County. In 2001, it bought a quarter of a billion dollars worth of goods and services in Southeastern Connecticut. It pays taxes. It pays a lot of taxes, $17 million in state and local taxes. Again, if you look at the indirect and direct effects, you are talking about roughly $60 million in state and local taxes as paid for by the nuclear power station.
(MS-M-2)

Comment: Of significance also to the economy of Southeastern Connecticut is the availability of safe and reliable electricity.
(MS-M-3)

Comment: And so the availability of safe and reliable nuclear power in Southeastern Connecticut gives us a cost-competitive advantage versus other parts of the state and other parts of the country in maintaining our economy. We support the relicensing of the Millstone Station.
(MS-M-4)

Comment: Suffice it to say that Millstone produces the equivalent of approximately 48 percent of the electricity that's used in Connecticut on a daily basis.
(MS-O-1)

Comment: I'm wondering if I understand correctly that there will be no major upgrades to the power plant that constitutes "refurbishment." Does this mean that major refurbishments are ongoing or will occur prior to 2015? Do improvements made before relicensing approval require the same level of scrutiny as refurbishments anticipated during the extended license period?
(MS-Q-3)

Comment: Page E-4-29 indicates that Dominion Nuclear Connecticut does not anticipate any related tax increase driven changes to off-site land use and development patterns. Well, I am here to say is that the impact of Millstone Point Station on tax revenue, infrastructure installation, and the overall level of service in Waterford is different than any other community in the State of Connecticut.
(MS-Q-8)

Comment: Now, on the down side, deregulation has suddenly removed two-thirds of the value of Millstone Point Station. We are left struggling to adjust and maintain a stable community.
(MS-Q-9)

Comment: Dominion is a key contributor to the regional and state economy directly employing more than 1,300 persons at the Millstone Station and annually purchasing more than $68 million in goods and services state-wide.
(MS-S-1)

Comment: I can't see how the taxes can go down on Millstone two and three. Unit 1, I can see where they went down because it's no longer in operation. But the value of the plants should be top-notched.
(MS-W-5)

Comment: Early today, Don Klepper-Smith, the economist, a very noted economist in the State of Connecticut, was the principal conducting that study and the figure that the overall impact that Millstone has on the economy of the region is $500 million. That's a major, major impact. That's includes goods and services purchased as well as personnel.
(MS-AA-2)

Comment: When restructuring occurred, our state legislature through the help of Melodie Peters and Andrea Stillman were very, very generous to the town of Waterford. In fact, they provided a ten year soft landing to the town. I stand corrected, but my memory, I believe, if it serves me correct, the ten years started with the sale of the plant. We got the equivalent the first year of the old assessment, the difference between the old assessment and the new assessment on the tenth year. The ninth year, it went down to 90 percent of that amount. Eighty percent. Seventy percent and it goes out for ten years.
(MS-AA-3)

Response: *The comments are related to the socioeconomic impacts on public services provided by public utilities and on offsite land use. These socioeconomic issues are specific to Millstone, and they will be addressed as Category 2 issues in Chapters 2 and 4 of the SEIS.*

5. Land Use

Comment: Sixth, issues of current land use of the property include a fill pile on Gardener's Wood Road. This pile was determined to contain materials of concern. What will occur with this pile if relicensing is approved?
(MS-Q-11)

Response: *The comment is related to land use. Land use issues are specific to Millstone, and they will be addressed as Category 2 issues in Chapters 2 and 4 of the SEIS.*

6. Human Health

Comment: My first comment has to be directed to the application materials and the assessment that appears to have been undertaken so far by the NRC. It seems to suffer from a major omission. That is, consideration of the biological effects of the ongoing operations of Millstone on the human population. Without even getting into the other aspects of the environment, we know that there has been a very significant effect on the human population in this community over the 34 years that the Millstone Reactors have been in operation. We have heard the business contributions ballyhoo here, but has anybody yet tallied up the enhancements to the health care professions in this industry going to the incidences of devastation and disease, despair brought about to individuals and families through cancer and other illnesses directly

attributable, we know, to the routine emissions from Millstone to the air and the water? We know that certain facilities such as the Community Cancer Center are doing well as businesses because of their patient load.
(MS-I-1)

Comment: We know that for our own organization, the Connecticut Coalition Against Millstone, we have suffered devastating losses just in the past year. We do not see any analysis in the present materials that have been submitted as to the deaths and illnesses of workers at Millstone. We have in mind particularly at the moment our wonderful stalwart, a friend and supporter, Joe Besade, who passed away this year. He had a devestating kind of cancer, suffered horribly, and there is every good reason to believe or every bad reason to believe that he suffered his illness and died because of what he was exposed to when he worked at the Millstone Nuclear Power Station. We don't see that you people have tracked any of the workers at Millstone since 1970 to the present time. What has happened to them? Where are they? Why have so many died prematurely? Why have so many suffered health effects? That's workers.
(MS-I-2)

Comment: Where is the information in this application and the NRC analysis of the human population and the areas around the communities immediately in the shadow of Millstone and even beyond? We know that there are cancer clusters. These have been identified to either side of Millstone and the beautiful areas. Take Millstone out of the picture and go to Jordan Cove and Niantic Bay, and these are some of the prettiest, most seemingly pristine areas of Southeastern Connecticut. They have identified cancer clusters. Go door to door. People have died. People are dying. There is a cancer wave, a cancer epidemic in this community that needs to be analyzed here during this process to determine the effects on the human population from the operations-to-date of Millstone. When the facts come in, there will be no question whatsoever that this plant, this facility must close because of its effect on the human population.
(MS-I-3)

Comment: ... in 1997, the Nuclear Energy Advisory Council commissioned a study looking to the incidence of cancer. It was initiated first because of our other plant down in Haddam. But the data was basically good for Millstone as well because Connecticut is such a small state. The scientists in the State of Connecticut indicated they could see no correlation between the operation of the nuclear plant in Waterford with the incidence of cancer in the State of Connecticut.
(MS-P-1)

Comment: The health of the public has not been considered or I'm not sure if it has at this point, but it must be taken into account. As a mother and a citizen, I know all too often the

heartbreaking stories of folks who have died and been stricken with cancers and leukemia. People are dying here and they have illnesses that should not be here. I believe it is caused by radiation.
(MS-V-4)

Comment: I have some information about some of the discharges that come from nuclear power plants. As far as the air, the routine releases, there is no filtering technology that exists for some gases like xenon 135 which decays into cesium 135, an isotope which multiplies, an isotope with a three million year half life. Also routine releases occur into the ocean. Radioactive corrosion products stick to the interior surfaces of the reactor vessels. Some call that radioactive crud. Fission products also enter the cooling water from leaks into the fuel rods. I'm sorry. I'm confused. I'll skip on. There's a maze of more than 50 miles of piping through which cooling water circulates. Leaks are bound to occur. In fact, the Nuclear Regulatory Commission allows leaks of up to 10 gallons a minute and this is a question I have. As nuclear plants age, the leaks generally increase. Also with a nuclear power plant, some of the discharge goes into the water and that, as well, cannot all be filtered. Tritium, for example, cannot be filtered. Tritiated water, a major byproduct of nuclear power plants, can be incorporated into the cells of the body. Some of the hazards resulting from tritium uptake include mutations, tumors and cell death. Dr. John Gofman, in his most recent report on low dose radiation, says that there is no such thing as a safe dose of radiation and that a low dose received slowly causes as many cancers as the same dose delivered all at once.
(MS-V-5)

Comment: ... while we cannot lower the level of natural radiation, it is my opinion that no one has the right to add manmade radiation on top of it. Any exposure to radiation increases the risk of genetic mutations, cancers and other life-shortening diseases.
(MS-V-6)

Comment: This is a document, "Millstone Power Station" - Dominion took the Nuclear out of its name - "2001 Radioactive Effluent Release Report." You can't see it from where you are, but I have extra copies I'm going to pass out. It shows all the different ways the radioactivity released into the air and into our waters makes its way through the environment, into our food supply, into our bodies and the bodies of other living things.
(MS-X-2)

Comment: Unfortunately, there's all too many stories, but those stories, I would argue, are backed up by a preponderance of evidence indicating that the radioactive releases from Millstone have caused all too many of these diseases and all too many of those kinds of deaths.
(MS-X-3)

Comment: Exhibit A is a report entitled "Elevated Childhood Cancer Incidents Proximate to U.S. Nuclear Power Plants." It's authored by Joseph Mangano and Janet Sherman of the Radiation and Public Health Project in New York City. It appeared in the Archives of Environmental Health in February of 2003. I'll read the abstract brief as follows: "Numerous reports document elevated cancer rates among children living near nuclear facilities in various nations. Little researching has examined U.S. rates near the nations 103 operating reactors. This study determined that cancer instance for children under 10 years of age who live within 30 miles of each of 14 nuclear plants in the Eastern United States exceeds the national average. The excess 12.4 percent risk suggests that one in nine cancers among children who reside near nuclear reactors is linked to radioactive emissions. Instance is particularly elevated for leukemia. Childhood cancer mortality exceeds the national average in seven of the 14 study areas." Of those 14 nuclear plants in the Eastern United States, one of those was Millstone. (MS-X-4)

Comment: Exhibit B is an excerpt from this document, "Cancer Incidence in Connecticut Counties 1995 by 1999." This is a publication of the Connecticut Tumor Registry. The Connecticut Tumor Registry is the oldest tumor registry in the United States that's been collecting this information since 1935. And keep in mind that our communities have suffered nearly 35 years of nuclear contamination from Millstone since Unit 1 started up in 1970. Looking at the –- And also Millstone's radioactive releases are among the highest, if not the highest, of U.S. nuclear power plants. Particularly in the 1970's, the mid '70s, Unit 1 was operating with damaged fuel rods which exacerbated that problem. So we have a cumulative dose to our communities of nearly 35 years now. Looking at the records in more recent years since restart, I've seen that these releases are still continuing. Fortunately, they're not as excessive as they were back in the '70s, but they are still continuing. If you look at the record, the documents closely, you see that for what are called the liquid releases into Long Island Sound and Niantic Bay, each year there are hundreds of what are called batch releases. There are more releases. If you look at the documents closely, you see that there are identified in Unit 2 and Unit 3 continuous release points. If you look at the total amount of radioactivity that's documented, most of it comes from this continuous release points. So our communities are pretty much on daily basis being subjected to these releases.
(MS-X-5)

Comment: Going back to the Connecticut Tumor Registry Report '95 to '99, it reports the incidence of cancers. That is how many people get cancer as differentiated from the mortality, those who contract it who die because fortunately, not everyone who gets it dies. It reports the incidence rate per 100,000 population adjusted for age. ... So for those years in New London County, it's broken down by gender also. For females, New London County was number one among the eight states. Males, we're number two, just barely a little bit lower than Tolland County. There's an early report, 1995 to 1998, in which New London County was number one for both male and female. ... So New London County for the years we're talking about was

number one for the following cancers: esophagus for males, colon and rectum for females, colon for females, rectum for females, liver for males, breasts for females, cervix for females, uterus for females, other female genital, females of course, bladder, males, bladder, females, multi-myeloma for females in a tie with Fairfield County. ... Suffice it to say, that the total kind of cancers in which New London County was counted as a separate county because for some of these, it was lumped in with other counties, was a total of 39. Okay. New London County had 12 No. 1s, six No. 2s, five No. 3s and seven No. 4s for a total of 30 out of 39. Not a very good record.
(MS-X-6)

Comment: Document No. 3 is called "The Radiation Exposure Compensation Act." In 1990, Congress passed this act saying that people that were downwind of atmospheric nuclear tests in the '50s and '60s in parts of Utah and Nevada and Arizona and also people who worked in uranium mines should be compensated for the damages that they suffered because of those tests that were done in name of national security. It names specific diseases for the downwinders. Those were specified diseases. They're called lymphocytic leukemia, multiple myeloma, lymphomas other than Hodgkin's Disease and primary cancer of the thyroid, breast, esophagus, stomach, pharynx, small intestine, pancreas, bile ducts, gall bladder or liver except cirrhosis or hepatis B. The reason why I'm bringing this up is because if you look at the breakdown of the specific kinds of cancers in New London County, '95 to '98, pretty much all of those that were named in this 1990 Act of Congress show upon this list. They are caused by ionizing radiation, the kind of radiation that's released from Millstone every day and has been for almost 35 years now.
(MS-X-7)

Comment: The final document I'm going to bring up is a summary of a document by Joseph Mangano, who is one of the authors of the first document I've talked about. This was from 1998 and the title of it is "2,500 Excess Cancer Cases in New London County Since 1970: Radioactive Emissions from Millstone May Be The Cause." "About 2500 excess cancers have occurred in New London County since the first Millstone Nuclear Power reactor in Waterford opened in 1970. About 800 of these cases resulted in death, using official figures published by the National Cancer Institute and the Connecticut Tumor Registry." ... "In the '50s and '60s," I'm quoting from the document now, "New London County cancer incidence rate was eight percent below the state average, rising to two percent below from '71 to '84 and 2.5 percent above in '89 to '91." So that goes from eight percent below the state average to 2.5 percent above. "In Millstone's first 14 years, the county cancer mortality rate was 11 percent above the nation compared to five percent above in the '50s and '60s according the National Cancer Institute. An approximate total 800 additional cancer deaths occurred in the county since Millstone opened."
(MS-X-8)

Comment: Then Mangano also looks at specific kinds of cancers. For children, leukemia in Millstone's first 14 years, leukemia cases for New London County for children under 10 was 55 percent higher than the state and leukemia deaths 45 percent higher. Again, his source is the National Cancer Institute.
(MS-X-9)

Comment: For thyroid cancer –- And I should mention that in those worst years of 1970s when Millstone was operating with damaged fuel rods, it was releasing dangerous amounts of radioactive iodine into the air and into the water. So the rate of thyroid cancer in New London County has risen twice as fast as the rest of Connecticut after 1970. Before understanding that, thyroid cancer is normally, if there is such a thing as normal any more, a very rare disease and it predominantly strikes females. For Millstone, about three cases per year were diagnosed in the county. By the early 1990, the number jumped to 17. That's according to Connecticut Tumor Registry.
(MS-X-10)

Comment: And he also looked at the four towns nearest the reactor, being East Lyme, Groton, Waterford and New London. Females cancers in ‘89 to ‘91, cancer cases in these four towns were 15 percent higher than the state tumor registry. Female only cancers were especially high in breast cancer, 20 percent greater than the state. Cervical cancer, 26 percent greater. Ovarian cancer, 35 percent greater and uterine cancer, 29 percent greater.
(MS-X-11)

Comment: For skin cancer - this is the last thing I'm going to say - malignant myeloma incidence in the four towns in ‘89 to ‘90 was 65 percent greater than for the rest of Connecticut. Connecticut Tumor Registry. You might say, “Well we live at the shore. We go to the beach all the time. So that's why.” But Mangano took the trouble to look at the rest of the Connecticut coastal towns and found that, yes, their rate was higher than the state also, but it was only seven percent higher compared to ours which was 65 percent higher.
(MS-X-12)

Comment: In the transcript of the May 18 public meeting re Millstone, on page 104, line 6, it reads: Mr. Steinberg (inaudible) What I actually said was: "Except Millstone. The study found a problem around Millstone with childhood leukemia." This was in reference to the NCI 1990 study of US nuclear power plants that Mr. Emch was discussing. I was referring to this passage from the study's conclusions: "On examination of the data for individual facilities, only the incidence data for the area around Millstone nuclear power plant ... showed a significantly increased relative risk of leukemia ages 0-9." I am requesting that the above be entered into the public record. Thank you.
(MS-X-13)

Comment: I'm going to read you some excerpts from the Nuclear Energy Advisory Council's Report to the Governor and the State Legislature of 2001, "Cancer Risk Study."... "As a result of its findings, the CASE committee concluded that atmospheric emissions from Connecticut Yankee have not had a detectable influence on cancer incident. The committee also concluded that an additional study of this topic is unlikely to produce any positive correlation." ... The committee then performed an analysis to compare the calculated doses with the Connecticut Tumor Registry data. Results of logistic regression analysis comparing these incidents, population counts and estimated exposure levels did not identify meaningful associations among the cancers and the radiation exposures in the towns. In comparison for some tumors, a negative correlation was found. Conclusions. The committee found that exposure to radionuclides emitted from Connecticut Yankee are so low as to be negligible. The committee also found no meaningful associations among the cancers studied, pediatric leukemia, adult chronic leukemia, multiple myeloma and thyroid cancer and the proximity of the Connecticut Yankee. ... I go back to the NEAC report now. "NEAC initiated this study in request and in response to public concern raised at this meeting. NEAC expressed its sincere appreciation to CASE and its leadership for this important study which clearly demonstrated that nuclear plant emissions had not had a detectable influence on cancer incidence in the State of Connecticut. As the CASE report used data from the Connecticut Tumor Registry, a like study of Millstone emissions would provide a similar result."
(MS-Z-1)

Comment: In considering the causes of these cancers, the radioactive releases from Millstone must be included, as the reactors have the highest contribution to manmade radioactive pollution in the county.
(MS-AK-1)

Comment: I also encourage you and the NRC staff to investigate the high incidences of ionizing radiation-related cancers and other related diseases in the Millstone vicinity. You are well advised to consult *Millstone and Me* by Michael Steinberg as an introductory source.
(MS-AL-4)

Response: *The comments are related to human health issues. Human health issues were evaluated in the GEIS and were determined to be Category 1 issues. However, the comments provided a large amount of information and health statistics related to the area around Millstone, which are being evaluated by the NRC staff to determine if they constitute significant, new information. Human health issues will be addressed Chapter 4 of the SEIS.*

7. Uranium Fuel Cycle and Waste Management

Comment: Nuclear energy is very, very dirty. That's why nobody wants to keep nuclear waste in their backyard. That's why everybody is talking about shipping it out somewhere far, far away. It's probably the dirtiest form of production of energy that can be fathomed. Even in the process of uranium enrichment, there are all kinds of ways in which the air is polluted through generation of fossil power.
(MS-I-7)

Comment: Nuclear plants are anything but clean and to say they don't burn fossil fuel, well that really burns me up too. Fossil fuel is used in mining the uranium, processing the uranium into the fuel. Onsite for construction, there's a lot of fossil fuel used. The energy to operate, perhaps they use their own electricity and at some point, we'll be transporting this waste to a final resting place and that will take a good amount of fossil fuel there.
(MS-V-2)

Comment: It would seem to me that it's something that could be done in a matter of days, not weeks, if the bureaucracy wanted to get going to figure out whether dry casks are safer than the water pools. It's not secret that the spent-fuel pools are the weak link in the safety of the plants from a terrorist attack standpoint. It would seem to me a no-brainer that dry casks harden, dry cask bunkers are safer and that it could quickly be determined and that everybody whether you're pro or anti-nuclear, whether you're industry or regulatory, we could all agree that this is the cardinal safety issue that needs to be addressed and could be addressed in a matter of months, I would think.
(MS-Y-2)

Response: *The comments are related to the uranium fuel cycle and waste management issues. Uranium fuel cycle and waste management issues were evaluated in the GEIS and were determined to be Category 1 issues. The comments provide no significant, new information on these public service issues; therefore, the comments will not be evaluated further.*

8. Postulated Accidents

Comment: I'm looking at Table F.3-2 submitted January 2004 on page E-F-80. This is one page of many that list a number of potential improvements that the company itself believes could enhance safety and operations at Millstone. Let me read one to you. "187, potential improvement, automate start capability of Terry turbine. Discussion, operator fails to start the

Terry turbine." Then there's an analysis of what it would cost to make this potential improvement. There is a conclusion that it is not worth the cost. It is not cost beneficial since the cost is greater than twice the benefit. That doesn't sound to me like the company has decided always to go for safety over cost.
(MS-I-8)

Response: *The comment is related to the severe accident mitigation alternatives analysis. This analysis will be discussed in Chapter 5 and Appendix G of the SEIS.*

9. Alternatives

Comment: While the town is continuously concerned about the plant's impacts on the fisheries of Long Island Sound, the installation of cooling towers on this site has broad aesthetic as well as land use implications.
(MS-Q-5)

Comment: I would like to conclude by saying it's time to consider phasing out these plants and move ahead with combinations of conservation and alternative energies such as gas, wind and solar technologies which are moving forward.
(MS-V-7)

Comment: ... the biggest problem is there are alternative methods out there and we do not need an energy to produce electricity.
(MS-W-1)

Comment: They've had co-generation plants start up that's helped produced just as much power as Unit 3 and there's more and more.
(MS-W-2)

Comment: We can diversify our energy. We can't depend on nuclear. We can't depend on oil.
(MS-W-8)

Response: *The comments are related to the environmental impacts of alternatives to license renewal at Millstone. The GEIS included an extensive discussion of alternative energy sources. Environmental impacts associated with various reasonable alternatives to renewal of the operating licenses for Millstone will be evaluated in Chapter 8 of the SEIS.*

Appendix B

Contributors to the Supplement

Appendix B

Contributors to the Supplement

The overall responsibility for the preparation of this supplement was assigned to the Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission (NRC). The statement was prepared by members of the Office of Nuclear Reactor Regulation with assistance from other NRC organizations, the Los Alamos National Laboratory and the Pacific Northwest National Laboratory.

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(a) Los Alamos National Laboratory is operated for the U.S. Department of Energy by the University of California.
(b) Pacific Northwest National Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute.

Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to Dominion Nuclear Connecticut, Inc.'s Application for License Renewal of Millstone Power Station, Units 2 and 3

Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to Dominion Nuclear Connecticut, Inc.'s Application for License Renewal of Millstone Power Station, Units 2 and 3

This appendix contains a chronological listing of correspondence between the U.S. Nuclear Regulatory Commission (NRC) and Dominion Nuclear Connecticut, Inc. (DNC) and other correspondence related to the NRC staff's environmental review, under 10 CFR Part 51, of DNC's application for renewal of the Millstone Power Station (MPS), Units 2 and 3, operating licenses. All documents, with the exception of those containing proprietary information, have been placed in the Commission's Public Document Room, at One White Flint North, 11555 Rockville Pike (first floor), Rockville, MD, and are available electronically from the Public Electronic Reading Room found on the Internet at the following Web address: <http://www.nrc.gov/reading-rm.html>. From this site, the public can gain access to the NRC's Agencywide Documents Access and Management System (ADAMS), which provides text and image files of NRC's public documents in the publicly available records component of ADAMS. The ADAMS accession number for each document is included below.

January 20, 2004	Letter from Mr. David A. Christian, DNC, to NRC submitting the applications for the renewal of the operating licenses for MPS, Units 2 and 3 (Accession No. ML040260070).
January 23, 2004	NRC Press Release No. 04-011 "NRC Makes License Renewal Application Available for the Millstone Nuclear Power Plant" (Accession No. ML040230280).
January 28, 2004	NRC staff letter to Mr. David A. Christian regarding the receipt and availability of the license renewal applications for MPS, Units 2 and 3 (Accession No. ML040280258).
February 5, 2004	NRC staff letter to Ms. Mildred Hodge, Library Director, Thames River Campus, Norwich, Connecticut, regarding the maintenance of reference material for public access related to the MPS license renewal environmental review (Accession No. ML040400181).

February 5, 2004	NRC staff letter to Ms. Judy Liskov, Assistant Director, Waterford Public Library, Waterford, Connecticut, regarding the maintenance of reference material for public access related to the MPS license renewal environmental review (Accession No. ML040400209).
February 6, 2004	NRC Press Release No. 04-002 "NRC to Hold Public Meeting in Connecticut on License Renewal Application for Millstone 2 and 3" (Accession No. ML040370209).
February 12, 2004	Petition to Intervene and Request for Hearing in Proceedings Concerning the Application to Extend the Operating Licenses for MPS, Units 2 and 3 (Accession No. ML040760946).
February 13, 2004	Letter from Mr. David R. Lewis, Counsel for DNC, to the NRC in the Matter of Dominion Nuclear Connecticut, Inc., Millstone Power Station, Units 2 and 3 (Accession No. ML040760954).
March 1, 2004	Letter from Ms. Nancy Burton, Esq., to NRC regarding Millstone Nuclear Power Station, Units 2 and 3 License Renewal Application (Accession No. ML040760958).
March 2, 2004	Letter from Mr. Paul B. Eccard, Town of Waterford, to NRC, request for party status and designation of the representative for MPS, Units 2 and 3 (Accession No. ML040700550).
March 4, 2004	NRC staff letter to Ms. Nancy Burton, Esq., regarding Petition to Intervene and Request for Hearing, dated February 12, 2004 (Accession No. ML040760940).
March 4, 2004	Letter to NRC from Mr. David R. Lewis, Counsel for DNC, in the Matter of Dominion Nuclear Connecticut, Inc., Millstone Power Station, Units 2 and 3 (Accession No. ML040760961).
March 8, 2004	NRC staff letter to Mr. David A. Christian regarding the determination of acceptability and sufficiency for docketing, proposed review schedule, and opportunity for hearing regarding the license renewal applications for MPS, Units 2 and 3 (Accession No. ML040680968).

March 10, 2004	NRC staff letter from the Office of General Counsel to Ms. Annette Vietti-Cook, Secretary, Rulemakings and Adjudications Staff, NRC; In the Matter of Dominion Nuclear Connecticut, Inc., Millstone Power Station, Units 2 and 3 (Accession No. ML040830141).
March 12, 2004	NRC Press Release No. 04-033 “NRC Announces Opportunity for Hearing on Application to Renew Millstone Nuclear Power Station, Units 2 and 3, Operating Licenses” (Accession No. ML040720480).
March 16, 2004	Letter to NRC from First Selectman Paul B. Eccard, Town of Waterford, submitting a request for party status and designation of representative in the Matter of Dominion Nuclear Connecticut, Inc., Millstone Power Station, Units 2 and 3 (Accession No. ML040790721).
March 17, 2004	NRC staff letter to Ms. Patricia A. Kurkul, Regional Administrator, National Marine Fisheries Service (NOAA Fisheries), Request for List of Protected Species Within the Area Under Evaluation for the MPS, Units 2 and 3, License Renewal (Accession No. ML040770760).
March 18, 2004	NRC staff letter to Mr. Marvin Moriarty, Regional Director, U.S. Fish and Wildlife Service, Request for List of Protected Species Within the Area Under Evaluation for the MPS, Units 2 and 3, License Renewal (Accession No. ML040780653).
March 22, 2004	Motion to Vacate NRC Secretary Determination of Petition Prematurity and to Accept Petition to Intervene and Request for Hearing as of Date of Filing and to Apply ‘OLD’ CFR Hearing Rules to Said Petition (Accession No. ML041040339).
March 24, 2004	Order In the Matter of Dominion Nuclear Connecticut, Inc., Millstone Nuclear Power Station, Units 2 and 3 regarding Motion to Vacate (Accession No. ML040850646).
March 25, 2004	Memo from Mr. Richard Gallagher, Dominion, regarding telecommunication on March 22, 2004 to NRC requests for Documents which Pertain to the Study of the Winter Flounder Population in the area around Millstone (Accession No. ML040930048).

March 29, 2004	Memo from Mr. Richard Gallagher, Dominion, regarding telecommunication on March 22, 2004 to NRC requests for Documents Pertaining to the Study of the Winter Flounder Population in the area around Millstone (Accession No. ML040930259).
March 30, 2004	NRC staff letter to Mr. Paul Loether, Director, Connecticut Historical Commission, regarding MPS, Units 2 and 3, License Renewal Review (Accession No. ML040900503).
March 31, 2004	NRC staff letter to Mr. David A. Christian, Senior Vice President and Chief Nuclear Officer, DNC, Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process for License Renewal for the MPS, Units 2 and 3 (Accession No. ML040920231).
April 1, 2004	NRC staff letter to Mr. Paul Eccard, First Selectman, Town of Waterford, Acknowledgment of Receipt of Your Letters of Representatives Regarding the Re-Licensing MPS, Units 2 and 3 (Accession No. ML040920601).
April 1, 2004	NRC Staff's Unopposed Motion for an Extension of Time to Respond to Connecticut Coalition Against Millstone's (CCAM's) Petition to Intervene and Request Hearing (Accession No. ML040930079).
April 2, 2004	Notice of Appearance of David R. Lewis and Lillian M. Cuoco, on behalf of Dominion Nuclear Connecticut, Inc., In the Matter of Dominion Nuclear Connecticut, Inc., Millstone Nuclear Power Station, Units 2 and 3 (Accession No. ML040990165).
April 2, 2004	NRC Staff's Response to CCAM's Motion to Vacate and to Accept Petition to Intervene and Request for Hearing (Accession No. ML040970522).
April 2, 2004	Dominion's Answer to CCAM's Motion to Vacate Secretary Determination (Accession No. ML040990158).
April 2, 2004	Letter to Mr. G. Paul Bollwerk, III, Chief Administrative Judge, from Mr. David R. Lewis, Counsel for DNC, In the Matter of Dominion Nuclear Connecticut, Inc., Millstone Nuclear Power Station, Units 2 and 3 (Accession No. ML040990178).

April 2, 2004	Letter to Mr. G. Paul Bollwerk, III, Chief Administrative Judge, from Ms. Nancy Burton, Esq., In the Matter of Dominion Nuclear Connecticut, Inc., Millstone Nuclear Power Station, Units 2 and 3 (Accession No. ML041130236).
April 5, 2004	Email from Mr. G. Paul Bollwerk, III, Chief Administrative Judge, to Ms. Nancy Burton, Esq., regarding MPS, Units 2 and 3 license renewal (Accession No. ML041060622).
April 5, 2004	Order Granting Response Time Extension Motion to the NRC staff (Accession No. ML040990515).
April 8, 2004	NRC staff letter to Mr. Dona Klima, Director, Office of Federal Agency Programs, Advisory Council on Historic Preservation, Regarding MPS, Units 2 and 3, License Renewal Review (Accession No. ML041000158).
April 12, 2004	CCAM's Reply to NRC Staff and Dominion Response to Motion to Vacate (Accession No. ML041130035).
April 12, 2004	Notice of Public Meeting to Discuss Environmental Scoping Process for MPS, Units 2 and 3, License Renewal Application (Accession No. ML041050788).
April 14, 2004	NRC staff letter to the Honorable Matthew Thomas, Chief Sachem, Narragansett Indian Tribe, Request for Comments Concerning MPS, Units 2 and 3, Operating License Renewal (Accession No. ML041050878).
April 14, 2004	NRC staff letter to the Honorable Michael J. Thomas, Chairman, Mashantucket Pequot Tribal Nation, Request for Comments Concerning MPS, Units 2 and 3, Operating License Renewal (Accession No. ML041050880).
April 15, 2004	Letter from Mr. Michael J. Amaral, U.S. Fish and Wildlife Service, providing a response to the March 18, 2004, NRC staff letter requesting information regarding threatened and endangered species in the vicinity of the MPS, Units 2 and 3 (Accession No. ML041190230).

April 16, 2004	Memo from Mr. Richard Gallagher, DNC to NRC, regarding e-mail on April 15, 2004, requesting documents pertaining to the study of the winter flounder population in the area around Millstone (Accession No. ML041120271).
April 19, 2004	E-mail to Mr. Ted B. Doerr from NRC, providing comments regarding the Site Audit Needs (Accession No. ML041240396).
April 26, 2004	E-mail to Mr. Richard Gallagher from NRC, regarding questions and comments on the List of Onsite Data Needs (Accession No. ML041240402).
April 27, 2004	Letter from Mr. Charles H. Evans, Director, Connecticut Department of Environmental Protection, Office of Long Island Sound Programs to NRC and Dominion regarding coastal zone consistency concurrence (Accession No. ML041320497).
April 29, 2004	E-mail from Richard Gallagher, Dominion, to NRC, requesting additional information regarding severe accident mitigation alternatives review for Millstone (Accession No. ML041240405).
May 4, 2004	Memorandum and Order regarding CCAM's Motion to Vacate, In the Matter of Dominion Nuclear Connecticut, Inc., Millstone Nuclear Power Station, Units 2 and 3 (Accession No. ML041250232).
May 11, 2004	NRC Press Release No. 04-030 "NRC Seeks Public Input On Environmental Impact Statement For Proposed Millstone Nuclear Plant License Renewal" (Accession No. ML041320568).
May 14, 2004	Letter from Ms. Nancy Burton, Connecticut Coalition Against Millstone, to NRC, requesting motion of reconsideration of CLI-04-12 (Accession No. ML041420177).
May 18, 2004	NRC Public Meeting Feedback Form "Public Scoping Meetings to Discuss Environmental Issues Pertaining to the Application for License Renewal of Millstone Power Station, Units 2 and 3" (Accession No. ML041700578).
May 18, 2004	Letter from Ms. Annette L. Vietti-Cook, Secretary of the Commission, Commission Order Denying the Connecticut Coalition Against Millstone Motion for Reconsideration of CLI-04-12 (Accession No. ML041390500).

May 19, 2004	Establishment of Atomic Safety and Licensing Board In the Matter of Dominion Nuclear Connecticut, Inc., Millstone Nuclear Power Station, Units 2 and 3 (Accession No. ML041600187).
May 24, 2004	Note to file regarding the docketing of additional documents pertaining to winter flounder in support of the environmental review of MPS, Units 2 and 3 license renewal application (Accession No. ML041460138).
May 24, 2004	Note to file regarding the docketing of additional documents pertaining to winter flounder in support of the environmental review of MPS, Units 2 and 3 license renewal application (Accession No. ML041460283).
May 24, 2004	Note to file regarding the docketing of e-mails sent to DNC in support of the environmental review of MPS, Units 2 and 3 license renewal application (Accession No. ML041460250).
May 24, 2004	Comment letter from the Honorable Fred W. Thiele, Jr., Assemblyman, regarding the environmental review of MPS, Units 2 and 3 license renewal application (Accession No. ML041620373).
June 1, 2004	Note to file regarding the docketing of documents pertaining to winter flounder in support of the environmental review of MPS, Units 2 and 3 license renewal application (Accession No. ML041560169).
June 1, 2004	E-mail from Mr. Charles D. Stephani providing scoping comments regarding MPS, Units 2 and 3 license renewal review (Accession No. ML041770290).
June 2, 2004	E-mail from Hortense and Ralph Carpenter providing scoping comments regarding MPS, Units 2 and 3 license renewal review (Accession No. ML041770288).
June 3, 2004	E-mail from Kelly L. Streich providing scoping comments regarding MPS, Units 2 and 3 license renewal review (Accession No. ML041770177).
June 4, 2004	E-mail from Mr. Douglas Schwartz providing scoping comments regarding MPS, Units 2 and 3 license renewal review (Accession No. ML041770175).
June 4, 2004	Letter from Ms. Nancy Burton, Esq., to NRC staff regarding the MPS, Units 2 and 3 license renewal review (Accession No. ML041770182).

June 7, 2004	NRC Staff Answer to Petition to Intervene and Request for Hearing of CCAM (Accession No. ML041600187).
June 7, 2004	DNC's Answer to CCAM's Petition to Intervene and Request for Hearing (Accession No. ML041680556).
June 22, 2004	NRC staff letter to Mr. David A. Christian, DNC, forwarding request for additional information regarding severe accident mitigation alternatives for the MPS, Units 2 and 3 license renewal review (Accession No. ML041740175).
June 24, 2004	Summary of Public Scoping Meetings to Support Review to support the review of MPS, Units 2 and 3 license renewal review (Accession No. ML041830272).
June 24, 2004	CCAM's Motion for Leave to File Reply to Licensee and NRC Staff Answers to Petition, Amended Petition and Declarations of CCAM Members *NUNC PRO TUNC* (Accession No. ML041800056).
June 25, 2004	NRC Press Release No. 04-078: "NRC Atomic Safety Licensing Board to Hold Prehearing Conference June 30 on Proposed Millstone License Renewal" (Accession No. ML041770406).
July 2, 2004	CCAM's Motion for Stay of Proceedings (Accession No. ML041910373).
July 27, 2004	NRC letter to DNC forwarding the summary of site audit to support the review of MPS, Units 2 and 3 license renewal review (Accession No. ML042100293).
July 28, 2004	Memorandum and Order Ruling on Standing and Contentions in the Matter of MPS, Units 2 and 3 (Accession No. ML042210313).
July 28, 2004	Letter from First Selectman Paul B. Eccard, Town of Waterford, to NRC regarding MPS, Units 2 and 3 license renewal review (Accession No. ML042160111).
August 12, 2004	CCAM's Notice of Appeal of the decision of the Atomic Safety and Licensing Board's Memorandum and Order (Ruling on Standing and Contentions (Accession No. ML042300617).

August 12, 2004	CCAM's Motion for Reconsideration and Request for Leave to Amend Petition (Accession No. ML042320548).
August 13, 2004	Letter from Leslie N. Hartz, DNC, forwarding response to request for additional information regarding MPS, Units 2 and 3 license renewal review (Accession No. ML042320613).
August 17, 2004	NRC staff letter to Mr. Paul B. Eccard, acknowledging receipt of comments regarding MPS, Units 2 and 3 license renewal review (Accession No. ML042320342).
August 17, 2004	Declaration of Ernest J. Sternglass in the Matter of DNC, Millstone Power Station, Units 2 and 3 (Accession No. ML042330247).
August 18, 2004	NRC Staff Answer to Notice of Appeal of CCAM (Accession No. ML042320445).
August 18, 2004	NRC Staff Response to CCAM's Motion for Reconsideration and Request for Leave to Amend Petition (Accession No. ML042320500).
August 27, 2004	NRC staff letter to Mr. David A. Christian, DNC, forwarding the environmental scoping summary report associated with the staff's review of MPS, Units 2 and 3 applications (Accession No. ML042400543).
September 16, 2004	E-mail correspondence between NRC staff and DNC regarding the SAMA review for MPS, Units 2 and 3 applications (Accession No. ML042710222).
September 20, 2004	Memorandum and Order Denying Motion for Reconsideration and Request for Leave to Amend Petition in the Matter of MPS, Units 2 and 3 (Accession No. ML042640524).
September 21, 2004	Letter from Ms. Mary A. Colligan, NOAA Fisheries, providing a response to the March 18, 2004, NRC staff letter requesting information regarding threatened and endangered species in the vicinity of the MPS, Units 2 and 3 (Accession No. ML042810294).
September 24, 2004	Summary of telephone conference conducted with the Town of Waterford regarding MPS, Units 2 and 3 applications (Accession No. ML042710257).

September 24, 2004	Summary of telephone conference regarding the SAMA review of MPS, Units 2 and 3 applications (Accession No. ML042710529).
October 6, 2004	Letter from Mr J. Paul Loether, Connecticut State Historic Preservation Officer, providing comments regarding MPS, Units 2 and 3 License Renewal Application effect on historic properties (Accession No. ML042880497).
October 6, 2004	Letter from First Selectman Paul B. Eccard, Town of Waterford, to Richard L. Emch, Jr., NRC, response to September 24, 2004, letter from NRC regarding MPS, Units 2 and 3 license renewal review (Accession No. ML043210191).
October 25, 2004	Note to File from Richard L. Emch, Jr., NRC. Subject: Summary of Telephone Conference Regarding SAMA Analyses Conducted on October 7, 2004, with Dominion Connecticut Nuclear, Inc. In Support of the Environmental Review of the License Renewal Application for Millstone Power Station Units 2 and 3. (Accession No. ML0430004490).
October 29, 2004	Note to File from Richard L. Emch, Jr., NRC. Subject: Correction of Summary Dated September 24, 2004, of Telephone Conference Regarding SAMA Analyses Conducted on September 13, 2004, with Dominion Connecticut Nuclear, Inc. in Support of the Environmental Review of the License Renewal Application for Millstone Power Station Units 2 and 3. (Accession No. ML 0430303620).
November 9, 2004	NRC staff letter to Ms. Patricia A. Kurkul, Regional Administrator, NOAA Fisheries, Request for Concurrence - Biological Assessment for Millstone Power Station, Units 2 and 3 (Accession No. ML043170594).
November 9, 2004	NRC staff letter to Mr. Marvin Moriarty, Regional Director, U.S. Fish and Wildlife Service, Request for Concurrence - Biological Assessment for Millstone Power Station, Units 2 and 3 (Accession No. ML043170643).

Appendix D

Organizations Contacted

Appendix D

Organizations Contacted

During the course of the staff's independent review of environmental impacts from operations during the renewal term, the following Federal, State, regional, local, and Native American tribal agencies were contacted:

Chamber of Commerce of Eastern Connecticut, Inc., Gales Ferry, CT

Connecticut Commercial Realty, New London, CT

Connecticut Department of Environmental Protection, Bureau of Air Management, Division of Radiation, Hartford, CT

Connecticut Department of Environmental Protection, Bureau of Waste Management, Hartford, CT

Connecticut Department of Environmental Protection, Bureau of Water Management, Hartford, CT

Connecticut Department of Environmental Protection, Marine Fisheries Division, Old Lyme, CT

Connecticut Department of Environmental Protection, Office of Long Island Sound Programs, Hartford, CT

Connecticut Historical Commission, Hartford, CT

National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center, Milford Laboratory, Milford, CT

Southeastern Connecticut Council of Governments, Norwich, CT

Southeastern Connecticut Enterprise Region, New London, CT

Town of Waterford, CT

U.S. Geological Survey, Woods Hole, MA

United Way of Southeastern Connecticut, Gales Ferry, CT

University of Connecticut, Department of Physiology and Neurobiology, Storrs, CT

Waterford Public Schools, Waterford, CT

Appendix E

Millstone Compliance Status and Consultation Correspondence

Appendix E

Millstone Compliance Status and Consultation Correspondence

Correspondence received during the process of evaluation of the application for renewal of the operating licenses for Millstone Power Station Units 2 and 3 (Millstone) are identified in Table E-1. Copies of the correspondence are included at the end of this appendix.

The licenses, permits, consultations, and other approvals obtained from Federal, State, regional, and local authorities for Millstone are listed in Table E-2.

Table E-1. Consultation Correspondence

Source	Recipient	Date of Letter
U.S. Nuclear Regulatory Commission (P. T. Kuo)	National Marine Fisheries Service (P. A. Kurkul)	March 17, 2004
U.S. Nuclear Regulatory Commission (P. T. Kuo)	U.S. Fish and Wildlife Service (M. Moriarty)	March 18, 2004
U.S. Nuclear Regulatory Commission (P. T. Kuo)	Connecticut Historical Commission (Paul Loether)	March 30. 2004
U.S. Nuclear Regulatory Commission (P. T. Kuo)	Advisory Council on Historic Preservation (D. Klima)	April 8, 2004
U.S. Nuclear Regulatory Commission (P. T. Kuo)	Narragansett Indian Tribe (M. Thomas, Chief Sachem)	April 14, 2004
U.S. Nuclear Regulatory Commission (P. T. Kuo)	Mashantucket Pequot Tribal Nation (M. J. Thomas)	April 14, 2004
U.S. Fish and Wildlife Service (M. J. Amaral)	U.S. Nuclear Regulatory Commission (P. T. Kuo)	April 15, 2004
Connecticut Department of Environmental Protection (C. H. Evans)	U.S. Nuclear Regulatory Commission (R. Emch)	April 27, 2004
State of Connecticut Commission on Culture and Tourism (J. Paul Loether)	U.S. Nuclear Regulatory Commission (P. T. Kuo)	October 6, 2004

Table E-1. Consultation Correspondence (contd.)

Source	Recipient	Date of Letter
U.S. Nuclear Regulatory Commission (P. T. Kuo)	NOAA Fisheries (P. A. Kurkul)	November 9, 2004
U.S. Nuclear Regulatory Commission (P. T. Kuo)	U.S. Fish and Wildlife Service (M. Moriarty)	November 9, 2004

Table E-2. Federal, State, Local, and Regional Licenses, Permits, Consultations, and Other Approvals for Millstone

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
NRC	10 CFR Part 50	Operating license, Millstone Unit 2	DPR-65	09/26/75	07/31/15	Authorizes operation of Unit 2
NRC	10 CFR Part 50	Operating license, Millstone Unit 3	NPF-49	01/31/86	11/25/25	Authorizes operation of Unit 3
USACE	Section 10, River and Harbor Act (33 USC 403)	Permit	CT-NIAN-78-507	10/11/78	No expiration date	Install and maintain sandbag dike for ecology laboratory mariculture work.
USACE	Section 10, River and Harbor Act (33 USC 403)	Permit	CT-NIAN-77-377 (LOP)	09/19/77	No expiration date	Install and maintain ecology laboratory seawater intake pipes.
USDOT	49 USC 5108	Registration	061202550034KL	06/13/02	06/30/04	Shipment of hazardous materials
FWS	Migratory Bird Treaty Act (16 USC 703-712)	Depredation Permit	MB728673-0	06/07/03	06/30/04	Removal of birds, eggs and nests from utility structures and property.
FWS	Section 7 of the Endangered Species Act (16 USC 1536)	Consultation				Requires a Federal agency to consult with FWS regarding whether a proposed action will affect endangered or threatened terrestrial species.
NMFS	Section 7 of the Endangered Species Act (16 USC 1536)	Consultation				Requires a Federal agency to consult with NMFS regarding whether a proposed action will affect endangered or threatened aquatic species.

Table E-2. (contd.)

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
Connecticut Historical Commission	Section 106 of the National Historic Preservation Act (16 USC 470f)	Consultation				The National Historic Preservation Act requires Federal agencies to take into account the effect of any undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places.
Connecticut Department of Environmental Protection (CTDEP)	Section 307 of the Coastal Zone Management Act [16 USC 1456(c)(3)(A)]	Consistency determination with the Connecticut Coastal Management Program				The Connecticut Department of Environmental Protection waived the review to coordinate with the State NPDES permit review process.
CTDEP	CGS 4-182, 22a-430, 22a-430-1 et seq.	National Pollution Discharge Elimination System Permit	NPDES permit CT0003263	12/14/92		Renewal application submitted 6/13/97; plant discharges to Long Island Sound
CTDEP	CGS 22a-430b	General Permit for stormwater discharges	GSI001430	09/25/03		Stormwater discharges; industrial activities
CTDEP	CGS 22a-6K	Emergency Authorization	EA 0100176	10/13/00		Transferred 3/31/01: plant discharges to Long Island Sound
CTDEP	CGS 22a-430	General Permit for Discharge of Minor Photographic Processing Wastewater	GPH000354	10/20/95	10/20/05	Discharge of minor photographic process wastewater to municipal sewer
CTDEP	CGS 22a-430	General Permit for the Discharge of Water Treatment Wastewater	GWT 000175	03/26/01	05/01/05	Water treatment wastewater

Table E-2. (contd.)

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
CTDEP	CGS 22a-430	General Permit for Miscellaneous Discharges of Sewer Compatible Wastewater	GMI000012	03/13/02	04/30/11	Wastewater discharges from Fire Training Facility
CTDEP	Ct. P.A. 82-402, Section 4	Registration	2000-018-PWR-SU (Unit 2)	07/12/83		Transferred on 03/31/01; No expiration date; Divert large volume of water from Long Island Sound for steam condenser cooling water.
CTDEP	Ct. P.A. 82-402, Section 4	Registration	2000-019-PWR-SU (Unit 3)	07/12/83		Transferred on 03/31/01; No expiration date; Divert large volume of water from Long Island Sound for steam condenser cooling water.
CTDEP	CGS 22a-174	Permit	199-0003-0043	08/10/00		Emissions from fire training mock-up facility and two propane-fired water pumps
CTDEP	CGS 22a-174	Permit	199-0003-0044	04/27/99		Emissions from diesel-fired trash water pump
CTDEP	CGS 22a-174	Permit	199-0003-0045	04/27/99		Emissions from diesel-fired motorpool air compressor
CTDEP	CGS 22a-174	Permit	199-0003-0046	04/27/99		Operate diesel-fired motorpool air compressor
CTDEP	CGS 22a-174	Permit	199-0004-0056	11/09/99		Emissions from Unit 2 emergency diesel generator (1 of 2)
CTDEP	CGS 22a-174	Permit	199-0003-0055	11/09/99		Emissions from Unit 2 emergency diesel generator (2 of 2)

Table E-2. (contd.)

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
CTDEP	CGS 22a-174	Permit	199-0003-0007	01/24/86		Emissions from Unit 3 auxiliary boiler (1 of 2)
CTDEP	CGS 22a-174	Permit	199-0003-0008	01/24/86		Emissions from Unit 3 auxiliary boiler (2 of 2)
CTDEP	CGS 22a-174	Permit	199-0003-0009	05/21/85		Emissions from Unit 3 emergency diesel generator (1 of 2)
CTDEP	CGS 22a-174	Permit	199-0003-0010	05/21/85		Emissions from Unit 3 emergency diesel generator (2 of 2)
CTDEP	CGS 22a-174	Permit	199-0003-0017	08/25/92		Emissions from station blackout emergency diesel generator (3 of 3)
CTDEP	CGS 22a-174	Permit	199-0003-0053	05/27/99		Emissions from Unit 3 ESF diesel compressor
CTDEP	CGS 22a-449	Notification Site ID	170-8414	03/27/01		Unit 3 emergency generator underground storage tank E6, #2 diesel oil
CTDEP	CGS 22a-449	Notification Site ID	170-8414	03/27/01		Unit 3 emergency generator underground storage tank E7, #2 diesel oil
CTDEP	CGS 22a-449	Notification Site ID	170-8414	03/27/01		Unit 3 auxiliary boiler underground storage tank F8, #4 heating oil
CTDEP	CGS 22a-449	Notification Site ID	170-8414	03/27/01		Unit 3 auxiliary boiler underground storage tank F9, #4 heating oil
CTDEP	CGS 22a-449	Notification Site ID	170-8425	03/27/01		Simulator building underground storage tank, #2 heating oil

Table E-2. (contd.)

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
CTDEP	CGS 22a-449	Notification Site ID	170-8486	03/27/01		Unit 2 emergency diesel underground storage tank, #2 fuel oil. This tank has been retired.
South Carolina Department of Health and Environmental Control	South Carolina Radioactive Waste Transportation and Disposal Act (Act No. 429 of 1980)	Permit	0013-06-04	12/10/03	12/31/04	Transport radioactive wastes
Tennessee Department of Environment and Conservation	Rule 1200-2-10.32	License	T-CT003-L04	12/02/03	12/31/04	Ship radioactive materials
CTDEP	CGS 26-60	Scientific Collector Permit	219	01/17/03	01/16/06	Collect fish and lobsters
CTDEP	CGS Title 22a, Chapter 445	Permit (Part A application)	not applicable	12/22/00		Store radioactive hazardous (i.e., mixed) waste
CTDEP	CGS 22a-174	Permit	199-0038-TV	01/29/03	01/29/08	Emissions (Title V permit)

CFR = Code of Federal Regulations
USACE = U.S. Army Corps of Engineers
USDOT = U.S. Department of Transportation
FWS = U.S. Fish and Wildlife Service
NRC = U.S. Nuclear Regulatory Commission
EPA = U.S. Environmental Protection Agency
NMFS = National Marine Fisheries Service
USC = United States Code
CGS = Connecticut General Statutes
ESF = Engineered Safeguards Features

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 17, 2004

Patricia A. Kurkul, Regional Administrator
NOAA Fisheries
Northeast Regional Office
One Blackburn Drive
Gloucester, MA 09130-2298

SUBJECT: REQUEST FOR LIST OF PROTECTED SPECIES WITHIN THE AREA UNDER EVALUATION FOR MILLSTONE POWER STATION, UNITS 2 AND 3, LICENSE RENEWAL

Dear Ms. Kurkul:

The U.S. Nuclear Regulatory Commission (NRC) is reviewing an application submitted by Dominion Nuclear Connecticut Inc. (DNC) for the renewal of the operating licenses for Millstone Power Station, Units 2 and 3 (MPS). MPS is located on the north shore of Long Island Sound in Waterford, Connecticut, approximately 40 miles southeast of Hartford, Connecticut. As part of the review of the license renewal application, the NRC is preparing a Supplemental Environmental Impact Statement (SEIS) under the provisions of the National Environmental Policy Act (NEPA) of 1969, as amended, which include an analysis of pertinent environmental issues, including endangered or threatened species and impacts to fish and wildlife. This letter is being submitted under the provisions of the Endangered Species Act of 1973, as amended, and the Fish and Wildlife Coordination Act of 1934, as amended.

The proposed action would include the use and continued maintenance of existing plant facilities and transmission lines. The MPS site covers approximately 525 acres, of which approximately 220 acres are industrial. The area surrounding MPS is characterized by old field, mesic hardwood forest, coastal marsh and beach habitats. DNC also maintains a 50-acre wildlife refuge in the eastern portion of the MPS site.

Each MPS unit uses a once-through open-cycle cooling system with intakes on Niantic Bay and surface discharges to an old quarry cut, which empties into Long Island Sound. Occasional dredging or de-mucking at the intakes is performed as a normal part of operation.

For the specific purpose of connecting MPS to the regional transmission system, there is a total of approximately 91 miles of transmission line corridors that occupy approximately 3,052 acres of land. These transmission line corridors are being evaluated as part of the SEIS process. The transmission line corridors traverse New London, Toland, Hartford, Middlesex, and New Haven Counties. The corridors pass through land that is primarily agricultural and forest land. The enclosed transmission line map shows the transmission system that is being evaluated in the SEIS. Four 345-kilovolt (kV) lines connect MPS to the electric grid. All four transmission lines run northward from the plant in a common corridor (415 to 500 feet wide) for 9.1 miles to Hunts Brook Junction. At Hunts Brook Junction, the lines diverge, with two lines running north

P. Kurkul 2

to the Card and Manchester Substations, one line running east to the Montville Station, and one line running west to the Southington Substation. These four lines share corridors with other previously existing transmission lines.

To support the EIS preparation process and to ensure compliance with Section 7 of the Endangered Species Act of 1973, the NRC requests a list of endangered, threatened, candidate, and proposed species, and designated and proposed critical habitat under the jurisdiction of NOAA Fisheries, that may be in the vicinity of MPS site and its transmission line corridors. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act. The NRC has also contacted the Fish and Wildlife Service and requested a list of species and information on protected, proposed, and candidate species and critical habitat that may be in the vicinity of MPS and its associated transmission lines.

We plan to hold two public NEPA scoping meetings on May 18, 2004, at the Waterford Town Hall Auditorium, 15 Rope Ferry Road in Waterford, Connecticut. On May 19, 2004, we plan to conduct a site audit. You and your staff are invited to attend both the site audit and the public meetings. Your office will receive a copy of the draft SEIS along with a request for comments. The anticipated publication date for the draft SEIS is December 2004.

If you have any questions concerning the NRC staff review of this license renewal application, please contact Mr. Richard L. Emch, Jr., Senior Project Manager at 301-415-1590 or RLE@nrc.gov.

Sincerely,

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-336 and 50-423

Enclosures: 1. MPS Transmission Line Map
2. MPS Site Layout

cc w/encl.: See next page

Figure 3-2
Transmission Line Map

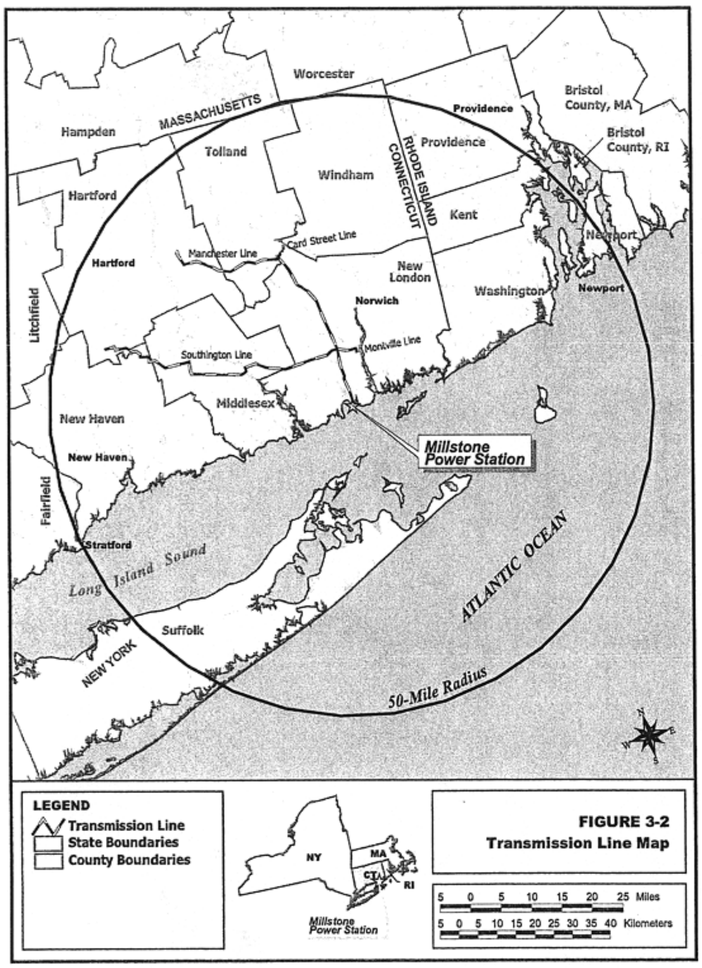
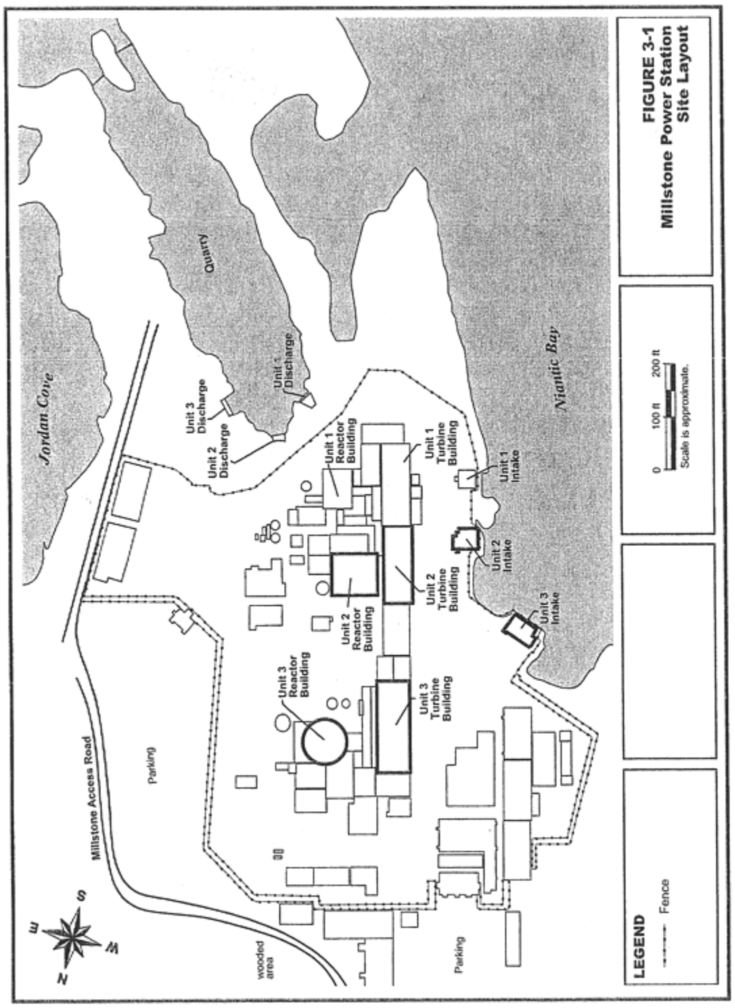


Figure 3-1
Miillstone Power Station Site Layout



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 18, 2004

Marvin Moriarty, Regional Director
Northeast Regional Office
U.S. Fish and Wildlife Service
300 Westgate Center Drive
Hadley, MA 01035-9589

SUBJECT: REQUEST FOR LIST OF PROTECTED SPECIES WITHIN THE AREA UNDER EVALUATION FOR THE MILLSTONE POWER STATION, UNITS 2 AND 3 LICENSE RENEWAL

Dear Mr. Moriarty:

The U.S. Nuclear Regulatory Commission (NRC) is reviewing an application submitted by Dominion Nuclear Connecticut Inc. (DNC) for the renewal of the operating licenses for Millstone Power Station, Units 2 and 3 (MPS). MPS is located on the north shore of Long Island Sound in Waterford, Connecticut, approximately 40 miles southeast of Hartford, Connecticut. As part of the review of the license renewal application, the NRC is preparing a Supplemental Environmental Impact Statement (SEIS) under the provisions of the National Environmental Policy Act (NEPA) of 1969, as amended, which includes an analysis of pertinent environmental issues, including endangered or threatened species and impacts to fish and wildlife. This letter is being submitted under the provisions of the Endangered Species Act of 1973, as amended, and the Fish and Wildlife Coordination Act of 1934, as amended.

The proposed action would include the use and continued maintenance of existing plant facilities and transmission lines. The MPS site covers approximately 525 acres, of which approximately 220 acres is industrial. The area surrounding MPS is characterized by old field, mesic hardwood forest, coastal marsh and beach habitats. DNC also maintains a 50-acre wildlife refuge in the eastern portion of the MPS site.

Each MPS unit uses a once-through open-cycle cooling system with intakes on Niantic Bay and surface discharges to an old quarry cut, which empties into Long Island Sound. Occasional dredging or de-mucking at the intakes is performed as a normal part of operation.

For the specific purpose of connecting MPS to the regional transmission system, there is a total of approximately 91 miles of transmission line corridors that occupy approximately 3,052 acres of land. These transmission line corridors are being evaluated as part of the SEIS process. The transmission line corridors traverse New London, Toland, Hartford, Middlesex, and New Haven Counties. The corridors pass through land that is primarily agricultural and forest land. The enclosed transmission line map shows the transmission system that is being evaluated in the SEIS. Four 345-kilovolt (kV) lines connect MPS to the electric grid. All four transmission lines run northward from the plant in a common corridor (415 to 500 feet wide) for 9.1 miles to Hunts Brook Junction. At Hunts Brook Junction, the lines diverge, with two lines running north

1

M. Moriarty - 2 -

to the Card and Manchester Substations, one line running east to the Montville Station, and one line running west to the Southington Substation. These four lines share corridors with other previously existing transmission lines.

To support the SEIS preparation process and to ensure compliance with Section 7 of the Endangered Species Act, the NRC requests a list of species and information on protected, proposed, and candidate species and critical habitat that may be in the vicinity of MPS and its associated transmission lines. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act.

We plan to hold two public NEPA scoping meetings on May 18, 2004, at the Waterford Town Hall Auditorium, 15 Rope Ferry Road in Waterford, Connecticut. On May 19, 2004, we plan to conduct a site audit. You and your staff are invited to attend both the site audit and the public meetings. Your office will receive a copy of the draft SEIS along with a request for comments. The anticipated publication date for the draft SEIS is December 2004.

If you have any questions concerning the NRC staff review of this license renewal application, please contact Mr. Richard L. Emch, Jr., Senior Project Manager at 301-415-1590 or RLE@nrc.gov.

Sincerely,

for

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-336, 50-423

Enclosures: 1. MPS Transmission Line Map
2. MPS Site Layout

cc w/encl.: See next page

Figure 3-2
Transmission Line Map

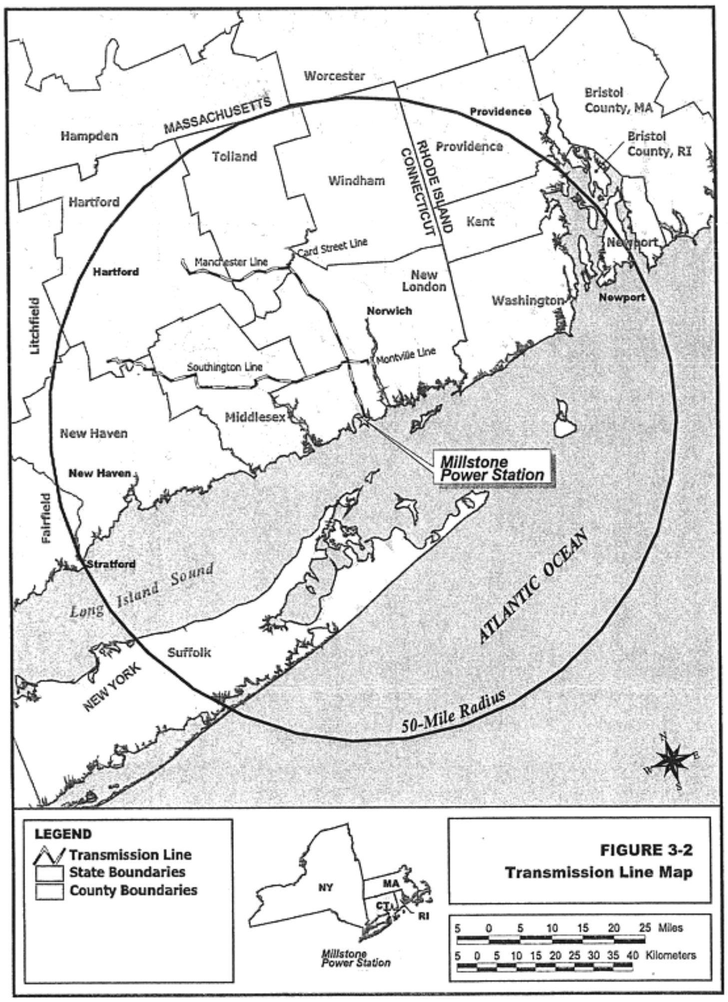
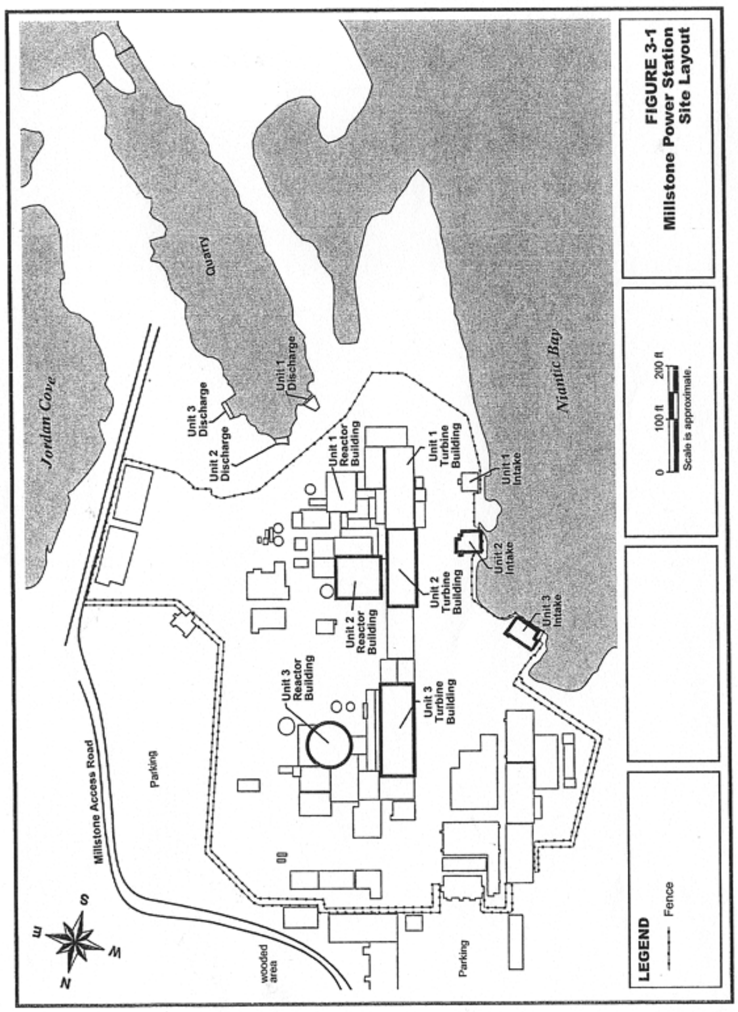


Figure 3-1
Miillstone Power Station Site Layout



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 30, 2004

Mr. Paul Loether, Director
Connecticut Historical Commission
59 South Prospect Street
Hartford, CT 06106

SUBJECT: MILLSTONE POWER STATION, UNITS 2 AND 3 LICENSE RENEWAL REVIEW

Dear Mr. Loether:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application to renew the operating licenses for Millstone Power Station, Units 2 and 3 (MPS), which is located on the north shore of Long Island Sound in Waterford, Connecticut, approximately 40 miles southeast of Hartford, Connecticut. MPS is operated by Dominion Nuclear Connecticut Inc. (DNC). The application for renewal was submitted by DNC on January 22, 2004, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 54 (10 CFR Part 54). The NRC has established that, as part of the staff review of any nuclear power plant license renewal action, a site-specific Supplemental Environmental Impact Statement (SEIS) to its "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS), NUREG-1437, will be prepared under the provisions of 10 CFR Part 51, the NRC rules that implement the National Environmental Policy Act of 1969 (NEPA). In accordance with 36 CFR 800.8, the SEIS will include analyses of potential impacts to historic and archaeological resources.

In the context of the National Historic Preservation Act of 1966, as amended, the NRC staff has determined that the area of potential effect (APE) for a license renewal action is the area at the power plant site and its immediate environs that may be impacted by post-license renewal land-disturbing operations or projected refurbishment activities associated with the proposed action. The APE may extend beyond the immediate environs in those instances where post-license renewal land-disturbing operations or projected refurbishment activities, specifically related to license renewal, may potentially have an effect on known or proposed historic sites. This determination is made irrespective of ownership or control of the lands of interest.

While preparing its application, DNC contacted your office by letter dated July 31, 2003. In its letter, DNC stated there are no plans to significantly alter current operations over the license renewal period. DNC further stated that no expansion of existing facilities is planned, and no major structural modifications have been identified for the purpose of supporting license renewal. In addition, no land-disturbing activities are anticipated beyond those required for routine maintenance and repairs. Your office responded in a letter dated August 5, 2003, stating that the proposed undertaking will have no effect on historic, architectural, or archaeological resources listed on or eligible for the National Register of Historic Places.

P. Loether 2

On May 18, 2004, the NRC will conduct two public NEPA scoping meetings at the Waterford Town Hall Auditorium, 15 Rope Ferry Road in Waterford, Connecticut. You and your staff are invited to attend. Your office will receive a copy of the draft SEIS along with a request for comments. The anticipated publication date for the draft SEIS is December 2004. If you have any questions or require additional information, please contact Mr. Richard L. Emch, Jr., Senior Project Manager at 301-415-1590 or RLE@nrc.gov.

Sincerely,

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-336, 50-423

Enclosure: As stated

cc w/o encl.: See next page

1

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

April 8, 2004

Mr. Don Klima, Director
Office of Federal Agency Programs
Advisory Council on Historic Preservation
Old Post Office Building
1100 Pennsylvania Avenue, NW, Suite 809
Washington, DC 20004

SUBJECT: MILLSTONE POWER STATION, UNITS 2 AND 3 LICENSE RENEWAL REVIEW

Dear Mr. Klima:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application to renew the operating licenses for Millstone Power Station, Units 2 and 3 (MPS), which is located on the north shore of Long Island Sound in Waterford, Connecticut, approximately 40 miles southeast of Hartford, Connecticut. MPS is operated by Dominion Nuclear Connecticut Inc. (DNC). The application for renewal was submitted by DNC on January 22, 2004, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 54 (10 CFR Part 54). The NRC has established that, as part of the staff review of any nuclear power plant license renewal action, a site-specific Supplemental Environmental Impact Statement (SEIS) to its "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS), NUREG-1437, will be prepared under the provisions of 10 CFR Part 51, which implements the National Environmental Policy Act of 1969 (NEPA). In accordance with 36 CFR 800.8, the SEIS will include analyses of potential impacts to historic and cultural resources. A draft SEIS is scheduled for publication in December of 2004, and will be provided to you for review and comment.

If you have any questions or require additional information, please contact the Senior Project Manager for the Millstone project, Mr. Richard L. Emch, Jr., at 301-415-1590 or RLE@nrc.gov.

Sincerely,

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-336, 50-423

cc: See next page

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Field Office
70 Commercial Street, Suite 300
Concord, New Hampshire 03301-5087

RE: License Renewal, Millstone Power Station, Units 2 & 3
Waterford, CT

April 15, 2004

Pao-Tsin Kuo
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Mr. Kuo:

I have reviewed your request for information on endangered and threatened species and their habitats for the above-referenced project. The following comments are provided in accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531-1543) and the Fish and Wildlife Coordination Act (48 Stat., 401, as amended; 16 U.S.C. 661 et seq.).

The following is a list of federally-protected and candidate species that may be in the vicinity of MPS and the associated transmission lines: the federally-endangered roseate tern (*Sterna dougallii dougallii*) nests on the Atlantic coast/islands, federally-threatened piping plover (*Charadrius melodus*) nests on the Atlantic coast, the federally-threatened puritan tiger beetle (*Cicindela puritana*) is found in Middlesex County, the federally-threatened small whorled pogonia (*Isotria medeoloides*) is found in Hartford/New Haven/Fairfield/New London/Windham/Tolland /Middlesex and Litchfield Counties, and the federally-threatened bald eagle (*Haliaeetus leucocephalus*) uses the entire state for migratory/nesting purposes. In addition, the New England cottontail (*Sylvilagus transitionalis*) has been proposed as a canditate for federal listing. The New England cottontail may be found in the vicinity of the MPS and associated transmission lines.

With regard to our concerns under the provisions of the Fish and Wildlife Coordination Act, we are unable to provide detailed comments on the potential effects of the proposed action on fish and wildlife resources at this time. We will provide further comments after we review the Supplemental Environmental Impact Statement.

- 2 -

Thank you for your cooperation and please contact me at 603-223-2541, extension 23, for endangered species questions, and contact Greg Mannesto of our Rhode Island office at 401-364-9124 for any other concerns you might have. **In the future, in order to expedite your reply, please direct any inquiries of this nature to this office at the above address.**

Sincerely yours,

Michael J. Amaral

Michael J. Amaral
Endangered Species Specialist
New England Field Office

1

STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION

April 27, 2004

Mr. Richard Emch
Environmental Project Manager
USNRC OWFN
11555 Rockville Pike
Rockville, MD 20852

and

Ms. P. F. Faggert
V.P. and Chief Env. Officer
Dominion
5000 Dominion Blvd.
Glen Allen, VA 23060

RE: Request to renew the operating licenses for
Units 2 and 3 of the Millstone Power Station in
Waterford, Connecticut
Dominion Nuclear Connecticut, applicant

Dear Mr. Emch and Ms. Faggert:

We are in receipt of a request for Federal coastal consistency concurrence for renewal of the operating licenses for Units 2 and 3 at the Millstone Power Station in Waterford, Connecticut. This consistency concurrence request was submitted pursuant to 15 CFR 930.50.

Continued operation of the Millstone Nuclear Power plant requires renewal of the NPDES permit previously issued for the discharge of cooling waters. A request for that permit renewal was submitted by the applicant in a timely fashion and is currently pending before the Department.

In the interest of permit coordination, we have elected to waive the separate Federal coastal consistency review for this particular operating license application. However, this waiver should not be construed as our determination that the proposed activities are consistent with Connecticut's approved coastal management program. Instead, the State of Connecticut will evaluate the consistency of this proposed activity for conformance with the relevant coastal management policies, standards and criteria in conjunction with the State's NPDES permit review process as required by the Connecticut Coastal Management Act [Connecticut General Statutes (CGS) sections 22a-90 through 22a-112].

Phone 860.424.3034 Fax 860.424.4054

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April 27, 2004 Page 2

This waiver is provided in response to the Federal coastal consistency concurrence request and the supporting documentation submitted to this Office on January 27, 2004. Any subsequent modification, addition or deletion to the proposed activity, regardless of its magnitude or impact, constitutes a new application for the purposes of federal consistency certification. Accordingly, all such modifications, additions or deletions must be submitted to the State of Connecticut for a coastal consistency concurrence pursuant to 15 CFR 930.50.

If you have any questions regarding this matter, you may contact Margaret Welch of this Office via e-mail at margaret.welch@po.state.ct.us or by phone at 860.424.3034. Thank you.

Sincerely,

Charles H. Evans

Charles H. Evans, Director
Office of Long Island Sound Programs

CHE/MLW/w

cc: Allison Castellan
Charles Nezianya
Edward Wilds

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930-2298

SEP 21 2004

Pao-Tsin Kuo
Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
US Nuclear Regulatory Commission
MS T-11 F1
Washington, DC 20555

Re: Millstone Power Station Units 2 and 3 license renewal

Dear Mr. Kuo,

This is in response to your letter dated March 17, 2004 requesting information on the presence of threatened, endangered, candidate and proposed species listed under the jurisdiction of the National Marine Fisheries Service (NOAA Fisheries) in the vicinity of the Millstone Power Station located on the north shore of Long Island Sound in Waterford, Connecticut. The US Nuclear Regulatory Commission (NRC) is reviewing an application submitted by Dominion Nuclear Connecticut Inc. (DNC) for the renewal of the operating licenses for Millstone Power Station, Units 2 and 3 (MPS). In support of this review, the NRC is currently preparing a Supplemental Environmental Impact Statement (EIS).

Four species of federally threatened or endangered sea turtles under the jurisdiction of the National Marine Fisheries Service (NOAA Fisheries) may be found seasonally in the waters of Long Island. Sea turtles are expected to be in the vicinity of the project area in warmer months, typically from May 1 to November 15. The sea turtles in northeastern nearshore waters are typically small juveniles with the most abundant being the federally threatened loggerhead (*Caretta caretta*) followed by the federally endangered Kemp's ridley (*Lepidochelys kempi*). Loggerhead turtles have been found to be relatively abundant off the Northeast (from near Nova Scotia, Canada to Cape Hatteras, North Carolina). From November to March in 1985 through 1988, 130 cold-stunned turtles were collected along the Long Island shoreline, including 97 Kemp's ridleys. The waters of Long Island Sound have also been found to be warm enough to support federally endangered green sea turtles (*Chelonia mydas*) from June through October. The three species of chelonid turtles found in the Northeast remain very briefly in open ocean waters, spending most of their time during the summer months in harbors and estuarine waters. Federally endangered leatherback sea turtles (*Dermochelys coriacea*) may be found in the waters of Long Island Sound during the warmer months as well.

Federally endangered North Atlantic right whales (*Eubalaena glacialis*), humpback whales (*Megaptera novaeangliae*), and fin whales (*Balaenoptera physalus*) may all also be found seasonally in Northeast waters. North Atlantic right whales have been documented in the nearshore waters of New York from January through September. Humpback whales feed during the spring, summer, and fall over a range that encompasses the eastern coast of the United States. Fin whales are common in waters of the United States Exclusive Economic Zone, principally offshore from Cape Hatteras northward. While these whale species are not considered residents of Long Island Sound, it is possible that transients may enter the area during seasonal migrations.

The entrainment and impingement of sea turtles at several nuclear power plants on the East Coast has been documented. As sea turtles may be seasonally present in the vicinity of the intakes associated with the MPS, NOAA Fisheries recommends that this impact be fully addressed in the SEIS being prepared in anticipation of license renewal actions. NOAA Fisheries staff look forward to reviewing the SEIS and will be available to NRC staff to discuss any potential impacts on listed species. Please contact Julie Crocker of my staff ((978)281-9328 x6530 or julie.crocker@noaa.gov) if you would like to set up a conference call or meeting.

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended, states that each Federal agency shall, in consultation with the Secretary, insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Any discretionary federal action that may affect a listed species must undergo Section 7 consultation. As listed species may be present in the project area, the NRC is responsible for determining whether the proposed action is likely to affect any listed species. The NRC should then submit their determination along with a request for concurrence, to the attention of the Endangered Species Coordinator, NOAA Fisheries, Northeast Regional Office, Protected Resources Division, One Blackburn Drive, Gloucester, MA 01930. After reviewing this information, NOAA Fisheries would then be able to conduct a consultation under section 7 of the ESA.

Should you have any questions about these comments or about the section 7 consultation process in general, please contact Julie Crocker at (978)281-9328 ext. 6530.

Sincerely,

Mary A. Colligan
Assistant Regional Administrator
for Protected Resources

Cc: Ludwig, F/NER4

File Code: Sec 7 NRC Millstone Nuclear Power Plant

STATE OF CONNECTICUT
COMMISSION ON CULTURE AND TOURISM

October 6, 2004

Mr. Pao-Tsin Kuo
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Millstone Power Station
Units 2 and 3 License Renewal
Waterford, CT

Dear Mr. Kuo:

The State Historic Preservation Office has reviewed the above-named project. This office expects that the proposed undertaking will have no effect on historic, architectural, or archaeological resources listed on or eligible for the National Register of Historic Places.

This office appreciates the opportunity to have reviewed and commented upon the proposed undertaking.

We recommend that the responsible agency provide concerned citizens with the opportunity to review and comment upon the proposed undertaking in accordance with the National Historic Preservation Act and the Connecticut Environmental Policy Act.

For further information please contact Dr. David A. Poirier, Staff Archaeologist.

Sincerely,

J. Paul Loether
Division Director and Deputy
State Historic Preservation Officer

A106

Historic Preservation and Museum Division
Amos Bull House, 59 South Prospect Street, Hartford, Connecticut 06106
860-566-3005 860-566-5078 fax

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 9, 2004

Ms. Patricia A. Kurkul, Regional Administrator
NOAA Fisheries
Northeast Regional Office
One Blackburn Drive
Gloucester, MA 09130-2298

SUBJECT: REQUEST FOR CONCURRENCE - BIOLOGICAL ASSESSMENT FOR MILLSTONE POWER STATION, UNITS 2 AND 3 LICENSE RENEWAL

Dear Ms. Kurkul:

The U.S. Nuclear Regulatory Commission (NRC) has prepared the enclosed biological assessment (BA) to evaluate whether the proposed renewal of the Millstone Power Station, Units 2 and 3 (MPS) operating licenses for a period of an additional 20 years would have adverse effects on listed species. The proposed action (license renewal) is not a major construction activity. MPS is located on the north shore of Long Island Sound in Waterford, Connecticut, approximately 40 miles southeast of Hartford, Connecticut.

By letter dated March 17, 2004, to the National Oceanic and Atmospheric Administration (NOAA) - Fisheries, the NRC requested a list of Federally threatened or endangered aquatic species that may be in the vicinity of MPS and its associated transmission lines. In a letter dated September 21, 2004, NOAA Fisheries provided a list of Federally threatened or endangered species. Your office identified one threatened and three endangered species of sea turtles that may be seasonally found in the waters of Long Island. These include the loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempi*), green turtles (*Chelonia mydas*), and leatherback turtles (*Dermochelys coriacea*). The letter also identified three other endangered species known to occur seasonally in Northeast waters, the North Atlantic right whales (*Eubalaena glacialis*), humpback whales (*Megaptera novaeangliae*), and fin whales (*Balaenoptera physalus*). The NRC has also included in its evaluation the endangered shortnose sturgeon (*Acipenser brevirostrum*); this species is known to occur in the Connecticut River, which flows into Long Island Sound approximately 10 miles east of the Millstone site.

In addition the staff also contacted U.S. Fish and Wildlife Service (FWS) by letter dated March 18, 2004, requesting a list of Federally threatened or endangered terrestrial species that may be in the vicinity of MPS. In a letter dated April 15, 2004, FWS identified the following terrestrial species: the endangered roseate tern (*Sterna dougallii dougallii*); the threatened piping plover (*Charadrius melodus*), puritan tiger beetle (*Cicindela puritana*), small whorled pogonia (*Isotria medeoloides*), and bald eagle (*Haliaeetus leucophalus*); and one candidate species, the New England cottontail (*Sylvilagus transitionalis*).

The staff has determined that license renewal for Millstone would have no effect on the puritan tiger beetle, shortnose sturgeon, loggerhead sea turtle, green sea turtle, leatherback sea turtle, Kemp's ridley sea turtle, piping plover, right whale, finback whale, and humpback whale. License renewal may affect, but is not likely to adversely affect, the bald eagle, roseate tern, New England cottontail, and small whorled pogonia.

P. Kurkul -2-

We are requesting your concurrence with our determination. In reaching our conclusion, the NRC staff relied on information provided by the licensee, on literature research and interviews with experts performed by NRC staff, and on information provided by FWS (i.e., including current listings of species provided by the FWS, Concord, New Hampshire, New England Field Office) and NOAA Fisheries (Northeast Regional Office).

If you have any questions regarding this BA or the staff's request, please contact Mr. Richard L. Emch, Jr., Senior Environmental Project Manager, at 301-415-1590 or via e-mail at rle@nrc.gov.

Sincerely,

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-336 and 50-423

Enclosures: As stated

cc w/encl.: See next page

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 9, 2004

Mr. Marvin Moriarty, Regional Director
Northeast Regional Office
U.S. Fish and Wildlife Service
300 Westgate Center Drive
Hadley, MA 01035-9589

SUBJECT: REQUEST FOR CONCURRENCE - BIOLOGICAL ASSESSMENT FOR MILLSTONE POWER STATION, UNITS 2 AND 3 LICENSE RENEWAL

Dear Mr. Moriarty:

The U.S. Nuclear Regulatory Commission (NRC) has prepared the enclosed biological assessment (BA) to evaluate whether the proposed renewal of the Millstone Power Station, Units 2 and 3 (MPS) operating licenses for a period of an additional 20 years would have adverse effects on listed species. The proposed action (license renewal) is not a major construction activity. MPS is located on the north shore of Long Island Sound in Waterford, Connecticut, approximately 40 miles southeast of Hartford, Connecticut.

By letter dated March 18, 2004, to the U.S. Fish and Wildlife Service (FWS), the NRC requested a list of Federally threatened or endangered terrestrial species that may be in the vicinity of MPS and its associated transmission lines. In a letter dated April 15, 2004, the FWS provided a list of Federally threatened or endangered species. The FWS identified the following terrestrial species: the endangered roseate tern (*Sterna dougallii dougallii*); the threatened piping plover (*Charadrius melodus*), puritan tiger beetle (*Cicindela puritana*), small whorled pogonia (*Isotria medeoloides*), and bald eagle (*Haliaeetus leucophalus*); and one candidate species, the New England cottontail (*Sylvilagus transitionalis*).

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The staff has determined that license renewal for Millstone would have no effect on the puritan tiger beetle, shortnose sturgeon, loggerhead sea turtle, green sea turtle, leatherback sea turtle, Kemp's ridley sea turtle, piping plover, right whale, finback whale, and humpback whale. License renewal may affect, but is not likely to adversely affect, the bald eagle, roseate tern, New England cottontail, and small whorled pogonia.

M. Moriarty -2-

We are requesting your concurrence with our determination. In reaching our conclusion, the NRC staff relied on information provided by the licensee, on literature research and interviews with experts performed by NRC staff, and on information provided by FWS (i.e., including current listings of species provided by the FWS, Concord, New Hampshire, New England Field Office) and NOAA Fisheries (Northeast Regional Office).

If you have any questions regarding this BA or the staff's request, please contact Mr. Richard L. Emch, Jr., Senior Environmental Project Manager, at 301-415-1590 or via e-mail at rle@nrc.gov.

Sincerely,

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-336 and 50-423

Enclosures: As stated

cc w/encl.: See next page

ENCLOSURE 1

BIOLOGICAL ASSESSMENT

Biological Assessment

Millstone Power Station
License Renewal Review

October 2004

Docket Numbers
50-336
50-423

U.S. Nuclear Regulatory Commission
Rockville, Maryland

1

1.0 Introduction

The U.S. Nuclear Regulatory Commission (NRC) issues operating licenses for domestic nuclear power plants in accordance with the provisions of the Atomic Energy Act of 1954, as amended, and NRC implementing regulations. The purpose and need for the proposed action (that is, renewal of an operating license) is to provide an option that allows electric power generation to continue beyond the term of the current nuclear power plant operating license, so future generating needs can be met if the operator and State regulatory agencies pursue that option.

Dominion Nuclear Connecticut, Inc. (Dominion) has prepared an environmental report in conjunction with its application for renewal of the Millstone Nuclear Plant, Units 2 and 3 (Millstone) operating licenses, as provided for by the following NRC regulations:

- Title 10, Energy, Code of Federal Regulations (CFR) Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," Section 54.23, Contents of application - environmental information (10 CFR 54.23).
- Title 10, Energy, CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," Section 51.53, Postconstruction environmental reports, Subsection 51.53(c), Operating license renewal stage [10 CFR 51.53(c)].

The NRC is reviewing an application submitted by Dominion (the applicant) for the renewal of the operating licenses for Millstone for a period of an additional 20 years. There will be no major construction, refurbishment, or replacement activities associated with this action. This biological assessment examines the potential effects of the continued operation of Millstone on 14 Federally listed species and one species proposed for candidate listing that could occur within the Millstone site, near the site, or along its associated transmission line rights-of-way (ROWs). This consultation is pursuant to Section 7(a)(2) of the Endangered Species Act.

In letters dated March 17 and 18, 2004, the NRC requested that the National Oceanographic and Atmospheric Administration (NOAA) - Fisheries (also known as the National Marine Fisheries Service or NMFS) and the U.S. Fish and Wildlife Service (FWS), respectively to provide lists of Federally listed endangered or threatened species and information on protected, proposed, and candidate species, as well as any designated critical habitat, that may be in the vicinity of Millstone and its associated transmission line ROWs (NRC 2004a, 2004b). The project area is defined as the Millstone site, its associated transmission line ROWs, and adjacent areas of Long Island Sound. In letters from the FWS (FWS 2004a) and the NMFS (NMFS 2004a), the NRC was provided a list of Federally protected species in the project area. A total of eight aquatic and six terrestrial species afforded protection under the Endangered Species Act of 1973 or candidates for such protection were identified that could potentially inhabit the project area.

-2-

2.0 Proposed Action

The proposed action is the renewal of the operating licenses for Millstone. The current operating license for Unit 2 expires on July 31, 2015, and for Unit 3 on November 25, 2025. Dominion has submitted an application to the NRC to renew these operating licenses for an additional 20 years of operation (i.e., until July 31, 2035, for Unit 2 and November 25, 2045, for Unit 3). The renewed licenses, if issued, will be effective from their date of issuance until 20 years after the expiration date of the current operating licenses.

Millstone is located on Millstone Point in Niantic Bay, between the Niantic and Thames Rivers on Long Island Sound, near Waterford in New London County, Connecticut (Figure 1). The nearest large cities are New Haven, approximately 64 km (40 mi) to the west, and Hartford, approximately 64 km (40 mi) to the northwest. The site is situated on the edge of Long Island Sound and Niantic Bay and is approximately 32 km (20 mi) west of Rhode Island. At one time, there were three operating nuclear power plants at the Millstone site. Construction on Unit 1 began in 1966, on Unit 2 in 1970, and on Unit 3 in 1974. Unit 1 was a boiling-water reactor that was permanently shut down in 1995. The facility is in long-term storage awaiting decontamination and dismantlement as part of station decommissioning. Unit 1 is not part of this license renewal application. Millstone Unit 2 is a two-loop, closed-cycle, pressurized-water nuclear reactor with a calculated electrical output of approximately 870 megawatts electric (MW[e]); while Millstone Unit 3 is a four-loop, closed-cycle, pressurized-water nuclear reactor with a calculated electrical output of approximately 1,154 MW(e) (Dominion 2004a).

Long Island Sound is the source of water for the once-through turbine condenser cooling systems at Millstone. The system withdraws salt water from Long Island Sound though intakes, pumps the water through the condenser for cooling, and surface discharges heated water to Long Island Sound approximately 610 m (2000 ft) southeast of the withdrawal points (Dominion 2004a).

Intake structures for Units 2 and 3 are located on the eastern shore of Niantic Bay, which is fed by Long Island Sound (Figure 2). The structures consist of four reinforced-concrete bays for Unit 2 and six bays for Unit 3. When both Units 2 and 3 are operating at full power, the 10 pumps (one for each bay) pump a total of 92 m^3/s (1.46 million gpm) into 2-m (7-ft) diameter conveyance pipes. Cooling water then moves through the condensers. After passing through each unit's condensers, cooling water is discharged to the former granite quarry. The heated discharge water then flows through two cuts excavated from the bedrock at the eastern end of the quarry into Long Island Sound. Figure 2 shows the intake structures, quarry, and discharge points for the Millstone circulating water system.

The intake structures are designed to minimize the possibility of clogging or impingement of aquatic organisms. Before the intake water reaches the circulating water pumps, the water passes through trash racks consisting of 1-cm (3/8-in. thick) metal bars spaced horizontally on 5-cm (2-in.) centers. The water then flows through vertical traveling screens with 1-cm (3/8-in.) mesh that prevent debris and large organisms from entering the cooling system. A cutoff wall in front of the intake extends 2.7 m (9 ft) below the surface to prevent surface water debris and organisms from entering the intake. Individual trash and fish return troughs collect and sluice debris and fish from the screens. Unit 3 was originally constructed with a fish return trough;

-3-

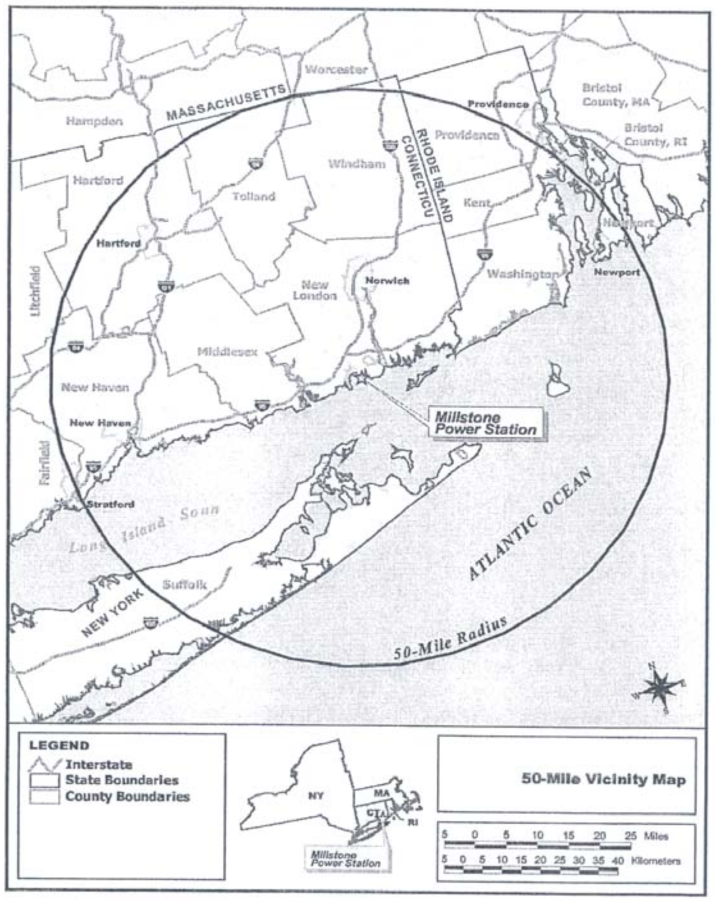

Figure 1. Location of Millstone, 80-km (50-mi) Region

-4-

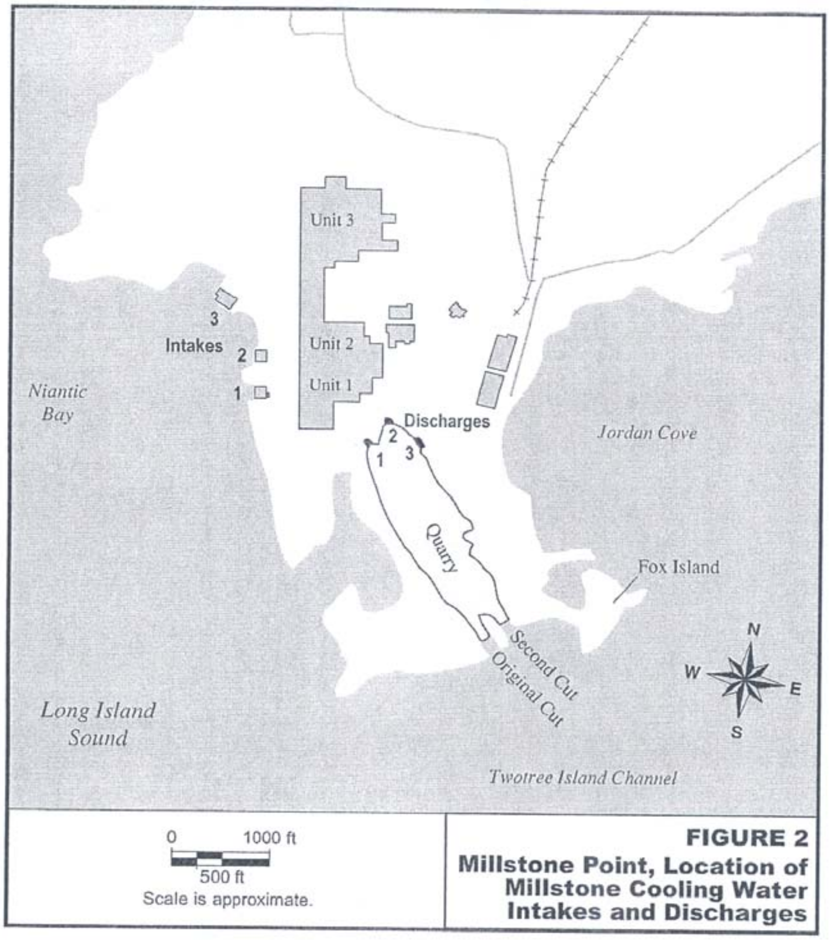

FIGURE 2
Millstone Point, Location of Millstone Cooling Water Intakes and Discharges

Figure 2. Millstone Point, Location of Millstone Cooling Water Intake and Discharges

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a fish return trough was added to Unit 2 in 2000. Water velocity in front of the Unit 2 structure is estimated to be about 0.2 m/s (0.6 ft/s) (Dominion 2004a).

Biocides are added to the intake water to prevent biofouling. Sodium hypochlorite is injected on a periodic basis, and the system is designed to maintain a 0.2 parts per million (ppm) chlorine concentration (Dominion 2004a). Residual chlorine is monitored in the effluent water. Thermal backwashing is also performed to prevent mussels from fouling the intake structure pump bays.

3.0 Environmental Setting

3.1 Terrestrial Resources

The Millstone site is located in the Southern New England Coastal Plains and Hills of the Northeastern Coastal Zone ecoregion (U.S. Environmental Protection Agency [EPA] 2004a). Pre-settlement vegetation would have consisted primarily of winter deciduous hardwood forests with some salt marsh and beach habitat types. Out of approximately 212 ha (525 ac) that comprise the Millstone site, current land use includes approximately 89 ha (220 ac) of developed area, a 20-ha (50-ac) natural area, and a 12-ha (30-ac) ballpark licensed to the town of Waterford. Until 1960, the site was used as a granite quarry, which operated for 200 years (Dominion 2004a).

The current terrestrial environment includes old field habitats dominated by eastern red cedar (*Juniperus virginiana*), scarlet oak (*Quercus coccinea*), black cherry (*Prunus serotina*), and blackberry (*Rubus* spp.) (Dominion 2004a). Common invasive exotics in this habitat include multiflora rose (*Rosa multiflora*) and Japanese honeysuckle (*Lonicera japonica*). Winter deciduous hardwood forest dominated by various species of oak (*Quercus* spp.), pignut hickory (*Carya glabra*), black birch (*Betula lenta*), red maple (*Acer rubrum*), and American beech (*Fagus grandifolia*) is the most common undisturbed habitat type. Along the coast, beach and coastal marsh habitats are dominated by beach grass (*Ammopila breviligulata*), toadflax (*Linaria vulgaris*), evening primrose (*Oenothera biennis*), seaside goldenrod (*Solidago sempervirens*), salt meadow grass (*Spartina patens*), salt grass (*Distichlis spicata*), Bigelow's glasswort (*Salicornia bigelovii*), and smooth cordgrass (*Spartina alterniflora*). Ponds and wetlands in the eastern portion of the site are managed as a wildlife refuge.

Terrestrial habitats on the Millstone site support common wildlife species such as white-tailed deer (*Odocoileus virginianus*), gray squirrel (*Sciurus carolinensis*), cottontail rabbits (*Sylvilagus* spp.), red fox (*Vulpes vulpes*), woodchucks (*Marmota monax*), and wild turkey (*Meleagris gallopavo*). Coastal marshes and the wildlife refuge on the site contain habitat that supports waterfowl such as mallard ducks (*Anas platyrhynchos*), wood ducks (*Aix sponsa*), Canada geese (*Branta canadensis*), common mergansers (*Mergus merganser*), black ducks (*Anas rubripes*), herons, and egrets. Osprey (*Pandion haliaetus*) nest platforms have been maintained at Millstone for over 35 years and 173 fledglings have been produced over that time period (Dominion 2004a).

Four 345-KV transmission lines connect Millstone to the power grid (Table 1) (Dominion 2004a). The ROWs traverse New London, Middlesex, Hartford, Tolland, and the northeast corner of New Haven counties. The four lines share a common ROW for 14.5 km (9 mi) north to Hunts

Brook Junction (Figure 3). At Hunts Brook Junction two lines run north in the same ROW to the Card Street Substation where one line continues on to the Manchester Substation, one line runs east to the Montville Station and one line runs west to the Southington Substation. All Millstone lines share ROWs with lines from other sources and would be maintained if Millstone ceased operating. Transmission lines traverse abandoned fields, pasture, cultivated fields, forests, and wetlands as well as a number of conservation areas (Dominion 2004a). The Card Street/Manchester line crosses the Pease Brook Wildlife Management Area. The Southington line crosses the Nehantic State Forest, Cockaponset State Forest, and Hartman Park, a municipal park owned by the town of Lyme, Connecticut.

Table 1. Millstone Transmission Line Corridors.

		Length		Width		Max Area[a]	
Substation	**kV**	**km**	**(mi)**	**m**	**(ft)**	**ha**	**(ac)**
Hunts Brook Junction	345	14	(9)	152	(500)	220	(545)
Montville	345	6	(4)	99	(325)	64	(158)
Card Street	345	32	(20)	91	(300)	294	(727)
Manchester	345	61	(38)	91	(300)	559	(1382)
Southington	345	71	(44)	76	(250)	539	(1333)

[a] Max area calculations use maximum right-of-way width estimates (Dominion 2004a).

Connecticut Light and Power (CL&P), a subsidiary of Northeast Utilities conducts maintenance activities on these transmission lines and ROWs. These activities include, but are not restricted to, maintenance of vegetation in each ROW, replacement of poles or towers, installation of lightning arresters and counterpoise, and upgrading of existing equipment.

CL&P manages vegetation within the ROWs with an approach it calls "two-zone maintenance" (NU 2004). The area directly beneath the transmission lines and extending out 4.5 m (15 ft) on either direction is called the "wire zone." Most vegetation in the wire zone is kept short except for the occasional clusters of eastern red cedar that are maintained for nesting habitat. The area from the edge of the wire zone to the outside edge of the ROWs is called the "side zone." The side zone acts as a transition between the towers and conductors of the wire zone and the forest. The side zone is maintained as a multi-layered habitat with low growing trees and shrubs.

Vegetation is managed through a combination of mowing, trimming, and herbicide treatments. All personnel applying herbicides are required to possess a valid applicator's license (NU 2004). Wetlands and other water bodies are protected from herbicides by a 3-m (10-ft) vegetative border (NU 2004). Mowing is conducted only between the months of November and April to minimize impacts to wet soils, nesting birds, and wildlife forage. The Connecticut Department of Environmental Protection (CTDEP) reviews all ROW management plans to assure protection

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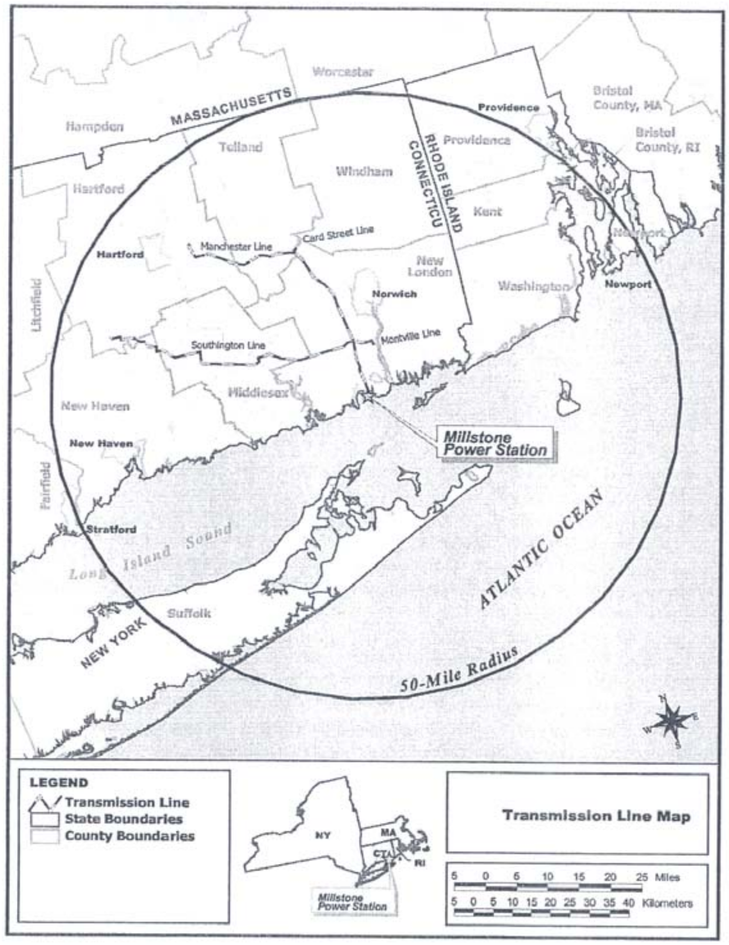

Figure 3. Millstone Site and Associated Transmission Lines

-8-

of threatened and endangered species. CL&P personnel work closely with maintenance crews to ensure that treatments are implemented properly.

CL&P encourages collaboration with conservation groups to use the ROWs for wildlife habitat improvement. It has also developed a list of plant species and wildlife habitat types that it attempts to promote through its vegetation management actions. Contractors are required to identify and target non-native, invasive plant species (NU 2004).

3.2 Aquatic Resources

Aquatic resources in the vicinity of Millstone are primarily associated with marine and estuarine environments that are part of Long Island Sound. Millstone is bordered on the west by Niantic Bay, to the east by Jordan Cove, and to the south by the Twotree Island Channel (Dominion 2004b). The plant is located approximately 1.6 km (1 mi) southeast of the mouth of the Niantic River, and approximately 5.5 km (3.5 mi) west of the Thames River. Cooling water intakes are located in Niantic Bay on the western shoreline of Millstone Point and are situated approximately 4.6 to 7.6 m (15 to 25 ft) below mean sea level. Once-through cooling water is discharged into an abandoned granite quarry located in approximately the center of Millstone Point. Water then flows from the quarry over a weir into Long Island Sound near the Twotree Island Channel (Figure 2). Rated flows for Millstone Units 2 and 3 are 36 and 59 $m^3 s^{-1}$ (1275 and 2097 $ft^3 s^{-1}$) respectively.

Long Island Sound is a large water body, with a surface area of 3420 km^2 (1320 mi^2), and 965 km (600 mi) of coastline. The drainage area associated with the water body is approximately 27,070 km^2 (16,820 mi^2). The average depth of the sound is 19 m (63 ft); and the approximate volume is 68 trillion L (18 trillion gallons). Millstone Point lies on the western shore of Long Island Sound, near the mouth of the sound. This area of Long Island Sound experiences a salinity of approximately 23 parts per thousand due to the influence of three major rivers: the Thames, the Housatonic, and the Connecticut Rivers. Ambient water temperature near the Millstone cooling water intakes can range from 1°C to 22°C (34°F to 72°F) over the course of a year. Linear regression performed on daily and annual seawater temperatures near Millstone over a 25-year period revealed a significant long-term increase in water temperature of 1.55°C (2.8°F) based on daily means and 1.01°C (1.8°F) based on annual means (Keser et al. 2003).

Millstone Point is situated approximately 5.6 km (3.5 mi) west of the Thames River, in an area that experiences strong tidal currents that influence the nearshore ecosystem, which include rocky coastlines and boulder and gravel substrate beaches that support a variety of fish, invertebrate, and marine plant life . The average tidal flow through Twotree Island Channel is approximately 3400 $m^3 s^{-1}$ (1.2×10^6 $ft^3 s^{-1}$) with a maximum flow of about 8500 $m^3 s^{-1}$ (3.0×10^6 $ft^3 s^{-1}$). This translates into current velocities of about 1.8 to 3.30 km hr^{-1} (1 to 1.8 knots), with slightly lower velocities near the plant. Weak currents predominate in both the Niantic River and Jordan Cove. Tidal fluctuation in this area is not severe, with mean and maximum ranges of 0.8 and 1.0 m (2.6 to 3.3 ft), respectively (Dominion 2004b).

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EPA Region 1 has identified Long Island Sound as "an estuary of national significance" and listed six problem areas of concern associated with water quality (EPA 2004b):

1. Low dissolved oxygen (hypoxia)
2. Toxic contamination
3. Pathogen contamination
4. Floatable debris
5. Habitat degradation and loss, and living resource health associated with Items 1-4
6. Land use and development resulting in habitat loss and degradation of water quality

These problem areas have resulted in a variety of long-term, integrated studies of Long Island Sound by both state and Federal agencies.

- **Chemical Contaminants Near Millstone**

Specific chemical data associated with sediment, water, or biota near the Millstone study area were not available for review, but in general, surficial sediment associated with the eastern portion of Long Island Sound exhibits lower levels of common contaminants (heavy metals, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides) than the western portion. United States Geological Survey (USGS) data (Mecray et al. 2004) showed regional patterns of high metals concentrations in the western sound, with relatively low concentrations associated with the eastern sound in the vicinity of Millstone. Draft data (Battelle 1999) associated with surficial samples from the Thames River indicated most metals were below NOAA effects-range-median (Long et al. 1998), and organic constituents were at or near detection limits with the exception of the PAH, perylene, which was detected at concentrations ranging from approximately 20 to 1200 µg/kg dry weight. It is suspected the source of this compound is biogenic rather than anthropogenic.

A citizens' group conducted limited chemical and radiological monitoring of bottom sediments in the vicinity of Millstone and reported possible elevated levels of hydrazine and uranium in the bottom sediments of Jordon Cove (CTDEP 2002). The chemical compound 1,1-dimethylhydrazine (UMDH) was reported as detected in two sediment samples at low levels. It was postulated that the UMDH might be due to hydrazine used at Millstone for corrosion control. CTDEP reviewed available information and concluded that the detections likely were false positives because of questionable quality of the analytical procedures, and it was unlikely that hydrazine could accumulate in bottom sediments because it degrades rapidly into water and nitrogen. In addition, the particular chemical form of hydrazine used at Millstone is different than UMDH. There are also industrial facilities in the area that commonly use hydrazine. CTDEP also concluded that the types and levels of uranium measured in sediments near Millstone reflected naturally occurring background levels (CTDEP 2002). Neither concern was judged by CTDEP to be sufficiently credible to warrant further investigation.

- **Important Fish and Shellfish Communities Near Millstone**

A variety of commercially, recreationally, or environmentally important fish and shellfish live or spend a portion of their life cycle in the vicinity of Millstone, and also commonly occur in Long

-10-

Island Sound (Table 2). Many of these species live in the waters near Millstone, travel through the area during their seasonal migrations in and out of Long Island Sound, or pass close to the plant as they enter rivers adjacent to Millstone during their spawning seasons. Because of their proximity to Millstone, they may be susceptible to entrainment, impingement, or to lethal or sublethal effects associated with plant operations. In order to assess relative species abundance near Millstone operations, a variety of collection and enumeration methods have been employed, including sampling cooling water discharge using plankton nets to determine ichthyoplankton (fish eggs and larvae) abundance, shore-zone seines to capture small fish, and bottom trawls to capture larger, demersal fish (Dominion 2004b). In general, assessments of fish and shellfish have included sampling stations in direct proximity to the plant (e.g., within a radius of approximately 3 km [2 mi]). Sampling stations have included a station located near the Unit 2 and 3 cooling water discharge, stations in the Niantic River and Bay, and stations in Jordan Cove. Far-field reference sites were not included in the fish and shellfish monitoring programs, nor were sampling grids located at varying distances from the area of interest to identify environmental gradient effects. Plume dynamic studies and assessments of intertidal ecosystems, however did use far-field reference or control sites.

Table 2. Important Fish and Shellfish Species.

Common Name	Scientific Name
winter flounder	*Pseudopleuronectes americanus*
lobster	*Homarus americanus*
American sandlance	*Ammodytes americanus*
anchovy	*Anchoa* spp.
silversides	*Menidia* spp.
grubby	*Myoxocephalus aenaeus*
cunner	*Tautogolabrus adspersus*
tautog	*Tautoga onitis*

Eelgrass Community

Eelgrass (*Zostera marina*) is one of the dominant seagrasses in coastal regions of the northern hemisphere, and common in eastern Long Island Sound near the Millstone facility. This seagrass is important because of its significant influence on the nearshore environment. Eelgrass beds provide habitat and cover for many larval and juvenile forms of fish and invertebrates, support significant primary and secondary production, and serve as a food source for numerous waterfowl or planktonic grazers (Kesar et al., 2003). Eelgrass beds in the vicinity of Millstone have been monitored for many years to evaluate population dynamics and document change over time. Sampling locations included areas associated with thermal plume discharge (Jordan Cove, White Point), and reference locations associated with the Niantic River (Dominion 2004b). Studies near Millstone and in Long Island Sound have shown considerable variation in the extent of eelgrass beds at all locations, probably due to water body temperature

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fluctuations, eutrophication, sedimentation, turbidity, the presence of nuisance organisms (mussels and green algae blooms) and possible changes associated with nearshore hydrodynamics. Studies conducted at Millstone have suggested that eelgrass abundance and distribution at Jordan Cove and White Point has been affected by the thermal plume discharge, but have observed relative stable biomass and distribution over the past 16 years at other locations adjacent to the facility (Dominion 2004b). Studies have also noted dramatic changes in eelgrass populations in the Niantic River, resulting in multiple relocations of reference sites over the past 20 years due to die-off that is attributable to poor water quality and potential biological disturbances (Dominion 2004b).

Rocky Intertidal Communities

A rich and varied rocky intertidal habitat exists in the region surrounding Millstone, and includes marine alga, polychaeteous annelids, crustaceans, and molluscs. All of these organisms are important contributors to the structure and function of nearshore ecosystems. Environmental studies conducted by Dominion have included sites at Fox Island, Millstone Point, White Point, and a reference location near Giant's Neck (Figure 2). Cooling water discharge stations have included a location close to the quarry cuts and one location approximately 200 m (660 ft) southeast of the quarry cut. Millstone monitoring programs have been in effect since 1979 and are intended to provide 1) an environmental baseline of abundance of important species, and 2) a means to detect change in community structure and function near the Millstone facility.

Algal studies have been conducted since 1979, and have identified over 140 species that occur or have occurred in the area during the study duration. Dominion scientists have data on organisms that represent the more common marine flora or fauna, including barnacles, the algae *Fucus* spp., the red alga *Chondrus* spp., and the marine mussel *Mytilus edulis*. Community analyses using clustering techniques suggest that plant impacts are generally limited to approximately 150 m (490 ft) of shoreline on the east side of the discharge to Long Island Sound (Dominion 2004b). Detectable changes at the community level have been observed in the study area, as have ecosystem-level changes (e.g. water temperature fluctuations, nutrient concentrations, light intensity). Of particular note is the presence of the red alga *Antithamnion pectinatum*, an exotic species native to the Pacific Ocean that was not previously reported in the Atlantic.

Benthic Infauna

Benthic infaunal communities near Millstone are consistent with soft-bottom, nearshore environments associated with New England. These communities typically contain a diverse assemblage of species that collectively contribute to the stability of the nearshore food web. Subtidal communities in the vicinity of Millstone and at a reference site located near Giants Neck have been sampled and studied since 1980. During the 2003 sampling, marine polychaetes were the most abundant taxa, followed by oligochaetes, arthropods, and molluscs (Dominion 2004b). The following infaunal taxa were selected as representative of sites affected by Millstone: oligochaetes, the polychaetes *Aricidea catherinae*, *Mediomastus ambiseta*, *Tharyx* spp., *Polycirrus eximius*, *Protodorvillea gaspeensis*, *Parapionosyllis longicirrata*, and the bivalve mollusc *Nuculana annulata* (Dominion 2004b). Monitoring studies have been helpful in detecting changes in benthic infauna community structure and linking the observed changes to

-12-

both natural and anthropogenic disturbances. Millstone activities relating to cooling water discharge and required maintenance dredging have produced observable effects to the structure of benthic communities in the immediate vicinity of the plant. This was clearly evident by the response of the benthic community during extended shutdowns during 1996-1998.

4.0 Assessment of Federally Listed Species

Several Federally listed species are known to occur in the vicinity of the Millstone site or associated transmission line ROWs. No FWS-designated critical habitat is found within the site or associated ROWs.

4.1 Aquatic Species

Eight Federally listed marine species could occur in Long Island Sound in the vicinity of Millstone. These include three species of whales and four species of turtle (NMFS 2004a, FWS 2004b) (Table 3). The staff has also evaluated the potential impacts of continued Millstone operation on the shortnose sturgeon (*Acipenser brevirostrum*). The shortnose sturgeon is a Federally listed endangered species that is found in the Connecticut River, which flows into Long Island Sound approximately 10 miles east of the Millstone site.

Table 3. Aquatic Endangered and Threatened Aquatic Species

Scientific Name	Common Name	Federal Status[a]
	FISH	
Acipenser brevirostrum	shortnose sturgeon	Endangered
	TURTLES	
Caretta caretta	loggerhead	Endangered
Chelonia mydas	green turtle	Threatened
Dermochelys coriacea	leatherback turtle	Endangered
Lepidochelys kempii	Kemp's Ridley	Endangered
	WHALES	
Balaena glacialis	right whale	Endangered
Balaenoptera physalus	finback whale	Endangered
Megaptera novaengliae	humpback whale	Endangered

(a) FWS 2004b, NMFS 2004a.

Shortnose Sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon is Federally listed as endangered in the entire range (FWS 2004b). Two populations of shortnose sturgeon are present in the Connecticut River. One of these is landlocked in the upper part of the river between the Holyoke dam and Turners Falls dam in Massachusetts, and the other population is located in the lower Connecticut River from the Holyoke Dam to Long Island Sound. An estimated 1200 to 1500 shortnose sturgeon are found in freshwater and estuarine portions of the Connecticut River and are presumed to occasionally

-13-

range into adjacent areas of Long Island Sound (FWS 2001). No shortnose sturgeon have been impinged or captured in more than 30 years of sampling at Millstone (Dominion 2004a). The primary threats to this species are dam building, water pollution, and dredging (NatureServe 2004).

Although this species has not been recorded for the area and it is highly unlikely that individuals could even occasionally be present. The intake structures at Dominion have been fitted with fish sluiceways that return fish and other organisms that become impinged during cooling water intake. It is unknown how impingement and returns affect mortality of shortnose sturgeon but it is expected that the mortality rate would be low. The species has a bottom orientation, it is a strong swimmer and its robustness would likely minimize the potential for impingement.

The staff reviewed the design, operation, and location of the intake and discharge structures at Millstone and the impingement and entrainment data collected during plant operation. The staff also visited the site and reviewed the life history information about the shortnose sturgeon. On the basis of this information, the staff has determined that the continued operation of Millstone over the 20-year renewal period will have no effect on the shortnose sturgeon.

Loggerhead (*Caretta caretta*)

The loggerhead sea turtle is Federally listed as threatened throughout its range (FWS 2004b). There are currently no critical habitats designated for this species, although the NMFS is currently working on a status review based on a 2002 petition to reclassify the Northern and Florida Panhandle subpopulations with endangered status and to designate critical habitat for both subpopulations (NMFS 2004b). The range for the Atlantic population of loggerheads extends from Newfoundland to Argentina, with primary nesting areas located in Florida, Georgia, and the Carolinas.

The NMFS (2004b) has noted that loggerheads can become impinged on intake structures of coastal power plants and estimates the mortality rate for impingement is 2 percent (NMFS 2004b). The applicant has not reported any incidences of impingement of loggerheads or incidental takes during trawling studies in over 30 years of sampling operations.

The staff reviewed the design, operation, and location of the intake and discharge structures at Millstone and the impingement and entrainment data collected during plant operation. On the basis of this information, and that previously provided for the aquatic resources in the vicinity of the plant, the staff has determined that continued operation of Millstone over the 20-year renewal period will have no effect on the loggerhead sea turtle.

Green Turtle (*Chelonia mydas*)

The green sea turtle is Federally listed as endangered in the breeding colony populations in Florida and on the Pacific coast of Mexico and threatened for all other areas (FWS 2004b). The western Atlantic population of green turtles ranges from Massachusetts south to the U.S. Virgin Islands and Puerto Rico, with important feeding grounds in Florida, and primary nesting sites on the east coast of Florida, the U.S. Virgin Islands and Puerto Rico (NMFS 2004c).

NMFS (2004c) has noted that green sea turtles can become impinged on intake structures of coastal power plants and estimates the impingement mortality for green sea turtles at 7 percent (NMFS 2004c). The applicant has not reported any incidences of impingement of green turtles or incidental takes during trawling studies in over 30 years of sampling operations.

The staff reviewed the design, operation, and location of the intake and discharge structures at Millstone and the impingement and entrainment data collected during plant operation. On the basis of this information, and that previously provided for the aquatic resources in the vicinity of the plant, the staff has determined that continued operation of Millstone over the 20-year renewal period will have no effect on the green turtle.

Leatherback Turtle (*Dermochelys coriacea*)

The leatherback sea turtle is Federally listed as endangered throughout its range (FWS 2004b). The western Atlantic population of leatherback sea turtles ranges from Nova Scotia to Puerto Rico and the U.S. Virgin Islands. During the summer, leatherbacks are typically found along the east coast of the U.S. from the Gulf of Maine to central Florida. Critical habitat designated in the area around the U.S. Virgin Islands, with nesting sites located from Georgia to the U.S. Virgin Islands (NMFS 2004d).

The primary threats to the survival of leatherback sea turtles include habitat destruction, incidental catch in commercial fisheries, and harvest of eggs and meat (NMFS 2004d). Impingement of leatherback sea turtles is not listed by NMFS as one of the human impacts on this species (NMFS 2004d). The applicant has not reported any incidences of impingement of leatherback turtles or incidental takes during trawling studies in over 30 years of sampling operations.

The staff reviewed the design, operation, and location of the intake and discharge structures at Millstone and the impingement and entrainment data collected during plant operation. On the basis of this information, and that previously provided for the aquatic resources in the vicinity of the plant, the staff has determined that continued operation of Millstone over the 20-year renewal period will have no effect on the leatherback turtle.

Kemp's Ridley (*Lepidochelys kempii*)

The Kemp's ridley sea turtle is Federally listed as endangered throughout its range (FWS 2004b). This species is found primarily in coastal areas of the Gulf of Mexico and the northwestern Atlantic, with a major nesting beach on the northeastern coast of Mexico (NMFS 2004e).

Habitat degradation, pollution, and ingestion of floating debris are among the most significant threats to Kemp's ridley sea turtles (NMFS 2004e). Impingement of Kemp's ridley was not listed in NMFS (2004e) as one of the human impacts on this species. The applicant did not report any incidences of impingement of Kemp's ridley or incidental takes during trawling studies in over 30 years of sampling operations.

-15-

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The staff reviewed the design, operation, and location of the intake and discharge structures at Millstone and the impingement and entrainment data collected during plant operation. On the basis of this information, and that previously provided for the aquatic resources in the vicinity of the plant, the NRC concludes that continued operation of Millstone over the 20-year renewal period will have no effect on the Kemp's ridley.

Right Whale (*Eubalaena glacialis*)

The right whale is Federally listed as endangered throughout its range (FWS 2004b). With a population estimated at 291 individuals in 1998, the North Atlantic right whale is considered to be one of the most critically endangered populations of large whales in the world (NMFS 2002). This population ranges from wintering and calving grounds in the coastal waters of the southeastern United States to summer feeding and nursery grounds in New England waters and northward (NMFS 2002). In 1994, the NMFS designated three critical habitats for the North Atlantic right whale: Cape Cod Bay/Massachusetts Bay, Great South Channel, and the Southeastern USA. At the present time, injuries and mortality caused by ship strikes are the primary source of human impacts to right whales, with some additional impacts from fishery entanglements. Right whales have been sighted near Long Island Sound (NMFS 2004a), but are not known to move into the shallow waters immediately offshore of the Millstone site (Dominion 2004b).

On the basis of this information, and that previously provided for the aquatic resources in the vicinity of the plant, the staff has determined that continued operation of Millstone over the 20-year renewal period will have no effect on the right whale.

Finback Whale (*Balaenoptera physalus*)

The finback (fin) whale is Federally listed as endangered throughout its range (FWS 2004b). The current minimum population estimate from a 1999 survey for the western North Atlantic fin whale was 2362 (NMFS 2002). Fin whales are found principally in waters from North Carolina north to Nova Scotia. New England waters provide an important feeding ground for this species. There are no critical habitats designated for the fin whale, although a recovery plan has been drafted. At the present time, injuries and mortality caused by ship strikes are the primary source of human impacts to fin whales. It is possible that fin whales could enter Long Island Sound, but they are not known to move into the shallow waters immediately offshore of the Millstone site (Dominion 2004b).

On the basis of this information, and that previously provided for the aquatic resources in the vicinity of the plant, the staff has determined that continued operation of Millstone over the 20-year renewal period will have no effect on the fin whale.

Humpback Whale (*Megaptera novaeangliae*)

The humpback whale is Federally listed as endangered throughout its range (FWS 2004b). The overall abundance for the North Atlantic humpback whale population was estimated in 1992/1993 at 11,570 individuals (NMFS 2002). North Atlantic humpback whales are found during the spring, summer, and fall over a range covering the eastern coast of the United

-16-

States. New England waters are an important feeding ground for this species. A recovery plan for humpback whales has been developed and implemented. Injuries and mortality from fishery entanglements and ship strikes are the primary human impacts on humpback whales. Disturbance from whale watching traffic is also of concern, particularly in coastal New England waters. It is possible that humpback whales could enter Long Island Sound, but they are not known to move into the shallow waters immediately offshore of the Millstone site (Dominion 2004b).

On the basis of this information, and that previously provided for the aquatic resources in the vicinity of the plant, the staff has determined that continued operation of Millstone over the 20-year renewal period will have no effect on the humpback whale.

4.2 Terrestrial Species

A total of five Federally listed and one potential candidate terrestrial species was identified (FWS 2004a) as having the potential to occur in New London county or counties traversed by transmission line ROWs (Middlesex, Hartford, Tolland, and the northeast corner of New Haven) (Table 4).

Table 4. Terrestrial Endangered and Threatened Species

Scientific Name	Common Name	Federal Status[a]
	INSECTS	
Cicindela puritana	Puritan tiger beetle	Threatened
	BIRDS	
Charadrius melodus	piping plover	Threatened
Haliaeetus leucocephalus	bald eagle	Endangered
Sterna dougallii dougallii	roseate tern	Endangered
	MAMMALS	
Sylvilagus transitionalis	New England cottontail	Proposed for Candidacy
	PLANTS	
Isotria medeoloides	small whorled pogonia	Threatened

(a) FWS 2004a, 2004b.

Puritan Tiger Beetle (*Cicindela puritana*)

The Puritan tiger beetle is Federally listed as threatened. This species is known from two disjunct populations, one along Chesapeake Bay in Maryland and one along the Connecticut River, in northern Connecticut (CTDEP 2004). Although this species is reported to occur in Middlesex County (FWS 2004b), CTDEP distribution maps clearly show the Connecticut population to be centered primarily along the Connecticut River in Hartford County (CTDEP 2004). The Millstone ROW for the Manchester transmission line does not cross the Connecticut River in Hartford County. The Puritan tiger beetle is restricted to sandy habitats typically found along river banks. Habitat has been depleted through riverbank stabilization and

1

flood control practices. There is no known habitat for this species near the Millstone site or within associated transmission line ROWs.

The staff has determined that continued operation of Millstone over the 20-year license renewal term will have no effect on the Puritan tiger beetle.

Piping Plover (*Charadrius melodus*)

The piping plover is Federally listed as threatened. This species is a shorebird that is found nesting in sandy beach habitats along seacoasts (CTDEP 2004). Piping plovers nest from North Carolina north to Nova Scotia. Nesting generally occurs from March through July. Historically, these birds were killed for consumption and the feathers used for adornment. Current threats include development and beach stabilization.

CTDEP range maps (CTDEP 2004) show piping plover habitat extending no further east than the east side of the mouth of the Connecticut River. There have been no reported sitings of piping plovers at the site. It is not likely that the necessary beach habitat for nesting is present in the vicinity of the site.

For these reasons, the staff has determined that continued operation of Millstone over the 20-year license renewal term will have no effect on the piping plover.

Bald Eagle (*Haliaeetus leucocephalus*)

The bald eagle is Federally listed as threatened. This species is a large raptor that is found along the coastline and around lakes and rivers. Eagles generally nest in tall trees or on cliff faces near water and away from human disturbance. Eagle populations have declined in the Connecticut due to loss of habitat, human disturbance, and pesticide contamination. There are reported to be up to 100 eagles wintering along major rivers and reservoirs in Connecticut (CTDEP 2004). There are no known nesting pairs near the Millstone site or along transmission corridors. However, individuals have been seen foraging in the area.

Although no bald eagles are known to nest at the Millstone site, Dominion does maintain a raptor reporting program and will follow CTDEP recommendations should bald eagles nest on the Millstone site. For these reasons, the staff has determined that continued operation of Millstone over the 20-year license renewal term may affect, but is not likely to adversely affect, the bald eagle.

Roseate Tern (*Sterna dougallii dougallii*)

The roseate tern is Federally listed as endangered. This species is a seabird that is found almost exclusively on saltwater coastlines. Roseate terns nest in colonies on coastal beaches and offshore islands. Historically, tern populations in Connecticut have been impacted by unrestricted market hunting and more recently by the expansion of predatory great black-backed and herring gull populations throughout their range in the state (CTDEP 2004).

Fox Island (Figure 2) is a small promontory extending off the Millstone site and into Long Island Sound. This site is used by multiple species of seabirds and it is known to be used by roseate terns during the fall migration period. Roseate terns are not known to nest in the vicinity of the Millstone site (Dominion 2004a). Fox Island is managed as a tern sanctuary in the fall and access is strictly controlled. For these reasons, the staff has determined that continued operation of Millstone over the 20-year license renewal term may affect, but is not likely to adversely affect, the roseate tern.

New England Cottontail Rabbit (*Sylvilagus transitionalis*)

The FWS is in the process of determining if the New England cottontail rabbit will be proposed for listing as a candidate species. Populations in Connecticut were considered abundant through the mid 1930s, but competition from introduced Eastern cottontails (*Sylvilagus floridanus*) and loss of agriculture-related habitat has led to a decline is numbers (CTDEP 2004). This species is found in brushy habitats associated with fencelines and edges of fields and forests. Transmission line corridors are not considered high quality habitat due to the abundance of perching raptors and other predators that use the corridors. However, the species may use corridors for dispersal from one site to another. Surveys of eastern and New England cottontail rabbits have found New England cottontail rabbits near the Millstone site and in areas crossed by transmission lines (Goodie et al. 2004). Considering the population trends of this species it is likely to be listed before or during the period of license renewal.

Vegetation management techniques used on the Millstone site and associated transmission line corridors maintain the early successional habitat types that the New England cottontail requires. The CTDEP reviews all ROW management plans to assure protection of threatened and endangered species. CL&P personnel work closely with maintenance crews to ensure that treatments are implemented properly. The staff has determined that with implementation of current management procedures and safeguards, continued operation of Millstone over the 20-year license renewal term may affect, but is not likely to adversely affect, the New England cottontail.

Small Whorled Pogonia (*Isotria medeoloides*)

The small whorled pogonia is Federally listed as threatened. This species occurs in isolated populations throughout the eastern United States. In Connecticut it is reported to occur in New London, Middlesex, Tolland, Hartford, and New Haven counties. New England populations of this orchid are found almost exclusively on acidic, well drained, fragipan (a subsurface impermiable layer) soils (NatureServe 2004). Common plant associates include red maple, eastern hemlock (*Tsuga canadensis*), paper birch (*Betula papyrifera*), northern red oak (*Quercus rubra*), eastern white pine (*Pinus strobus*), and American beech (*Fagus grandifolia*). Isotria populations are found in second growth and mature forests. The major threats to this species are habitat destruction through development and forestry.

Habitat for the small whorled pogonia may exist at the Millstone site or along associated transmission line ROWs. The Millstone site is covered by glacial soils (Dominion 2004a) which can have subsurface fragipan layers. Some of the common plant associates are found on the site (red maple, American beech). This plant has been recorded in the towns of Lyme and

Glastonbury, Connecticut but is not known to currently occur at these sites (NRC 1984). ROW maintenance activities should not greatly impact the small whorled pogonia as long as soil disturbance is minimized. Mowing of some portions of the transmission line ROWs is only conducted between the months of November and April to minimize impacts to wet soils (NU 2004).

The CTDEP reviews all ROW management plans to assure protection of threatened and endangered species. CL&P personnel work closely with maintenance crews to ensure that treatments are implemented properly. The staff has determined that with implementation of current management procedures and safeguards, continued operation of Millstone over the 20-year license renewal term may affect, but is not likely to adversely affect, the small whorled pogonia.

5.0 Conclusions

The staff identified six terrestrial and eight aquatic species listed as threatened, endangered, or proposed for candidate under the Endangered Species Act that have a reasonable potential to occur in the vicinity of Millstone, along associated transmission line ROWs, or in adjacent areas of Long Island Sound. The Millstone site and the transmission line ROWs may cross or contain suitable habitat for some of these species. Given this possibility, Northeast Utilities has designed and implemented maintenance procedures for its transmission line rights-of-way that protect listed species and their habitats.

The staff has determined that license renewal for Millstone would have no effect on the Puritan tiger beetle, shortnose sturgeon, loggerhead, green turtle, leatherback turtle, Kemp's ridley, piping plover, right whale, finback whale, and the humpback whale. License renewal may affect, but is not likely to adversely affect, the bald eagle, the roseate tern, the New England cottontail, and the small whorled pogonia.

6.0 References

Atomic Energy Act of 1954. 42 United States Code (USC) 2011, et seq.

Battelle Duxbury Operations (Battelle). 1999. *Draft Final Data Report for Thames River Vibratory Core Sampling at Uncasville*, CT. Duxbury, Maryland.

Connecticut Department of Environmental Protection (CTDEP). 2002. Letter from Water Management Bureau, Robert L. Smith, Chief, to Scott M. Cullen, STAR Foundation.

Connecticut Department of Environmental Protection (CTDEP). 2004. *Wildlife in Connecticut, Endangered and Threatened Species Series.* Accessed at: http://dep.state.ct.us/burnatr/wildlife/factshts on April 27 through Sept 21, 2004.

Dominion Nuclear Connecticut (Dominion). 2004a. Applicants Environmental Report-Operating License Renewal Stage, Millstone Power Station Units 2 and 3, Dominion Nuclear Connecticut. Docket No. 50-336, License No. DPR-65; Docket No. 50-423, License No. NPF-49. January 2004.

1

Dominion Nuclear Connecticut (Dominion). 2004b. *Annual Report 2003. Monitoring the Marine Environment of Long Island Sound at Millstone Power Station, Waterford, Connecticut.* Millstone Environmental Laboratory, Dominion Nuclear Connecticut. April 2004.

Goodie, T.J., M.A. Gregonis, and H.J. Kilpatrick. 2004. *Preliminary assessment of New England cottontail (Sylvilagus transitionalis) and eastern cottontail (Sylvilagus floridanus) distribution in Connecticut, October 2000-March 2004.* Connecticut Department of Environmental Protection.

Keser, M., J.T. Swenarton, J.M. Vozarik, and J.F. Foertch. 2003. *Decline in eelgrass (Zostera marina L.) In Long Island Sound near Millstone Point, Connecticut (USA) unrelated to thremal input.* Journal of Sea Research 49, 11-26.

Long, E.R., L.S. Field, D.P. MacDonald. 1998. *Predicting toxity in marine sediments with numerical sediment quality guidelines.* Environmental Toxicology and Chemistry 17(4):714-727.

Mecray, E.L., M.R. Buchholtz ten Brink, and S. Shah. 2004. *Metal Distributions in the surface sediments of Long Island Sound.* U.S. Geological Survey (USGS), USGS OFR 00-304: Chapter 6. http://pubs.usgs.gov/of/of00-304/htmldocs/chap06/index.htm#RESULTS

National Marine Fisheries Service (NMFS). 2002. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2002.* Accessed at: http://www.nmfs.noaa.gov/prot_res/PR2/Stock_Assessment_Program/sars.html#Overview. on June 24, 2004.

National Marine Fisheries Service (NMFS). 2004a. Letter from National Marine Fisheries Service, providing a response to the March 17, 2004 NRC staff letter requesting information regarding threatened and endangered species in the vicinity of the MPS, Units 2 and 3. (Accession No. ML042810294)

National Marine Fisheries Service (NMFS). 2004b. *Loggerhead Sea Turtles (Caretta caretta).* Accessed at: http://www.nmfs.noaa.gov/prot_res/species/turtles/loggerhead.html. on June 24, 2004.

National Marine Fisheries Service (NMFS). 2004c. *Green Sea Turtle (Chelonia mydas)* Accessed at: http://www.nmfs.noaa.gov/prot_res/species/turtles/green.html. on June 24, 2004.

National Marine Fisheries Service (NMFS). 2004d. *Hawksbill Sea Turtle (Eretmochelys imbricata).* Accessed at http://www.nmfs.noaa.gov/prot_res/species/turtles/hawksbill.html. on June 24, 2004.

National Marine Fisheries Service (NMFS). 2004e. *Kemp's Ridley Turtle (Lepidochelys kempii)* Accessed at: http://www.nmfs.noaa.gov/prot_res/species/turtles/kemps.html. on June 24, 2004.

1

NatureServe 2004. *NatureServe Explorer: an Online Encyclopedia of Life.* Version 3.1, NatureServe, Arlington, Virginia. Accessed at: http://www.natureserve.org. on September 17-21, 2004

Northeast Utilities (NU). 2004. *Section III, Technical Requirements. Specification for Rights-of-Way Vegetation Management.*

U.S. Environmental Protection Agency (EPA). 2004a. *Ecoregions of Massachusetts, Connecticut, and Rhode Island.* Accessed at: http://www.epa.gov/wed/pages/ecoregions/mactri_eco.htm on September 21, 2004.

U.S. Environmental Protection Agency (EPA). 2004b. *Long Island Sound, An Estuary of National Significance.* U.S. Environmental Protection Agency, Region 1: New England. Access at: http://www.epa.gov/region01/eco/lis/ccmp.intro.html. on June 24, 2004.

U.S. Fish and Wildlife Service (FWS). 1999. Title 50- Wildlife and Fisheries, Part 17- Endangered and Threatened Wildlife and Plants, Subpart B- Lists. U.S. Fish and Wildlife Service, December 21, 1999.

U.S. Fish and Wildlife Service (FWS). 2001. *Fish Facts - Shortnose Sturgeon.* Connecticut River Coordinator's Office website. Accessed at: http://www.fws.gov/r5crc/fish/zf_acbr.html. on June 24, 2004.

U.S. Fish and Wildlife Service (FWS). 2004a. Letter from U.S. Fish and Wildlife Service, providing a response to the March 18, 2004 NRC staff letter requesting information regarding threatened and endangered species in the vicinity of the MPS, Units 2 and 3. (Accession No. ML041190230)

U.S. Fish and Wildlife Service (FWS). 2004b. *Species Information, Threatened and Endangered Animals and Plants website.* Accessed at http://endangered.fws.gov/wildlife.html. Accessed August 2, 2004 through September 23, 2004.

U.S. Nuclear Regulatory Commission (NRC). 1984. *Final Environmental Statement related to operation of Millstone Nuclear Power Station, Unit No. 3.* Docket No. 50-423. NUREG-1064. Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2004a. NRC staff letter to Ms. Patricia A. Kurkul, Regional Administrator, National Marine Fisheries Service (NOAA Fisheries), Request for List of Protected Species Within the Area Under Evaluation for the MPS, Units 2 and 3, License Renewal. (Accession No. ML040780653)

U.S. Nuclear Regulatory Commission (NRC). 2004b. NRC staff letter to Mr. Marvin Moriarty, Regional Administrator, National Marine Fisheries Service (NOAA Fisheries), Request for List of Protected Species Within the Area Under Evaluation for the MPS, Units 2 and 3, License Renewal. (Accession No. ML040770760)

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Appendix F

GEIS Environmental Issues Not Applicable to Millstone Power Station Units 2 and 3

Appendix F

GEIS Environmental Issues Not Applicable to Millstone Power Station Units 2 and 3

Table F-1 lists those environmental issues listed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996; 1999)[a] and 10 Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B, Table B-1, that are not applicable to Millstone Power Station, Units 2 and 3, because of plant or site characteristics.

Table F-1. GEIS Environmental Issues Not Applicable to Millstone Power Station Units 2 and 3

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)			
Altered thermal stratification of lakes	1	4.2.1.2.2 4.4.2.2	Millstone does not discharge into a lake.
Temperature effects on sediment transport capacity	1	4.2.1.2.3 4.4.2.2	Millstone does not discharge into a small river.
Eutrophication	1	4.2.1.2.3 4.4.2.2	Millstone does not discharge into a lake.
Water-use conflicts (plants with cooling ponds or cooling towers using makeup water from a small river with low flow)	2	4.3.2.1 4.4.2.1	The Millstone cooling system does not use make-up water from a small river with low flow.
AQUATIC ECOLOGY (FOR ALL PLANTS)			
Premature emergence of aquatic insects	1	4.2.2.1.7 4.4.3	Aquatic insects are only present in fresh water environments.
AQUATIC ECOLOGY (FOR PLANTS WITH COOLING TOWER BASED HEAT DISSIPATION SYSTEMS)			
Entrainment of fish and shellfish in early life stages	1	4.3.3	This issue is related to heat-dissipation systems that are not installed at Millstone.
Impingement of fish and shellfish	1	4.3.3	This issue is related to heat-dissipation systems that are not installed at Millstone.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

Table F-1. (contd)

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
AQUATIC ECOLOGY (FOR PLANTS WITH COOLING TOWER BASED HEAT DISSIPATION SYSTEMS)			
Heat shock	1	4.3.3	This issue is related to heat-dissipation systems that are not installed at Millstone.
GROUND-WATER USE AND QUALITY			
Ground-water use conflicts (potable and service water, and dewatering; plants that use >100 gpm)	2	4.8.1.1 4.8.2.1	Millstone uses <100 gpm of groundwater.
Ground-water use conflicts (plants using cooling towers withdrawing makeup water from a small river)	2	4.8.1.3 4.4.2.1	This issue is related to heat-dissipation systems that are not installed at Millstone.
Ground-water use conflicts (Ranney wells)	2	4.8.1.4	Millstone do not have or use Ranney wells.
Ground-water quality degradation (Ranney wells)	1	4.8.2.2	Millstone do not have or use Ranney wells.
Ground-water quality degradation (cooling ponds in salt marshes)	1	4.8.3	Millstone does not use cooling ponds.
Ground-water quality degradation (cooling ponds at inland sites)	2	4.8.3	Millstone is not located at an inland site.
TERRESTRIAL RESOURCES			
Cooling tower impacts on crops and ornamental vegetation	1	4.3.4	This issue is related to a heat-dissipation system that is not installed at Millstone.
Cooling tower impacts on native plants	1	4.3.5.1	This issue is related to a heat-dissipation system that is not installed at Millstone.
Bird collisions with cooling towers	1	4.3.5.2	This issue is related to a heat-dissipation system that is not installed at Millstone.
Cooling pond impacts on terrestrial resources	1	4.4.4	This issue is related to a heat-dissipation system that is not installed at Millstone.

Table F-1. (contd)

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
	HUMAN HEALTH		
Microbial organisms (occupational health)	1	4.3.6	This issue is related to a heat-dissipation system that is not installed at Millstone.
Microbial organisms (public health) (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river).	2	4.3.6	This issue is related to a heat-dissipation system that is not installed at Millstone.

F.1 References

10 CFR Part 51. Code of Federal Regulations, *Title 10, Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Main Report*, *Section 6.3, Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants*, *Final Report*. NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

Appendix G

Connecticut State-Listed Terrestrial Species for Hartford, Middlesex, New London, and Tolland Counties with the Potential to Occur at the Millstone Site or Along Associated Transmission Line Rights-of-Way

Appendix G

Connecticut State-Listed Terrestrial Species for Hartford, Middlesex, New London, and Tolland Counties with the Potential to Occur at the Millstone Site or Along Associated Transmission Line Rights-of-Way

Table G-1. Connecticut State-Listed Terrestrial Species for Hartford, Middlesex, New London, and Tolland Counties with the Potential to Occur at the Millstone Site or Along Associated Transmission Line Rights-of-Way

Scientific Name	Common Name	State Status[a]
	AMPHIBIANS	
Ambystoma jeffersonianum	Jefferson salamander	SC
Ambystoma laterale	blue-spotted salamander	T
Gyrinophilus porphyriticus	northern spring salamander	T
Rana pipiens	northern leopard frog	SC
Scaphiopus holbrookii	eastern spadefoot	E
	BIRDS	
Aegolius acadius	northern saw-whet owl	SC
Ammodramus caudacutus	saltmarsh sharp-tailed sparrow	SC*
Ammodramus henslowii	Henslow's sparrow	SC*
Ammodramus maritimus	seaside sparrow	SC
Ammodramus savannarum	grasshopper sparrow	E
Anas discors	blue-winged teal	T
Asio flammeus	short-eared owl	T
Asio otus	long-eared owl	E
Bartramia longicauda	upland sandpiper	E
Botaurus lentiginosus	American bittern	E
Caprimulgus vociferus	whip-poor-will	SC
Cistothorus platensis	sedge wren	E
Corvus corax	common raven	SC

Table G-1. (contd)

Scientific Name	Common Name	State Status[a]
BIRDS		
Egretta caerulea	little blue heron	SC
Empidonax alnorum	alder flycatcher	SC
Eremophila alpestris	horned lark	E
Falco peregrinus	peregrine falcon	E
Falco sparverius	American kestrel	T
Gallinula chloropus	common moorhen	E
Gavia immer	common loon	SC
Haematopus palliatus	American oystercatcher	SC
Ixobrychus exilis	least bittern	T
Laterallus jamaicensis	black rail	E
Melanerpes erythrocephalus	red-headed woodpecker	E
Parula americana	northern parula	SC
Passerculus sandwichensis	savannah sparrow	SC
Passerculus sandwichensis ssp. *princeps*	Ipswich sparrow	SC
Plegadis falcinellus	glossy ibis	SC
Pooecetes gramineus	vesper sparrow	E
Progne subis	purple martin	T
Rallus elegans	king rail	E
Sterna hirundo	common tern	SC
Sturnella magna	eastern meadowlark	SC
Toxostoma rufum	brown thrasher	SC
Tyto alba	barn owl	E
Vermivora chrysoptera	golden-winged warbler	E
INVERTEBRATES		
Acronicta lanceolaria	a noctuid moth	SC*
Apamea burgessi	a noctuid moth	SC
Apodrepanulatrix liberiaria	New Jersey tea inchworm	SC

Table G-1. (contd)

Scientific Name	Common Name	State Status[a]
	INVERTEBRATES	
Callophrys henrici	Henry's elfin	SC
Callophrys irus	frosted elfin	T
Calopteryx dimidiata	sparkling jewelwing	SC
Catocala pretiosa	precious underwing moth	SC*
Chaetaglaea cerata	a noctuid moth	SC*
Cicindela formosa ssp. *generosa*	pine barrens tiger beetle	SC
Cicindela hirticollis	beach-dune tiger beetle	SC
Cicindela lepida	dune ghost tiger beetle	E
Cicindela purpurea	tiger beetle	SC*
Cicindela tranquebarica	dark-bellied tiger beetle	SC
Citheronia regalis	regal moth	SC*
Cordulegaster erronea	tiger spiketail	T
Cucullia speyeri	a noctuid moth	SC
Eacles imperialis ssp. *imperialis*	imperial moth	SC*
Enallagma doubldayi	Atlantic bluet	SC
Enallagma minusculum	little bluet	SC
Enallagma pictum	scarlet bluet	SC
Erynnis brizo	sleepy duskywing	T
Erynnis lucilius	columbine duskywing	E
Erynnis martialis	mottled duskywing	SC*
Erynnis persius ssp. *persius*	persius duskywing	E
Eucoptocnemis fimbriaris	a noctuid moth	SC
Euphyes bimacula	two-spotted skipper	T
Exyra rolandiana	pitcher plant moth	SC
Geopinus incrassatus	a ground beetle	SC
Gomphus adelphus	mustached clubtail dragonfly	T

Table G-1. (contd)

Scientific Name	Common Name	State Status[(a)]
INVERTEBRATES		
Gomphus descriptus	harpoon clubtail dragonfly	T
Gomphus fraternus	midland clubtail dragonfly	T
Gomphus vastus	cobra clubtail dragonfly	SC
Gomphus ventricosus	skillet clubtail dragonfly	SC
Grammia phyllira	phyllira tiger moth	SC*
Hetaerina americana	American rubyspot	SC
Hemileuca maia maia	buckmoth	E
Hybomitra frosti	a horse fly	T
Hybomitra typhus	a horse fly	SC
Ladona deplanata	blue corporal dragonfly	SC
Lepipolys perscripta	scribbled sallow	SC
Leptophlebia bradleyi	a mayfly	SC
Leucorrhinia glacialis	crimson-winged whiteface dragonfly	T
Lycaena epixanthe	bog copper	SC
Lycaena hyllus	bronze copper	SC
Merycomyia whitneyi	tabanid fly	SC
Mitoura hesseli	Hessel’s hairstreak	E
Papaipema duovata	seaside goldenrod stem borer	SC
Paraleptophlebia assimilis	a mayfly	SC
Pomatiopsis lapidaria	slender walker	SC
Psectraglaea carnosa	pink sallow	T
Schinia spinosae	a noctuid moth	SC
Speyeria idalia	regal fritillary	SC*
Sphodros niger	purse-web spider	SC
Stylurus amnicola	riverine clubtail dragonfly	T
Tabanus fulvicallus	horse fly	SC
Williamsonia lintneri	banded bog skimmer	E

Table G-1. (contd)

Scientific Name	Common Name	State Status[a]
	INVERTEBRATES	
Zale curema	a noctuid moth	SC
Zale obliqua	a noctuid moth	SC
Zale submedia	a noctuid moth	T
	MAMMALS	
Cryptotis parva	least shrew	E
Lasiurus borealis	eastern red bat	SC
Lasiurus cinereus	hoary bat	SC
Puma concolor ssp. *couguar*	eastern cougar	SC*
Synaptomys cooperi	southern bog lemming	SC
	PLANTS	
Acalypha virginica	Virginia copperleaf	SC
Agalinis acuta	sandplain gerardia	E
Agastache nepetoides	yellow giant hyssop	SC*
Agastache scrophularifolia	purple giant hyssop	E
Alopecurus aequalis	orange foxtail	T
Amelanchier sanguinea	roundleaf shadbush	E
Andromeda glaucophylla	bog rosemary	T
Angelica lucida	sea-coast angelica	E
Angelica venenosa	hairy angelica	SC*
Aplectrum hyemale	puttyroot	SC*
Arenaria glabra	smooth mountain sandwort	T
Arenaria macrophylla	large-leaved sandwort	E
Arethusa bulbosa	arethusa	SC*
Aristida longespica	needlegrass	SC
Aristida purpurascens	arrowfeather	SC
Aristolochia serpentaria	Virginia snakeroot	SC

Table G-1. (contd)

Scientific Name	Common Name	State Status[(a)]
PLANTS		
Asclepias purpurascens	purple milkweed	SC
Asclepias variegata	white milkweed	SC*
Asplenium montanum	mountain spleenwort	T
Asplenium ruta-muraria	wallrue spleenwort	T
Aster nemoralis	bog aster	E
Aster prenanthoides	crooked-stem aster	SC*
Aster radula	rough-leaved aster	E
Aster spectabilis	showy aster	T
Aster X blakei	Blake's aster	E
Aster X herveyi	Hervey's aster	SC
Bidens eatonii	Eaton's beggar-ticks	T
Blephilia ciliata	downy woodmint	SC*
Blephilia hirsuta	hairy woodmint	SC*
Calystegia spithamaea	low bindweed	SC*
Cardamine longii	Long's bitter-cress	SC*
Carex aestivalis	summer sedge	SC
Carex alata	broadwing sedge	E
Carex barrattii	Barratt's sedge	E
Carex bushii	sedge	SC
Carex buxbaumii	brown bog sedge	E
Carex collinsii	Collins' sedge	SC*
Carex crawfordii	Crawford sedge	SC*
Carex cumulata	clustered sedge	T
Carex davisii	Davis' sedge	E
Cares exilis	sedge	E
Carex hitchcockiana	Hitchcock's sedge	SC
Carex limosa	sedge	E

Table G-1. (contd)

Scientific Name	Common Name	State Status[a]
PLANTS		
Carex lupuliformis	false hop sedge	SC
Carex nigromarginata	black-edge sedge	SC*
Carex oligocarpa	eastern few-fruit sedge	SC
Carex oligosperma	few-seeded sedge	SC*
Carex polymorpha	variable sedge	E
Carex pseudocyperus	cyperus-like sedge	E
Carex squarrosa	sedge	SC
Carex sterilis	dioecious sedge	SC
Carex tuckermanii	Tuckerman sedge	SC
Carex typhina	sedge	SC
Castilleja coccinea	indian paintbrush	E
Cercis canadensis	eastern redbud	SC*
Chamaelirium luteum	devil's-bit	E
Chenopodium rubrum	coast blite	SC*
Chrysopsis falcata	sickle-leaf golden-aster	E
Cirsium horridulum	yellow thistle	E
Coeloglossum viride var. *virescens*	long-bracted green orchid	SC
Corollorhiza trifida	early coralroot	SC
Corydalis flavula	yellow corydalis	T
Crassula aquatica	pygmyweed	E
Cuphea viscosissima	blue waxweed	SC*
Cuscuta coryli	hazel dodder	SC*
Cypripedium parviflorum	yellow lady's-slipper	SC
Cypripedium reginae	showy lady's slipper	E
Deschampsia caespitosa	tufted hairygrass	SC
Desmodium glabellum	Dillen tick-trefoil	SC

Table G-1. (contd)

Scientific Name	Common Name	State Status[a]
PLANTS		
Desmodium humifusum	trailing tick-trefoil	SC
Desmodium sessilifolium	sessile-leaf tick-trefoil	SC*
Dicentra canadensis	squirrel-corn	T
Diplachne maritima	saltpond grass	E
Diplazium pycnocarpon	narrow-leaved glade fern	E
Draba reptans	whitlow-grass	SC
Dryopteris goldiana	Goldie’s fern	SC
Echinodorus tenellus var. *parvulus*	bur-head	E
Eleocharis equisetoides	horse-tail spikerush	E
Eleocharis microcarpa var. *filiculmis*	spike-rush	SC*
Eleocharis quadrangulata var. *crassior*	spike-rush	E
Elymus trachycaulus var. *subsecundus*	slender wheatgrass	SC
Elymus wiegandii	Wiegand’s wild rice	SC
Equisetum palustre	marsh horsetail	SC*
Equisetum pratense	meadow horsetail	E
Eriocarpon parkeri	Parker’s pipewort	E
Eriophorum vaginatum var. *spissum*	hare’s tail	T
Eupatorium album	white thoroughwort	E
Eupatorium aromaticum	small white snakeroot	E
Gaultheria hispidula	creeping snowberry	T
Gaylussacia dumosa var. *bigeloviana*	dwarf hucklberry	T
Geranium bicknellii	Bicknell northern crane’s-bill	SC*
Gnaphalium purpureum	purple cudweed	SC*
Goodyera repens var. *ophioides*	dwarf rattlesnake plantain	SC*
Helianthemum propinquum	low frostweed	T
Hemicarpha micrantha	dwarf bulrush	E
Hottonia inflata	featherfoil	SC

Table G-1. (contd)

Scientific Name	Common Name	State Status[a]
	PLANTS	
Houstonia longifolia	longleaf bluet	E
Hudsonia ericoides	golden-heather	E
Hudsonia tomentosa	false beach-heather	SC
Hydrastis canadensis	golden-seal	E
Hydrocotyle umbellata	water pennywort	E
Hydrocotyle verticillata	whorled pennywort	E
Hydrophyllum virginianum	Virginia waterleaf	SC
Hypericum adpressum	creeping St. John's wort	SC*
Hypericum pyramidatum	great St. John's wort	SC
Ilex glabra	ink-berry	T
Isanthus brachiatus	false pennyroyal	E
Juncus debilis	weak rush	SC*
Lachnanthes caroliana	Carolina redroot	E
Ledum groenlandica	Labrador tea	T
Liatris scariosa var. *novae-anglica*	blazing star	SC
Ligusticum scothicum	scotch lovage	E
Lilaeopsis chinensis	lilaeopsis	SC
Limosella subulata	mudwort	SC
Linnaea borealis var. *americana*	twinflower	E
Linum intercursum	sandplain flax	SC*
Linum sulcatum	yellow flax	SC
Liparis liliifolia	lily-leaved twayblade	E
Liquidambar styraciflua	sweet gum	SC
Ludwigia polycarpa	many-fruit false-loosestrife	SC*
Ludwigia sphaerocarpa	globe-fruited false-loosestrife	E
Lycopus amplectens	clasping-leaved water-horehound	SC

Table G-1. (contd)

Scientific Name	Common Name	State Status[a]
	PLANTS	
Lygodium palmatum	climbing fern	SC
Malaxis unifolia	green adder's-mouth	E
Megalodonta beckii	water-marigold	T
Milium effusum	tall millet-grass	SC*
Mimulus alatus	winged monkey-flower	SC
Moneses uniflora	one-flower wintergreen	E
Myriophyllum pinnatum	cutleaf water-milfoil	E
Nuphar advena	large yellow pond lily	SC*
Nuphar microphylla	small yellow pond lily	SC
Nymphaea odorata var. *tuberosa*	water lily	SC*
Onosmodium viginianum	gravel-weed	E
Ophioglossum pusillum	adder's tongue	T
Opuntia humifusa	eastern prickly-pear	SC
Orontium aquaticum	golden club	SC
Oryzopsis pungens	slender mountain-ricegrass	SC
Oxalis violacea	violet wood-sorrel	SC
Panax quinquefolius	American ginseng	SC
Panicum amarum	panic grass	T
Panicum commonsianum	panic grass	SC
Panicum rigidulum var. *elongatum*	tall flat panic grass	SC*
Panicum scabriusculum	panic grass	E
Panicum xanthophysum	panic grass	SC*
Paronychia fastigiata	hairy forked chickweed	SC*
Paspalum laeve	field paspalum	E
Paspalum setaceum var. *psammophilum*	bead grass	SC*
Pedicularis lanceolata	swamp lousewort	T
Phaseolus polystachios var. *aquilonius*	wild kidney bean	SC*

Table G-1. (contd)

Scientific Name	Common Name	State Status[a]
PLANTS		
Pinus resinosa	red pine	E
Plantago virginica	hoary plantain	SC
Platanthera blephariglottis	white-fringed orchid	T
Platanthera ciliaris	yellow-fringed orchid	T
Platanthera dilatata	tall white bog orchid	SC*
Platanthera flava	pale green orchid	SC
Platanthera hookeri	Hooker orchid	SC*
Platanthera orbiculata	large roundleaf orchid	SC*
Podostemum ceratophyllum	threadfoot	SC
Polygala cruciata	field milkwort	SC
Polygala nuttallii	Nuttall's milkwort	E
Polymnia canadensis	small-flowered leafcup	E
Populus heterophylla	swamp cottonwood	E
Potamogeton confervoides	pondweed	SC*
Potemogeton pusillus var. *gemmiparus*	capillary pondweed	E
Potamogeton vaseyi	Vasey's pondweed	E
Potentilla arguta	tall cinquefoil	SC
Prunus alleghaniensis	Alleghany plum	SC*
Puccinellia langeana ssp. *alaskana*	goose grass	SC*
Pycnanthemum clinopodioides	basil mountain-mint	E
Pyrola secunda	one-sided pyrola	SC*
Ranunculus ambigens	water-plantain spearwort	E
Ranunculus cymbalaria	seaside crowfoot	SC*
Ranunculus pensylvanicus	bristly buttercup	SC*
Ranunculus sceleratus	cursed crowfoot	SC
Rhynchospora macrostachya	beaked rush	T

Table G-1. (contd)

Scientific Name	Common Name	State Status[a]
PLANTS		
Rhynchospora scirpoides	long-beaked baldrush	E
Ribes glandulosum	skunk currant	T
Ribes rotundifolium	wild currant	SC*
Ribes triste	swamp red currant	E
Rosa nitida	shining rose	SC
Rotala ramosior	toothcup	T
Rubus cuneifolius	sand bramble	SC
Rumex maritimus var. *fueginus*	sea-side dock	SC*
Sabatia stellaris	marsh pink	E
Sagittaria cuneata	waputo	SC*
Sagittaria subulata	arrowleaf	SC
Salix exigua	sandbar willow	T
Salix pedicellaris	bog willow	E
Salix petiolaris	slender willow	SC*
Saururus cernuus	lizard's tail	E
Scheuchzeria palustris	pod grass	E
Schizachne purpurascens	purple oat	SC
Schwalbea americana	chaffseed	SC*
Scirpus cylindricus	salt-marsh bulrush	SC
Scirpus hudsonianus	cotton bulrush	SC*
Scirpus longii	Long's bulrush	SC*
Scirpus paludosus var. *atlanticus*	bayonet grass	SC
Scirpus torreyi	Torrey's bulrush	T
Scleria pauciflora var. *caroliniana*	few-flowered nutrush	E
Scleria reticularis	reticulated nutrush	E
Scleria triglomerata	nutrush	E
Scutellaria integrifolia	hyssop skullcap	E

Table G-1. (contd)

Scientific Name	Common Name	State Status[(a)]
	PLANTS	
Senecio pauperculus	ragwort	E
Senna hebecarpa	wild senna	SC
Silene stellata	starry campion	SC
Smilacina trifolia	three-leaved false Solomon's-seal	T
Solidago elliottii	Elliott goldenrod	SC
Solidago rugosa var. sphagnophila	early wrinkle-leaved goldenrod	SC*
Spergularia canadensis	Canada sand-spurry	T
Spiranthes tuberosa var. *grayi*	little ladies'-tresses	SC*
Sporobolus clandestinus	rough dropseed	E
Sporobolus neglectus	small dropseed	E
Stachys hyssopifolia	hyssop-leaf hedge-nettle	E
Stachys tenuifolia	smooth hedge-nettle	SC
Stellaria borealis	northern stitchwort	SC
Streptopus amplexifolius var. *americanus*	white mandarin	T
Thuja occidentalis	northern white cedar	T
Trichomanes intricatum	Appalachian gametophyte	SC
Triosteum angustifolium	narrow-leaved horse gentian	SC*
Triphora trianthophora	nodding pogonia	SC*
Trisetum spicatum var. *molle*	spiked false oats	SC*
Utricularia fibrosa	fibrous bladderwort	SC*
Utricularia resupinata	bladderwort	E
Uvularia grandiflora	large-flowered bellwort	E
Vaccinium myrtilloides	velvetleaf blueberry	SC*
Vaccinium vitis-idea var. *minus*	mountain cranberry	SC*
Valerianella radiata var. *fernaldii*	beaked corn-salad	SC*
Verbena simplex	narrow-leaved vervain	SC*

Table G-1. (contd)

Scientific Name	Common Name	State Status[a]
	PLANTS	
Vibernum nudum	possum haw	SC*
Viola canadensis	Canada violet	SC
Viola selkirkii	great-spurred violet	SC
Vitis novae-angliae	New England grape	SC
Waldsteinia fragarioides	barren strawberry	SC
Xyris montana	northern yellow-eyed grass	T
Xyris smalliana	Small's yellow-eyed grass	E
Zizia aptera	golden alexanders	E
	REPTILES	
Clemmys insculpta	wood turtle	SC
Crotalus horridus	timber rattlesnake	E
Eumeces fasciatus	five-lined skink	T
Heterodon platirhinus	eastern hognose snake	SC
Terrapene carolina	eastern box turtle	SC
Thamnophis sauritus	eastern ribbon snake	SC

(a) E=endangered, T = threatened, SC = species of concern, (*) = believed extirpated (CTDEP 2004)

Appendix H

NRC Staff Evaluation of Severe Accident Mitigation Alternatives (SAMAs) for Millstone Power Station, Unit 2, in Support of the License Renewal Application

Appendix H

NRC Staff Evaluation of Severe Accident Mitigation Alternatives (SAMAs) for Millstone Power Station, Unit 2, in Support of the License Renewal Application

H.1 Introduction

Dominion Nuclear Connecticut, Inc. (Dominion) submitted an assessment of SAMAs for Millstone Power Station, Unit 2 (MPS2) as part of the Environmental Report (ER) (Dominion 2004a). This assessment was based on the most recent MPS2 Probabilistic Risk Assessment (PRA) available at that time, a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System 2 (MACCS2) computer program, and insights from the MPS2 Individual Plant Examination (IPE) (NNECO 1993) and Individual Plant Examination of External Events (IPEEE) (NNECO 1995). In identifying and evaluating potential SAMAs, Dominion considered SAMA analyses performed for other operating plants, as well as industry and NRC documents that discuss potential plant improvements, such as NUREG-1560 (NRC 1997a). Dominion identified 196 potential SAMA candidates. This list was reduced to 44 unique SAMA candidates by eliminating SAMAs that were not applicable to MPS2 due to design differences, had already been implemented, or were related to a reactor coolant pump (RCP) seal loss of coolant accident (LOCA). Dominion assessed the costs and benefits associated with each of the remaining SAMAs and concluded in the ER that one of the candidate SAMAs evaluated would be cost-beneficial for MPS2.

Based on a review of the SAMA assessment, the NRC issued a request for additional information (RAI) to Dominion by letter dated June 22, 2004 (NRC 2004). Key questions concerned: peer reviews of the PRA, dominant risk contributors at MPS2 and the SAMAs that address these contributors, the mapping of Level 1 PRA results into the Level 2 analysis, the potential impact of external event initiators and uncertainties on the assessment results, detailed information on some specific candidate SAMAs, and consideration of additional SAMAs. Dominion submitted additional information by letter dated August 13, 2004 (Dominion 2004b) including: summaries of peer review comments and their impact on the SAMA analysis; importance measures and corresponding SAMA candidates; information regarding the Level 2 analysis; information related to the resolution of IPEEE outliers and the impact of external events in the risk analysis; an assessment of the impact of uncertainties; and additional information regarding specific SAMAs. Dominion's responses addressed the staff's concerns.

As a result, Dominion identified one SAMA that is cost-beneficial, and a second SAMA that would be cost-beneficial if it can be accomplished via a severe accident management guideline, without a hardware modification.

An assessment of SAMAs for MPS2 is presented below.

H.2 Estimate of Risk for MPS2

Dominion's estimates of offsite risk at MPS2 are summarized in Section H.2.1. The summary is followed by the staff's review of Dominion's risk estimates in Section H.2.2.

H.2.1 Dominion's Risk Estimates

Two distinct analyses are combined to form the basis for the risk estimates used in the SAMA analysis: (1) the MPS2 Level 1 and 2 PRA model, which is an updated version of the IPE (NNECO 1993), and (2) a supplemental analysis of offsite consequences and economic impacts (essentially a Level 3 PRA model) developed specifically for the SAMA analysis. The identification of candidate SAMAs was based on Revision 2 of the PRA model, dated April 2001; the quantification of SAMA benefits was based on Revision 3, dated October 2002 (Dominion 2004b). The scope of the MPS2 PRA does not include external events.

The baseline core damage frequency (CDF) for the purpose of the SAMA evaluation is approximately 7.17×10^{-5} per year. The CDF is based on the risk assessment for internally-initiated events. Dominion did not include the contribution to risk from external events or internal flooding within the MPS2 risk estimates; however, it did account for the potential risk reduction benefits associated with external events by increasing the estimated benefits for internal events by 30 percent. This is discussed further in Sections H.4 and H.6.2.

The breakdown of CDF by initiating event is provided in Table H-1. As shown in this table, LOCAs, loss of cooling water to the primary side components (COOL) including service water (SW) and reactor building closed cooling water (RBCCW), loss of DC power, and transients including anticipated transients without scram (ATWS) are dominant contributors to the CDF. LOCAs are dominated by small-break LOCAs which make up about 36 percent of the total CDF. Bypass events [i.e., steam generator tube rupture (SGTR) and interfacing systems loss of coolant accident (ISLOCA)] contribute less than four percent to the total internal events CDF. In response to an RAI, Dominion estimated the contribution to CDF from internal floods to be approximately 2×10^{-7} per year (Dominion 2004b).

The Level 2 PRA model is based on the original Level 2 model of the IPE (NNECO 1993). The model has been revised to reflect modified plant damage states and new release categories.

These revisions were made to make the plant damage states (PDSs) and release categories consistent with those used for Millstone Power Station Unit 3 (MPS3). The result of this analysis is a matrix that transforms the PDS frequencies to the release category frequencies. The source terms for each release category (also termed the source term category) were obtained from the results of MAAP 3.0B analyses of the dominant core damage sequences in the IPE.

Table H-1. Millstone Unit 2 Core Damage Frequency

Initiating Event or Accident Class	CDF (Per Year)	% Contribution to CDF
LOCA	2.66×10^{-5}	37.1
COOL (SW+Seal LOCA+ RBCCW)[1]	1.44×10^{-5}	20.1
Loss of DC power	1.03×10^{-5}	14.4
ATWS	8.68×10^{-6}	12.1
Transients	4.66×10^{-6}	6.5
SGTR	2.22×10^{-6}	3.1
Station blackout (SBO)	2.15×10^{-6}	3.0
Steamline and main feed line breaks	1.72×10^{-6}	2.4
Loss of offsite power (LOOP)	8.60×10^{-7}	1.2
ISLOCA	1.43×10^{-7}	0.2
Total CDF	7.17×10^{-5}	100

[1] COOL represents the loss of cooling water to the primary side components, leading to an eventual degradation of the reactor coolant pump seal integrity.

The offsite consequences and economic impact analyses use the MACCS2 code to determine the offsite risk impacts on the surrounding environment and public. Inputs for this analysis include plant-specific and site-specific input values for core radionuclide inventory, source term and release characteristics, site meteorological data, projected population distribution within a 80 km [50-mi] radius for the year 2030, emergency response evacuation modeling, and economic data. The core radionuclide inventory is based on the generic pressurized water reactor (PWR) inventory provided in the MACCS2 manual, adjusted to represent the MPS2 power level of 2700 MW(t). The magnitude of the onsite impacts (in terms of clean-up and decontamination costs and occupational dose) is based on information provided in NUREG/BR-0184 (NRC 1997b).

In the ER, Dominion estimated the dose to the population within 80 km (50 mi) of the MPS2 site to be approximately 0.174 person-Sv (17.4 person-rem) per year. The breakdown of the total population dose by containment release mode is summarized in Table H-2. Intermediate containment failures dominate the population dose risk at MPS2, followed by SGTR and late containment failures. Early containment failures and ISLOCAs make relatively small contributions, each being less than three percent of the total. Containment isolation and basemat failures are each indicated to be zero contributors to risk. As indicted in the response to an RAI, these release modes are incorporated into other release modes with similar characteristics (Dominion 2004b).

Table H-2. Breakdown of Population Dose by Containment Release Mode (Unit 2)

Containment Release Mode	Population Dose (Person-rem[1] Per Year)	% Contribution
Intermediate failure	12.4	71
SGTR	2.5	14.4
Late failure	1.63	9.4
Early failure	0.48	3
ISLOCA	0.42	2.4
Containment isolation failure	0	0
Basemat failure	0	0
Total Population Dose	**17.4**	**100**

[1]One person-rem = 0.01 person-Sv

H.2.2 Review of Dominion's Risk Estimates

Dominions's determination of offsite risk at MPS2 is based on the following three major elements of analysis:

- the Level 1 and 2 risk models that form the bases for the 1993 IPE submittal (NNECO 1993) and the 1995 IPEEE submittal (NNECO 1995),

- the major modifications to the IPE models that have been incorporated in the MPS2 PRA, and

- the MACCS2 analyses performed to translate fission product source terms and release frequencies from the Level 2 PRA model into offsite consequence measures.

Each of these analyses was reviewed to determine the acceptability of Dominion's risk estimates for the SAMA analysis, as summarized below.

The staff's review of the MPS2 IPE is described in an NRC report dated May 21, 1996 (NRC 1996). Based on a review of the original IPE submittal, the staff concluded that IPE submittal met the intent of Generic Letter 88-20 (NRC 1988); that is, the IPE was of adequate quality to be used to look for design or operational vulnerabilities. The staff did, however, identify a number of weaknesses in the IPE analysis. In response to an RAI, Dominion indicated that all of these weaknesses have been addressed in the PRA used for the SAMA analysis (Dominion 2004b).

A comparison of internal events risk profiles between the IPE and the PRA used in the SAMA analysis indicates an increase of approximately 3.8×10^{-5} per year in the total CDF (from 3.4×10^{-5} per year to 7.17×10^{-5} per year). The change is a net result of modeling changes and some minor plant design changes that have been implemented at MPS2 since the IPE. A summary listing of those changes that resulted in the greatest impact on the total CDF was provided in the ER and in response to RAIs (Dominion 2004a, 2004b), and include:

- added credit for passive ventilation in the intake structure
- updated the loss of normal power event frequency
- added new cross-tie to Unit 3 AC power sources to mitigate SBO conditions at Unit 2
- modified the total loss of cooling event tree by updating nodes for failure of the operator to trip the reactor coolant pumps and reactor coolant pump seal LOCA
- modified the AC power distribution logic by adding the MPS2 normal station service transformer as the power source (not previously modeled)
- modified the DC logic to: (1) transfer to the loss of DC when emergency diesel generators and DC buses are not available, and (2) add a loss of DC bus A and B event as first event to be considered in the SBO event tree.

An additional change that has a significant impact on the CDF value is the truncation value used in the PRA model. For the PRA version used for the SAMA analysis, Dominion used a truncation value of 1.0×10^{-11}. In contrast, use of a truncation value of 2.0×10^{-9} (as used in previous versions of the PRA) would result in a CDF of about 5×10^{-5} per year. This alone would account for approximately half of the noted increase in CDF since the IPE.

The IPE CDF value for MPS2 is comparable to the CDF values reported in the IPEs for other Combustion Engineering (CE) PWR plants. Figure 11.6 of NUREG-1560 shows that the IPE-based total internal events CDF for CE PWRs ranges from $1x10^{-5}$ to $3x10^{-4}$ per year (NRC 1997a). It is recognized that other plants have reduced their values for CDF after the IPE submittals due to modeling and hardware changes. The current internal events CDF results for MPS2 remain comparable to the results for other plants of similar vintage and characteristics.

The staff considered the peer review performed for the MPS2 PRA, and the potential impact of the review findings on the SAMA evaluation. In response to an RAI, Dominion described the external peer review, which was the Combustion Engineering Owners Group (CEOG) Peer Review of PRA Revision 0 performed in 1999 (Dominion 2004b). The review resulted in 25 Level A facts and observations (extremely important and necessary to address to ensure technical adequacy) and 59 Level B facts and observations (important and necessary to address but may be deferred until next PRA update). The majority of the recommendations from this review were addressed or reflected in Revision 3 of the MPS2 PRA. Seven of the Level A recommendations are yet to be resolved, while 25 of the Level B recommendations are yet to be resolved. Those Level A recommendations not yet incorporated are in the areas of accident sequence analysis, human reliability analysis, dependency analysis, and quantification. The Level B recommendations not yet incorporated affect all PRA elements. Dominion has reviewed all of the unresolved facts and observations and concluded that they have negligible impact on the SAMA analysis (Dominion 2004b). The staff has also reviewed Dominion’s assessment of the impacts of the outstanding peer review comments and has come to the same conclusion.

Given that (1) the MPS2 PRA has been peer reviewed and the potential impact of the peer review findings on the SAMA evaluation has been assessed, (2) Dominion satisfactorily addressed staff questions regarding the PRA (Dominion 2004b), and (3) the CDF falls within the range of contemporary CDFs for CE plants, the staff concludes that the Level 1 PRA model is of sufficient quality to support the SAMA evaluation.

The licensee submitted an IPEEE in December 1995 (NNECO 1995), in response to Supplement 4 of Generic Letter 88-20. While the IPEEE submittal did not specifically state a criterion for identifying a vulnerability to severe accident risk in regard to the external events related to seismic, fire, or other external events, a number of outliers or "opportunities for safety enhancements" were identified. The current status of these outliers was provided by Dominion in response to a staff RAI. In the response, Dominion stated that of a total of 29 items, 21 were resolved prior to 2003. The remaining eight items were closed in August 2003 (Dominion 2004b). In a letter dated January 12, 2001, the staff concluded that the IPEEE submittal met the intent of Supplement 4 to Generic Letter 88-20, and that the licensee's IPEEE process is capable of identifying the most likely severe accidents and severe accident vulnerabilities (NRC 2001).

The seismic portion of the IPEEE consisted of a 0.3g focused-scope seismic evaluation using the Electric Power Research Institute (EPRI) methodology for Seismic Margins Assessment (SMA). A total of 16 components were initially estimated to have high confidence low probability of failure (HCLPF) capacities less than the review level earthquake peak ground acceleration of 0.3g. The lowest of these were included in the list of outliers to be resolved. The actions taken by the licensee to resolve seismic outliers included modification of the RBCCW and chilled water surge tanks supports, and modification to anchorage of battery racks. Other items were resolved by verifying component adequacy by calculation or by correcting housekeeping problems. After resolution of these outliers, three components remained with HCLPF values less than the 0.3g review level earthquake: the turbine building housing the auxiliary feedwater (AFW) pumps (0.25g), the 125 VDC vital bus 201B (0.26g), and the RBCCW heat exchangers (0.29g). Dominion concluded that because of adequate seismic margins and the complexity associated with increasing the seismic capacity of a structure, no cost-effective SAMAs related to seismic events could be identified (Dominion 2004b). The staff agrees that it is unlikely that cost-effective SAMAs that address seismic vulnerabilities will exist. This is due to high cost of structural modifications compared to the benefits expected.

The MPS2 IPEEE does not provide numerical estimates of the CDF contributions from seismic initiators. Section F.2.4 of the ER indicates that the seismic CDF is 9.1×10^{-6} per year. Since the SMA does not result in a numerical value, the staff asked Dominion to provide the basis for the seismic CDF value given in the ER (NRC 2004). In response, Dominion indicated that the value used is the seismic CDF for Millstone Power Station Unit 3 (MPS3) obtained from the MPS3 seismic PRA. The staff notes that for MPS3 all of the plant components or structures whose failure would significantly impact CDF have HCLPF values equal to or greater than the review level earthquake acceleration of 0.3g, whereas MPS2 has three components/structures with HCLPF values that are below 0.3g. This would indicate that the seismic CDF for MPS2 may be greater than that for MPS3.

Even though the MPS2 seismic CDF may be larger than that used to estimate the added benefit of SAMA candidates due to their impact on seismic risk, the staff believes that the seismic CDF would remain a relatively small contributor to the total CDF. This is due to the small contribution that low magnitude earthquakes make to the CDF. The impact of low magnitude earthquakes (in the range of 0.1 to 0.3g) is principally in causing initiating events and for a LOOP reducing the likelihood of offsite power recovery. The frequency of these seismic initiating events is several orders of magnitude less than that due to random failures. Even a station blackout following a seismic LOOP has a frequency considerably less than that due to internal events. For higher magnitude earthquakes, the impact of structural failures starts to become more important. However, as indicated above, SAMAs to mitigate these risk contributors are not expected to be cost-effective.

The licensee's IPEEE fire analysis was based on EPRI's Fire Induced Vulnerability Evaluation methodology. This methodology employs a graduated focus on the most important fire zones using qualitative and quantitative screening criteria. The fire zones or compartments were subjected to at least two screening phases. In the first phase, a zone was screened out if a fire could not cause an initiating event and if the zone contained no equipment or cables needed to mitigate an initiating event. In the second phase screening, three quantitative criteria were used: (1) a zone is screened out if the CDF is less than $1x10^{-6}$ per year from evaluating the plant model assuming all equipment in the zone is lost, (2) a zone is screened out if contains a single train of safety equipment and the fire induced unavailability is small compared to that due to internal events, and (3) a zone is screened out if the effect of a fire is similar to but less severe than that in another analyzed zone. Of a total of 87 fire zones, 13 zones comprising five fire areas were not screened out and were subjected to a more detailed quantitative analysis. These areas are:

Fire Area	Description	CDF (per year)
AUXB-1	auxiliary building	$2.76x10^{-6}$
A-24	cable vault	$2.83x10^{-7}$
A-25	main control room	$6.57x10^{-7}$
I-1A	intake structure pump room	$9.66x10^{-7}$
TB	turbine building general areas	$1.63x10^{-6}$

The fire CDF for MPS2 is approximately $6.3x10^{-6}$ per year or about nine percent of the MPS2 internal events CDF.

In an RAI, the staff asked Dominion to explain, for each important fire area, what measures were taken to further reduce risk, and explain why these CDFs cannot be further reduced in a cost-effective manner (NRC 2004). For each area, Dominion provided a discussion of the major fire contributors assumed in the analysis and the existing plant features to address fire events. Dominion identified several improvements that have been implemented to address fire-related issues and confirmed that all fire-related plant outliers identified in IPEEE were implemented prior to the SAMA analysis. Dominion also discussed the potential for further cost-effective hardware changes to address the fire-related matters listed above, including improvements to detection systems, enhancements to suppression capabilities, and changes that would improve cable separation and train separation (Dominion 2004b). Dominion concluded that no further modifications would be cost-effective for any of the fire areas.

The staff notes that although additional SAMAs to reduce the fire risk contributors might be viable, given the low level of risk from fires and the improvements that have already been implemented, it is unlikely that further modifications would both substantially reduce risk and remain cost-beneficial.

The risk associated with other external events at MPS2 is small. While the CDFs due to high winds, floods and other events were not estimated since they were screened out using the NUREG-1407 approach (NRC 1991), a number of possible enhancements were identified in the IPEEE. These enhancements, primarily related to high winds and external flooding, have all been resolved (NRC 2001).

In the SAMA analysis, Dominion accounted for the additional risk contribution due to external events by increasing the benefit derived from the internal events model by 30 percent. This was determined by summing the following CDF contributions:

- Fire 6.3×10^{-6} per year
- Internal flooding 0.2×10^{-6} per year
- Seismic 9.1×10^{-6} per year

The fire contribution is discussed above. The internal flood contribution is based on the IPE analysis, but has subsequently been dropped from the internal events model. The total external events CDF from the above is 1.6×10^{-5} per year, or approximately 22 percent of the CDF due to internal events. This was rounded up to 30 percent for the SAMA analysis.

The MPS2 Level 2 PRA analysis is based on the IPE. The IPE results were transformed to reflect new plant damage state and release category definitions. This process is described in Section F.2.3 of the ER (Dominion 2004a), and further clarified in response to RAIs (Dominion 2004b, 2004c). The resulting plant damage state to release category transformation matrix and release category frequencies are provided in Tables F.2-4 and F.2-6 of the ER, respectively (Dominion 2004a). The release fractions for each release category were obtained from MAAP 3.0B analysis for the dominant sequences in the IPE and are provided in Table F.1-2 of the ER (Dominion 2004a). In response to an RAI concerning the use of IPE dominant sequences to determine the release fractions used in the SAMA analysis, Dominion provided a discussion and a comparison of the plant damage states and release categories for the IPE and SAMA analyses (Dominion 2004b). The staff reviewed Dominion's source term estimates for the major release categories and found the release fractions to be within the range of the release fractions for similar plants. Dominion also provided the results of several sensitivity studies relative to the source term and release characteristics including doubling the plume release height, doubling the duration of source term release time, setting source term for M9 and M11 (late and basemat failures with sprays) equal to M10 (basemat failure without sprays), and using the MPS3 data for release category M1A (ISLOCA sequence). The results showed that these parameter variations had only a minor impact (less than 10 percent) on the estimated dollar benefits for the candidate SAMAs. The staff concludes that the process used for determining the release category frequencies and source terms is reasonable and appropriate for the purposes of the SAMA analysis.

As discussed previously, the fission product inventory used in the consequence analysis is based on a fission product inventory scaled from generic information. In response to an RAI concerning the impact of current and future fuel management practices, Dominion described a conservative bounding analysis of core fission product inventory considering a range of enrichments and burnups (Dominion 2004b). Using this inventory would result in a 22-percent increase in total benefit from eliminating all risk. Using realistic mid-life or average conditions would result in a smaller increase in the maximum benefit. The staff concludes that the scaling based on the plant-specific power level yields sufficiently accurate and reasonable results for the dose assessment.

The staff reviewed the process used by Dominion to extend the containment performance (Level 2) portion of the PRA to an assessment of offsite consequences (essentially a Level 3 PRA). This included consideration of the major input assumptions used in the offsite consequence analyses. The MACCS2 code was utilized to estimate offsite consequences. Plant-specific input to the code includes the source terms for each release category and the MPS2 reactor core radionuclide inventory (both discussed above), site-specific meteorological data, projected population distribution within a 80 km (50 mile) radius for the year 2030, and emergency evacuation modeling. This information is provided in Appendix F to the ER (Dominion, 2004a).

Dominion used site-specific meteorological data processed from hourly measurements for the 2000 calendar year as input to the MACCS2 code. The hourly data (wind direction, wind speed, and stability class) were collected from the onsite meteorological tower. Precipitation data were recorded at the Green Airport near Providence, Rhode Island, the closest weather station to Millstone. Morning and afternoon mixing height values were obtained from the National Climatic Data Center. The applicant also considered the impact on SAMA benefits of using meteorological data for 1998 and 1999. The results of these sensitivity cases showed that the benefits increased by an average of about five percent. The staff considers the use of the 2000 data in the base case to be reasonable.

The population distribution the applicant used as input to the MACCS2 analysis was estimated for the year 2030, based primarily on SECPOP90 (NRC 1997c). U.S. Census Bureau Year 2000 population data, projected to year 2030, was then used to update the SECPOP90 population data (Dominion 2004a). The staff questioned the difference between the use of SECPOP90 and SECPOP2000, and what the impact would be if the latter was used. In response, Dominion noted that the expected impact of using SECPOP2000 would be negligible since census data from 2000 were used to update the SECPOP90 file. The staff considers the methods and assumptions for estimating population reasonable and acceptable for purposes of the SAMA evaluation.

The emergency evacuation model was modeled as a single evacuation zone extending out 16 km (10 mi) from the plant. It was assumed that 100 percent of the population would move at an average speed of approximately 1.49 meters per second with a delayed start time of 7200 seconds from the offsite alarm reference time point (Dominion 2004a). Dominion performed sensitivity studies exploring the impact of the fraction of population that evacuates and the evacuation speed. The results demonstrated that the total dose and economic cost results are insensitive to these parameters (Dominion 2004a). The staff concludes that the evacuation assumptions and analysis are reasonable and acceptable for the purposes of the SAMA evaluation.

Much of the site-specific economic data was provided from SECPOP90 (NRC 1997c) by specifying the data for counties surrounding the plant to a distance of 50 miles. The SECPOP90 input file was updated to 2001 using cost of living and other data from the Bureau of the Census and the Department of Agriculture (Dominion 2004a). The agricultural economic data were updated using available data from the 1997 Census of Agriculture (USDA 1998).

The staff concludes that the methodology used by Dominion to estimate the offsite consequences for MPS2 provides an acceptable basis from which to proceed with an assessment of risk reduction potential for candidate SAMAs. Accordingly, the staff based its assessment of offsite risk on the CDF and offsite doses reported by Dominion.

H.3 Potential Plant Improvements

The process for identifying potential plant improvements, an evaluation of that process, and the improvements evaluated in detail by Dominion are discussed in this section.

H.3.1 Process for Identifying Potential Plant Improvements

Dominion's process for identifying potential plant improvements (SAMAs) consisted of the following elements:

- review of the most significant basic events from the MPS2 PRA Model, Rev. 2 (April 2001),

- review of items not already evaluated and/or implemented during the IPE and IPEEE,

- review of SAMA analyses submitted in support of original licensing and license renewal activities for other operating nuclear power plants, and

- review of other NRC and industry documentation discussing potential plant improvements.

Based on this process, an initial set of 196 candidate SAMAs was identified. In Phase 1 of the evaluation, Dominion performed a qualitative screening of the initial list of SAMAs and eliminated SAMAs from further consideration using the following criteria:

- the SAMA is not applicable at MPS2,

- the SAMA has already been implemented at MPS2, or the MPS2 design meets the intent of the SAMA, or

- the SAMA is related to a RCP seal vulnerability stemming from charging pump dependency on component cooling water (CCW). (MPS2 does not have this vulnerability because it relies on the RBCCW system rather than CCW for RCP seal injection.)

Based on this screening, 152 SAMAs were eliminated leaving 44 for further evaluation. Of the SAMAs eliminated, 53 were eliminated because they were not applicable, 91 were eliminated because they already had been implemented, five were eliminated because they were related to RCP seal vulnerability, and three were similar to and combined with other SAMAs. A cost estimate was prepared for each of the 44 remaining candidates to focus on those that had a possibility of having a net positive benefit. To account for the potential impact of external events, the estimated benefits based on internal events were multiplied by a factor of 1.3 for all SAMAs except those related to ISLOCA and SGTR-initiated events.

Of the 44 SAMAs evaluated, one was identified as potentially cost-beneficial. Other SAMAs were evaluated and subsequently eliminated, as described in Sections H.4 and H.6.1 below.

H.3.2 Review of Dominion's Process

Dominion's efforts to identify potential SAMAs focused primarily on areas associated with internal initiating events. The initial list of SAMAs generally addressed the accident categories that are dominant CDF contributors or issues that tend to have a large impact on a number of accident sequences at MPS2.

The preliminary review of Dominion's SAMA identification process raised some concerns regarding the completeness of the set of SAMAs identified and the inclusion of plant-specific risk contributors. The staff requested additional information regarding the top 30 cut sets and certain sequences (NRC 2004). In response to the RAI, Dominion provided a listing of the top contributors to risk, the associated plant damage state, and a cross-reference between the top contributors to risk from a later version of the PRA and the SAMAs that addressed those risk contributors (Dominion 2004b).

The staff noted that Dominion based the SAMA identification process on PRA Revision 2 (dated April 2001) and the SAMA quantification on Revision 3 (dated October 2002). The staff questioned Dominion regarding the impact on the SAMA identification process if the later version of the PRA was used to identify potential SAMAs (NRC 2004). In response, Dominion reassessed the SAMA identification process considering the later PRA revision. The basic events not included in the initial Unit 2 PRA importance list were identified. Those events with a risk reduction worth greater than or equal to 1.005 from the more recent PRA model were specifically evaluated. These events were compared to the SAMA list to determine which events were already addressed by a SAMA. Dominion determined that all of the additional basic events map to previously identified SAMAs. As a result, no new SAMAs were created (Dominion 2004c). Based on these additional assessments, Dominion concluded that the set of 196 SAMAs evaluated in the ER addresses the major contributors to CDF and offsite dose, and that the review of the top risk contributors does not reveal any new SAMAs.

The staff questioned Dominion regarding use of the second screening criterion (i.e., screening out a SAMA on the basis that it has already been implemented at MPS2) to eliminate SAMAs that were identified based on review of the PRA (NRC 2004). In response, Dominion provided qualitative or quantitative details on the plant-specific SAMAs that were screened using this criterion (SAMAs 161, 162, 163, 164, 167, 168, 169, 171, 177, 178, 180, 181, 188, and 196). None of these SAMAs were determined to be cost-beneficial based on this further evaluation.

The staff questioned Dominion about lower cost alternatives to some of the SAMAs evaluated, including the use of portable battery chargers and a direct-drive diesel AFW pump (NRC 2004). In response, Dominion identified several lower cost alternatives, all of which are covered by an existing procedure or severe accident management guideline (SAMG), or could be instituted following evaluation and guidance by the Technical Support Center (Dominion 2004b). This is discussed further in Section H.6.2.

The staff also questioned Dominion about several other candidate SAMAs that were found to be potentially cost-beneficial at another CE plant but not addressed by MPS2 (NRC 2004). In response, Dominion provided an evaluation of the applicability and/or costs and benefits for these SAMAs at MPS2. Based on this assessment, all of the SAMAs were dismissed except one involving adding a capability to flash the field on the emergency diesel generator to enhance SBO event recovery (Dominion 2004b). This is discussed further in Section H.6.2.

The staff notes that the set of SAMAs submitted is not all inclusive, since additional, possibly even less expensive, design alternatives can always be postulated. However, the staff concludes that the benefits of any additional modifications are unlikely to exceed the benefits of the modifications evaluated and that the alternative improvements would not likely cost less than the least expensive alternatives evaluated, when the subsidiary costs associated with maintenance, procedures, and training are considered.

The staff concludes that Dominion used a systematic and comprehensive process for identifying potential plant improvements for MPS2, and that the set of potential plant improvements identified by Dominion is reasonably comprehensive and, therefore, acceptable. This search included reviewing insights from the IPE and IPEEE and other plant-specific studies, reviewing plant improvements considered in previous SAMA analyses, and using the knowledge and experience of its PRA personnel. While explicit treatment of external events in the SAMA identification process was limited, it is recognized that the prior implementation of plant modifications for seismic events and the absence of external event vulnerabilities reasonably justifies examining primarily the internal events risk results for this purpose.

H.4 Risk Reduction Potential of Plant Improvements

Dominion evaluated the risk-reduction potential of the 44 remaining SAMAs that were applicable to MPS2. A majority of the SAMA evaluations were performed in a bounding fashion in that the SAMA was assumed to completely eliminate the risk associated with the proposed enhancement. Such bounding calculations overestimate the benefit and are conservative.

Dominion estimated the potential benefits for each SAMA by generating a revised set of plant damage state frequencies. Using these revised frequencies, a revised Level 3 (dollars averted) calculation was performed. The benefit was calculated using the fault trees, event trees, and databases from Revision 3 of the MPS2 PRA. The assumptions made to evaluate the benefit were provided in response to an RAI (Dominion 2004b, 2004c). Table G-3 lists the assumptions considered to estimate the risk reduction for each of the evaluated SAMAs, the estimated risk reduction in terms of percent reduction in CDF and population dose, and the estimated total benefit (present value) of the averted risk (including the 1.3 multiplier to account for benefits in external events). The determination of the benefits for the various SAMAs is further discussed in Section H.6.

The staff has reviewed Dominion's bases for calculating the risk reduction for the various plant improvements and concludes that the rationale and assumptions for estimating risk reduction are reasonable and generally conservative (i.e., the estimated risk reduction is higher than what would actually be realized). Accordingly, the staff based its estimates of averted risk for the various SAMAs on Dominion's risk reduction estimates. The estimated risk reduction for several of the SAMAs was negligible or zero. In these instances, the SAMA either affects sequences or phenomena that do not contribute to risk at MPS2, or represents an ineffective plant improvement. As such, a minimal impact on risk is not unreasonable in those cases.

H.5 Cost Impacts of Candidate Plant Improvements

Dominion personnel experienced in estimating the cost of performing work at a nuclear plant estimated the costs of implementing the 44 candidate SAMAs. For some of the SAMAs considered, the cost estimates were sufficiently greater than the benefits calculated such that it was not necessary to perform a detailed cost estimate. Cost estimates typically included procedures, engineering analysis, training, and documentation, in addition to any hardware.

The staff reviewed the bases for the applicant's cost estimates (presented in Section F.3 of Appendix F to the ER). For certain improvements, the staff also compared the cost estimates to estimates developed elsewhere for similar improvements, including estimates developed as part of other licensees' analyses of SAMAs for operating reactors and advanced light-water reactors. The cost estimates provided were in the form of ranges. For purposes of evaluating specific SAMAs, the staff selected the low end values from the range to represent the costs. For some SAMAs, the costs appeared to be over-estimated. Therefore, the staff asked the applicant to justify the costs for those SAMAs that had significant benefits (NRC 2004). In response to the staff's request, Dominion provided a discussion of the components and activities that were considered in estimating the costs of those SAMAs for which the benefit was determined to be $50,000 or more. The discussion included a description of the modification, if any procedure changes and training would be required, and if any new instrumentation and maintenance would be required (Dominion 2004b). The staff reviewed the costs and subsequent explanations and found them to be reasonable and generally consistent with estimates provided in support of other plants' analyses.

The staff concludes that the cost estimates provided by Dominion are sufficient and adequate for use in the SAMA evaluation.

Table H-3. SAMA Cost/Benefit Screening Analysis for Millstone Power Station, Unit 2

SAMA	Assumptions	% Risk Reduction		Total Benefit ($)	Cost ($)
		CDF	Population Dose		
3 - Enhance loss of RBCCW procedure to ensure cool down of reactor coolant system (RCS) prior to seal LOCA	**Set RCP seal failure and loss of the RBCCW system to zero (This SAMA is bolded because it was determined to be cost-beneficial)**	**7.8**	**4.9**	**173,300**	**100,000**
8 - Eliminate RCP thermal barrier dependence on RBCCW such that loss of RBCCW does not result directly in core damage	Set loss of the RBCCW system to zero	6.9	4.6	155,500	5,000,000
10 - Create an independent RCP seal cooling system, with dedicated diesel	Eliminate the need for RCP cooling from the fault tree	6	3.9	135,400	6,000,000
11 - Create an independent RCP seal cooling system, without dedicated diesel	Same as SAMA #10	6	3.9	135,400	5,000,000
22 - Improve ability to cool residual heat removal heat exchangers	Set RBCCW heat exchanger failures to zero	0.3	0.3	7,300	2,500,000
34 - Install a containment vent large enough to remove ATWS decay heat	Set the electrical and mechanical reactor trip probabilities to zero	9.9	4.0	204,300	10,000,000
35 - Install a filtered containment vent to remove decay heat	Set the containment spray component failures to zero	16.2	16.0	414,300	12,000,000
36 - Install an unfiltered hardened containment vent	Same as SAMA #35	16.2	16.0	414,300	10,000,000

Table H-3. SAMA Cost/Benefit Screening Analysis for Millstone Power Station Unit 2

SAMA	Assumptions	% Risk Reduction CDF	% Risk Reduction Population Dose	Total Benefit ($)	Cost ($)
43 - Create a reactor cavity flooding system	Re-bin intermediate and late containment failures without sprays into corresponding release categories with sprays	0	16.4	84,700	18,000,000
44 - Create other options for reactor cavity flooding	Same as SAMA #43	0	16.4	84,700	18,000,000
75 - Create a water backup for diesel cooling	Set loss of emergency diesel generator (EDG) ‘A’ and ‘B’ and common cause failure (CCF) of EDG ‘A’ and ‘B’ to zero	1.5	2.8	44,600	10,000,000
77 - Provide a connection to alternate offsite power source (the nearby dam)	Remove cutsets containing loss of the unit 3 cross-tie and grid and weather related losses of normal power from the base case. Set unit 3 cross-tie and grid and weather related initiators to zero	8.3	13.9	234,900	6,000,000
81 - Install a fast acting motor generator output breaker	Set 125 VDC Buses 201A and 201B initiators to zero	1.0	1.7	29,200	3,000,000
87 - Replace steam generators with new design	Set steam generator tube rupture initiating event frequency to zero	3	12.7	126,900	200,000,000
93 - Install additional instrumentation and inspection to prevent ISLOCA sequences	Set the ISLOCA containment release category frequency to zero	0.2	2.4	22,100	12,000,000
94 - Increase frequency of valve leakage testing	Same as SAMA #93	0.2	2.4	22,100	2,000,000
99 - Ensure all ISLOCA releases are scrubbed	Same as SAMA #93	0.2	2.4	22,100	4,000,000

Table H-3. SAMA Cost/Benefit Screening Analysis for Millstone Power Station Unit 2

SAMA	Assumptions	% Risk Reduction		Total Benefit ($)	Cost ($)
		CDF	Population Dose		
100 - Add redundant and diverse limit switch to each containment isolation valve	Same as SAMA #93	0.2	2.4	28,700	18,000,000
123 - Provide capability for diesel-driven, low pressure vessel makeup	Set failure of the low pressure safety injection (LPSI) pumps and CCF of the LPSI pumps to zero	0	0	0	7,500,000
124/125 - Provide an additional high pressure injection pump with independent diesel	Set failure of the high pressure safety injection (HPSI) pumps and CCF of the HPSI pumps to zero	10.5	13.0	286,100	10,000,000
127 - Implement a reactor water storage tank (RWST) makeup procedure	Set probability of RWST rupture and RWST unavailability to zero	0.2	0.5	7,400	50,000
150 - Provide an additional instrumentation & control system (e.g. ATWS Mitigation System Actuation Circuitry)	Set electrical reactor trip and turbine trip to zero	8.7	3.5	177,900	600,000
159 - Install turbine-drive AFW pump	Set failure of the turbine driven AFW pumps to zero	8.0	5.1	178,100	12,000,000

Table H-3. SAMA Cost/Benefit Screening Analysis for Millstone Power Station Unit 2

SAMA	Assumptions	% Risk Reduction		Total Benefit ($)	Cost ($)
		CDF	Population Dose		
165 - Install independent air-operated valve (AOV) around existing RBCCW/engineered safeguards feature room service (ESFRS) AOV in “A” train to improve reliability of engineered safety feature room cooler	Set failure of RBCCW/ESFRS AOV 2-RB-68.1A to open to zero	0.2	0.3	4,900	4,000,000
166 - Install additional motor-driven AFW pump	Set failure of the motor driven AFW pumps ‘A’ and ‘B’ to zero	2.2	1.1	47,400	12,000,000
170 - Install redundant parallel containment sump motor-operated valve (MOV) to provide additional flow path during containment swapover in recirculation	Set failure of MOV 2-CS-16.1A to open to zero	6.0	5.3	146,900	2,000,000
172 - Add a redundant 125 VDC bus	Set loss of 125 VDC buses 201A and 201B initiators and bus faults to zero	0.1	0.3	4,100	5,000,000
173 - Install diverse valve around existing service water AOV in each train to improve reliability of cooling water supply to RBCCW heat exchangers	Set failure of AOVs 2-SW-8.1A/B/C to open and CCF to open to zero	8.0	4.6	175,000	1,000,000
174 - Install additional AOV in series with existing AOV in each train to improve isolation of RBCCW supply to non-essential Spent Fuel Pool heat exchanger	Set failure of AOV 2-RB-8.1A to close to zero	3.4	2.1	74,900	2,000,000

Table H-3. SAMA Cost/Benefit Screening Analysis for Millstone Power Station Unit 2

SAMA	Assumptions	% Risk Reduction		Total Benefit ($)	Cost ($)
		CDF	Population Dose		
176 - Install additional AOV around existing service water AOV in “A” train to improve reliability of cooling water supply to RBCCW heat exchanger	Set failure of AOV 2-SW-8.1A to open to zero	2.2	1.3	48,600	3,000,000
179 - Automate RCP trip circuitry on loss of seal cooling	Set failure of operator to trip RCPs on loss of thermal barrier cooling to zero	6.0	3.9	135,400	3,000,000
182 - Automate the start and alignment of the RBCCW pump	Set failure of operator to align stand-by RBCCW pump to zero	0	0	0	1,000,000
183 - Automate isolation feature of faulted steam generator	Set failure of operator to isolate faulted steam generator to zero	1.3	0.6	27,400	5,000,000
184 - Install redundant AFW regulating valve following regulating valve fail to open	Set failure of operator to open AFW regulating bypass valve on failure of AFW regulating valve to open to zero	0.7	0.4	15,900	2,000,000
185 - Install redundant ESFRS fan	Eliminate the need for ESFRS fan F-15B from the fault tree and set the unavailability of ESFRS fans F-15A and F-15B as well as their CCF to zero	0.2	0.3	4,900	450,000
186 - Install diverse strainers L-1A, B, C to all three SW pump discharge lines to prevent CCF	Set failure of CCF of all 3 SW pump strainer initiator as well as CCF of strainers to operate to zero	0.5	0.7	13,200	2,000,000
187 - Automate start capability of Terry turbine	Set failure of operator to start the Terry turbine to zero	0.2	0.3	4,500	1,500,000
189 - Automate emergency boration of RCS	Set the electrical and mechanical reactor trip probabilities to zero	0.9	0.5	18,700	2,000,000
190 - Install redundant parallel valve in charging pump suction line to RWST	Set failure of the RWST isolation valve AOV 2-CH-192 to open to zero	1.0	0.5	22,100	1,000,000

Table H-3. SAMA Cost/Benefit Screening Analysis for Millstone Power Station Unit 2

SAMA	Assumptions	% Risk Reduction		Total Benefit ($)	Cost ($)
		CDF	Population Dose		
192 - Install additional MOV on volume control tank outlet line similar to MOV-CH-501 for closure to assure boric acid flow to charging pump	Set all failures relating to MOV 2-CH-501 to close to zero	0.7	0.4	15,500	2,000,000
193 - Install additional AFW bypass line with diverse check valves and regulating valves similar to check valves 2-FW-12A and 12B and regulating valves 2-FW-43A and 43B to steam generators	Set failure of the AOVs 2-FW-43A/B to open, their CCF to open, their air accumulators to operate, as well as CCF of CVs 2-FW-12A/B to open to zero	1.0	0.5	21,700	1,000,000
195 - Install an MOV around existing RBCCW/ESFRS AOV in each train to improve reliability of ESF room coolers	Set failures of AOVs 2-RB-68.1A/B to open and CCF to open to zero	0.4	0.7	11,600	500,000

H.6 Cost-Benefit Comparison

Dominion's cost-benefit analysis and the staff's review are described in the following sections.

H.6.1 Dominion Evaluation

The methodology used by Dominion was based primarily on NRC's guidance for performing cost-benefit analysis, i.e., NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997b). The guidance involves determining the net value for each SAMA according to the following formula:

Net Value = (APE + AOC + AOE + AOSC) - COE

where,

APE = present value of averted public exposure ($)
AOC = present value of averted offsite property damage costs ($)
AOE = present value of averted occupational exposure costs ($)
AOSC = present value of averted onsite costs ($)
COE = cost of enhancement ($).

If the net value of a SAMA is negative, the cost of implementing the SAMA is larger than the benefit associated with the SAMA and it is not considered cost-beneficial. Dominion's derivation of each of the associated costs is summarized below.

<u>Averted Public Exposure (APE) Costs</u>

The APE costs were calculated using the following formula:

APE = Annual reduction in public exposure ( ) person-rem/year)
x monetary equivalent of unit dose ($2,000 per person-rem)
x present value conversion factor (10.76 based on a 20-year period with a 7-percent discount rate).

As stated in NUREG/BR-0184 (NRC 1997b), it is important to note that the monetary value of the public health risk after discounting does not represent the expected reduction in public health risk due to a single accident. Rather, it is the present value of a stream of potential losses extending over the remaining lifetime (in this case, the renewal period) of the facility. Thus, it reflects the expected annual loss due to a single accident, the possibility that such an accident could occur at any time over the renewal period, and the effect of discounting these potential future losses to present value. For the purposes of initial screening, Dominion calculated an APE of approximately $375,000 for the 20-year license renewal period, which assumes elimination of all severe accidents.

Averted Offsite Property Damage Costs (AOC)

The AOCs were calculated using the following formula:

AOC = Annual CDF reduction
x offsite economic costs associated with a severe accident (on a per-event basis)
x present value conversion factor.

For the purposes of initial screening, which assumes all severe accidents are eliminated, Dominion calculated an annual offsite economic risk of about $13,700 based on the Level 3 risk analysis. This results in a discounted value of approximately $147,500 for the 20-year license renewal period.

Averted Occupational Exposure (AOE) Costs

The AOE costs were calculated using the following formula:

AOE = Annual CDF reduction
x occupational exposure per core damage event
x monetary equivalent of unit dose
x present value conversion factor.

Dominion derived the values for averted occupational exposure from information provided in Section 5.7.3 of the regulatory analysis handbook (NRC 1997b). Best estimate values provided for immediate occupational dose (3300 person-rem) and long-term occupational dose (20,000 person-rem over a 10-year cleanup period) were used. The present value of these doses was calculated using the equations provided in the handbook in conjunction with a monetary equivalent of unit dose of $2,000 per person-rem, a real discount rate of 7-percent, and a time period of 20 years to represent the license renewal period. For the purposes of initial screening, which assumes all severe accidents are eliminated, Dominion calculated an AOE of approximately $27,300 for the 20-year license renewal period.

Averted Onsite Costs (AOSC)

Averted onsite costs (AOSC) include averted cleanup and decontamination costs and averted power replacement costs. Repair and refurbishment costs are considered for recoverable accidents only and not for severe accidents. Dominion derived the values for AOSC based on information provided in Section 5.7.6 of the regulatory analysis handbook (NRC 1997b).

Dominion divided this cost element into two parts – the Onsite Cleanup and Decontamination Cost, also commonly referred to as averted cleanup and decontamination costs, and the replacement power cost.

Averted cleanup and decontamination costs (ACC) were calculated using the following formula:

ACC = Annual CDF reduction
x present value of cleanup costs per core damage event
x present value conversion factor.

The total cost of cleanup and decontamination subsequent to a severe accident is estimated in the regulatory analysis handbook to be $\$1.5 \times 10^9$ (undiscounted). This value was converted to present costs over a 10-year cleanup period and integrated over the term of the proposed license extension. For the purposes of initial screening, which assumes all severe accidents are eliminated, Dominion calculated an ACC of approximately $831,700 for the 20-year license renewal period.

Long-term replacement power costs (RPC) were calculated using the following formula:

RPC = Annual CDF reduction
x present value of replacement power for a single event
x factor to account for remaining service years for which replacement power is required
x reactor power scaling factor

Dominion based its calculations on the value of 870 MW(e). Therefore, Dominion applied power scaling factor of 870 MW(e)/910 MW(e) to determine the replacement power cost. For the purposes of initial screening, which assumes all severe accidents are eliminated, Dominion calculated the RPC to be approximately $540,300.

Using the above equations, Dominion estimated the total present dollar value equivalent associated with completely eliminating severe accidents at MPS2 to be about $1,920,000.

<u>Dominion's Results</u>

The total benefit associated with each of the 44 SAMAs evaluated by Dominion is provided in Table H-3. These values were determined based on the above equations for the various averted costs together with the estimated annual reductions in CDF and population dose, and then increased by a multiplier of 1.3 to account for additional risk reduction in external events. The values for total benefit reported in Table H-3 include this multiplier. As a result, one of the 44 SAMAs was considered to be cost-beneficial:

SAMA 3: Enhance loss of RBCCW procedure to ensure cool down of RCS prior to seal LOCA. The resolution of this issue is expected to be either a new procedure or a procedure modification that will require actions to prevent/mitigate a seal LOCA upon loss of RBCCW.

As stated in the ER, Dominion is addressing SAMA 3 as part of a comprehensive industry initiative in response to Generic Safety Issue 23, “Reactor Coolant Pump Seal Failure.” Additionally, the CEOG is addressing this issue in CEOG Task 1136, “Model for Failure of RCP Seals Given Loss of Seal Cooling.” The SAMA is anticipated to be implemented before the period of extended operation, and is being addressed under the current license (Dominion 2004b).

In response to an RAI, Dominion assessed the applicability and feasibility of several SAMAs considered by another CE plant. As a result, Dominion eliminated all of the SAMAs questioned except one – adding a capability to flash the field on the EDG (using a portable generator) to enhance SBO event recovery. Dominion stated that this SAMA is not expected to be cost-beneficial because it would likely require a plant modification to install a disconnect to allow the connection of a portable (temporary) generator, as well as development of a new SAMG. However, Dominion stated that if this SAMA can be accomplished via a SAMG without a hardware modification, the SAMA would be cost-beneficial and will be implemented prior to the period of extended operation (Dominion 2004b).

H.6.2 Review of Dominion’s Cost-Benefit Evaluation

The cost-benefit analysis performed by Dominion was based primarily on NUREG/BR-0184 (NRC 1997b) and was conducted in a manner consistent with this guidance.

In order to account for uncertainties in the cost estimates, Dominion applied a factor of two margin in assessing whether SAMAs were cost-beneficial, i.e., a SAMA was considered to be cost-beneficial if the total benefit is within a factor of two of the estimated cost. The staff asked the applicant to consider the impact of uncertainty in the CDF (NRC 2004). In response, Dominion stated that CDF uncertainty calculations are not available in the current version of the Millstone PRA model. However, based on a review of recent SAMA analyses in support of license renewal, the 95th percentile CDF ranged from a factor of 2.0 to a factor of 6.4 greater than the mean CDF. Dominion stated that, in order to provide conservatism, it compared the costs to twice the calculated benefit. Dominion further indicated that most of the benefit calculations were performed in a bounding fashion, i.e., the SAMA is completely effective, and that such estimates would be substantially less if a more realistic analysis were performed for each SAMA (Dominion 2004b).

The staff questioned the approach of increasing the benefit (based on internal events) by 30 percent to account for external events (NRC 2004). In response to the RAI, Dominion stated that a multiplier of 1.3 was utilized because the external events analyses are not readily quantifiable (Dominion 2004b). The utilization of a multiplier on the benefits obtained from the internal events PRA to incorporate the impact of external events makes the implicit assumption that the consequences from external events sequences are the same as the consequences from internal events sequences. To demonstrate the robustness of the analysis, Dominion performed a sensitivity study that increased the assumed contribution from external events from 30 percent to 60 percent of the internal event benefits. The result was that the increased benefit exceeded the lower bound of the cost estimate range for only SAMA 3, which was already determined to be cost-beneficial. Therefore, Dominion concluded that the use of the 1.3 multiplier is acceptable.

Dominion assessed the impact of other factors on the analysis results, such as the contribution of external event initiators that were not explicitly included in the MPS2 risk profile, the use of a 3 percent discount rate as compared to the 7 percent discount rate used in the baseline calculations, as well as a 15-percent real discount rate (Dominion 2004a). These sensitivity cases resulted in an increase in the benefit calculation of about 30 percent or less. These analyses did not change Dominion's conclusion that none of the candidate SAMAs would be cost-beneficial except as noted above. In addition, Dominion performed sensitivity analyses that addressed assumptions made in other parts of the cost-benefit analysis, including meteorological data, source term, and evacuation. Dominion also considered the sensitivity to the impact of current and future fuel management practices. These sensitivity cases are bounded by the three-percent discount rate sensitivity study.

The staff notes that accounting for each of these factors would tend to increase the benefit as compared to the baseline case analysis. However, the calculated benefits used in the baseline analysis are generally over-estimated and , therefore, conservative. The staff concludes that the use of the factor of two to account for uncertainties, coupled with the fact that the calculated benefits are generally conservative, provides a reasonable treatment of uncertainties and is adequate for the SAMA evaluation.

The staff questioned Dominion about lower cost alternatives to some of the SAMAs evaluated, including the use of a direct-drive diesel AFW pump (NRC 2004). In response, Dominion identified and evaluated several lower cost alternatives to those considered in the ER. These alternatives included 1) installing a RBCCW header cross-tie, 2) using the hydrogen purge system as an unfiltered hardened containment vent, 3) using the existing systems to flood the reactor cavity, 4) providing reactor water storage tank makeup, and 5) using the diesel fire pump as a backup to the turbine-driven AFW pump. Dominion concluded that all of the alternatives considered are either covered by an existing procedure or SAMG, or could be instituted following evaluation and guidance by the Technical Support Center. With regard to the specific lower cost alternative involving a direct-drive diesel AFW pump, Dominion stated that the alternative would not be viable at MPS2 due to room and ventilation constraints as well as costs. Dominion further stated that MPS2 has a SAMG for using the diesel fire pump to provide water to the AFW system (Dominion 2004b).

The staff also questioned Dominion about several other candidate SAMAs that were found to be potentially cost-beneficial at another CE plant but not addressed by MPS2 analysis (NRC 2004). In response, Dominion provided an evaluation of the applicability and/or costs and benefits for these SAMAs at MPS2. Based on this assessment, all of the SAMAs were dismissed except one involving adding a capability to flash the field on the emergency diesel generator to enhance SBO event recovery. Dominion stated that the ability to flash the field on the EDG (using a portable generator) to enhance SBO event recovery would likely require a plant modification to install a disconnect to allow the connection of a portable (temporary) generator, as well as a new SAMG. However, If a hardware modification is not required, then the SAMA would be cost-beneficial. Dominion committed to complete its evaluation of this SAMA, and if cost-beneficial, will develop a SAMG prior to the period of extended operation (Dominion 2004b).

The staff concludes that, with the exception of the two potentially cost-beneficial SAMAs discussed above, the costs of the SAMAs would be higher than the associated benefits. This conclusion is supported by uncertainty assessment and sensitivity analysis and upheld despite a number of additional uncertainties and non-quantifiable factors in the calculations, summarized as follows:

- A factor of two was used to account for uncertainties. Even if a higher factor were considered to reflect a larger uncertainty in CDF, e.g., a factor of five, only two additional SAMAs would be close to becoming cost-beneficial–SAMAs 150, and 175. However, these SAMAs involve hardware modifications that are not expected to be cost-beneficial under more realistic assumptions regarding risk reduction.

- Sensitivity calculations were performed with respect to the discount rate (3 percent and 15 percent) and various MACCS2 parameters, including meteorological data, evacuation speed, evacuation delay time, and source terms. The results of these sensitivity studies showed that none of the risk benefits were increased by more than 30 percent. Since this is less than the margin between cost and benefit for the SAMAs considered, the uncertainties in these parameters would not alter the conclusions.

H.7 Conclusions

Dominion compiled a list of 196 SAMA candidates using the SAMA analyses as submitted in support of licensing activities for other nuclear power plants, NRC and industry documents discussing potential plant improvements, plant-specific insights from the MPS2 PRA model. A qualitative screening removed SAMA candidates that (1) were not applicable at MPS2 due to design differences, (2) had already been implemented at MPS2, or (3) were related to RCP seal vulnerability. A total of 152 SAMAs were eliminated leaving 44 for further evaluation.

For the remaining SAMA candidates, a more detailed design and cost estimate were developed as shown in Table H-3. The cost-benefit analyses showed that one of the SAMA candidates was cost-beneficial. Upon completion of a three-percent discount rate sensitivity study, as well as other sensitivity studies, no additional SAMA candidates were determined to be cost-beneficial. To account for uncertainties, Dominion compared the costs of the SAMA with twice the calculated benefit. As a result, no additional SAMAs were cost-beneficial.

The staff reviewed the Dominion analysis and concluded that the methods used and the implementation of those methods were sound. The treatment of SAMA benefits and costs, the generally large negative net benefits, and the inherently small baseline risks support the general conclusion that the SAMA evaluations performed by Dominion are reasonable and sufficient for the license renewal submittal. The unavailability of an external event PRA model precluded a quantitative evaluation of SAMAs specifically aimed at reducing risk of external event initiators; however, improvements that have been realized as a result of the IPEEE process and the inclusion of a multiplier to account for external events would minimize the likelihood of there being cost-beneficial enhancements in this area.

Based on its review of the Dominion SAMA analysis, the staff concurs that none of the candidate SAMAs are cost-beneficial, except for SAMA 3 and possibly an additional SAMA involving adding a capability to flash the field on the EDG (using a portable generator) to enhance SBO event recovery. This is based on conservative treatment of costs and benefits. This conclusion is consistent with the low residual level of risk indicated in the MPS2 PRA and the fact that MPS2 has already implemented many of plant improvements identified from the IPE and IPEEE processes. Although the one SAMA candidate is cost-beneficial and a second SAMA may be cost-beneficial if it can be implemented via procedural enhancements, neither of these SAMAs relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of the license renewal pursuant to 10 CFR Part 54.

H.8 References

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

Dominion Nuclear Connecticut, Inc. (Dominion). 2004a. *Applicant's Environmental Report–Operating License Renewal Stage, Millstone Power Station Units 2 and 3.* Dominion Nuclear Connecticut, Inc., Richmond, Virginia. January 2004.

Dominion Nuclear Connecticut, Inc. (Dominion). 2004b. Letter from Leslie N. Hartz, Dominion, to United States Nuclear Regulatory Commission Document Control Desk. Subject: Dominion Nuclear Connecticut, Inc., Millstone Power Sation Units 2 and 3, Response to Request for Additional Information, License Renewal Applications. August 13, 2004.

Dominion Nuclear Connecticut, Inc. (Dominion). 2004c. Email from Richard J. Gallagher, Dominion, to Richard Emch, NRC. Subject: Clarification of RAI Responses. September 16, 2004.

Northeast Nuclear Energy Company (NNECO). 1993. Letter from S. E. Scace, NNECO, to U.S. Nuclear Regulatory Commission Document Control Desk. Subject: Millstone Nuclear Power Station Unit 2, Response to Generic Letter 88-20 Individual Plant Examination for Severe Accident Vulnerabilities Summary Report, December 30, 1993.

Northeast Nuclear Energy Company (NNECO). 1995. Letter from D. B. Miller, NNECO, to U.S. Nuclear Regulatory Commission Document Control Desk. Subject: Millstone Nuclear Power Station Unit 2, Response to Generic Letter 88-20, Supplements 4 and 5 Individual Plant Examination for External Events Summary Report, December 29, 1995.

U.S. Nuclear Regulatory Commission (NRC). 1988. Generic Letter 88-20, "Individual Plant Examination for Severe Accident Vulnerabilities," November 23, 1988.

U.S. Nuclear Regulatory Commission (NRC). 1990. NUREG-1150, *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants*, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1991. NUREG-1407, *Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities*, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1996. Letter from Daniel G. McDonald, U.S. NRC, to Ted C. Feigenbaum, Northeast Utilities Service Company. Subject: NRC Staff's Evaluation of the Individual Plant Examination (IPE) Submittal for Millstone Nuclear Power Station, Unit No. 2 (B14702), (TAC NO. M74433), May 21, 1996.

U.S. Nuclear Regulatory Commission (NRC). 1997a. NUREG-1560, *Individual Plant Examination Program: Perspectives on Reactor Safety and Plant Performance*, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1997b. NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook*, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1997c. NUREG/CR-6525, *SECPOP90: Sector Population, Land Fraction, and Economic Estimation Program*, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2001. Letter from Jacob I. Zimmerman, U.S. NRC, to R. G. Lizotte, Northeast Nuclear Energy Company. Subject: Millstone Nuclear Power Station, Unit No. 2 – Individual Plant Examination of External Events (IPEEE) (TAC NO. M83642), January 12, 2001.

U.S. Nuclear Regulatory Commission (NRC). 2004. Letter from Richard L. Emch, Jr., NRC, to David A. Christian, Dominion. Subject: Request for Additional Information (RAI) Regarding Severe Accident Mitigation Alternatives for the Millstone Power Station, Units 2 and 3 (TAC NOS. MC1827 and MC1828), June 22, 2004.

U.S. Department of Agriculture (USDA). 1998. 1997 Census of Agriculture, National Agriculture Statistics Service, 1998.

Appendix I

NRC Staff Evaluation of Severe Accident Mitigation Alternatives (SAMAs) for Millstone Power Station, Unit 3, in Support of the License Renewal Application Review

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I.1 Introduction

Dominion Nuclear Connecticut, Inc. (Dominion) submitted an assessment of SAMAs for Millstone Power Station, Unit 3 (MPS3) as part of the Environmental Report (ER) (Dominion 2004a). This assessment was based on the most recent MPS3 Probabilistic Risk Assessment (PRA) available at that time, a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System 2 (MACCS2) computer program, and insights from the MPS3 Individual Plant Examination (IPE) (NNECO 1990) and Individual Plant Examination of External Events (IPEEE) (NNECO 1991). In identifying and evaluating potential SAMAs, Dominion considered SAMA analyses performed for other operating plants, as well as industry and NRC documents that discuss potential plant improvements, such as NUREG-1560 (NRC 1997a). Dominion identified 185 potential SAMA candidates. This list was reduced to 52 unique SAMA candidates by eliminating SAMAs that were not applicable to MPS3 due to design differences, had already been implemented, or were related to a reactor coolant pump (RCP) seal loss of coolant accident (LOCA). Dominion assessed the costs and benefits associated with each of the remaining SAMAs and concluded in the ER that none of the candidate SAMAs evaluated would be cost-beneficial for MPS3.

Based on a review of the SAMA assessment, the NRC issued a request for additional information (RAI) to Dominion by letter dated June 22, 2004 (NRC 2004). Key questions concerned: peer reviews of the PRA, dominant risk contributors at MPS3 and the SAMAs that address these contributors, the mapping of Level 1 PRA results into the Level 2 analysis, the potential impact of external event initiators and uncertainties on the assessment results, detailed information on some specific candidate SAMAs, and consideration of additional SAMAs. Dominion submitted additional information by letter dated August 13, 2004 (Dominion 2004b) including: summaries of peer review comments and their impact on the SAMA analysis; importance measures and corresponding SAMA candidates; information regarding the Level 2 analysis; information related to the resolution of IPEEE outliers and the impact of external events in the risk analysis; an assessment of the impact of uncertainties; and additional information regarding specific SAMAs. Dominion's responses addressed the staff's concerns.

As a result, Dominion identified one SAMA that would be cost-beneficial if it can be accomplished via a severe accident management guideline, without a hardware modification.

An assessment of SAMAs for MPS3 is presented below.

I.2 Estimate of Risk for MPS3

Dominion's estimates of offsite risk at MPS3 are summarized in Section I.2.1. The summary is followed by the staff's review of Dominion's risk estimates in Section I.2.2.

I.2.1 Dominion's Risk Estimates

Two distinct analyses are combined to form the basis for the risk estimates used in the SAMA analysis: (1) the MPS3 Level 1 and 2 PRA model, which is an updated version of the IPE (NNECO 1990), and (2) a supplemental analysis of offsite consequences and economic impacts (essentially a Level 3 PRA model) developed specifically for the SAMA analysis. The identification of candidate SAMAs was based on Revision 4 of the PRA model, dated October 1999; the quantification of SAMA benefits was based on an October 2002 update of the PRA (referred to as Revision 0, using a new naming convention) (Dominion 2004b). The scope of the MPS3 PRA does not include external events.

The baseline core damage frequency (CDF) for the purpose of the SAMA evaluation is approximately 2.57×10^{-5} per year. The CDF is based on the risk assessment for internally-initiated events. Dominion did not include the contribution to risk from external events or internal flooding within the MPS3 risk estimates; however, it did account for the potential risk reduction benefits associated with external events by increasing the estimated benefits for internal events by 60 percent. This is discussed further in Sections I.4 and I.6.2.

The breakdown of CDF by initiating event is provided in Table I-1. As shown in this table, LOCAs, RCP seal LOCAs, transients including anticipated transients without scram (ATWS), and loss of offsite power (LOOP) are dominant contributors to the CDF. Bypass events [i.e., steam generator tube rupture (SGTR) and interfacing systems LOCA (ISLOCA)] contribute less than five percent to the total internal events CDF. The contribution to CDF from internal floods is estimated to be 8.6×10^{-7} per year (NNECO 1990).

The Level 2 PRA model is based on the Level 2 model used in the Millstone Unit 3 Probabilistic Safety Study (NNECO 1983) and the IPE (NNECO 1990). The result of this analysis is a set of formulae for transforming the MPS3 plant damage state (PDS) frequencies into containment release category frequencies. The source terms for each release category (also termed the source term category) were obtained from the results of MAAP 4 analyses of the dominant core damage sequences in the IPE.

Table I-1. Millstone Unit 3 Core Damage Frequency

Initiating Event or Accident Class	CDF (Per Year)	% Contribution to CDF
RCP Seal LOCA	5.66×10^{-6}	22.0
Transients	4.04×10^{-6}	15.7
LOCAs	3.42×10^{-6}	13.3
LOOP	2.77×10^{-6}	10.8
ATWS	2.39×10^{-6}	9.3
Steamline break inside containment	2.31×10^{-6}	9.0
Station blackout (SBO)	1.78×10^{-6}	6.9
Total loss of service water	1.28×10^{-6}	5.0
SGTR	1.00×10^{-6}	3.9
Loss of one vital DC bus	4.18×10^{-7}	1.6
Steamline break outside containment	3.79×10^{-7}	1.5
ISLOCA	2.21×10^{-7}	0.9
Instrument tube LOCA	5.04×10^{-8}	0.2
Total CDF	2.57×10^{-5}	100

The offsite consequences and economic impact analyses use the MACCS2 code to determine the offsite risk impacts on the surrounding environment and public. Inputs for this analysis include plant-specific and site-specific input values for core radionuclide inventory, source term and release characteristics, site meteorological data, projected population distribution within a 80 km [50-mi] radius for the year 2040, emergency response evacuation modeling, and economic data. The core radionuclide inventory is based on the generic pressurized water reactor (PWR) inventory provided in the MACCS2 manual, adjusted to represent the MPS3 power level of 3411 MW(t). The magnitude of the onsite impacts (in terms of clean-up and decontamination costs and occupational dose) is based on information provided in NUREG/BR-0184 (NRC 1997b).

In the ER, Dominion estimated the dose to the population within 80 km (50 mi) of the MPS3 site to be approximately 0.128 person-Sv (12.8 person-rem) per year. The breakdown of the total population dose by containment release mode is summarized in Table I-2. Late containment failures dominate the population dose risk at MPS3, followed by SGTR and ISLOCAs. Early failures and containment isolation failures are each indicated to be zero contributors to risk. As indicated in the response to an RAI, these release modes were deleted from the IPE model because of low contribution (i.e., <0.1 percent) (Dominion 2004b).

Table I-2. Breakdown of Population Dose by Containment Release Mode (Unit 3)

Containment Release Mode	Population Dose (Person-rem[1] Per Year)	% Contribution
Late failure	6.60	51.5
SGTR	2.77	21.6
ISLOCA	2.23	17.4
Intermediate failure	0.93	7.2
No containment failure	0.24	1.9
Basemat failure	0.05	0.4
Early failure	0	0
Containment isolation failure	0	0
Total Population Dose	**12.8**	**100**

[1]One person-rem = 0.01 person-Sv

I.2.2 Review of Dominion's Risk Estimates

Dominions's determination of offsite risk at MPS3 is based on the following three major elements of analysis:

- the Level 1 and 2 risk models that form the bases for the 1990 IPE submittal (NNECO 1990) and the 1991 IPEEE submittal (NNECO 1991),

- the major modifications to the IPE models that have been incorporated in the MPS3 PRA, and

- the MACCS2 analyses performed to translate fission product source terms and release frequencies from the Level 2 PRA model into offsite consequence measures.

Each of these analyses was reviewed to determine the acceptability of Dominion's risk estimates for the SAMA analysis, as summarized below.

The staff's review of the MPS3 IPE is described in an NRC report dated May 5, 1992 (NRC 1992). Based on a review of the original IPE submittal, the staff concluded that IPE submittal met the intent of Generic Letter 88-20 (NRC 1988); that is, the IPE was of adequate quality to be used to look for design or operational vulnerabilities. The staff did, however, identify a number of weaknesses in the IPE analysis. In response to an RAI, Dominion indicated that all of these weaknesses have been addressed in the PRA used for the SAMA analysis (Dominion 2004b).

A comparison of internal events risk profiles between the IPE and the PRA used in the SAMA analysis indicates a decrease of approximately 3×10^{-5} per year in the total CDF (from 5.52×10^{-5} per year to 2.57×10^{-5} per year). The change is a net result of modeling improvements and some minor plant design changes that have been implemented at MPS3 since the IPE was submitted. A summary listing of those changes that resulted in the greatest impact on the total CDF was provided in the ER and in response to an RAI (Dominion 2004a, 2004b), and include:

- modified the SBO logic to consider the SBO diesel battery capacity limitation and hardware/procedural changes implemented to cope with the condition,
- incorporated the latest revision of the MPS3 plant-specific database,
- modified the SBO event tree to incorporate the results of core uncovery time based on the most probable RCP seal LOCA leakage rates,
- incorporated the accident sequence analysis for LOCAs, SBO, ATWS, and total loss of service water (SW),
- removed initiating events associated with common cause failure (CCF) to run 3 and 4 SW pumps, based on industry guidance on identification of CCF groupings.

An additional change that has a significant impact on the CDF value is the truncation value used in the PRA model. For the PRA version used for the SAMA analysis, Dominion used a truncation value of 1.0×10^{-11}. In contrast, use of a truncation value of 2.0×10^{-9} (as used in previous versions of the PRA) would result in a CDF of about 2.04×10^{-5} per year rather than a value of 2.57×10^{-5} per year as used in the SAMA analysis.

The IPE CDF value for MPS3 is comparable to the CDF values reported in the IPEs for other Westinghouse PWR plants. Figure 11.6 of NUREG-1560 shows that the IPE-based total internal events CDF for four-loop Westinghouse plants ranges from 4×10^{-6} to 3×10^{-4} per year (NRC 1997a). It is recognized that other plants have reduced the values for CDF subsequent to the IPE submittals due to modeling and hardware changes. The current internal events CDF results for MPS3 remain comparable to the results for other plants of similar vintage and characteristics.

The staff considered the peer review performed for the MPS3 PRA, and the potential impact of the review findings on the SAMA evaluation. In response to an RAI, Dominion described the external peer review, which was the Westinghouse Owners Group Peer Review performed in September 1999 (Dominion 2004b). The review resulted in four Level A facts and observations (extremely important and necessary) and 41 Level B facts and observations (important and necessary but may be delayed until next update). Two of the Level A and 24 of the Level B recommendations are yet to be incorporated. The Level A recommendations not yet incorporated are in the areas of accident sequence analysis and human reliability analysis. Both involve the completeness of the treatment of pre-initiator human errors. The Level B recommendations not yet incorporated affect essentially all PRA elements. Dominion has reviewed all of the unresolved facts and observations and concluded that they have negligible impact on the SAMA analysis (Dominion 2004b). The staff has also reviewed Dominion's assessment of the impacts of the outstanding peer review comments and has come to the same conclusion.

Given that (1) the MPS3 PRA has been peer reviewed and the potential impact of the peer review findings on the SAMA evaluation has been assessed, (2) Dominion satisfactorily addressed staff questions regarding the PRA (Dominion 2004b), and (3) the CDF falls within the range of contemporary CDFs for Westinghouse plants, the staff concludes that the Level 1 PRA model is of sufficient quality to support the SAMA evaluation.

The licensee included external events in the IPE submittal in August 1990 (NNECO 1990). The external events analysis in the IPE/IPEEE is taken from the "Millstone Unit 3 Probabilistic Safety Study" (NNECO 1983). This submittal and several updates were reviewed extensively by the NRC staff as documented in NUREG-1152 (NRC 1985a) and by contractors as documented in NUREG/CR-4142 (NRC 1985b) and NUREG/CR-4143 (NRC 1985c). While the IPEEE submittal did not identify any vulnerabilities to severe accident risk from external events, a number of minor improvements were identified. In a letter dated May 26, 1998, the staff concluded that the IPEEE submittal met the intent of Supplement 4 to Generic Letter 88-20, and that the licensee's IPEEE process is capable of identifying the most likely severe accidents and severe accident vulnerabilities (NRC 1998).

The seismic PRA performed for MPS3 resulted in a seismic CDF of 9.1×10^{-6} per year. The dominant contributor to this was seismically-induced SBO. In NUREG-1152, the staff recommended that two alternatives be further evaluated (improve the anchorage system for the emergency diesel generator lube oil coolers and add a manually-operated, AC independent containment spray system). In response to an RAI, Dominion indicated that the first of these alternatives has been implemented at MPS3. Dominion provided additional information concerning the costs related to the other alternative. Dominion concluded that, because of adequate seismic margins and the complexity associated with increasing the seismic capacity of a structures and components, no cost-effective SAMAs could be identified (Dominion 2004b). The staff agrees that it is unlikely that cost-effective SAMAs to further reduce seismic risk will exist. This is due to high cost of structural modifications compared to the benefits expected.

The fire PRA performed for MPS3 resulted in a fire CDF of 4.9×10^{-6} per year. The dominant contributors are fires in the charging and component cooling pump area, cable spreading area, and control room. The dominant fire areas and the associated CDF for those areas are:

Fire Area	Description	CDF (per year)
AB-1	Charging and component cooling pumps area	1.07×10^{-6}
CB-8	Cable spreading area	9.89 x 10-^{7}
CB-9	Control room	7.28×10^{-7}

A subsequent modification to the fire detection system in the cable spreading area has reduced the CDF in this area to 3.75×10^{-7} per year (Dominion 2004b).

In a RAI, the staff asked Dominion to explain, for each important fire area, what measures were taken to further reduce risk, and explain why these CDFs cannot be further reduced in a cost-effective manner (NRC 2004). For each area, Dominion provided a discussion of the major fire contributors assumed in the analysis and the existing plant features to address fire events. Dominion identified several improvements that have been implemented to address fire-related issues. Dominion also discussed the potential for further cost-effective hardware changes to address the fire-related matters listed above, including improvements to detection systems, enhancements to suppression capabilities, and changes that would improve cable separation and train separation (Dominion 2004b). Dominion concluded that no further modifications would be cost-effective for any of the fire areas.

The staff notes that although additional SAMAs to reduce the fire risk contributors might be viable, given the low level of risk from fires and the improvements that have already been implemented, it is unlikely that further modifications would both substantially reduce risk and remain cost-beneficial.

In the SAMA analysis, Dominion accounted for the additional risk contribution due to external events by increasing the benefit derived from the internal events model by 60 percent. This was determined by summing the following CDF contributions:

- Fire 4.9×10^{-6} per year

- C Internal flooding 0.9×10^{-6} per year
- C Seismic 9.1×10^{-6} per year

The fire contribution is discussed above. The internal flooding CDF of 8.6×10^{-7} per year was obtained directly from the MPS3 IPE (NNECO 1990). This value is the result of a bounding, screening-type analysis. The total external events CDF from the above is 1.49×10^{-5} per year, or approximately 58 percent of the CDF due to internal events. This was rounded up to 60 percent for the SAMA analysis.

The MPS3 Level 2 PRA analysis is based on the IPE (NNECO 1990). The result of this analysis is a set of formulae for transforming the MPS3 plant damage state (PDS) frequencies into containment release category frequencies. This is described in Section I.2.3 of the ER (Dominion 2004a), and further clarified in response to RAIs (Dominion 2004b, 2004c). The formulae and the release category frequencies are provided in Tables I.2-4 and I.2-6 of the ER, respectively (Dominion 2004a). The release fractions for each release category were obtained from MAAP 4 analysis for the dominant sequences in the IPE and are provided in Table I.1-2 of the ER (Dominion 2004a). In response to an RAI concerning the use of IPE dominant sequences to determine the release fractions used in the SAMA analysis, Dominion provided a discussion and a comparison of the PDSs and release categories for the IPE and SAMA analyses (Dominion 2004b). The staff reviewed Dominion's source term estimates for the major release categories and found the release fractions to be within the range of the release fractions for like plants. Dominion also provided results of several sensitivity studies relative to the source term and release characteristics including doubling the plume release height, doubling the duration of source term release time, and varying source term release fractions. The results showed that these parameter variations had only a minor impact (less than 20 percent) on the estimated dollar benefits for the candidate SAMAs. The staff concludes that the process used for determining the release category frequencies and source terms is reasonable and appropriate for the purposes of the SAMA analysis.

During the staff's review of the Level 2 model, the staff identified an error in the formulae used to translate PDS frequencies into release category frequencies. Dominion confirmed the error and determined that it resulted in a slight overestimation of the benefits for candidate SAMAs, which is conservative for the cost-benefit analysis (Dominion 2004b).

As discussed previously, the fission product inventory used in the consequence analysis is based on a fission product inventory scaled from generic information. In response to an RAI concerning the impact of current and future fuel management practices, Dominion described a conservative bounding analysis of core fission product inventory considering a range of enrichments and burnups (Dominion 2004b). Using this inventory would result in a 28-percent increase in total benefit from eliminating all risk. Using realistic mid-life or average conditions would result in a smaller increase in the maximum benefit. The staff concludes that the scaling based on the plant-specific power level yields sufficiently accurate and reasonable results for the dose assessment.

The staff reviewed the process used by Dominion to extend the containment performance (Level 2) portion of the PRA to an assessment of offsite consequences (essentially a Level 3 PRA). This included consideration of the major input assumptions used in the offsite consequence analyses. The MACCS2 code was utilized to estimate offsite consequences. Plant-specific input to the code includes the source terms for each release category and the MPS3 reactor core radionuclide inventory (both discussed above), site-specific meteorological data, projected population distribution within a 80 km (50 mile) radius for the year 2040, and emergency evacuation modeling. This information is provided in Appendix G to the ER (Dominion, 2004a).

Dominion used site-specific meteorological data processed from hourly measurements for the 2000 calendar year as input to the MACCS2 code. The hourly data (wind direction, wind speed, and stability class) were collected from the onsite meteorological tower. Precipitation data were recorded at the Green Airport near Providence, Rhode Island, the closest weather station to Millstone. Morning and afternoon mixing height values were obtained from the National Climatic Data Center. The applicant also considered the impact on SAMA benefits of using meteorological data for 1998 and 1999. The results of these sensitivity cases showed that the benefits increased by an average of about five percent. The staff considers the use of the 2000 data in the base case to be reasonable.

The population distribution the applicant used as input to the MACCS2 analysis was estimated for the year 2040, based primarily on SECPOP90 (NRC 1997c). U.S. Census Bureau Year 2000 population data, projected to year 2040, was then used to update the SECPOP90 population data (Dominion 2004a). The staff questioned the difference between the use of SECPOP90 and SECPOP2000, and what the impact would be if the latter was used. In response, Dominion noted that the expected impact of using SECPOP2000 would be negligible since census data from 2000 was used to update the SECPOP90 file. The staff considers the methods and assumptions for estimating population reasonable and acceptable for purposes of the SAMA evaluation.

The emergency evacuation model was modeled as a single evacuation zone extending out 16 km (10 mi) from the plant. It was assumed that 100 percent of the population would move at an average speed of approximately 1.49 meters per second with a delayed start time of 7200 seconds from the offsite alarm reference time point (Dominion 2004a). Dominion performed sensitivity studies exploring the impact of the fraction of population that evacuates and the evacuation speed. The results demonstrated that the total dose and economic cost results are insensitive to these parameters (Dominion 2004a). The staff concludes that the evacuation assumptions and analysis are reasonable and acceptable for the purposes of the SAMA evaluation.

Much of the site-specific economic data were provided from SECPOP90 (NRC 1997c) by specifying the data for counties surrounding the plant to a distance of 50 miles. The SECPOP90 input file was updated to 2001 using cost of living and other data from the Bureau of the Census and the Department of Agriculture (Dominion 2004). The agricultural economic data were updated using available data from the 1997 Census of Agriculture (USDA 1998).

The staff concludes that the methodology used by Dominion to estimate the offsite consequences for MPS3 provides an acceptable basis from which to proceed with an assessment of risk reduction potential for candidate SAMAs. Accordingly, the staff based its assessment of offsite risk on the CDF and offsite doses reported by Dominion.

I.3 Potential Plant Improvements

The process for identifying potential plant improvements, an evaluation of that process, and the improvements evaluated in detail by Dominion are discussed in this section.

I.3.1 Process for Identifying Potential Plant Improvements

Dominion's process for identifying potential plant improvements (SAMAs) consisted of the following elements:

- review of the most significant basic events from the MPS3 PRA Model, Rev. 4 (October 1999),
- review of items not already evaluated and/or implemented during the IPE and IPEEE,
- review of SAMA analyses submitted in support of original licensing and license renewal activities for other operating nuclear power plants, and
- review of other NRC and industry documentation discussing potential plant improvements.

Based on this process, an initial set of 185 candidate SAMAs was identified. In Phase 1 of the evaluation, Dominion performed a qualitative screening of the initial list of SAMAs and eliminated SAMAs from further consideration using the following criteria:

- the SAMA is not applicable at MPS3,
- the SAMA has already been implemented at MPS3, or the MPS3 design meets the intent of the SAMA, or

- the SAMA is related to a RCP seal vulnerability stemming from charging pump dependency on component cooling water (CCW). (MPS3 does not have this vulnerability because the charging pumps do not rely on CCW for RCP seal injection.)

Based on this screening, 133 SAMAs were eliminated leaving 52 for further evaluation. Of the SAMAs eliminated, 47 were eliminated because they were not applicable, 77 were eliminated because they already had been implemented, and 9 were eliminated because they were related to RCP seal vulnerability. A cost estimate was prepared for each of the 52 remaining candidates to focus on those that had a possibility of having a net positive benefit. To account for the potential impact of external events, the estimated benefits based on internal events of each SAMA were multiplied by a factor of 1.6 for all SAMAs except those related to ISLOCA and SGTR-initiated events.

The 52 SAMAs were evaluated and subsequently eliminated, as described in Sections I.4 and I.6.1 below.

I.3.2 Review of Dominion's Process

Dominion's efforts to identify potential SAMAs focused primarily on areas associated with internal initiating events. The initial list of SAMAs generally addressed the accident categories that are dominant CDF contributors or issues that tend to have a large impact on a number of accident sequences at MPS3.

The preliminary review of Dominion's SAMA identification process raised some concerns regarding the completeness of the set of SAMAs identified and the inclusion of plant-specific risk contributors. The staff requested additional information regarding the top 30 cut sets and certain sequences (NRC 2004). In response to the RAI, Dominion provided a listing of the top contributors to risk, the associated plant damage state, and a cross-reference between the top contributors to risk from a later version of the PRA and the SAMAs that addressed those risk contributors (Dominion 2004b).

The staff noted that Dominion based the SAMA identification process on PRA Revision 4 (dated October 1999) and the SAMA quantification on an October 2002 update of the PRA (referred to as Revision 0). The staff questioned Dominion regarding the impact on the SAMA identification process if the later version of the PRA was used to identify potential SAMAs (NRC 2004). In response, Dominion reassessed the SAMA identification process considering the later PRA revision. The basic events not included in the initial Unit 3 PRA importance list were identified. Those events with a risk reduction worth greater than or equal to 1.005 from the more recent PRA model were specifically evaluated. These events were compared to the SAMA list to determine which events were already addressed by a SAMA. Dominion determined that all of the additional basic events map to previously identified SAMAs. As a result, no new SAMAs were created (Dominion 2004c). Based on these additional assessments, Dominion concluded that the set of 185 SAMAs evaluated in the ER addresses the major contributors to CDF and offsite dose, and that the review of the top risk contributors does not reveal any new SAMAs.

The staff questioned Dominion regarding use of the second screening criterion (i.e., screening out a SAMA on the basis that it has already been implemented at MPS3) to eliminate SAMAs that were identified based on review of the PRA (NRC 2004). In response, Dominion provided qualitative or quantitative details on the plant-specific SAMAs that were screened using this criterion (SAMAs 159, 163, 165, 166, 167, 174, 181 and 185). None of these SAMAs were determined to be cost-beneficial based on this further evaluation.

The staff questioned Dominion about lower cost alternatives to some of the SAMAs evaluated, including the use of portable battery chargers and a direct-drive diesel auxiliary feedwater (AFW) pump (NRC 2004). In response, Dominion identified several lower cost alternatives, all of which are covered by an existing procedure or severe accident management guideline (SAMG), or could be instituted following evaluation and guidance by the Technical Support Center. This is discussed further in Section I.6.2.

The staff notes that the set of SAMAs submitted is not all inclusive, since additional, possibly even less expensive, design alternatives can always be postulated. However, the staff concludes that the benefits of any additional modifications are unlikely to exceed the benefits of the modifications evaluated and that the alternative improvements would not likely cost less than the least expensive alternatives evaluated, when the subsidiary costs associated with maintenance, procedures, and training are considered.

The staff concludes that Dominion used a systematic and comprehensive process for identifying potential plant improvements for MPS3, and that the set of potential plant improvements identified by Dominion is reasonably comprehensive and therefore acceptable. This search included reviewing insights from the IPE and IPEEE and other plant-specific studies, reviewing plant improvements considered in previous SAMA analyses, and using the knowledge and experience of its PRA personnel. While explicit treatment of external events in the SAMA identification process was limited, it is recognized that the prior implementation of plant modifications for seismic and fire events and the absence of external event vulnerabilities reasonably justifies examining primarily the internal events risk results for this purpose.

I.4 Risk Reduction Potential of Plant Improvements

Dominion evaluated the risk-reduction potential of the 52 remaining SAMAs that were applicable to MPS3. A majority of the SAMA evaluations were performed in a bounding fashion in that the SAMA was assumed to completely eliminate the risk associated with the proposed enhancement. Such bounding calculations overestimate the benefit and are conservative.

Dominion estimated the potential benefits for each SAMA by generating a revised set of PDS frequencies. Using these revised frequencies, a revised Level 3 (dollars averted) calculation was performed. The benefit was calculated using the fault trees, event trees, and databases from Revision 0 of the MPS3 PRA. The assumptions made to evaluate the benefit were provided in response to an RAI (Dominion 2004b, 2004c). Table I-3 lists the assumptions considered to estimate the risk reduction for each of the evaluated SAMAs, the estimated risk reduction in terms of percent reduction in CDF and population dose, and the estimated total benefit (present value) of the averted risk (including the 1.6 multiplier to account for benefits in external events). The determination of the benefits for the various SAMAs is further discussed in Section I.6.

The staff has reviewed Dominion's bases for calculating the risk reduction for the various plant improvements and concludes that the rationale and assumptions for estimating risk reduction are reasonable and generally conservative (i.e., the estimated risk reduction is higher than what would actually be realized). Accordingly, the staff based its estimates of averted risk for the various SAMAs on Dominion's risk reduction estimates. The estimated risk reduction for several of the SAMAs was negligible or zero. In these instances, the SAMA either affects sequences or phenomena that do not contribute to risk at MPS3, or represents an ineffective plant improvement. As such, a minimal impact on risk is not unreasonable in those cases.

I.5 Cost Impacts of Candidate Plant Improvements

Dominion personnel experienced in estimating the cost of performing work at a nuclear plant estimated the costs of implementing the 52 candidate SAMAs. For some of the SAMAs considered, the cost estimates were sufficiently greater than the benefits calculated that it was not necessary to perform a detailed cost estimate. Cost estimates typically included procedures, engineering analysis, training, and documentation, in addition to any hardware.

The staff reviewed the bases for the applicant's cost estimates (presented in Section I.3 of Appendix G to the ER). For certain improvements, the staff also compared the cost estimates to estimates developed elsewhere for similar improvements, including estimates developed as part of other licensees' analyses of SAMAs for operating reactors and advanced light-water reactors. The cost estimates provided were in the form of ranges. For purposes of evaluating specific SAMAs, the staff selected the low end values from the range to represent the costs. For some SAMAs, the costs appeared to be over-estimated. Therefore, the staff asked the applicant to justify the costs for those SAMAs that had significant benefits (NRC 2004). In response to the staff's request, Dominion provided a discussion of the components and activities that were considered in estimating the costs of those SAMAs for which the benefit was

Table I-3. SAMA Cost/Benefit Screening Analysis for Millstone Power Station, Unit 3

SAMA	Assumptions	% Risk Reduction		Total Benefit ($)	Cost ($)
		CDF	Population Dose		
9 - Provide additional SW pump that can be connected to either SW header	Set failures of SW pumps and CCF of SW pumps to zero	8.5	9.6	164,800	10,000,000
10 - Create an independent RCP seal cooling system with dedicated diesel	Eliminate the need for RCP cooling from the fault tree	22.8	22.3	419,800	10,000,000
11 - Create an independent RCP seal cooling system without dedicated diesel	Same as SAMA #10	22.8	22.3	419,800	5,000,000
20/21 - Develop a new procedure for cross-tying either the CCW pumps or SW pumps (including analysis, validation, and training)	Changed fault tree from failure of one train to failure of one train of SW AND failure of the opposite train or failure of operator action to align the opposite train (prob. 0.10)	1.7	0.3	14,100	150,000
34 - Install a containment vent large enough to remove ATWS decay heat	Set failure of reactor protection system electrical components (except reactor trip breakers), CCF of reactor trip breakers, CCF of 10 or more control rods to insert, and CCF of 35 or more control rods to insert to zero	9.3	1.3	103,400	10,000,000
35 - Install a filtered containment vent to remove decay heat	Set CCF of recirculation air conditioning units to operate, misalignment of manual valve 3RHS*V43, loss of the recirculation spray system, CCF of motor-operated valves (MOV) 3SWP*MOV50A/B to close, and CCF of 3SWP*MOV71A/B to close to zero	5.8	6.4	110,800	12,000,000

Table I-3. SAMA Cost/Benefit Screening Analysis for Millstone Power Station Unit 3

SAMA	Assumptions	% Risk Reduction		Total Benefit ($)	Cost ($)
		CDF	Population Dose		
36 - Install an unfiltered hardened containment vent	Same as SAMA #35	5.8	6.4	110,800	10,000,000
43 - Create a reactor cavity flooding system	Set release categories with intermediate and late containment failure and basemat failure to zero	<0.1	41.9	344,800	18,000,000
44 - Creating other options for reactor cavity flooding	Same as SAMA #43	<0.1	41.9	344,800	18,000,000
60 - Provide additional DC battery capability	Lengthen time for restoration of offsite power to become available to prolong DC battery life	2.2	2.6	42,800	600,000
61 - Use fuel cells instead of lead-acid batteries	Same as SAMA #60	2.2	2.6	42,800	3,000,000
63 - Improved bus cross tie ability	Changed fault tree from failure of one AC bus to failure of one AC bus AND failure of the opposite AC bus or failure of operator action to align the opposite AC bus (prob. 0.01)	27.8	17.9	429,600	2,000,000
64 - Alternate battery charging capability	Same as SAMA #60	2.2	2.6	42,800	5,000,000
67 - Create AC power cross tie capability across units	Create cross-tie logic (prob. 0.02) with the Millstone Power Station unit 2 (MPS2) emergency diesel generators (EDGs) in the fault tree	8.6	10.4	170,800	4,000,000
73 - Install gas turbine generators	Set failures of EDGs 'A' and 'B' and CCF of EDGs 'A' and 'B' to zero	29.9	24.2	500,100	8,000,000

Table I-3. SAMA Cost/Benefit Screening Analysis for Millstone Power Station Unit 3

SAMA	Assumptions	% Risk Reduction		Total Benefit ($)	Cost ($)
		CDF	Population Dose		
75 - Create a river water backup for diesel cooling	Same as SAMA #76	0.7	0.5	11,100	750,000
76 - Use firewater as a backup for diesel cooling	Eliminate failures of SW supply to the EDGs from the fault tree	0.7	0.5	11,100	750,000
77 - Provide a connection to alternate offsite power source (the nearest dam)	Eliminate failures of LOOP from the fault tree	38.4	30.0	635,100	6,000,000
80 - Create an auto-loading of the SBO diesel	Set failure of the operator to correctly start and align the SBO diesel to zero	2.4	2.9	47,400	7,000,000
87 - Replace steam generators with new design	Eliminate the possibility of SGTR events from the fault tree	3.5	21.6	144,800	175,000,000
93 - Additional instrumentation and inspection to prevent ISLOCA sequences	Set the ISLOCA containment release category frequency to zero	0.8	17.4	83,600	9,000,000
94 - Increase frequency of valve leak testing	Same as SAMA #93	0.8	17.4	83,600	2,000,000
99 - Ensure all ISLOCA releases are scrubbed	Same as SAMA #93	0.8	17.4	83,600	4,000,000
100 - Add redundant and diverse limit switch to each containment isolation valve	Same as SAMA #93	0.8	17.4	83,600	18,000,000
112 - Proceduralize local manual operation of AFW when control power is lost	Set all recoveries of offsite power to zero	2.2	2.6	42,800	100,000

Table I-3. SAMA Cost/Benefit Screening Analysis for Millstone Power Station Unit 3

SAMA	Assumptions	% Risk Reduction CDF	% Risk Reduction Population Dose	Total Benefit ($)	Cost ($)
113 - Provide portable generators to be hooked in to the turbine driven AFW train after battery depletion	Bounded by SAMA #112	1.9	2.3	38,400	5,000,000
120 - Create passive secondary side coolers	Eliminate failures of the AFW system from the fault tree	40.6	15.4	532,900	50,000,000
123 - Provide capability for diesel-driven, low pressure vessel makeup	Eliminate failures of the emergency core cooling system injection from the fault tree	19.7	22.9	396,000	7,500,000
124/125 - Provide an additional high pressure injection (HPSI) pump with independent diesel	Set failures of HPSI pumps and CCF of HPSI pumps to zero	3.5	1	42,800	10,000,000
138 - Create automatic swapover to recirculation on refueling water storage tank depletion	Set failure of operator to establish sump recirculation after a LOCA to zero	1.7	0.3	19,800	2,000,000
156 - Install secondary side guard pipes up to the main steam isolation valves (MSIVs)	Eliminate steam line break inside containment from the fault tree	13.4	22.5	335,700	10,000,000
160 - Install turbine-driven AFW pump	Set failures of the turbine-driven AFW pumps to zero	42.0	33.5	712,200	12,000,000
161 - Install SBO diesel	Set failures of the SBO diesel to zero	5.3	6.4	105,400	8,000,000
162 - Install charging system train	Set failures of charging pumps and CCF of charging pumps to zero	7.2	3.6	103,300	20,000,000
164 - Install safety injection train	Set failures of HPSI pumps and CCF of HPSI pumps to zero	3.5	1	42,800	20,000,000
168 - Automate feed and bleed	Set failures of operator to establish feed and bleed cooling to zero	28.8	21.5	480,800	1,000,000
169 - Improve boron injection reliability with new procedure and hardware	Eliminate failures of emergency boration from the fault tree	0	0	0	2,000,000
170 - Add another air-operated valve (AOV) to isolate SW	Set failures of MOVs 3SWP*MOV50A/B and 3SWP*MOV71A/B to close, CCF of 3SWP*MOV50A/B to close, and CCF of 3SWP*MOV71A/B to close to zero	7.1	8.9	143,800	2,000,000

Table I-3. SAMA Cost/Benefit Screening Analysis for Millstone Power Station Unit 3

SAMA	Assumptions	% Risk Reduction		Total Benefit ($)	Cost ($)
		CDF	Population Dose		
171 - Install another containment recirculation system (RSS) parallel flow path	Same as SAMA #172	1.7	1.5	28,800	10,000,000
172 - Add a redundant train of RSS	Set failures of RSS pumps and CCF of RSS pumps to zero	1.7	1.5	28,800	20,000,000
173 - Add additional SW AOVs (air-to-close/air-to-open)	Same as SAMA #170	7.1	8.9	143,800	2,000,000
175 - Add a redundant DC bus	Set failures of vital 120 VDC buses 301A1 and 301B1 to zero	0.3	0.5	7,000	5,000,000
176 - Add a redundant charging pump	Set failures of the charging pumps and CCF of the charging pumps to zero	7.2	3.6	103,300	10,000,000
177 - Add a redundant block valve for the power-operated relief valve (PORV)	Eliminate failures of the PORVs to reseat from the fault tree	3.4	2.5	55,100	2,000,000
178 - Add redundant MSIVs	Eliminate failures of the MSIVs to close from the fault tree	0.8	0.2	10,000	5,000,000
179 - Add a redundant SW pump ventilation train	Eliminate failure of the SW train ‘A’ and train ‘B’ pump cubicle ventilation from the fault tree	2.1	1.7	34,700	1,000,000
180 - Add a redundant valve in series to isolate the steam line dumps to condenser	Eliminate failures of the steam dump valves to the condenser from the fault tree	4	0.5	44,300	5,000,000
182 - Add redundant AC bus	Changed fault tree from failure of one AC bus to failure of one AC bus AND failure of the opposite AC bus or failure of operator to align the opposite AC bus (prob. 0.01)	27.8	17.9	429,600	15,000,000
183 - Add redundant AFW flow path	Set CCF o f the discharge and injection AFW check valves to open to zero	0.9	0.3	11,200	15,000,000
184 - Add redundant demineralized water storage tank (DWST)	Set failure of the DWST to zero	0.8	0.2	9,800	5,000,000

determined to be $50,000 or more. The discussion included a description of the modification, if any procedure changes and training would be required, and if any new instrumentation and maintenance would be required (Dominion 2004b). The staff reviewed the costs and subsequent explanations and found them to be reasonable and generally consistent with estimates provided in support of other plants' analyses.

The staff concludes that the cost estimates provided by Dominion are sufficient and appropriate for use in the SAMA evaluation.

I.6 Cost-Benefit Comparison

Dominion's cost-benefit analysis and the staff's review are described in the following sections.

I.6.1 Dominion Evaluation

The methodology used by Dominion was based primarily on NRC's guidance for performing cost-benefit analysis, i.e., NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997b). The guidance involves determining the net value for each SAMA according to the following formula:

$$\text{Net Value} = (\text{APE} + \text{AOC} + \text{AOE} + \text{AOSC}) - \text{COE}$$

where,

APE = present value of averted public exposure ($)
AOC = present value of averted offsite property damage costs ($)
AOE = present value of averted occupational exposure costs ($)
AOSC = present value of averted onsite costs ($)
COE = cost of enhancement ($).

If the net value of a SAMA is negative, the cost of implementing the SAMA is larger than the benefit associated with the SAMA and it is not considered cost-beneficial. Dominion's derivation of each of the associated costs is summarized below.

<u>Averted Public Exposure (APE) Costs</u>

The APE costs were calculated using the following formula:

APE = Annual reduction in public exposure ( ) person-rem/year)
x monetary equivalent of unit dose ($2,000 per person-rem)
x present value conversion factor (10.76 based on a 20-year period with a 7-percent discount rate).

As stated in NUREG/BR-0184 (NRC 1997b), it is important to note that the monetary value of the public health risk after discounting does not represent the expected reduction in public health risk due to a single accident. Rather, it is the present value of a stream of potential losses extending over the remaining lifetime (in this case, the renewal period) of the facility. Thus, it reflects the expected annual loss due to a single accident, the possibility that such an accident could occur at any time over the renewal period, and the effect of discounting these potential future losses to present value. For the purposes of initial screening, Dominion calculated an APE of approximately $275,900 for the 20-year license renewal period, which assumes elimination of all severe accidents.

Averted Offsite Property Damage Costs (AOC)

The AOCs were calculated using the following formula:

AOC = Annual CDF reduction
x offsite economic costs associated with a severe accident (on a per-event basis)
x present value conversion factor.

For the purposes of initial screening, which assumes all severe accidents are eliminated, Dominion calculated an annual offsite economic risk of about $21,800 based on the Level 3 risk analysis. This results in a discounted value of approximately $234,700 for the 20-year license renewal period.

Averted Occupational Exposure (AOE) Costs

The AOE costs were calculated using the following formula:

AOE = Annual CDF reduction
x occupational exposure per core damage event
x monetary equivalent of unit dose
x present value conversion factor.

Dominion derived the values for averted occupational exposure from information provided in Section 5.7.3 of the regulatory analysis handbook (NRC 1997b). Best estimate values provided for immediate occupational dose (3300 person-rem) and long-term occupational dose (20,000 person-rem over a 10-year cleanup period) were used. The present value of these doses was calculated using the equations provided in the handbook in conjunction with a monetary equivalent of unit dose of $2,000 per person-rem, a real discount rate of 7-percent, and a time period of 20 years to represent the license renewal period. For the purposes of initial screening, which assumes all severe accidents are eliminated, Dominion calculated an AOE of approximately $11,000 for the 20-year license renewal period.

Averted Onsite Costs (AOSC)

Averted onsite costs (AOSC) include averted cleanup and decontamination costs and averted power replacement costs. Repair and refurbishment costs are considered for recoverable accidents only and not for severe accidents. Dominion derived the values for AOSC based on information provided in Section 5.7.6 of the regulatory analysis handbook (NRC 1997b).

Dominion divided this cost element into two parts – the Onsite Cleanup and Decontamination Cost, also commonly referred to as averted cleanup and decontamination costs, and the replacement power cost.

Averted cleanup and decontamination costs (ACC) were calculated using the following formula:

ACC = Annual CDF reduction
x present value of cleanup costs per core damage event
x present value conversion factor.

The total cost of cleanup and decontamination subsequent to a severe accident is estimated in the regulatory analysis handbook to be $\$1.5 \times 10^9$ (undiscounted). This value was converted to present costs over a 10-year cleanup period and integrated over the term of the proposed license extension. For the purposes of initial screening, which assumes all severe accidents are eliminated, Dominion calculated an ACC of approximately $334,400 for the 20-year license renewal period.

Long-term replacement power costs (RPC) were calculated using the following formula:

RPC = Annual CDF reduction
x present value of replacement power for a single event
x factor to account for remaining service years for which replacement power is required
x reactor power scaling factor

Dominion based its calculations on the value of 1154 MW(e). Therefore, Dominion applied power scaling factor of 1154 MW(e)/910 MW(e) to determine the replacement power cost. For the purposes of initial screening, which assumes all severe accidents are eliminated, Dominion calculated the RPC to be approximately $288,600.

Using the above equations, Dominion estimated the total present dollar value equivalent associated with completely eliminating severe accidents at MPS3 to be about $1,145,000.

Dominion's Results

The total benefit associated with each of the 52 SAMAs evaluated by Dominion is provided in Table I-3. These values were determined based on the above equations for the various averted costs together with the estimated annual reductions in CDF and population dose, and then increased by a multiplier of 1.6 to account for additional risk reduction in external events. The values for total benefit reported in Table I-3 include this multiplier. As a result, all SAMAs that were evaluated were eliminated because the cost was expected to exceed the estimated benefit.

In response to an RAI regarding the costs of SAMA 112 (proceduralize local manual operation of AFW when control power is lost), Dominion assessed the applicability/feasibility of a procedure for manual operation of the turbine-driven AFW (TDAFW) pump when control power is lost, similar to that in place at MPS2. Dominion stated that this SAMA would likely require a plant modification to provide the level indication that would be necessary during SBO, in addition to a new procedure. However, Dominion stated that if this SAMA can be accomplished via a SAMG, without a hardware modification, then the SAMA would be cost-beneficial and will be implemented prior to the period of extended operation (Dominion 2004b).

I.6.2 Review of Dominion's Cost-Benefit Evaluation

The cost-benefit analysis performed by Dominion was based primarily on NUREG/BR-0184 (NRC 1997b) and was conducted in a manner consistent with this guidance.

In order to account for uncertainties in the cost estimates, Dominion applied a factor of two margin in assessing whether SAMAs were cost-beneficial, i.e., a SAMA was considered to be cost-beneficial if the total benefit is within a factor of two of the estimated cost. The staff asked the applicant to consider the impact of uncertainty in the CDF (NRC 2004). In response, Dominion stated that CDF uncertainty calculations are not available in the current version of the Millstone PRA model. However, based on a review of recent SAMA analyses in support of license renewal, the 95th percentile CDF ranged from a factor of 2.0 to a factor of 6.4 greater than the mean CDF. Dominion stated that in order to provide conservatism, it compared the cost to twice the calculated benefit. Dominion further indicated that most of the benefit calculations were performed in a bounding fashion, i.e., the SAMA is completely effective, and that such estimates would be substantially less if a more realistic analysis were performed for each SAMA (Dominion 2004b).

The staff questioned the approach of increasing the benefit (based on internal events) by 60 percent to account for external events (NRC 2004). In response to the RAI, Dominion stated that a multiplier of 1.6 was utilized because the external events analyses are not readily quantifiable (Dominion 2004b). The utilization of a multiplier on the benefits obtained from the internal events PRA to incorporate the impact of external events makes the implicit assumption that the consequences from external events sequences are the same as the consequences from internal events sequences. To demonstrate the robustness of the analysis, Dominion performed a sensitivity study that increased the assumed contribution from external events from 60 percent to 120 percent of the internal event benefits. The result was that the increased benefit exceeded the lower bound of the cost estimate range for only 2 SAMAs (112 and 168). Dominion stated that external events are dominated by LOOP and SBO (approximately 85 percent of the external events CDF comes from SBO). SAMA 168 (automate feed and bleed) would have no benefit for SBO sequences because feed and bleed cannot be achieved without power. Additionally, this SAMA could create additional means for a spurious power-operated relief valve opening or safety injection (a negative benefit). Therefore, Dominion concluded that the use of the 1.6 multiplier is acceptable. SAMA 112 is discussed further below.

Dominion assessed the impact of other factors on the analysis results, such as the contribution of external event initiators that were not explicitly included in the MPS2 risk profile, the use of a 3 percent discount rate as compared to the 7 percent discount rate used in the baseline calculations, as well as a 15-percent real discount rate (Dominion 2004a). These sensitivity cases resulted in an increase in the benefit calculation of about 30 percent or less. These analyses did not change Dominion's conclusion that none of the candidate SAMAs would be cost-beneficial except as noted above. In addition, Dominion performed sensitivity analyses that addressed assumptions made in other parts of the cost-benefit analysis, including meteorological data, source term, and evacuation. Dominion also considered the sensitivity to the impact of current and future fuel management practices. These sensitivity cases are generally bounded by the three-percent discount rate sensitivity study.

The staff notes that accounting for each of these factors would tend to increase the benefit as compared to the baseline case analysis. However, the calculated benefits used in the baseline analysis are generally over-estimated and therefore conservative. The staff concludes that the use of the factor of two to account for uncertainties, coupled with the fact that the calculated benefits are generally conservative, provides a reasonable treatment of uncertainties and is adequate for the SAMA evaluation.

The staff questioned Dominion about lower cost alternatives to some of the SAMAs evaluated, including the use of a direct-drive diesel AFW pump (NRC 2004). With regard to the specific lower cost alternative involving a direct-drive diesel AFW pump, Dominion stated that the alternative would not be viable at MPS3 due to room and ventilation constraints as well as costs. Dominion further stated that MPS3 has a SAMG for using the diesel fire pump to provide water to the AFW system (Dominion 2004b).

Dominion also identified and evaluated several lower cost alternatives to those considered in the ER. These included (1) installing an unfiltered hardened containment vent, (2) using existing systems to flood the reactor cavity, (3) creating a new SAMG to direct manual control of AFW, and (4) using the fire water system to fill the steam generators. Dominion concluded that three of the alternatives are covered by an existing procedure or SAMG, or could be instituted following evaluation and guidance by the Technical Support Center. The alternative involving creation of a new SAMG to direct manual control of the AFW pump is not currently covered by an existing procedure, but is related to SAMA 112.

SAMA 112 involves physical modifications to provide steam generator level indication in an SBO scenario, as well as the development of an emergency operating procedure that would direct the manual control of the TDAFW pump (Dominion 2004b). This SAMA was estimated to have a benefit of about $43,000 and an implementation cost of about $100,000. As such, it would not be cost-beneficial. As an alternative to SAMA 112, Dominion considered the development of a SAMG without the hardware modification. This improvement could be effective in a more limited number of sequences in which auxiliary feedwater control power is lost, but steam generator level indications are not. Development of a SAMG for manual control of the pump would involve engineering to determine the feasibility, creation of the new SAMG, field verification of the actual operation, and final SAMG production. Dominion estimated the cost of this alternative to be in the range of $50,000 - $60,000. The estimated benefit of this modification (after doubling to account for uncertainty) is greater than the expected cost; therefore, it is potentially cost-beneficial. As indicated in its RAI response, Dominion plans to complete its evaluation of this SAMA and, if it is cost-beneficial, will develop a SAMG addressing manual control of the turbine-driven AFW pump prior to the period of extended operation (Dominion 2004b).

The staff concludes that, with the exception of one potentially cost-beneficial SAMA discussed above, the costs of the SAMAs would be higher than the associated benefits. This conclusion is supported by uncertainty assessment and sensitivity analyses and upheld despite a number of additional uncertainties and non-quantifiable factors in the calculations, summarized as follows:

- A factor of two was used to account for uncertainties. Even if a higher factor were considered to reflect a larger uncertainty in CDF, e.g., a factor of five, only one additional SAMA would be close to becoming cost-beneficial – SAMA 168. However, this SAMA is not expected to be cost-beneficial under more realistic assumptions regarding risk reduction and implementation costs.

- Sensitivity calculations were performed with respect to the discount rate (3 percent and 15 percent) and various MACCS2 parameters, including meteorological data, evacuation speed, evacuation delay time, and source terms. The results of these sensitivity studies showed that none of the risk benefits was increased by more than 40 percent. Since this is less than the margin between cost and benefit for the SAMAs considered, the uncertainties in these parameters would not alter the conclusions.

I.7 Conclusions

Dominion compiled a list of 185 SAMA candidates using the SAMA analyses as submitted in support of licensing activities for other nuclear power plants, NRC and industry documents discussing potential plant improvements, plant-specific insights from the MPS3 PRA model. A qualitative screening removed SAMA candidates that (1) were not applicable at MPS3 due to design differences, (2) had already been implemented at MPS3, or (3) were related to RCP seal vulnerability. A total of 133 SAMAs were eliminated leaving 52 for further evaluation.

For the remaining SAMA candidates, a more detailed design and cost estimate were developed as shown in Table G-3. The cost-benefit analyses showed that none of the SAMA candidates was potentially cost-beneficial. Upon completion of a three-percent discount rate sensitivity study, as well as other sensitivity studies, no additional SAMA candidates were determined to be potentially cost-beneficial. To account for uncertainties, Dominion compared the cost of the SAMA with twice the calculated benefit. As a result, no additional SAMAs were cost-beneficial.

The staff reviewed the Dominion analysis and concluded that the methods used and the implementation of those methods was sound. The treatment of SAMA benefits and costs, the generally large negative net benefits, and the inherently small baseline risks support the general conclusion that the SAMA evaluations performed by Dominion are reasonable and sufficient for the license renewal submittal. The unavailability of an external event PRA model precluded a quantitative evaluation of SAMAs specifically aimed at reducing risk of external event initiators; however, improvements that have been realized as a result of the IPEEE process and the inclusion of a multiplier to account for external events would minimize the likelihood of identifying cost-beneficial enhancements in this area.

Based on its review of the Dominion SAMA analysis, the staff concurs that none of the candidate SAMAs are cost-beneficial, except for SAMA 112 – proceduralize local manual operation of AFW when control power is lost. This is based on conservative treatment of costs and benefits. This conclusion is consistent with the low residual level of risk indicated in the MPS3 PRA and the fact that MPS3 has already implemented many of plant improvements identified from the IPE and IPEEE processes. Although SAMA 112 may be cost-beneficial if it can be implemented via procedural enhancements, this SAMA does not relate to adequately managing the effects of aging during the period of extended operation. Therefore, it need not be implemented as part of the license renewal pursuant to 10 CFR Part 54.

I.8 References

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

Dominion Nuclear Connecticut, Inc. (Dominion). 2004a. *Applicant's Environmental Report–Operating License Renewal Stage, Millstone Power Station Units 2 and 3.* Dominion Nuclear Connecticut, Inc., Richmond, Virginia. January 2004.

Dominion Nuclear Connecticut, Inc. (Dominion). 2004b. Letter from Leslie N. Hartz, Dominion, to United States Nuclear Regulatory Commission Document Control Desk. Subject: Dominion Nuclear Connecticut, Inc., Millstone Power Sation Units 2 and 3, Response to Request for Additional Information, License Renewal Applications. August 13, 2004.

Dominion Nuclear Connecticut, Inc. (Dominion). 2004c. Email from Richard J. Gallagher, Dominion, to Richard Emch, NRC. Subject: Clarification of RAI Responses. September 16, 2004.

Northeast Nuclear Energy Company (NNECO). 1983. "Millstone Unit 3 Probabilistic Safety Study," August 1983.

Northeast Nuclear Energy Company (NNECO). 1990. Letter from E. J. Mroczka, NNECO, to U.S. Nuclear Regulatory Commission Document Control Desk. Subject: Millstone Nuclear Power Station Unit No. 3, Response to Generic Letter 88-20, Individual Plant Examination for Severe Accident Vulnerabilities, Summary Report Submittal, August 31, 1990.

Northeast Nuclear Energy Company (NNECO). 1991. Letter from J. F. Opeka, NNECO, to U.S. Nuclear Regulatory Commission Document Control Desk. Subject: Millstone Nuclear Power Station, Unit Nos. 1, 2 and 3, Response to Generic Letter 88-20 Supplement 4, Revised Response to Generic Letter 88-20 Supplement 1, Individual Plant Examinations (IPE) for Severe Accident Vulnerabilities, December 23, 1991.

U.S. Nuclear Regulatory Commission (NRC). 1985a. NUREG-1152, *Millstone 3 Risk Evaluation Report, An Overall Review and Evaluation of the Millstone Unit 3 Probabilistic Safety Study*, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1985b. NUREG/CR-4142, *A Review of the Millstone Probabilistic Safety Study*, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1985c. NUREG/CR-4143, *Review and Evaluation of the Millstone Unit 3 Probabilistic Safety Study, Containment Failure Modes, Radiological Source-Terms and Offsite Consequences*, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1988. Generic Letter 88-20, "Individual Plant Examination for Severe Accident Vulnerabilities," November 23, 1988.

U.S. Nuclear Regulatory Commission (NRC). 1990. NUREG-1150, *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants*, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1991. NUREG-1407, *Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities*, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1992. Letter from Vernon L. Rooney, U.S. NRC, to John F. Opeka, Northeast Nuclear Energy Company. Subject: Staff Evaluation of Millstone 3 Individual Plant Examination (IPE) - Internal Events, GL 88-20 (TAC NO. M74434), May 5, 1992.

U.S. Nuclear Regulatory Commission. 1996. NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plant*s, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1997a. NUREG-1560, *Individual Plant Examination Program: Perspectives on Reactor Safety and Plant Performance*, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1997b. NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook*, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1997c. NUREG/CR-6525, *SECPOP90: Sector Population, Land Fraction, and Economic Estimation Program*, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1998. Letter from James W. Andersen, U.S. NRC, to Martin L. Bowling, Jr., Northeast Nuclear Energy Company. Subject: Millstone Nuclear Power Station, Unit No. 3 – Individual Plant Examination of External Events (TAC NO. M83643), May 26, 1998.

U.S. Nuclear Regulatory Commission (NRC). 2004. Letter from Richard L. Emch, Jr., NRC, to David A. Christian, Dominion. Subject: Request for Additional Information (RAI) Regarding Severe Accident Mitigation Alternatives for the Millstone Power Station, Units 2 and 3 (TAC NOS. MC1827 and MC1828), June 22, 2004.

U.S. Department of Agriculture (USDA). 1998. 1997 Census of Agriculture, National Agriculture Statistics Service, 1998.

U.S. Nuclear Regulatory Commission (NRC). 2004. Letter from Richard L. Emch, Jr., NRC, to David A. Christian, Dominion. Subject: Request for Additional Information (RAI) Regarding Severe Accident Mitigation Alternatives for the Millstone Power Station, Units 2 and 3 (TAC NOS. MC1827 and MC1828), June 22, 2004.

U.S. Department of Agriculture (USDA). 1998. 1997 Census of Agriculture, National Agriculture Statistics Service, 1998.

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11. ABSTRACT *(200 words or less)*

This draft supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted to the NRC by the Dominion Nuclear Connecticut, Inc. (Dominion) to renew the OLs for Millstone Power Station, Units 2 and 3 (Millstone) for an additional 20 years under 10CFR Part54. This draft SEIS includes the NRC staff's analysis that considers and weighs the environmental impacts of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's preliminary recommendation regarding the proposed action.

The NRC staff's preliminary recommendation is that the Commission determine that the adverse environmental impacts of license renewal for Millstone are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2)the Environmental Report submitted by Dominion; (3) consultation with Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments received during the scoping process.

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