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GNRO-2012/00035

April 30, 2012

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Subject: Grand Gulf Nuclear Station (GGNS) 2011 Annual Radioactive Effluent Release Report (ARERR)
Grand Gulf Nuclear Station (GGNS), Unit 1
Docket No. 50-416
License No. NPF-29

Dear Sir or Madam:

Attached is the GGNS Annual Radioactive Effluent Release Report (ARERR) for the period January 1, 2011 through December 31, 2011. This report is submitted in accordance with the requirements of 10CFR50.36a(a)(2) and the GGNS Technical Specification (TS) 5.6.3. The ARERR also complies with the GGNS Offsite Dose Calculation Manual (ODCM).

This letter does not contain any commitments.

If you have questions or require additional information concerning this report, please contact Charles Nash at (601) 437-6936 or Christina Perino at (601) 437-6299.

Sincerely,

CLP\rrj

Attachment: 2011 Annual Radioactive Effluent Release Report

cc: (See Next Page)

cc:

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Port Gibson, MS 39150

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# Attachment

# to

# GNRO-2012/00035

# 2011 Annual Radioactive Effluent Release Report

# ENTERGY OPERATIONS, INC.
# GRAND GULF NUCLEAR STATION

# ANNUAL
# RADIOACTIVE EFFLUENT RELEASE EPORT

**January 1, 2011 - December 31, 2011**

4-23-12
**Prepared by**

4.23.12
**Reviewed by**

4/26/12
**Approved by**

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## I. INTRODUCTION

This Annual Radioactive Effluent Release Report (ARERR) for the period of January 1 through December 31, 2011, is submitted in accordance with Technical Specifications, Section 5.6.3, of Grand Gulf Nuclear Station (GGNS) License No. NPF-29. The monitoring of radioactive effluents is referenced in Offsite Dose Calculation Manual (ODCM) Appendix A, Sections 6.11 and 6.12.

Airborne discharges at GGNS are considered ground-level releases. All liquid and airborne discharges to the environment were analyzed in accordance with ODCM requirements. All effluent releases were within the concentration and total release limits specified by the ODCM. Projected offsite doses were within the dose limits specified by the ODCM.

The summation of all gaseous releases during the reporting period is reported in Table 1A.

Elevated gaseous releases are not applicable at GGNS as reported in Table 1B.

The summation of all ground-level gaseous release during the reporting period is reported in Table 1C.

The radioactive gaseous sampling and analysis program implemented at GGNS is described in Table 1D.

The summation of all liquid releases during the reporting period is reported in Table 2A.

The continuous and batch mode liquid releases are reported in Table 2B.

The radioactive liquid waste sampling and analysis program implemented at GGNS is described in Table 2C.

Solid radioactive waste and irradiated fuel shipments during the reporting period are summarized in Table 3.

Groundwater Protection Initiative (GPI) well sample tritium results are not included in the AREOR, but are included as Attachment I to the ARERR.

The annual summary of meteorological data (joint frequency distribution) will be maintained on site. The option to maintain meteorological data on site is in accordance with ODCM Administrative Controls Section 5.6.3. This data shall be provided to the Nuclear Regulatory Commission (NRC) upon request.

## II. DETAILED INFORMATION

A. Regulatory Limits

1. 10CFR20 Limits

a. Fission and Activation Gases - The release rate limit at any time for noble gases to areas at or beyond the site boundary shall be such that:

$D_{tb}$ = average total body dose rate in the current year (mrem/yr)

$= \overline{X/Q}\, \Sigma_i K_i\, Q_i' \leq 500$ mrem/yr

$D_s$ = average skin dose rate in the current year (mrem/yr)

$= \overline{X/Q}\, \Sigma_i\, (L_i + 1.1\, M_i)\, Q_i' \leq 3000$ mrem/yr

where the terms are defined in the GGNS ODCM.

b. Radioiodines, Tritium and Particulates - The release rate limit for the sampling period for all radioiodines, tritium and radioactive materials in particulate form with half-lives greater than 8 days shall be such that:

$D_o$ = average organ dose rate in current year (mrem/yr)

$= \Sigma_i\, W\, P_i\, \overline{Q'_i} \leq 1500$ mrem/yr

where the terms are defined in the GGNS ODCM.

c. Liquid Effluents - The concentration of radioactive materials released in liquid effluents to unrestricted areas from the site shall not exceed at any time ten times the values specified in 10CFR20, Appendix B, Table 2, Column 2. The concentration of dissolved or entrained noble gases, released in liquid effluents to unrestricted areas from all reactors at the site, shall be limited to $2 \times 10^{-4}$ microcuries/ml total activity.

## II. DETAILED INFORMATION (CONT'D)

2. 10CFR50, Appendix I Limits

a. Fission and Activation Gases - The dose from noble gases in gaseous effluents to areas at or beyond the site boundary shall be such that:

$D_\gamma$ = air dose due to gamma emissions from noble gases

$$= 3.17 \times 10^{-8} \Sigma_i M_i \overline{X/Q'} Q_i \leq 5 \text{ mrad/qtr}$$

$$\leq 10 \text{ mrad/yr}$$

$D_\beta$ = air dose due to beta emissions from noble gases

$$= 3.17 \times 10^{-8} \Sigma_i N_i \overline{X/Q'} Q_i \leq 10 \text{ mrad/qtr}$$

$$\leq 20 \text{ mrad/yr}$$

where the terms are defined in the GGNS ODCM.

b. Radioiodines, Tritium and Particulates - The dose to an individual from tritium, I-131, I-133 and radioactive material in particulate form with half-lives greater than 8 days in gaseous effluents shall be such that:

$D_p$ = dose to an individual from tritium, I-131, I-133 and radionuclides in particulate form with half-lives greater than 8 days (mrem)

$$= 3.17 \times 10^{-8} \Sigma_i R_i W' Q_i \leq 7.5 \text{ mrem/qtr Any Organ}$$

$$\leq 15 \text{ mrem/yr Any Organ}$$

where the terms are defined in the GGNS ODCM.

c. Liquid Effluents - The dose from radioactive materials in liquid effluents shall be such that:

$$D_{Tau} = \sum_i [A_{iTau} \sum_{l=1}^{m} \Delta t_l C_{il} F_l ] \leq 1.5 \text{ mrem/qtr Total Body}$$

$$\leq 5 \text{ mrem/qtr Any Organ}$$

$$\leq 3 \text{ mrem/yr Total Body}$$

$$\leq 10 \text{ mrem/yr Any Organ}$$

where the terms are defined in the GGNS ODCM.

## II. DETAILED INFORMATION (CONT'D)

3. 40CFR190 Limits

Doses are calculated for Fission and Activation Gases; Radioiodines and Particulates; and Liquid Effluents according to equations contained in Sections 2.(a), (b), and (c) respectively, with the exception that the limits applied are:

≤25 mrem/yr, Total Body or any Organ except Thyroid

≤75 mrem/yr, Thyroid

≤10 mrad γ/qtr or ≤20 mrad γ/yr, Fission and Activation Gases

≤20 mrad β/qtr or ≤40 mrad β/yr, Fission and Activation Gases

≤15 mrem/qtr or ≤30 mrem/yr, any Organ, Iodine and Particulates

≤3 mrem/qtr or ≤6 mrem/yr, Total Body, Liquid Effluents

≤10 mrem/qtr or ≤20 mrem/yr, any Organ, Liquid Effluents

B. Effluent Concentrations

1. Airborne

The Effluent Concentration Limit (ECL) of radioactive materials in gaseous effluents is limited by the dose rate restrictions given in Section II.A.1.a. In this case, the ECLs are actually determined by the dose factors in Table 2.1-1 of the GGNS ODCM.

2. Liquid

The ECL of radioactive materials in liquid effluents is limited by ten times the values in 10CFR20, Appendix B, Table 2, Column 2. The ECL chosen is the most conservative value of either the soluble or insoluble ECL for each radioisotope.

C. Average Energy

Not applicable for GGNS ODCM Appendix A.

## II. DETAILED INFORMATION (CONT'D)

D. Measurements and Approximations of Total Activity

The following discussion details the methods used to measure and approximate the total activity for the following:

| | |
|---|---|
| Fission and Activation Gases | Particulates |
| Radioiodines | Liquid Effluents |

Tables 1D and 2C give sampling frequencies and Lower Limit of Detection requirements for the analysis of gaseous and liquid effluent streams, respectively.

Values in the attached tables given as zero do not necessarily imply that the radionuclides were not present. A zero indicates that the radionuclide was not present at levels greater than the sensitivity requirements shown in Tables 1D and 2C. For some radionuclides, lower detection levels than required may be readily achievable; when a radionuclide is measured below its stated detection limits, it is reported.

1. For Fission and Activation Gases

The following noble gases are considered in evaluating gaseous airborne discharges:

| | | |
|---|---|---|
| Kr-87 | Kr-88 | Xe-133 |
| Xe-133m | Xe-135 | Xe-138 |

Periodic grab samples from Station effluent streams are analyzed by gamma spectral analysis utilizing high-resolution germanium detectors. (See Table 1D for sampling and analytical requirements.) Isotopic values thus obtained are used for dose release rate calculations due to effluent releases as given in Section II.A.1 of this report. Only those radionuclides that are detected are used in this computation. During the period between grab samples, the amount of radioactivity released is based on the effluent monitor readings. Monitors are assigned a calibration factor based upon the last isotopic analysis, using the following relationship:

$$C_i = U_i \div m$$

where

$C_i$ = isotopic calibration factor for isotope i

$U_i$ = concentration of isotope i in the grab sample in $\mu$Ci/ml

m = net monitor reading associated with the effluent stream (determined at the time of grab sampling)

## II. DETAILED INFORMATION (CONT'D)

These calibration factors, along with the hourly effluent monitor values and flow rates, are entered into the laboratory computer where the release rates for individual radionuclides are calculated and stored. If no activity is detected in the grab sample, the calibration factor defaults to a historical mixture of Kr-88, Xe-133, Xe-135m, Xe-135, and Xe-138.

2. For Particulates and Radioiodines

The radioiodines and radioactive materials in particulate form to be considered are:

| | |
|---|---|
| Zn-65 | Mo-99 |
| Mn-54 | Cs-134 |
| Fe-59 | Cs-137 |
| Co-58 | Ce-141 |
| Co-60 | Ce-144 |
| Sr-89 | I-131 |
| Sr-90 | I-133 |

Other radionuclides with half lives greater than 8 days.

3. For Continuous Releases

Continuous sampling is performed on the continuous release points when releasing (i.e.: Offgas/Radwaste Building, Containment Building, Fuel Handling Area, Turbine Building, and Turbine Building Occasional Release Point). Particulate material is collected by filtration. Radio-iodines are collected by adsorption onto a charcoal filter. Periodically these filters are removed and analyzed by gamma spectral analysis utilizing high-resolution germanium detectors to identify and quantify radioactive materials collected. Particulate filters are then analyzed for gross alpha and Strontium-89/90 as required. Gross alpha is analyzed using a gas flow proportional technique. Strontium-89/90 values are obtained by chemical separation and subsequent counting analysis using gas flow proportional techniques. Tritium concentrations are determined using distillation and liquid scintillation techniques. During major operational occurrences, the frequency of sampling is increased to satisfy the requirements of footnote "c" of Table 1D, "Radioactive Gaseous Waste Sampling and Analysis," (GGNS ODCM Appendix A, Table 6.11.4-1). Strontium analysis is performed by a qualified contract laboratory. Carbon-14(C-14) activity of 9.5 Curies released per year in gaseous form is obtained directly from the GGNS Final Safety Analysis Report Table 11.3-9. C-14 curies are reported in Tables 1A and 1C of this report and based on a constant release rate throughout the year.

4. For Batch Releases: Gases

Gaseous batch releases are not normally performed at GGNS.

## II. DETAILED INFORMATION (CONT'D)

5. For Batch Releases: Liquid Effluents

The radionuclides listed below are considered when evaluating liquid effluents:

| | |
|---|---|
| H-3 | Sr-90 |
| Mn-54 | Mo-99 |
| Fe-55 | I-131 |
| Co-58 | Cs-134 |
| Co-60 | Cs-137 |
| Fe-59 | Ce-141 |
| Zn-65 | Ce-144 |
| Sr-89 | |

Representative pre-release grab samples are obtained and analyzed as required by Table 2C. Isotopic analyses are performed by gamma spectral analysis utilizing high-resolution germanium detectors. Aliquots of each pre-released sample, proportional to the waste volume released, are composited in accordance with the requirements of Table 2C. Strontium-89/90 and Iron-55 values are obtained by individual chemical separations. Strontium-89/90 is analyzed using gas flow proportional techniques. Iron-55 is analyzed using liquid scintillation techniques. Gross alpha is analyzed using a gas flow proportional technique. Tritium is distilled and then analyzed using liquid scintillation techniques. Dissolved gases are determined employing grab sampling techniques and analyzed by gamma spectral analysis utilizing high-resolution germanium detectors. Iron and Strontium analyses are performed by a qualified contract laboratory.

E. Batch Releases

1. Liquid

| | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | Year |
|---|---|---|---|---|---|
| a. Number of releases | 1 | 28 | 48 | 30 | 107 |
| Time Period (in minutes) | | | | | |
| b. Total for all batches | 3.05E+02 | 7.55E+03 | 1.44E+04 | 8.90E+03 | 3.12E+04 |
| c. Max time for a batch | 3.05E+02 | 3.25E+02 | 3.20E+02 | 3.15E+02 | 3.25E+02 |
| d. Avg time for a batch | 3.05E+02 | 2.70E+02 | 3.00E+02 | 2.97E+02 | 2.91E+02 |
| e. Min time for a batch | 3.05E+02 | 0.00E+00 | 2.55E+02 | 1.95E+02 | 0.00E+00 |

2. Gaseous

No batch releases occurred during the report period.

## II. DETAILED INFORMATION (CONT'D)

F. Abnormal Releases

1. Liquid

a. Number of Releases: 0

b. Total Activity Released: 0.00E+00 Ci

No abnormal liquid releases were identified for this reporting period.

2. Gaseous

a. Number of Releases: 5

b. Total Activity Released: 2.91E+00 Ci

Five abnormal gaseous releases were identified during the reporting period. The releases were due to lack of negative pressure in the Turbine Building under certain operating conditions. The releases occurred August 19, August 20, August 26, and October 12, 2011, for a total release duration of 19.9 hours. Engineering determined the release flow rate during these periods was a maximum of 6,000 cfm. The turbine building exhaust stack sample results associated with these periods were used with annual average dispersion and deposition factors to determine the release rate and associated dose. The curies and doses are included in the Airborne Effluent Dose table in section III.B and in Table 1A and in Table 1C of this report.

## II. DETAILED INFORMATION (CONT'D)

G. Estimate of Total Error

1. Liquid

The maximum errors are collectively estimated to be as follows:

| | Fission & Activation Products | Tritium | Dissolved & Entrained Gases | Gross Alpha |
|---|---|---|---|---|
| Sampling % | 2.60E+01 | 2.60E+01 | 2.60E+01 | 2.60E+01 |
| Measurement % | 6.80E+01 | 6.50E+01 | 6.10E+01 | 9.20E+01 |
| **TOTAL %** | 7.30E+01 | 7.00E+01 | 6.60E+01 | 9.50E+01 |

Sampling errors include uncertainty associated with mixing, representative sampling and discharge volume. Measurement errors include uncertainty associated with instrument calibration and the preparation and counting of low-activity samples. Counting errors are based on measurements of blank samples. For germanium detectors, the least-readily-detectable radioisotope is used to determine the counting error. Calibration errors are calculated by summing the errors associated with the calibration of a particular instrument with a radioactive source.

The total error is calculated by taking the square root of the sum of the squares of the individual errors.

2. Gaseous

The maximum errors (not including sample line loss) are collectively estimated to be as follows:

| | Fission & Activation Products | Iodine | Particulate | Alpha | Gross Tritium |
|---|---|---|---|---|---|
| Sampling % | 3.20E+01 | 2.30E+01 | 2.20E+01 | 2.20E+01 | 2.30E+01 |
| Measurement % | 6.10E+01 | 6.70E+01 | 6.50E+01 | 1.01E+02 | 6.20E+01 |
| **TOTAL %** | 6.90E+01 | 7.10E+01 | 6.90E+01 | 1.03E+02 | 6.60E+01 |

Sampling errors include uncertainty associated with sample flow, vent flow and monitor calibration.

Measurement and total errors are calculated by the same methods used for liquid effluents.

3. Solid Radioactive Waste

Estimated Total Error % for all waste types is ±2.50E+01. Sampling errors include uncertainty associated with mixing and representative sampling.

## II. DETAILED INFORMATION (CONT'D)

H. Solid Radioactive Waste Shipments

See Table 3 for shipment information.

I. Meteorological Data

The data recovery for the reporting period was 98.9%. The predominant wind direction was from the South approximately 9.1% of the time. The predominant stability class was class "D" approximately 26.9% of the time. Average wind speed during the reporting period was approximately 4.5 miles per hour.

The annual meteorological data (Hourly Average Data or Joint Frequency Distribution) will be maintained on site in a file that shall be provided to the NRC upon request.

J. Radioactive Effluent Monitoring Instrumentation Operability

No instances of reportable inoperability were identified for this reporting period.

K. Annual Sewage Disposal Summary

There were no sewage disposals in 2011.

## III. RADIATION DOSE SUMMARY

Indicated below is the annual summary of offsite doses attributable to GGNS during 2011. Inspection of the values indicates that GGNS releases were within the 10CFR50, Appendix I, design objectives.

Since there are no other fuel cycle facilities within 8 km of GGNS, 40CFR190 limits were also met during this period.

A. Water-Related Exposure Pathways

The values calculated in this section utilize the information provided in Tables 2A and 2B of this report and the calculation methodology of the ODCM.

Liquid Effluents

Total body dose and critical organ doses are computed for the maximum exposed individual. The maximum dose contribution from liquid effluents is considered to occur in the adult age group via consumption of fish.

2011 Liquid Effluent Dose (mrem)

| | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | TOTAL |
|---|---|---|---|---|---|
| Bone | 0.00e+00 | 7.15e-03 | 1.65e-02 | 8.14e-03 | 3.18e-2 |
| Liver | 3.63e-05 | 1.15e-02 | 2.60e-02 | 2.19e-02 | 6.10e-2 |
| Thyroid | 3.54e-05 | 1.20e-03 | 1.70e-03 | 1.13e-03 | 4.05e-3 |
| Kidney | 3.54e-05 | 5.22e-03 | 1.04e-02 | 1.08e-02 | 2.73e-2 |
| Lung | 3.54e-05 | 2.66e-03 | 4.21e-03 | 1.96e-03 | 8.71e-3 |
| GI-LLI | 5.20e-05 | 5.57e-03 | 7.25e-03 | 2.44e-02 | 4.04e-2 |
| Whole Body | 3.74e-05 | 6.64e-03 | 1.70e-02 | 1.22e-02 | 3.66e-2 |

B. Airborne-Related Exposure Pathways

The values presented in this section utilize information provided in Tables 1A and 1C of this report and the calculation methodology of the ODCM. Carbon-14 doses were calculated using Electric Power Research Institute, EPRI, methodology and calculation software which was validated on site using Regulatory Guide 1.109. Dose and dose rates are computed for locations at the site boundary or at unrestricted areas within the site boundary. Because members of the public may, on occasion, be found within the site boundary, two fishing lakes, the recreational vehicle laydown area, and the GGNS Energy Services Center locations were also evaluated.

Consideration of site boundary locations as well as unrestricted areas within and beyond the site boundary provides assurance that offsite doses will not be substantially underestimated while attempting to provide an accurate dose calculation.

Doses for a Member of the Public are computed based on 2011 meteorological data and on the most recent land use census, with the most limiting location used.

During normal operations, the dispersion and deposition factors used for dose calculations are from five-year historical annual average meteorological data.

## III. RADIATION DOSE SUMMARY (CONT'D)

Organ Dose

The maximum organ dose to a MEMBER OF THE PUBLIC (critical receptor) from radioiodines, tritium, and particulates was calculated for this report using the most recent land use census and dispersion and deposition parameters from 2011 meteorological data. The critical receptor residence was determined to be located in the southwest sector at a distance of 1432 meters (0.89 miles) from the plant. Pathways considered for use in the organ dose calculations are inhalation, ground plane, grass/cow/meat, and vegetation. There is no grass/cow/milk pathway within five miles of GGNS. It was assumed that the age group receiving the maximum dose lived at the residence and that the receptor consumed food products that were raised or produced at the residence. This dose is documented in the following table as two separate entries. The first organ dose entry excludes C-14 while the second entry includes organ dose from tritium, radioiodines, particulates, and C-14.

Average Total Body and Skin Dose Rate

Individual total body and skin dose rates from exposure to a semi-infinite cloud of noble gas are computed for a location in the southwest sector at a distance of 1368 meters (0.85 miles) from the plant. This location corresponds to the highest annual average atmospheric dispersion factor for a location at or within the site boundary based on 2011 meteorological data.

The total body and skin dose rates reported are the quarterly average of the maximum instantaneous dose rates determined daily during the reporting period and represent the maximum possible dose rate received by members of the public.

Air Dose from Gamma and Beta Emissions

Air doses from gaseous effluents were calculated for this report using dispersion parameters from the 2011 meteorological data. The highest dispersion factor for an unrestricted area was in the southwest sector at the site boundary, 1368 meters (0.85 miles) from the plant.

Direct Radiation

Direct radiation dose is calculated by subtracting average doses measured by thermoluminescent dosimeter (TLD) badges located at control locations from average doses measured by TLD badges located near the site boundary. GGNS reported measured doses in 2011 as net exposure normalized to 92 days.

## III. RADIATION DOSE SUMMARY (CONT'D)

Carbon-14

C-14 is a naturally occurring isotope of carbon. Nuclear weapons testing in the 1950s and 1960s significantly increased the amount of C-14 in the atmosphere. C-14 is also produced in commercial nuclear reactors, but the amounts produced are much less than those produced naturally or from weapons testing. In recent years, the analytical methods for determining C-14 have improved. Coincidentally the radioactive effluents from commercial nuclear power plants have also decreased to the point that C-14 has emerged as a principal radionuclide in gaseous effluents.

The only significant dose pathway to a member of the public from C-14 release is through consumption of vegetation. Vegetation incorporates C-14 in form of carbon dioxide ($CO_2$) during photosynthesis so doses are calculated based on the $CO_2$ fraction of the carbon released in gaseous form. A $CO_2$ fraction of 95% is used based on EPRI Technical Report 1021106, "Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents". The highest atmospheric dispersion factors for an actual garden based on land use census are used to determine dose from C-14 because $CO_2$ is dispersed as a gas to the garden location where it is then incorporated into plant material.

C-14 dose is calculated for maximum organ dose to a MEMBER OF THE PUBLIC assuming all age groups utilize that garden location. This doses is then added to dose for the same organ from tritium, iodine, and particulates. This organ dose is recorded and compared to the limit in the following table.

## III. RADIATION DOSE SUMMARY (CONT'D)

| 2011 Airborne Effluent Dose (mrem) | | | | | |
|---|---|---|---|---|---|
| | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | TOTAL |
| Iodine, Tritium & Particulates (excluding Carbon-14) | | | | | |
| Child (mrem) | 6.94E-03 | 5.20E-03 | 4.83E-03 | 5.25E-03 | 2.22E-02 |
| Organ | Thyroid | Thyroid | Thyroid | GILLI | Thyroid |
| Applicable Limit | 7.5 | 7.5 | 7.5 | 7.5 | 15 |
| Percent of Limit | 9.26E-02 | 6.94E-02 | 6.45E-02 | 7.00E-02 | 1.48E-01 |
| Iodine, Tritium & Particulates (including Carbon-14) | | | | | |
| Child Bone (mrem) | 1.21E+00 | 1.22E+00 | 1.23E+00 | 1.23E+00 | 4.89E+00 |
| Applicable Limit | 7.5 | 7.5 | 7.5 | 7.5 | 15 |
| Percent of Limit | 1.61E+01 | 1.63E+01 | 1.64E+01 | 1.64E+01 | 3.26E+01 |
| Total Body Dose Rate (mrem/yr) | 1.27E-01 | 3.11E-01 | 3.33E-01 | 6.40E-01 | |
| Applicable Limit | 500 | 500 | 500 | 500 | |
| Percent of Limit | 2.54E-02 | 6.22E-02 | 6.66E-02 | 1.28E-01 | |
| Skin Dose Rate (mrem/yr) | 2.45E-01 | 7.39E-01 | 6.83E-01 | 1.22E+00 | |
| Applicable Limit | 3000 | 3000 | 3000 | 3000 | |
| Percent of Limit | 8.17E-03 | 2.46E-02 | 2.28E-02 | 4.07E-02 | |
| Gamma Air Dose* | 2.80E-02 | 6.33E-02 | 8.40E-02 | 1.34E-01 | 3.09E-01 |
| Applicable Limit | 5 | 5 | 5 | 5 | 10 |
| Percent of Limit | 5.60E-01 | 1.27E+00 | 1.68E+00 | 2.68E+00 | 3.09E+00 |
| Beta Air Dose* | 2.46E-02 | 8.41E-02 | 8.14E-02 | 1.15E-01 | 3.05E-01 |
| Applicable Limit | 10 | 10 | 10 | 10 | 20 |
| Percent of Limit | 2.46E-01 | 8.41E-01 | 8.14E-01 | 1.15E+00 | 1.53E+00 |
| Direct Radiation (mrem) | 0.3 | 0.0 | 0.2 | 0.0 | 0.5 |

*Measurement units are mrad

## IV. OFFSITE DOSE CALCULATION MANUAL/ RADIOACTIVE WASTE TREATMENT SYSTEM CHANGES

A. Offsite Dose Calculation Manual (ODCM)

No revisions to the ODCM were issued during the reporting period.

B. Radioactive Waste Treatment Systems

No major changes were made to the liquid or gaseous radwaste treatment systems during this reporting period.

TABLE 1A
ENTERGY OPERATIONS, INC.
GRAND GULF NUCLEAR STATION UNIT 1

EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS – SUMMATION OF ALL RELEASES

| REPORT FOR 2011 | Units | QTR 1 | QTR 2 | QTR 3 | QTR 4 | YEAR |
|---|---|---|---|---|---|---|
| **Fission and Activation Gases** | | | | | | |
| 1. Total Release | Ci | 3.54E+01 | 1.30E+02 | 1.18E+02 | 1.63E+02 | 4.46E+02 |
| 2. Avg. Release Rate | uCi/sec | 4.55E+00 | 1.66E+01 | 1.48E+01 | 2.05E+01 | 1.42E+01 |
| 3. Percent of TS Limit | % | 5.60E-01 | 1.27E+00 | 1.68E+00 | 2.68E+00 | 3.09E+00 |
| **Iodine-131** | | | | | | |
| 1. Total Release | Ci | 3.56E-05 | 1.75E-05 | 2.43E-05 | 3.00E-05 | 1.07E-04 |
| 2. Avg. Release Rate | uCi/sec | 4.58E-06 | 2.22E-06 | 3.06E-06 | 3.78E-06 | 3.41E-06 |
| 3. Percent of TS Limit | % | 6.05E-03 | 2.97E-03 | 4.14E-03 | 5.11E-03 | 9.13E-03 |
| **Particulates Half Life >= 8 days** | | | | | | |
| 1. Total Release | Ci | 1.33E-05 | 4.55E-06 | 2.84E-05 | 4.30E-05 | 8.92E-05 |
| 2. Avg. Release Rate | uCi/sec | 1.71E-06 | 5.79E-07 | 3.57E-06 | 5.41E-06 | 2.83E-06 |
| 3. Percent of TS Limit | % | 1.08E-02 | 7.14E-04 | 1.83E-03 | 1.45E-03 | 6.16E-03 |
| **Tritium** | | | | | | |
| 1. Total Release | Ci | 8.95E+00 | 6.90E+00 | 6.23E+00 | 6.58E+00 | 2.87E+01 |
| 2. Avg. Release Rate | uCi/sec | 1.15E+00 | 8.78E-01 | 7.84E-01 | 8.28E-01 | 9.09E-01 |
| 3. Percent of TS Limit | % | 8.52E-02 | 6.57E-02 | 5.94E-02 | 6.27E-02 | 1.37E-01 |
| **Carbon 14** | | | | | | |
| 1. Total Release | Ci | 2.34E+00 | 2.37E+00 | 2.39E+00 | 2.39E+00 | 9.50E+00 |
| 2. Avg. Release Rate | uCi/sec | 3.01E-01 | 3.01E-01 | 3.01E-01 | 3.01E-01 | 3.01E-01 |
| **Gross Alpha** | | | | | | |
| 1. Total Release | Ci | 2.37E-08 | 2.08E-08 | 0.00E+00 | 7.70E-08 | 1.21E-07 |
| 2. Avg. Release Rate | uCi/sec | 3.04E-09 | 2.65E-09 | 0.00E+00 | 9.68E-09 | 3.85E-09 |

TABLE 1B
ENTERGY OPERATIONS, INC.
GRAND GULF NUCLEAR STATION UNIT 1

EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS – ELEVATED RELEASES
JANUARY – DECEMBER 2011

(Not Applicable – GGNS Releases Are Considered Ground-Level)

TABLE 1C
ENTERGY OPERATIONS, INC.
GRAND GULF NUCLEAR STATION UNIT 1

EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS – GROUND-LEVEL RELEASE-CONTINUOUS

| REPORT FOR 2011 | Units | QTR 1 | QTR 2 | QTR 3 | QTR 4 | YEAR |
|---|---|---|---|---|---|---|
| **Fission and Activation Gases** | | | | | | |
| AR-41 | Ci | 5.15E+00 | 1.71E+01 | 1.37E+01 | 3.44E+00 | 3.94E+01 |
| KR-85M | Ci | 2.10E+00 | 6.12E+00 | 1.57E+01 | 1.96E+01 | 4.35E+01 |
| KR-87 | Ci | 1.20E-01 | 6.33E-02 | 0.00E+00 | 2.51E+00 | 2.69E+00 |
| KR-88 | Ci | 1.00E-01 | 1.14E+00 | 8.30E+00 | 1.98E+01 | 2.94E+01 |
| KR-89 | Ci | 0.00E+00 | 2.80E-01 | 0.00E+00 | 0.00E+00 | 2.80E-01 |
| XE-133 | Ci | 2.40E+00 | 3.12E+01 | 1.75E+01 | 1.48E+01 | 6.59E+01 |
| XE-135 | Ci | 3.14E+00 | 2.64E+01 | 3.02E+00 | 3.64E+00 | 3.62E+01 |
| XE-135M | Ci | 3.81E+00 | 7.08E+00 | 9.26E+00 | 1.90E+01 | 3.91E+01 |
| XE-137 | Ci | 6.12E+00 | 2.72E+01 | 2.49E+01 | 3.19E+01 | 9.01E+01 |
| XE-138 | Ci | 1.25E+01 | 1.39E+01 | 2.55E+01 | 4.81E+01 | 1.00E+02 |
| | | --- | --- | --- | --- | --- |
| Totals for Period... | Ci | 3.54E+01 | 1.30E+02 | 1.18E+02 | 1.63E+02 | 4.46E+02 |
| **Iodines** | | | | | | |
| I-131 | Ci | 3.56E-05 | 1.75E-05 | 2.43E-05 | 3.00E-05 | 1.07E-04 |
| I-133 | Ci | 1.61E-04 | 7.88E-05 | 1.20E-04 | 1.62E-04 | 5.22E-04 |
| I-135 | Ci | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | | --- | --- | --- | --- | --- |
| Totals for Period... | Ci | 1.97E-04 | 9.63E-05 | 1.45E-04 | 1.92E-04 | 6.29E-04 |
| **Particulates Half Life >= 8 days** | | | | | | |
| BA-140 | Ci | 0.00E+00 | 7.67E-07 | 7.12E-06 | 3.41E-05 | 4.20E-05 |
| CO-58 | Ci | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| CO-60 | Ci | 0.00E+00 | 0.00E+00 | 8.00E-06 | 3.52E-07 | 8.36E-06 |
| CR-51 | Ci | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| CS-137 | Ci | 0.00E+00 | 0.00E+00 | 5.38E-07 | 0.00E+00 | 5.38E-07 |
| MN-54 | Ci | 0.00E+00 | 0.00E+00 | 7.84E-07 | 0.00E+00 | 7.84E-07 |
| RU-106 | Ci | 0.00E+00 | 0.00E+00 | 8.12E-06 | 3.71E-06 | 1.18E-05 |
| SR-89 | Ci | 1.05E-05 | 3.79E-06 | 3.78E-06 | 4.83E-06 | 2.29E-05 |
| SR-90 | Ci | 2.79E-06 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 2.79E-06 |
| ZN-65 | Ci | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | | --- | --- | --- | --- | --- |
| Totals for Period... | Ci | 1.33E-05 | 4.55E-06 | 2.84E-05 | 4.30E-05 | 8.92E-05 |
| **Other** | | | | | | |
| H-3 | Ci | 8.95E+00 | 6.90E+00 | 6.23E+00 | 6.58E+00 | 2.87E+01 |
| C-14 | Ci | 2.34E+00 | 2.37E+00 | 2.39E+00 | 2.39E+00 | 9.50E+00 |
| Gross Alpha | Ci | 2.37E-08 | 2.08E-08 | 0.00E+00 | 7.70E-08 | 1.21E-07 |

TABLE 1D
ENTERGY OPERATIONS, INC.
GRAND GULF NUCLEAR STATION UNIT 1

EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
Radioactive Gaseous Waste Sampling and Analysis Program
JANUARY – DECEMBER 2011

| Gaseous Release Type | Sampling Frequency | Minimum Analysis Frequency | Type of Activity Analysis | Lower Limit of Detection (LLD) ( uCi/ml)[a] |
|---|---|---|---|---|
| A. (1) Radwaste Building Ventilation Exhaust | 31 Days Grab Sample (f) | 31 Days | Principal Gamma Emitters (b,e) H-3 | $\frac{1x10^{-4}}{1X10^{-6}}$ |
| (2) Fuel Handling Area Ventilation Exhaust | Continuous (d)(f) | 7 Days (c) Charcoal Sample | I-131 I-133 | $\frac{1x10^{-12}}{1x10^{-10}}$ |
| (3) Containment Ventilation Exhaust | Continuous (d)(f) | 7 Days (c) Particulate Sample | Principal Gamma Emitters (e) (I-131, Others) | $1x10^{-11}$ |
| (4A) Turbine Building Ventilation Exhaust | Continuous (d)(f) | 31 Days Composite Particulate Sample | Gross Alpha | $1x10^{-11}$ |
| (4B) Turbine Building Occasional Release Point(g) (when in service) | Continuous (d)(f) | 92 Days Composite Particulate Sample | Sr-89, Sr-90 | $1x10^{-11}$ |
| | Continuous (f) | Noble Gas Monitor | Noble Gases Gross Beta or Gamma | $1x10^{-6}$ |
| B. (1) Offgas Post Treatment Exhaust, whenever there is flow | 31 Days Grab Sample (f) | 31 Days | Principal Gamma Emitters (e) | $1x10^{-4}$ |
| (2) Standby Gas Treatment A Exhaust, whenever there is flow | 31 Days Grab Sample (f) | 31 Days | Principal Gamma Emitters(e) | $1x10^{-4}$ |
| (3) Standby Gas Treatment B Exhaust, whenever there is flow | 31 Days Grab Sample (f) | 31 Days | Principal Gamma Emitters(e) | $1x10^{-4}$ |

NOTE: Footnotes indicated are listed in GGNS ODCM, Appendix A, Table 6.11.4-1.

TABLE 2A
ENTERGY OPERATIONS, INC.
GRAND GULF NUCLEAR STATION UNIT 1

RADIOACTIVE EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS – SUMMATION OF ALL RELEASES

| REPORT FOR 2011 | Units | QTR 1 | QTR 2 | QTR 3 | QTR 4 | YEAR |
|---|---|---|---|---|---|---|
| **Fission and Activation Products** | | | | | | |
| 1. Total Release | Ci | 8.62E-06 | 1.08E-02 | 4.15E-03 | 1.16E-02 | 2.66E-02 |
| 2. Avg. Diluted Conc. | uCi/ml | 1.36E-09 | 5.69E-08 | 1.04E-08 | 3.90E-08 | 2.98E-08 |
| 3. Percent of Limit | % | 2.49E-03 | 4.43E-01 | 1.13E+00 | 8.12E-01 | 1.22E+00 |
| **Tritium** | | | | | | |
| 1. Total Release | Ci | 3.91E-01 | 1.57E+01 | 2.46E+01 | 1.82E+01 | 5.89E+01 |
| 2. Avg. Diluted Conc. | uCi/ml | 6.17E-05 | 8.23E-05 | 6.17E-05 | 6.11E-05 | 6.59E-05 |
| 3. Percent of Limit | % | 6.17E-01 | 8.23E-01 | 6.17E-01 | 6.11E-01 | 6.59E-01 |
| **Dissolved and Entrained Gases** | | | | | | |
| 1. Total Release | Ci | 4.10E-05 | 3.92E-04 | 1.74E-03 | 5.16E-04 | 2.69E-03 |
| 2. Avg. Diluted Conc. | uCi/ml | 6.47E-09 | 2.05E-09 | 4.36E-09 | 1.73E-09 | 3.01E-09 |
| 3. Percent of Limit | % | 3.24E-03 | 1.03E-03 | 2.18E-03 | 8.65E-04 | 1.15E-03 |
| **Gross Alpha Radioactivity** | | | | | | |
| 1. Total Release | Ci | 0.00E+00 | 2.19E-05 | 0.00E+00 | 0.00E+00 | 2.19E-05 |
| Volume of liquid waste | liters | 1.06E+05 | 2.64E+06 | 4.88E+06 | 3.04E+06 | 1.07E+07 |
| Volume of dil. water | liters | 6.23E+06 | 1.88E+08 | 3.94E+08 | 2.95E+08 | 8.84E+08 |

TABLE 2B
ENTERGY OPERATIONS, INC.
GRAND GULF NUCLEAR STATION UNIT 1

RADIOACTIVE EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS – CONTINUOUS AND BATCH MODES

| REPORT FOR 2011 | Units | QTR 1 | QTR 2 | QTR 3 | QTR 4 | YEAR |
|---|---|---|---|---|---|---|
| **Fission and Activation Products** | | | | | | |
| AG-110M | Ci | 0.00E+00 | 0.00E+00 | 0.00E+00 | 3.14E-04 | 3.14E-04 |
| AS-76 | Ci | 0.00E+00 | 0.00E+00 | 6.19E-05 | 0.00E+00 | 6.19E-05 |
| CE-141 | Ci | 0.00E+00 | 0.00E+00 | 4.09E-06 | 3.46E-06 | 7.55E-06 |
| CO-58 | Ci | 0.00E+00 | 0.00E+00 | 6.44E-05 | 1.02E-04 | 1.66E-04 |
| CO-60 | Ci | 8.62E-06 | 5.01E-04 | 6.22E-04 | 5.69E-03 | 6.82E-03 |
| CR-51 | Ci | 0.00E+00 | 0.00E+00 | 1.02E-03 | 6.42E-04 | 1.66E-03 |
| CS-134 | Ci | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.09E-05 | 1.09E-05 |
| CS-137 | Ci | 0.00E+00 | 3.02E-05 | 1.39E-04 | 4.60E-05 | 2.15E-04 |
| CU-64 | Ci | 0.00E+00 | 1.88E-05 | 0.00E+00 | 0.00E+00 | 1.88E-05 |
| FE-55 | Ci | 0.00E+00 | 1.00E-02 | 0.00E+00 | 0.00E+00 | 1.00E-02 |
| FE-59 | Ci | 0.00E+00 | 0.00E+00 | 3.71E-04 | 2.56E-04 | 6.28E-04 |
| I-131 | Ci | 0.00E+00 | 0.00E+00 | 0.00E+00 | 5.90E-06 | 5.90E-06 |
| MN-54 | Ci | 0.00E+00 | 1.16E-04 | 3.82E-04 | 2.99E-03 | 3.48E-03 |
| NA-24 | Ci | 0.00E+00 | 2.70E-05 | 3.94E-04 | 8.23E-05 | 5.03E-04 |
| RB-88 | Ci | 0.00E+00 | 0.00E+00 | 6.95E-04 | 8.96E-04 | 1.59E-03 |
| RU-106 | Ci | 0.00E+00 | 0.00E+00 | 6.42E-05 | 0.00E+00 | 6.42E-05 |
| SB-124 | Ci | 0.00E+00 | 0.00E+00 | 1.13E-04 | 2.12E-05 | 1.34E-04 |
| SB-125 | Ci | 0.00E+00 | 0.00E+00 | 1.46E-05 | 0.00E+00 | 1.46E-05 |
| SN-117M | Ci | 0.00E+00 | 0.00E+00 | 1.07E-05 | 0.00E+00 | 1.07E-05 |
| SR-92 | Ci | 0.00E+00 | 0.00E+00 | 0.00E+00 | 6.00E-05 | 6.00E-05 |
| TC-99M | Ci | 0.00E+00 | 1.30E-06 | 8.73E-05 | 5.40E-06 | 9.40E-05 |
| W-187 | Ci | 0.00E+00 | 0.00E+00 | 1.74E-05 | 0.00E+00 | 1.74E-05 |
| ZN-65 | Ci | 0.00E+00 | 1.30E-04 | 8.65E-05 | 5.00E-04 | 7.17E-04 |
| Totals for Period... | Ci | 8.62E-06 | 1.08E-02 | 4.15E-03 | 1.16E-02 | 2.66E-02 |
| **Tritium** | | | | | | |
| H-3 | Ci | 3.91E-01 | 1.57E+01 | 2.46E+01 | 1.82E+01 | 5.89E+01 |
| Totals for Period... | Ci | 3.91E-01 | 1.57E+01 | 2.46E+01 | 1.82E+01 | 5.89E+01 |
| **Dissolved and Entrained Gases** | | | | | | |
| KR-85M | Ci | 0.00E+00 | 0.00E+00 | 7.77E-06 | 0.00E+00 | 7.77E-06 |
| XE-133 | Ci | 1.70E-05 | 2.66E-04 | 1.15E-03 | 4.57E-04 | 1.89E-03 |
| XE-135 | Ci | 2.40E-05 | 1.26E-04 | 5.83E-04 | 5.83E-05 | 7.91E-04 |
| Totals for Period... | Ci | 4.10E-05 | 3.92E-04 | 1.74E-03 | 5.16E-04 | 2.69E-03 |
| **Gross Alpha Radioactivity** | | | | | | |
| ALPHA | Ci | 0.00E+00 | 2.19E-05 | 0.00E+00 | 0.00E+00 | 2.19E-05 |
| Totals for Period... | Ci | 0.00E+00 | 2.19E-05 | 0.00E+00 | 0.00E+00 | 2.19E-05 |

TABLE 2C
ENTERGY OPERATIONS, INC.
GRAND GULF NUCLEAR STATION UNIT 1

RADIOACTIVE EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM
JANUARY – DECEMBER 2011

| Liquid Release Type | Sampling Frequency | Minimum Analysis Frequency | Type of Activity Analysis | Lower Limit of Detection (LLD) ( uCi/ml)(a) |
|---|---|---|---|---|
| A. Batch Waste Release Tanks (c) | Prior to Release Each Batch | Prior to Release Each Batch | Principal Gamma Emitters (d) I-131 | $\frac{5x10^{-7}}{1X10^{-6}}$ |
| | Prior to Release One Batch /M | 31 Days | Dissolved and Entrained Gases (Gamma Emitters) | $1x10^{-5}$ |
| | Prior to Release Each Batch | 31 Days Composite (b) | H-3 Gross Alpha | $\frac{1x10^{-5}}{1x10^{-7}}$ |
| | Prior to Release Each Batch | 92 Days Composite (b) | Sr-89, Sr-90 Fe-55 | $\frac{5x10^{-8}}{1x10^{-6}}$ |
| B. SSW Basin (Before Blowdown) | Prior to Release Each Blowdown | Prior to Release Each Batch | Principal Gamma Emitters (d) I-131 | $\frac{5x10^{-7}}{1x10^{-6}}$ |

NOTE: Footnotes indicated are listed in GGNS ODCM, Appendix A, Table 6.11.1-1.

TABLE 3
ENTERGY OPERATIONS, INC.
GRAND GULF NUCLEAR STATION UNIT 1

RADIOACTIVE EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
SOLID RADIOACTIVE WASTE AND IRRADIATED FUEL SHIPMENTS
JANUARY – DECEMBER 2011

A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (NOT IRRADIATED FUEL)

| 1. Type of Waste | Unit | Class A | Class B | Class C | Est. Total Error % |
|---|---|---|---|---|---|
| a. Spent resins, filter sludges, evaporator bottoms, etc. | $m^3$<br>Ci | 7.65E+01<br>2.54E+02 | 5.52E+00<br>1.86E+03 | 0.00E+00<br>0.00E+00 | +/- 25% |
| b. Dry compressible waste, contaminated equipment, etc. | $m^3$<br>Ci | 4.26E+02<br>1.22E+00 | 0.00E+00<br>0.00E+00 | 0.00E+00<br>0.00E+00 | +/- 25% |
| c. Irradiated components, control rods, etc. | $m^3$<br>Ci | 0.00E+00<br>0.00E+00 | 0.00E+00<br>0.00E+00 | 0.00E+00<br>0.00E+00 | +/- 25% |
| d. Other: Condensate Pre-Coat Septa Bundle | $m^3$<br>Ci | 5.64E+00<br>1.13E+01 | 0.00E+00<br>0.00E+00 | 0.00E+00<br>0.00E+00 | +/- 25% |

2. Estimate of Major Nuclide Composition ( by type of waste)

a. Spent resins, filter sludges, evaporator bottoms, etc.
None
b. Dry compressible waste, contaminated equipment, etc.
None
c. Irradiated components, control rods, etc.
None

d. Other: Condensate Pre-Coat Septa Bundle

| Isotope (greater than 0.1%) | Percent | Curies |
|---|---|---|
| Ni-63 | 0.390 | 8.27E+00 |
| Co-60 | 9.497 | 2.02E+02 |
| Cr-51 | 0.660 | 1.40E+01 |
| Cs-137 | 0.132 | 2.80E+00 |
| Fe-55 | 75.113 | 1.59E+03 |
| Fe-59 | 0.843 | 1.79E+01 |
| Mn-54 | 10.085 | 2.14E+02 |
| Co-58 | 0.396 | 8.40E+00 |
| Zn-65 | 2.832 | 6.01E+01 |

TABLE 3
ENTERGY OPERATIONS, INC.
GRAND GULF NUCLEAR STATION UNIT 1

RADIOACTIVE EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
SOLID RADIOACTIVE WASTE AND IRRADIATED FUEL SHIPMENTS
JANUARY – DECEMBER 2011 (Cont)

3. Solid Waste Disposition

| Number of Shipments | Destination Name | City | State | Mode of Transportation |
|---|---|---|---|---|
| 10 | EnergySolutions(Duratek), LLC | Oak Ridge | TN | Hittman |
| 1 | EnergySolutions – Bulk Waste Disposal Facility | Clive | UT | Hittman |
| 14 | Studsvik | Erwin | TN | Hittman |

| NRC Class | Disposal Volume(ft^3) | Description | Number of Containers | Waste Type Description |
|---|---|---|---|---|
| B | 120.3 | 8/120 HIC | 2 | Poly HIC – RWCU-A |
| A | 202 | ES-210 | 3 | Carbon Steel Liner - SRT |
| A | 1180 | 20' SEALAND | 16 | 20FT Sealand |
| A | 199.4 | ES-210 (solidification) | 12 | Stainless Steel Liner CPS/RWCU-B |

B. Irradiated Fuel Shipments (Disposition)

| NUMBER OF SHIPMENTS | MODE OF TRANSPORTATION | DESTINATION |
|---|---|---|
| None | N/A | N/A |

**ATTACHMENT I**

## GPI Sample Results
JANUARY – DECEMBER 2011

GPI Ground Water samples are collected from onsite dewatering wells, DW; monitoring wells, MW; observation wells, OW; and sump wells, SW. Samples were analyzed for tritium and selected samples were analyzed for gamma and/or hard to detect (HTD) isotopes (Gross Alpha, Iron-55, Nickel-63, Strontium-89 and Strontium-90. Analyses are to the Lower Level of Detection (LLD) values for the GGNS Radiological Environmental Monitoring Program.

No dose to the public is attributed to ground water since wells with results above MDA are bounded by wells which are <MDA. Tritium, gamma and HTD results are shown in the table below.

MW-105B indicated one positive result near the detection level of 15 pCi/L for Manganese-54 (Mn-54) and Cobalt-60 (Co-60). All previous and subsequent samples for MW-105B measured <MDA for gamma emitting and hard to detect isotopes. All results were less than Reporting Levels of GGNS-ODCM table 6.12.1-2.

| LOCATION | DATE | TRITIUM (pCi/L) | GAMMA/HTD (pCi/L) |
|---|---|---|---|
| DW-01 | 01/25/2011 | 8497 | <MDA |
| DW-01 | 03/02/2011 | 11600 | <MDA |
| DW-01 | 04/22/2011 | 10423 | <MDA |
| DW-01 | 05/18/2011 | 10923 | |
| DW-01 | 06/08/2011 | 12565 | |
| DW-01 | 07/13/2011 | 17108 | |
| DW-01 | 08/05/2011 | 19519 | <MDA |
| DW-01 | 09/19/2011 | | <MDA |
| DW-01 | 09/29/2011 | 21100 | |
| DW-01 | 12/19/2011 | 14300 | |
| DW-03 | 03/02/2011 | <MDA | <MDA |
| DW-03 DUP | 03/02/2011 | 659 | |
| DW-03 | 04/21/2011 | 888 | <MDA |
| DW-03 | 05/17/2011 | <MDA | |
| DW-03 | 08/24/2011 | 738 | <MDA |
| DW-03 | 11/16/2011 | 636 | <MDA |
| DW-04 | 03/02/2011 | 1287 | <MDA |
| DW-04 | 04/21/2011 | 1109 | <MDA |
| DW-04 | 05/17/2011 | 775 | |
| DW-04 | 06/08/2011 | 776 | |
| DW-04 | 07/13/2011 | 873 | |
| DW-04 | 08/24/2011 | 1207 | <MDA |
| DW-04 | 11/16/2011 | 822 | <MDA |
| DW-04 DUP | 11/16/2011 | 643 | |

## ATTACHMENT I

### GPI Sample Results
JANUARY – DECEMBER 2011 (Cont)

| LOCATION | DATE | TRITIUM (pCi/L) | GAMMA/HTD (pCi/L) |
|---|---|---|---|
| DW-05 | 03/02/2011 | <MDA | <MDA |
| DW-05 | 04/21/2011 | <MDA | <MDA |
| DW-05 | 05/18/2011 | <MDA | |
| DW-05 | 06/08/2011 | <MDA | |
| DW-05 | 08/24/2011 | <MDA | <MDA |
| DW-05 | 11/16/2011 | <MDA | <MDA |
| | | | |
| DW-07 | 01/26/2011 | 3603 | <MDA |
| DW-07 | 03/01/2011 | 3164 | <MDA |
| DW-07 | 04/22/2011 | 2844 | <MDA |
| DW-07 | 05/17/2011 | 2495 | |
| DW-07 | 06/08/2011 | 2299 | |
| DW-07 | 07/12/2011 | 2110 | |
| DW-07 DUP | 07/12/2011 | 2344 | |
| DW-07 | 08/24/2011 | 2939 | <MDA |
| DW-07 DUP | 08/24/2011 | 3070 | <MDA |
| DW-07 | 11/16/2011 | 4430 | <MDA |
| | | | |
| DW-08 | 03/01/2011 | <MDA | <MDA |
| DW-08 | 04/19/2011 | <MDA | <MDA |
| | | | |
| MW-01 | 01/25/2011 | <MDA | <MDA |
| MW-01 | 03/02/2011 | <MDA | <MDA |
| MW-01 DUP | 03/02/2011 | <MDA | |
| MW-01 | 04/22/2011 | <MDA | <MDA |
| MW-01 | 05/18/2011 | <MDA | |
| MW-01 | 08/24/2011 | 814 | <MDA |
| MW-01 | 11/16/2011 | <MDA | <MDA |
| | | | |
| MW-02 | 06/08/2011 | 522 | |
| | | | |
| MW-07 | 01/25/2011 | 7135 | <MDA |
| MW-07 | 03/02/2011 | 10000 | <MDA |
| MW-07 | 08/05/2011 | 17404 | |
| | | | |
| MW-09 | 03/01/2011 | <MDA | <MDA |
| MW-09 | 04/21/2011 | 653 | <MDA |
| MW-09 | 05/18/2011 | <MDA | |
| MW-09 | 08/23/2011 | <MDA | <MDA |
| MW-09 | 11/16/2011 | <MDA | <MDA |

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### GPI Sample Results
JANUARY – DECEMBER 2011 (Cont)

| LOCATION | DATE | TRITIUM (pCi/L) | GAMMA/HTD (pCi/L) |
|---|---|---|---|
| MW-10 | 07/13/2011 | <MDA | |
| MW-1007C | 04/19/2011 | <MDA | <MDA |
| MW-1009C | 05/19/2011 | <MDA | |
| MW-100B | 01/26/2011 | <MDA | <MDA |
| MW-100B | 03/01/2011 | <MDA | <MDA |
| MW-100B | 03/03/2011 | <MDA | <MDA |
| MW-100B | 04/20/2011 | <MDA | <MDA |
| MW-100B | 05/17/2011 | <MDA | |
| MW-100B | 08/24/2011 | <MDA | <MDA |
| MW-100B | 11/16/2011 | <MDA | <MDA |
| MW-1012C | 05/19/2011 | <MDA | |
| MW-1020C | 04/21/2011 | <MDA | <MDA |
| MW-1020C DUP | 04/21/2011 | <MDA | <MDA |
| MW-1024C | 04/22/2011 | <MDA | <MDA |
| MW-1024C DUP | 04/22/2011 | <MDA | <MDA |
| MW-1026B | 03/02/2011 | <MDA | <MDA |
| MW-1026B | 04/20/2011 | <MDA | <MDA |
| MW-1026B | 05/18/2011 | <MDA | |
| MW-1026B | 08/24/2011 | <MDA | <MDA |
| MW-1026B | 11/17/2011 | <MDA | <MDA |
| MW-1027B | 03/02/2011 | <MDA | <MDA |
| MW-1027B | 04/21/2011 | <MDA | <MDA |
| MW-1027B | 05/18/2011 | <MDA | |
| MW-1027B | 08/05/2011 | <MDA | |
| MW-1027B | 11/17/2011 | <MDA | <MDA |
| MW-1027C | 04/22/2011 | <MDA | <MDA |

## ATTACHMENT I

### NEI Groundwater Protection Initiative Sample Results
JANUARY – DECEMBER 2011 (Cont)

| LOCATION | DATE | TRITIUM (pCi/L) | GAMMA/HTD (pCi/L) |
|---|---|---|---|
| MW-102B | 01/26/2011 | <MDA | <MDA |
| MW-102B | 03/03/2011 | <MDA | <MDA |
| MW-102B | 04/20/2011 | <MDA | <MDA |
| MW-102B | 05/17/2011 | <MDA | |
| MW-102B | 08/24/2011 | <MDA | <MDA |
| MW-102B | 11/16/2011 | 378 | <MDA |
| MW-103B | 06/08/2011 | <MDA | |
| MW-103B | 08/24/2011 | <MDA | <MDA |
| MW-103B | 11/15/2011 | <MDA | <MDA |
| MW-1042C | 04/21/2011 | <MDA | <MDA |
| MW-1043B | 03/02/2011 | <MDA | <MDA |
| MW-1043B | 04/21/2011 | <MDA | <MDA |
| MW-1043B | 05/18/2011 | <MDA | |
| MW-1043B | 08/24/2011 | <MDA | <MDA |
| MW-1043B | 11/17/2011 | <MDA | <MDA |
| MW-1045B | 03/02/2011 | <MDA | <MDA |
| MW-1045B | 04/21/2011 | <MDA | <MDA |
| MW-1045B | 05/18/2011 | <MDA | |
| MW-1045B | 08/24/2011 | <MDA | <MDA |
| MW-1045B DUP | 08/24/2011 | <MDA | <MDA |
| MW-1045B | 11/16/2011 | <MDA | <MDA |
| MW-104B | 06/08/2011 | <MDA | |
| MW-104B | 08/24/2011 | <MDA | <MDA |
| MW-104B | 11/15/2011 | <MDA | <MDA |
| MW-105B | 05/27/2011 | <MDA | |
| MW-105B | 06/08/2011 | 773 | |
| MW-105B | 07/14/2011 | 873 | |
| MW-105B | 08/05/2011 | 765 | |
| MW-105B | 09/29/2011 | 1040 | <MDA |
| MW-105B | 12/20/2011 | 716 | Co-60 18.5±6.9<br>Mn-54 9.7±5.0 |

## ATTACHMENT I

### GPI Sample Results
JANUARY – DECEMBER 2011 (Cont)

| LOCATION | DATE | TRITIUM (pCi/L) | GAMMA/HTD (pCi/L) |
|---|---|---|---|
| MW-106B | 01/26/2011 | <MDA | <MDA |
| MW-106B | 03/03/2011 | <MDA | <MDA |
| MW-106B | 04/20/2011 | <MDA | <MDA |
| MW-106B | 05/17/2011 | <MDA | |
| MW-106B DUP | 05/17/2011 | <MDA | |
| MW-106B | 08/24/2011 | <MDA | <MDA |
| MW-106B | 11/16/2011 | <MDA | <MDA |
| | | | |
| MW-107B | 01/26/2011 | 1935 | <MDA |
| MW-107B | 03/02/2011 | 2114 | |
| MW-107B | 04/21/2011 | 2341 | <MDA |
| MW-107B DUP | 04/21/2011 | 2105 | <MDA |
| MW-107B | 05/17/2011 | 2088 | |
| MW-107B DUP | 05/17/2011 | 2095 | |
| MW-107B | 06/08/2011 | 2355 | |
| MW-107B | 07/12/2011 | 2293 | |
| MW-107B | 08/24/2011 | 1913 | <MDA |
| MW-107B | 11/16/2011 | 2200 | <MDA |
| | | | |
| MW-1082C | 04/22/2011 | <MDA | <MDA |
| | | | |
| MW-108B | 07/13/2011 | 1012 | |
| MW-108B | 08/24/2011 | 931 | <MDA |
| MW-108B | 11/16/2011 | 944 | <MDA |
| | | | |
| MW-109B | 01/26/2011 | 759 | <MDA |
| MW-109B | 03/02/2011 | 880 | <MDA |
| MW-109B | 04/20/2011 | 985 | <MDA |
| MW-109B | 05/17/2011 | 725 | |
| MW-109B | 08/24/2011 | 1266 | <MDA |
| MW-109B | 11/16/2011 | 674 | <MDA |
| | | | |
| MW-110B | 01/26/2011 | <MDA | <MDA |
| MW-110B | 04/22/2011 | <MDA | <MDA |
| MW-110B | 05/17/2011 | <MDA | |
| MW-110B | 08/23/2011 | <MDA | <MDA |
| MW-110B | 11/16/2011 | <MDA | |

## ATTACHMENT I

### GPI Sample Results
JANUARY – DECEMBER 2011 (Cont)

| LOCATION | DATE | TRITIUM (pCi/L) | GAMMA/HTD (pCi/L) |
|---|---|---|---|
| MW-111B | 05/19/2011 | 5459 | |
| MW-111B | 06/08/2011 | 5010 | |
| MW-111B DUP | 06/08/2011 | 5229 | |
| MW-111B | 07/13/2011 | 3921 | |
| MW-111B | 08/05/2011 | 4457 | |
| MW-111B | 09/29/2011 | 6260 | <MDA |
| MW-111B | 12/19/2011 | 5780 | |
| MW-112B | 06/24/2011 | <MDA | |
| MW-112B | 07/13/2011 | <MDA | |
| MW-112B | 08/24/2011 | <MDA | <MDA |
| MW-112B | 09/29/2011 | <MDA | <MDA |
| MW-112B | 12/19/2011 | <MDA | |
| MW-1134B | 03/03/2011 | <MDA | <MDA |
| MW-1134B | 04/20/2011 | <MDA | <MDA |
| MW-1134B | 05/18/2011 | <MDA | |
| MW-1134B | 08/23/2011 | <MDA | <MDA |
| MW-1134B DUP | 08/23/2011 | <MDA | <MDA |
| MW-1134B | 11/16/2011 | <MDA | <MDA |
| MW-1134C | 04/22/2011 | <MDA | <MDA |
| MW-113B | 06/08/2011 | <MDA | |
| MW-113B DUP | 06/08/2011 | <MDA | |
| MW-113B | 07/13/2011 | <MDA | |
| MW-113B DUP | 07/13/2011 | <MDA | |
| MW-113B | 08/24/2011 | <MDA | <MDA |
| MW-113B | 11/15/2011 | <MDA | <MDA |
| MW-114B | 06/08/2011 | 437 | |
| MW-114B | 07/13/2011 | 808 | |
| MW-114B | 08/05/2011 | 735 | |
| MW-114B | 09/30/2011 | 965 | <MDA |
| MW-114B | 11/16/2011 | 929 | <MDA |
| MW-114B | 12/20/2011 | 1630 | <MDA |
| MW-115B | 11/04/2011 | 1250 | <MDA |
| MW-115B | 12/20/2011 | 927 | <MDA |

## ATTACHMENT I

### GPI Sample Results
JANUARY – DECEMBER 2011 (Cont)

| LOCATION | DATE | TRITIUM (pCi/L) | GAMMA/HTD (pCi/L) |
|---|---|---|---|
| MW-118B | 11/04/2011 | <MDA | <MDA |
| MW-118B | 12/20/2011 | <MDA | |
| MW-14 | 03/01/2011 | <MDA | <MDA |
| MW-14 | 04/21/2011 | <MDA | <MDA |
| MW-14 | 05/18/2011 | <MDA | |
| MW-14 | 08/23/2011 | <MDA | <MDA |
| MW-14 | 11/16/2011 | <MDA | <MDA |
| MW-18 | 07/13/2011 | <MDA | |
| MW-23 | 03/01/2011 | <MDA | <MDA |
| MW-23 | 04/20/2011 | 540 | <MDA |
| MW-23 | 05/18/2011 | <MDA | |
| MW-23 | 08/24/2011 | <MDA | <MDA |
| MW-23 | 11/16/2011 | <MDA | <MDA |
| MW-23 DUP | 11/16/2011 | <MDA | <MDA |
| MW-26 | 03/02/2011 | <MDA | <MDA |
| MW-26 | 04/21/2011 | <MDA | <MDA |
| MW-26 | 05/18/2011 | <MDA | |
| MW-26 DUP | 05/18/2011 | <MDA | |
| MW-26 | 08/23/2011 | <MDA | <MDA |
| MW-26 | 11/16/2011 | <MDA | <MDA |
| MW-26 DUP | 11/16/2011 | <MDA | <MDA |
| OW-209B | 01/25/2011 | 7774 | <MDA |
| OW-209B | 03/03/2011 | 8040 | <MDA |
| OW-209B DUP | 03/03/2011 | 7480 | |
| OW-209B | 04/20/2011 | 7062 | <MDA |
| OW-209B | 05/17/2011 | 7298 | |
| OW-209B | 06/08/2011 | 6732 | |
| OW-209B | 07/13/2011 | 6757 | |
| OW-209B | 08/05/2011 | 6308 | |
| OW-209B | 09/29/2011 | 6320 | <MDA |
| OW-209B | 12/20/2011 | 5930 | <MDA |
| SW-103B | 11/17/2011 | <MDA | <MDA |

(<MDA = less than minimum detectable activity)
(DUP = separate sample collected and analyzed)