



February 25, 2020

NG-20-0007
10 CFR 50.12
10 CFR 50.82(a)(8)(i)(A)
10 CFR 50.75(h)(1)(iv)

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Duane Arnold Energy Center
Renewed Facility Operating License No. DPR-49
Docket No. 50-331
Request for Exemptions from 10 CFR 50.82(a)(8)(i)(A) and 10 CFR 50.75(h)(1)(iv)

Reference:

NEDA Letter L-2019-009 to NRC dated January 18, 2019, Certification of Permanent Cessation of Power Operations (ADAMS Accession No. ML19023A196)

Pursuant to 10 CFR 50.12, NextEra Energy Duane Arnold, LLC (NEDA) requests an exemption from 10 CFR 50.82(a)(8)(i)(A) to allow use of its nuclear decommissioning trust funds (DTFs) for spent fuel management and other non-radiological site restoration activities at the Duane Arnold Energy Center (DAEC). These activities are described in the attached site specific decommissioning cost estimate (DCE) and will also be described in the DAEC Spent Fuel Management Plan (SFMP) and the Post-Shutdown Decommissioning Activities Report (PSDAR) that are expected to be submitted in the near future. The DCE transmitted with this exemption request will also support the SFMP and PSDAR filings. NEDA also requests, pursuant to 10 CFR 50.12, an exemption from 10 CFR 50.75(h)(1)(iv) to allow DAEC DTF disbursements for spent fuel management and other non-radiological site restoration activities to be made without prior notice, similar to withdrawals in accordance with 10 CFR 50.82(a)(8).

On January 18, 2019 (Reference), NEDA notified the U.S. Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 50.82(a)(1)(i) and 10 CFR 50.4(b)(8) of its intention to permanently cease power operations at DAEC in the fourth quarter 2020.

Table 1 of Attachment 1 demonstrates that the DTF contains the amount needed to cover the estimated costs of radiological decommissioning, spent fuel management, and site restoration activities. However, 10 CFR 50.82(a)(8)(i)(A) states that DTFs may only "be used by licensees if . . . [t]he withdrawals are for expenses for legitimate decommissioning activities consistent with the definition of decommissioning in § 50.2."

10 CFR 50.75(h)(1)(iv) similarly requires that trust agreements restrict disbursements (other than for ordinary administrative and other incidental expenses of the fund) to those allowed under Section 50.82(a)(8) and requires a 30-day advance notification to the NRC prior to making disbursements for expenses not covered under Section 50.82(a)(8). Historically, the NRC has not interpreted the 10 CFR 50.2 definition of “decommission” as including activities associated with spent fuel management or site restoration. Therefore, exemptions from 10 CFR 50.82(a)(8)(i)(A) and 10 CFR 50.75(h)(1)(iv) are needed to allow NEDA to use DTFs for DAEC spent fuel management and site restoration activities.

The requested exemptions from 10 CFR 50.82(a)(8)(i)(A) and 10 CFR 50.75(h)(1)(iv) are permissible under 10 CFR 50.12 because they are authorized by law, will not present an undue risk to the public health and safety, and are consistent with the common defense and security (10 CFR 50.12(a)(1)). In addition, application of the regulations in this particular circumstance is not necessary to achieve the underlying purpose of the rules being sought for exemption (10 CFR 50.12(a)(2)(ii)). The cost estimate provided in Table 1 of Attachment 1 identifies the estimated annual expenditures for radiological decommissioning, spent fuel management, and site restoration activities. Table 1 demonstrates that the DTF contains more than adequate funds to cover not only the estimated costs of radiological decommissioning, but also the estimated costs for spent fuel management and site restoration activities. Therefore, application of the restrictions in 10 CFR 50.82(a)(8)(i)(A) and 10 CFR 50.75(h)(1)(iv) is not necessary to ensure adequate funding for radiological decommissioning of DAEC. Additionally, the annual reporting requirements in 10 CFR 50.82(a)(8)(v) and (vi) will allow for continual NRC oversight of the status of the DTF.

NEDA requests these exemptions on its own behalf as 70% owner of the DAEC. The other licensed owners of the DAEC, 10% owner Corn Belt Power Cooperative (Corn Belt) and 20% owner Central Iowa Power Cooperative (CIPCO), are not seeking permission to use their DTF funds in this manner. The values in the DCE reflect 100% of the decommissioning costs. Attachment 1 Table 1 reduces those costs to reflect NEDA’s 70% share.

NEDA recognizes that if these exemption requests are approved, necessary amendments to its nuclear decommissioning trust agreements for DAEC will be subject to the prior notice requirements of 10 CFR 50.75(h)(1)(iii).

NEDA requests approval of these exemption requests by August 1, 2020 to support the schedule for post-defueled SFMP and site restoration activities. NEDA requests that the approved exemptions become effective upon approval.

NextEra Duane Arnold, LLC | Duane Arnold Energy Center
Request for Exemptions from 10 CFR 50.82(a)(8)(i)(A) and 10 CFR 50.75(h)(1)(iv)
Docket No. 50-331 NG-20-0007 Page 3 of 3

There are no new regulatory commitments made in this submittal. If you have any questions regarding these exemption requests, please contact J. Michael Davis, Licensing Manager at 319-851-7032.



Dean Curtland
Site Director, Duane Arnold Energy Center
NextEra Energy Duane Arnold, LLC

Attachments: 1) Request for Exemptions
2) Site Specific Decommissioning Cost Estimate

cc: Regional Administrator, USNRC, Region III
Project Manager, USNRC, Duane Arnold Energy Center
Resident Inspector, USNRC, Duane Arnold Energy Center
A. Leek (State of Iowa)

Attachment 1 to NG-20-0007

Requests for Exemption

16 pages follow

1. SPECIFIC EXEMPTION REQUESTS

Pursuant to 10 CFR 50.12, "Specific exemptions," NextEra Energy Duane Arnold, LLC (NEDA) requests an exemption from 10 CFR 50.82(a)(8)(i)(A) to allow it to use funds from its decommissioning trust funds (DTFs) for the Duane Arnold Energy Center (DAEC) for the management of spent fuel and non-radiological site restoration activities. NEDA also requests, pursuant to 10 CFR 50.12, an exemption from 10 CFR 50.75(h)(1)(iv) to allow NEDA's DTF to be amended to provide for disbursements for spent fuel management and site restoration activities to be made without prior notice, similar to withdrawals in accordance with 10 CFR 50.82(a)(8).

10 CFR 50.82(a)(8)(i)(A) and the applicable provisions of 10 CFR 50.75(h)(1)(iv) are provided below:

Section (a)(8)(i)(A) of 10 CFR 50.82, "Termination of license," states the following:

Decommissioning trust funds may be used by licensees if -- (A) The withdrawals are for expenses for legitimate decommissioning activities consistent with the definition of decommissioning in § 50.2.

Section (h)(1)(iv) of 10 CFR 50.75, "Reporting and recordkeeping for decommissioning planning," states, in part, that licensees that are not electric utilities shall provide in the terms of the arrangements governing the trust that:

Except for withdrawals being made under § 50.82(a)(8) or for payments of ordinary administrative costs (including taxes) and other incidental expenses of the fund (including legal, accounting, actuarial, and trustee expenses) in connection with the operation of the fund, no disbursement or payment may be made from the trust, escrow account, Government fund, or other account used to segregate and manage the funds until written notice of the intention to make a disbursement or payment has been given to the Director, Office of Nuclear Reactor Regulation, Director, Office of New Reactors, or Director, Office of Nuclear Material Safety and Safeguards, as applicable, at least 30 working days before the date of the intended disbursement or payment.

Section (h)(1)(iv) of 10 CFR 50.75 also states, in part:

Disbursements or payments from the trust, escrow account, Government fund, or other account used to segregate and manage the funds, other than for payment of ordinary administrative costs (including taxes) and other incidental expenses of the fund (including legal, accounting, actuarial, and trustee expenses) in connection with the operation of the fund, are restricted to decommissioning expenses or transfer to another financial assurance method acceptable under paragraph (e) of this section until final

decommissioning has been completed. After decommissioning has begun and withdrawals from the decommissioning fund are made under § 50.82(a)(8), no further notification need be made to the NRC.

10 CFR 50.2, "Definitions," contains the following definition of "decommission:"

... to remove a facility or site safely from service and reduce residual radioactivity to a level that permits - (1) Release of the property for unrestricted use and termination of the license; or (2) Release of the property under restricted conditions and termination of the license.

The included Table 1 demonstrates that the DTF contains the amount needed to cover the estimated costs of radiological decommissioning, as well as spent fuel management and site restoration activities. However, 10 CFR 50.82(a)(8)(i)(A) states that DTFs may only be used by licensees if the withdrawals are for expenses for legitimate decommissioning activities consistent with the definition of decommissioning in 10 CFR 50.2. Similarly, 10 CFR 50.75(h)(1)(iv) requires that trust agreements provide that disbursements (other than for ordinary administrative and other incidental expenses of the fund) are restricted to decommissioning expenses until final decommissioning is completed. The NRC construes the definition of "decommission" in 10 CFR 50.2 as not including activities associated with spent fuel management or site restoration.

10 CFR 50.75(h)(1)(iv) further provides that, except for withdrawals being made under 10 CFR 50.82(a)(8) or for payments of ordinary administrative and other incidental expenses, no disbursement may be made from the DTF without written notice to the NRC at least 30 working days in advance. Because disbursements for spent fuel management and site restoration activities would not be made under 10 CFR 50.82(a)(8), this provision would require advance notice to the NRC prior to any such disbursement.

Based on the above, NEDA has concluded that 10 CFR 50.82(a)(8)(i)(A) and 10 CFR 50.75(h)(1)(iv) would prohibit use of DTFs for activities related to spent fuel management and site restoration prior to completion of radiological decommissioning. As reflected in the Attachment 2 Decommissioning Cost Estimate (DCE), NEDA anticipates maintaining DAEC in a safe storage condition (SAFSTOR method) for an extended period prior to completion of radiological decommissioning. This will allow radioactive decay to occur, thereby reducing the quantity of contamination and radioactivity that must be disposed of during the decontamination and dismantlement process, as well as reducing occupational radiation exposure.

Exemptions from 10 CFR 50.82(a)(8)(i)(A) and 10 CFR 50.75(h)(1)(iv) are requested to allow NEDA to withdraw and use funds from the DTF for spent fuel management and site restoration activities. The exemptions would apply to NEDA's 70% share of all spent fuel management and site restoration activities at DAEC. As the NEDA DTF contains adequate funds to complete radiological decommissioning as well as spent fuel management activities and site restoration activities, these exemptions would not present

an undue risk to the public health and safety or prevent decommissioning from being completed as planned.

2. BASIS FOR EXEMPTION REQUESTS

NEDA anticipates using the SAFSTOR method of decommissioning at DAEC, deferring completion of radiological decommissioning until after a storage period, thus delaying (absent an exemption) the availability of excess amounts in the DTF for spent fuel management and site restoration activities. Attachment 2 provides a site-specific DCE for radiological decommissioning, spent fuel management, and site restoration activities in 2018 dollars.

Table 1, columns 2 through 6, show the DCE costs for each year of decommissioning. Table 1 reflects the projected annual cash flows required for decommissioning DAEC based on the SAFSTOR method from the DCE. The costs for site radiological decommissioning (license termination costs), spent fuel management, independent spent fuel storage installation (ISFSI) radiological decommissioning, and site restoration (non-radiological decommissioning) efforts are reflected. Table 1, column 7 escalates the costs to 2019 dollars to allow for proper comparison with the fund balance as of December 31, 2019. Table 1, column 8 shows NEDA's 70% portion of expenses.

Table 1 column 9 includes a cash flow analysis demonstrating that, with credited earnings (i.e., 2% real rate of return) during the SAFSTOR period, NEDA's DTF contains sufficient funds needed to cover its portion of the cost of radiological decommissioning, spent fuel management, and site restoration activities.

Table 1 projects a NEDA DTF balance of over \$211 million, as shown in 2019 dollars, at the end of decommissioning.

The DCE includes costs associated with site radiological decommissioning planning performed by a dedicated site organization prior to permanent shutdown. In accordance with 10 CFR 50.82(a)(8), NEDA was reimbursed \$991,661.14 for radiological decommissioning planning costs. In accordance with 10 CFR 50.82(a)(8)(ii), pre-shutdown DTF withdrawals will continue to be limited to no more than 3% of the NEDA 70% share of the calculated estimate under 10 CFR 50.75(c).

3. ADJUSTING COST ESTIMATES AND FUNDING LEVELS

10 CFR 50.82(a)(8)(iv) states the following:

For decommissioning activities that delay completion of decommissioning by including a period of storage or surveillance, the licensee shall provide a means of adjusting cost estimates and associated funding levels over the storage or surveillance period.

NEDA anticipates maintaining DAEC in a safe storage condition (SAFSTOR method) for an extended period prior to completion of radiological decommissioning. This will allow radioactive decay to occur, thereby reducing the quantity of contamination and radioactivity that must be disposed of during the decontamination and dismantlement

process as well as reducing the associated occupational radiation exposure.

NEDA's approach to address the requirements of 10 CFR 50.82(a)(8)(iv) with respect to "*adjusting [decommissioning] cost estimates and associated funding levels over the storage or surveillance period*" is discussed below.

During the SAFSTOR period, the site-specific DCE will be periodically updated in accordance with applicable regulatory requirements.

In accordance with 10 CFR 50.82(a)(8)(iv), decommissioning funding assurance will be reviewed and reported to the NRC annually during the SAFSTOR period. The latest DCE adjusted for inflation in accordance with applicable regulatory requirements will be used to demonstrate funding assurance. In addition, actual radiological and spent fuel management expenses will be included in the annual decommissioning status report. If the funding assurance demonstration shows the DTF is not sufficient, then an alternate funding mechanism allowed by 10 CFR 50.75(e) and the guidance provided in Regulatory Guide 1.159 (Reference 1) will be put in place. This may include a cash contribution, a parent company guarantee, or other mechanism.

4. JUSTIFICATION FOR EXEMPTIONS AND SPECIAL CIRCUMSTANCES

Pursuant to 10 CFR 50.12, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of the regulations of Part 50 which are authorized by law, will not present an undue risk to the public health and safety, and are consistent with the common defense and security. 10 CFR 50.12 also states that the Commission will not consider granting an exemption unless special circumstances are present. As discussed below, these exemption requests satisfy the provisions of Section 50.12.

4.1 Exemptions

A. The exemptions are authorized by law

The proposed exemptions from 10 CFR 50.82(a)(8)(i)(A) and 10 CFR 50.75(h)(1)(iv) would allow NEDA to use funds from the DTF for spent fuel management and site restoration activities, consistent with the DAEC Spent Fuel Management Plan (SFMP) and DCE. The SFMP is expected to be submitted in the near future. As stated above, 10 CFR 50.12 allows the NRC to grant exemptions from the requirements of 10 CFR Part 50. The proposed exemptions would not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission's regulations. The NRC has approved exemptions to other licensees to use DTFs for spent fuel management and site restoration (see Section 5). Therefore, the exemptions are authorized by law.

B. The exemptions will not present an undue risk to public health and safety

The underlying purpose of 10 CFR 50.82(a)(8)(i)(A) and 10 CFR 50.75(h)(1)(iv) is to provide reasonable assurance that adequate funds will be available for decommissioning of power reactors within 60 years of cessation of operations. Based on the site-specific cost estimate and the cash flow analysis provided in Table 1, use of funds in the DTF for spent fuel management and site restoration activities will not adversely impact NEDA's ability to terminate the DAEC license (i.e., complete radiological decommissioning) within 60 years. Furthermore, an exemption from 10 CFR 50.75(h)(1)(iv) to allow NEDA to make withdrawals from the DTF to cover expenses for spent fuel management and site restoration efforts without prior written notification to the NRC will not affect the sufficiency of funds in the DTF to accomplish radiological decontamination of the site. Additionally, the annual reporting requirements in 10 CFR 50.82(a)(8)(v) and (vi) will allow for continual NRC oversight of the status of the DTF.

Based on the above, no new accident precursors are created by using the DTF in the proposed manner. Thus, the probability of postulated accidents is not increased. Also, based on the above, the consequences of postulated accidents are not increased. No changes are being made in the types or amounts of effluents that may be released offsite. There is no significant increase in occupational or public radiation exposure. These exemptions do not diminish the effectiveness of other regulations that ensure available funding for decommissioning, including 10 CFR 50.82(a)(6) which prohibits licensees from performing any decommissioning activities that could foreclose unrestricted release of the site, result in significant environmental impacts not previously reviewed, or result in there no longer being reasonable assurance that adequate funds will be available for decommissioning. Therefore, the exemptions will not present an undue risk to the public health and safety.

C. The exemptions are consistent with the common defense and security

The proposed exemptions would allow NEDA to use its DTF for spent fuel management and site restoration efforts, consistent with the SFMP and cost estimate. Spent fuel management and site restoration activities are an integral part of the planned DAEC decommissioning process and will not adversely affect NEDA's ability to physically secure the site or protect special nuclear material. This change to enable use of funds in the DTF for spent fuel management and site restoration activities will not alter the scope or availability of sufficient funding for the DAEC security program. Therefore, the proposed exemptions are consistent with the common defense and security.

4.2 Special Circumstances

Pursuant to 10 CFR 50.12(a)(2), the NRC will not consider granting an exemption to its regulations unless special circumstances are present. NEDA has determined that special circumstances are present as discussed below.

A. Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule. (10 CFR 50.12(a)(2)(ii))

The underlying purpose of 10 CFR 50.82(a)(8)(i)(A) and 10 CFR 50.75(h)(1)(iv) is to provide reasonable assurance that adequate funds will be available for decommissioning of power reactors within 60 years of cessation of operations. Strict application of the rule would prohibit withdrawal of funds from the DTF for activities associated with spent fuel management and site restoration activities until final radiological decommissioning at DAEC has been completed. However, Table 1 (as discussed above) demonstrates that adequate funds are available in the DTF to complete radiological decommissioning, spent fuel management, and site restoration activities. The Table 1 cash flow analysis projects that the DTF will contain \$211.154 million, as shown in 2019 dollars, at the end of the decommissioning project in 2080 (using a 2.0% real rate of return).

The 30-day notification provision in 10 CFR 50.75(h)(1)(iv) was not intended to duplicate other reporting requirements that would exist after a plant commences decommissioning. The underlying purpose of notifying the NRC prior to withdrawal of funds from the DTF is to provide opportunity for NRC intervention, when deemed necessary, if the withdrawals are for expenses other than those authorized by 10 CFR 50.75(h)(1)(iv) and 10 CFR 50.82(a)(8) that could result in insufficient funds in the DTF to accomplish radiological decontamination of the site.

A comment, received during the rulemaking for the Decommissioning Trust Fund Provisions in 10 CFR 50.75(h)(1)(iv), noted that licensees that have complied with the requirements of 10 CFR 50.82(a)(4) regarding submittal of a Post-Shutdown Decommissioning Activities Report (PSDAR) and control disbursements in accordance with the provisions of 10 CFR 50.82(a)(6), (a)(7) and (a)(8) should be exempt from further restrictions on disbursements (Reference 2). The NRC agreed with the comment, because requiring notification in such circumstances would not provide any additional assurance that funding is available and would duplicate notification requirements in 10 CFR 50.82. If the NRC grants the requested exemption allowing NEDA to use funds in its DTF for spent fuel management and site restoration activities, the same consideration would justify dispensing with the 30-day notification requirement as well. The DCE identifies the estimated annual expenditures, and the annual reporting requirements in 10 CFR 50.82(a)(8)(v) and (vi) will allow continual NRC oversight of the status of the DTF. Applying the 30-day advance notification requirement in 10 CFR 50.75(h)(1)(iv) to disbursements for spent management and site restoration activities would duplicate these other reporting requirements and is not necessary to achieve the underlying purposes of the rule.

Therefore, since the underlying purposes of the rules would be achieved by allowing NEDA to use the DTF to fund the activities as discussed in the DAEC DCE and pending Spent Fuel Management Plan, the special circumstances of 10 CFR 50.12(a)(2)(ii) are present.

B. Compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted, or that are significantly in excess of those incurred by others similarly situated. (10 CFR 50.12(a)(2)(iii))

The NRC did not intend to prevent the use of these funds solely because they are commingled, and to do so would create an unnecessary financial burden without any corresponding safety benefit. The NRC does not preclude use of funds from the decommissioning trust in excess of those needed for radiological decommissioning for other purposes, such as spent fuel management and site restoration efforts. The NRC has stated that funding for spent fuel management and site restoration activities may be commingled in the decommissioning trust provided the licensee is able to identify and account for the radiological decommissioning funds separately from the funds set aside for spent fuel management and site restoration activities (see NRC Regulatory Issue Summary 2001-07, Revision 1, "10 CFR 50.75 Reporting and Recordkeeping for Decommissioning Planning" dated January 8, 2009 (Reference 3), and Regulatory Guide 1.184, Revision 1, "Decommissioning of Nuclear Power Reactors," (Reference 4)). The adequacy of the DTF to cover the cost of activities associated with decommissioning, the spent fuel management activities, and the site restoration activities is supported by the provided cash flow analysis. The amount of funds required for radiological decommissioning, spent fuel management, and site restoration activities will be identified and accounted for in the annual report required by 10 CFR 50.75(f) and 10 CFR 50.82(a)(8).

If NEDA cannot use its trust fund for spent fuel management and site restoration activities, it would be forced to provide additional funding that would not be recoverable from the DTF until the DAEC operating license is terminated. To prevent access to the excess funds in the trust would impose an unnecessary and undue burden in excess of that contemplated when the regulation was adopted without any corresponding safety benefit. Moreover, the precedents listed below in Section 5 show that not granting the exemption to NEDA would impose costs on NEDA in excess to those incurred by others similarly situated.

Therefore, compliance with the rule would result in an undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted, and that are significantly in excess of those incurred by others similarly situated and the special circumstances of 10 CFR 50.12(a)(2)(iii) are present.

5. PRECEDENT

This 10 CFR 50.82(a)(8)(i)(A) and 10 CFR 50.75(h)(1)(iv) request for exemptions is consistent with similar requests granted by the NRC to the following licensees:

- Dominion Energy Kewaunee, Inc. for Kewaunee Power Station (Reference 5)
- ZionSolutions LLC for Zion Power Station, Units 1 and 2 (Reference 6)
- Duke Energy Florida, Inc. for Crystal River Unit 3 (Reference 7)

- Entergy Nuclear Operations, Inc. for Vermont Yankee Nuclear Power Station (Reference 8)
- Exelon Generation Company, LLC for Oyster Creek Nuclear Generating Station (Reference 9)
- Entergy Nuclear Operations, Inc. for Pilgrim Nuclear Power Station (Reference 10)
- Pacific Gas and Electric Company for Diablo Canyon Nuclear Power Plant, Units 1 and 2 (Reference 11)
- Exelon Generation Company, LLC for Three Mile Island Nuclear Station, Unit 1 (Reference 12)

6. ENVIRONMENTAL ASSESSMENT

A. Environmental Considerations

Consistent with the Environmental Assessments prepared by NRC staff to document its environmental reviews (References 13 and 14) for the previous similar requests for exemption from 10 CFR 50.82(a)(8)(i)(A) and/or 10 CFR 50.75(h)(1)(iv), and pursuant to 10 CFR 51.21, the following environmental considerations are provided.

1. Description of Action

The proposed action would partially exempt NEDA from meeting the requirements set forth in 10 CFR 50.82(a)(8)(i)(A) and 10 CFR 50.75(h)(1)(iv). Specifically, the proposed action would allow NEDA to use funds from the DTF for spent fuel management and site restoration activities not associated with the radiological decontamination and would exempt NEDA from meeting the requirement for prior notification to the NRC for these activities.

2. Need for Action

As required by 10 CFR 50.82(a)(8)(i)(A), DTFs may be used by NEDA if the withdrawals are for legitimate decommissioning activity expenses, consistent with the definition of decommissioning in 10 CFR 50.2. This definition addresses radiological decontamination and does not include activities associated with the spent fuel management or site restoration. Similarly, the requirements of 10 CFR 50.75(h)(1)(iv) restrict the use of decommissioning trust fund disbursements (other than for ordinary and incidental expenses) to decommissioning expenses until final decommissioning has been completed. Therefore, partial exemptions from 10 CFR 50.82(a)(8)(i)(A) and 10 CFR 50.75(h)(1)(iv) are needed to allow NEDA to use funds from the DTF for spent fuel management and site restoration activities.

The adequacy of funds in the DTF to cover the costs of activities associated with irradiated fuel management, site restoration, and radiological decontamination through license termination is supported by the DCE and the tables included in the attachments to this request. NEDA needs access to the

funds in the DTF in excess of those needed for radiological decontamination to support spent fuel management and site restoration activities not associated with the radiological decontamination.

The requirements of 10 CFR 50.75(h)(1)(iv) further provide that, except for decommissioning withdrawals being made under 10 CFR 50.82(a)(8)(i)(A) or for payments of ordinary administrative costs and other incidental expenses of the trust, no disbursements may be made from the trust until written notice of the intention to make a disbursement has been given to the NRC at least 30 working days in advance of the intended disbursement. Therefore, an exemption from 10 CFR 50.75(h)(1)(iv) is needed to allow NEDA to use funds from the DTF for spent fuel management and site restoration activities without prior NRC notification.

3. Environmental Impacts of the Proposed Action

The proposed action involves exemptions from requirements that are of a financial or administrative nature and that do not have an impact on the environment. The exemptions do not authorize any additional regulatory or land-disturbing activities.

NEDA's exemption requests demonstrate that there is reasonable assurance that adequate funds are available in the DTF to complete all activities associated with decommissioning as well as spent fuel management and site restoration. There is no decrease in safety associated with the use of the DTF to fund activities associated with spent fuel management and site restoration. Paragraph 50.82(a)(8)(v) of 10 CFR requires a licensee to submit a financial assurance status report annually between the time of submitting its decommissioning cost estimate and submitting its final radiation survey and demonstrating that residual radioactivity has been reduced to a level that permits termination of its license. 10 CFR 50.82(a)(8)(iv) requires that if the remaining balance plus expected rate of return, plus any other financial surety mechanism does not cover the estimated costs to complete the decommissioning, additional financial assurance must be provided to cover the cost of completion. These annual reports provide a means for the NRC to monitor the adequacy of available funding. Since the exemptions would allow NEDA to use funds from the DTF that are in excess of those required for radiological decontamination of the site and the adequacy of funds dedicated for radiological decontamination are not affected by the proposed exemptions, there is reasonable assurance that there will be no environmental impact due to lack of adequate funding for decommissioning.

The environmental impacts of decommissioning have been generically evaluated by the NRC and documented in NUREG-0586, Supplement 1, "Generic Environmental Impact Statement (GEIS) on Decommissioning of Nuclear Facilities" (Decommissioning GEIS) (Reference 15). DAEC's PSDAR will discuss that the impacts from the planned decommissioning activities at

DAEC are less than and bounded by the impacts considered in the Decommissioning GEIS and NUREG-1496, "Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities" (Reference 16). NEDA believes that the PSDAR will contain the required information, including discussion that provides the reasons for concluding that the environmental impacts associated with the decommissioning activities at DAEC will be bounded by previous activities.

The proposed activity will not significantly increase the probability or consequences of radiological accidents. Additionally, the proposed changes have no direct radiological impacts. There will be no change to the types or amounts of radiological effluents that may be released, therefore, no change in occupational or public radiation exposure from the proposed changes. There are no materials or chemicals introduced into the plant that could affect the characteristics or types of effluents released offsite. In addition, the method of operation of waste processing systems will not be affected by the exemptions. The proposed exemptions will not result in changes to the design basis requirements of structures, systems, or components (SSCs) that function to limit or monitor the release of effluents. All the SSCs associated with limiting the release of effluents will continue to be able to perform their functions. Moreover, no changes would be made to plant buildings or the site property from the proposed changes. Therefore, there are no significant radiological environmental impacts associated with the proposed action.

With regard to potential non-radiological impacts, the proposed changes would have no direct impact on land use or water resources, including terrestrial and aquatic biota, as they involve no new construction or modification of plant operational systems. There would be no changes to the quality or quantity of non-radiological effluents and no changes to NEDA's National Pollutant Discharge Elimination System permit would be needed as a result of these exemptions. In addition, there would be no noticeable effect on socioeconomic conditions in the region, no environment justice impacts, no air quality impacts, and no impacts to historic and cultural resources from the proposed changes. Therefore, there are no significant non-radiological environment impacts associated with the proposed action.

Accordingly, it can be concluded that there are no significant environmental impacts associated with the proposed action.

4. Environmental Impacts of the Alternatives to the Proposed Action

As an alternative to the proposed action, NEDA considered the "no-action" alternative. This would result in no change in current environmental impacts. The environmental impacts of the proposed action and the alternative action are similar.

5. Alternative Use of Resources

There are no unresolved conflicts concerning alternative uses of available resources under the proposed action.

B. Conclusion as to Environmental Impacts

On the basis outlined above, the proposed exemptions will not have a significant effect on the quality of the human environment and will not involve potential incremental environmental impacts. The proposed exemptions do not require any additional Federal permits, licenses, or approvals.

7. CONCLUSION

The proposed exemptions would allow NEDA to use the DAEC DTF for the full scope of activities described in the decommissioning cost estimate, including the management of spent fuel and site restoration, and to make such disbursements in the same manner as withdrawals for radiological decommissioning.

Granting these exemptions will be consistent with the purposes underlying NRC decommissioning regulations as the exemptions: (1) would not foreclose release of the site for possible unrestricted use; (2) would not result in significant environmental impacts not previously reviewed by the NRC; and (3) would not undermine the existing and continuing reasonable assurance that adequate funds will be available for decommissioning.

Pursuant to the provisions of 10 CFR 50.12, NEDA is requesting permanent exemptions from 10 CFR 50.82(a)(8)(i)(A) and 10 CFR 50.75(h)(1)(iv) for DAEC. Based on the considerations discussed above, the requested exemptions are authorized by law, will not present an undue risk to the public health and safety, and are consistent with the common defense and security. In addition, special circumstances are present as set forth in 10 CFR 50.12(a)(2)(ii) and (iii).

8. REFERENCES

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2. Federal Register Notice (FRN) 67 FR 78332, Decommissioning Trust Provisions, December 24, 2002
3. NRC Regulatory Issue Summary 2001-07, Revision 1, 10 CFR 50.75 Reporting and Recordkeeping for Decommissioning Planning," January 8, 2009 (ADAMS Accession No. ML083440158)
4. Regulatory Guide 1.184, Revision 1, "Decommissioning of Nuclear Power Reactors," October 2013 (ADAMS Accession No. ML13144A840)

5. Letter from U.S. Nuclear Regulatory Commission to Dominion Entergy Kewaunee, Inc.; "Kewaunee Power Station – Exemptions from the Requirements of 10 CFR Part 50, Sections 50.82(a)(8)(i)(A) and 50.75(h)(1)(iv) (TAC NO. MF1438)," May 21, 2014 (ADAMS Accession No. ML13337A287)
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8. Letter from U.S. Nuclear Regulatory Commission to Entergy Nuclear Operations, Inc.; "Vermont Yankee Nuclear Power Station – Exemptions from the Requirements of 10 CFR Part 50, Sections 50.82(a)(8)(i)(A) and 10 CFR 50.75(h)(1)(iv) (TAC NO. MF5575)," June 17, 2015 (ADAMS Accession No. ML15128A219)
9. Letter from U.S. Nuclear Regulatory Commission to Exelon Generation Company, LLC; "Oyster Creek Nuclear Generating Station – Exemptions from the Requirements of 10 CFR 50.82(a)(8)(i)(A) and 50.75(h)(1)(iv) (EPID L-2018-LLE-0002)," October 19, 2018 (ADAMS Accession No. ML18227A025)
10. Letter from U.S. Nuclear Regulatory Commission to Entergy Nuclear Operations, Inc.; Pilgrim Nuclear Power Station – Request for Exemption from 10 CFR 50.82(a)(8)(i)(A) (EPID L-2018-LLE-0019), July 22, 2019 (ADAMS Accession No. ML19162A334)
11. Letter from U.S. Nuclear Regulatory Commission to Pacific Gas and Electric Company; "Diablo Canyon Nuclear Power Plant, Units 1 and 2 – Exemptions from the Requirements of 10 CFR Part 50, Sections 50.82(a)(8)(i)(A) and 50.82(a)(8)(ii) (EPID L-2018-LLE-0023)," September 10, 2019 (ADAMS Accession No. ML19163A104)
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14. Federal Register Notice 84FR42025, Environmental Assessment and Finding of No Significant Impact, Diablo Canyon Nuclear Power Plant, dated August 16, 2019 (ML19136A102)
15. NUREG 0586, "Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities," dated November, 2002

16. NUREG 1496, "Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities," dated July, 1997

Table 1
Annual SAFSTOR Decommissioning Cost Cash Flow for Duane Arnold Energy Center

Year	Site Radiological Decommissioning Cost 2018 Dollars from DCE	Spent Fuel Management Cost 2018 Dollars from DCE	ISFSI Radiological Decommissioning Cost 2018 Dollars from DCE	Site Restoration Cost 2018 Dollars from DCE	Total Cost in 2018 Dollars from DCE ⁱ	Total Cost Escalated at 1.8% to 2019 Dollars ⁱ	NEDA's 70% of Total Cost 2019 Dollars	NEDA Decommissioning DTF Balance Escalated at 2% minus 70% of Expenses ⁱ
2019								454,454 ⁱⁱ
2020	38,864 ⁱⁱⁱ	3,557 ^{iv}	0	0	42,421	43,184	30,229	433,314
2021	43,735	19,105	0	0	62,840	63,971	44,780	397,200
2022	15,949	57,546	0	0	73,495	74,818	52,373	352,772
2023	5,110	50,910	0	0	56,020	57,028	39,920	319,907
2024	14,895	3,222	0	0	18,117	18,443	12,910	313,395
2025	5,604	3,233	0	0	8,837	8,996	6,297	313,366
2026	2,201	3,233	0	0	5,434	5,532	3,872	315,761
2027	1,827	3,233	0	0	5,060	5,151	3,606	318,470
2028	1,827	3,233	0	0	5,060	5,151	3,606	321,234
2029	1,827	3,233	0	0	5,060	5,151	3,606	324,052
2030	1,884	3,233	0	0	5,117	5,209	3,646	326,887
2031	1,770	3,233	0	0	5,003	5,093	3,565	329,860
2032	1,770	3,504	0	0	5,274	5,369	3,758	332,699
2033	1,770	3,507	0	0	5,277	5,372	3,760	335,592
2034	1,770	3,507	0	0	5,277	5,372	3,760	338,544
2035	1,770	3,507	0	0	5,277	5,372	3,760	341,555
2036	1,770	3,507	0	0	5,277	5,372	3,760	344,625
2037	1,770	3,507	0	0	5,277	5,372	3,760	347,758
2038	1,770	3,507	0	0	5,277	5,372	3,760	350,953
2039	1,770	3,507	0	0	5,277	5,372	3,760	354,211
2040	2,411	3,507	0	0	5,918	6,025	4,218	357,078
2041	1,770	3,507	0	0	5,277	5,372	3,760	360,459
2042	1,770	3,507	0	0	5,277	5,372	3,760	363,908

Table 1
Annual SAFSTOR Decommissioning Cost Cash Flow for Duane Arnold Energy Center

Year	Site Radiological Decommissioning Cost 2018 Dollars from DCE	Spent Fuel Management Cost 2018 Dollars from DCE	ISFSI Radiological Decommissioning Cost 2018 Dollars from DCE	Site Restoration Cost 2018 Dollars from DCE	Total Cost in 2018 Dollars from DCE ¹	Total Cost Escalated at 1.8% to 2019 Dollars ¹	NEDA's 70% of Total Cost 2019 Dollars	NEDA Decommissioning DTF Balance Escalated at 2% minus 70% of Expenses ¹
2043	1,770	3,507	0	0	5,277	5,372	3,760	367,426
2044	1,770	3,507	0	0	5,277	5,372	3,760	371,014
2045	1,770	3,507	0	0	5,277	5,372	3,760	374,674
2046	1,770	3,507	0	0	5,277	5,372	3,760	378,408
2047	1,770	3,507	0	0	5,277	5,372	3,760	382,215
2048	1,770	3,507	0	0	5,277	5,372	3,760	386,099
2049	1,770	3,507	0	0	5,277	5,372	3,760	390,061
2050	1,770	3,507	0	0	5,277	5,372	3,760	394,102
2051	1,770	3,507	0	0	5,277	5,372	3,760	398,224
2052	1,770	3,507	0	0	5,277	5,372	3,760	402,428
2053	1,770	3,507	0	0	5,277	5,372	3,760	406,716
2054	2,055	3,507	0	0	5,562	5,662	3,963	410,887
2055	2,126	3,507	0	0	5,633	5,735	4,015	415,091
2056	1,770	3,507	0	0	5,277	5,372	3,760	419,632
2057	1,770	3,507	0	0	5,277	5,372	3,760	424,265
2058	1,770	3,507	0	0	5,277	5,372	3,760	428,990
2059	2,159	2,909	0	0	5,069	5,160	3,612	433,957
2060	3,077	0	0	0	3,077	3,133	2,193	440,443
2061	2,634	0	0	0	2,634	2,681	1,877	447,376
2062	2,634	0	0	0	2,634	82,61	1,877	454,446
2063	2,634	0	0	0	2,634	2,681	1,877	461,659
2064	2,634	0	0	0	2,634	2,681	1,877	469,015
2065	2,634	0	0	0	2,634	2,681	1,877	476,519
2066	2,634	0	0	0	2,634	2,681	1,877	484,172

Table 1
Annual SAFSTOR Decommissioning Cost Cash Flow for Duane Arnold Energy Center

Year	Site Radiological Decommissioning Cost 2018 Dollars from DCE	Spent Fuel Management Cost 2018 Dollars from DCE	ISFSI Radiological Decommissioning Cost 2018 Dollars from DCE	Site Restoration Cost 2018 Dollars from DCE	Total Cost in 2018 Dollars from DCE ⁱ	Total Cost Escalated at 1.8% to 2019 Dollars ⁱ	NEDA's 70% of Total Cost 2019 Dollars	NEDA Decommissioning DTF Balance Escalated at 2% minus 70% of Expenses ⁱ
2067	2,634	0	0	0	2,634	2,681	1,877	491,979
2068	2,634	0	0	0	2,634	2,681	1,877	499,942
2069	2,634	0	0	0	2,634	2,681	1,877	508,064
2070	2,634	0	0	0	2,634	2,681	1,877	516,349
2071	2,634	0	0	0	2,634	2,681	1,877	524,799
2072	2,634	0	0	0	2,634	2,681	1,877	533,418
2073	15,440	0	0	0	15,440	15,718	11,003	533,084
2074	32,608	0	0	0	32,608	33,195	23,237	520,509
2075	78,197	0	184	0	78,381	79,792	55,854	475,065
2076	94,001	0	403	0	94,404	96,103	67,272	417,295
2077	118,359	25	303	0	118,688	120,824	84,577	341,064
2078	101,052	4,873	731	6,212	112,868	114,899	80,429	267,456
2079	57,385	0	19	27,813	85,217	86,751	60,726	212,079
2080	4,828	0	0	2,422	7,250	7,381	5,167	211,154
Totalⁱ	723,271	259,466	1,640	36,447	1,020,824	1,039,199	727,439	

ⁱ Value may sum incorrectly due to numerical rounding.

ⁱⁱ Actual DTF balance as of 12/31/2019

ⁱⁱⁱ Of the \$4,099,000 Site Radiological Decommissioning costs estimated for 2019, as shown in the DCE, only \$1,416,659 was incurred during 2019, of which 70% (\$991,961) were reimbursed by NEDA from its DTF. The remaining expected 2019 costs of \$2,682,341 have been added to the 2020 costs. This is done to ensure that the cash flow reflects the total estimated cost even if certain costs were not withdrawn from the DTF in 2019.

^{iv} No Spent Fuel Management costs were withdrawn in 2019, therefore, the expected 2019 costs of \$233,000 have been added to the 2020 costs. This is done to ensure that the cash flow reflects the total estimated cost even if certain costs were not withdrawn from the DTF in 2019.

Attachment 2 to NG-20-0007
Site Specific Decommissioning Cost Estimate

72 pages follow

Attachment 2 to NG-20-0007
Site Specific Decommissioning Cost Estimate

72 pages follow



2018 Decommissioning Cost Estimate for the Duane Arnold Energy Center

Project No. 164053

Revision 2

Prepared for:
NextEra Energy Duane Arnold, LLC
Central Iowa Power Cooperative
Corn Belt Power Cooperative

Prepared by:
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121 W. Trade Street, Suite 2700
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Approved By: Michael S. Williams January 27, 2020
Mike Williams, Project Manager Date

Prepared By: Barry Sims January 27, 2020
Barry Sims, Senior Technical Advisor Date

- New Report
- Title Change
- Report Revision
- Report Rewrite

Effective
Date January 27, 2020

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1.0 EXECUTIVE SUMMARY	1
2.0 INTRODUCTION	4
2.1 Study Objective.....	4
2.2 Regulatory Framework	4
3.0 STUDY METHODOLOGY	7
3.1 General Description	7
3.2 Schedule Analysis.....	7
3.3 Decommissioning Staff.....	8
3.4 Waste Disposal.....	8
3.5 Final Status Survey	10
3.6 Contingency	11
3.7 Cost Reporting	12
4.0 SITE SPECIFIC TECHNICAL APPROACH.....	13
4.1 Facility Description.....	13
4.2 Decommissioning Periods for SAFSTOR	13
4.3 Decommissioning Staff.....	16
4.4 Spent Fuel Management Staff.....	16
4.5 Spent Fuel Shipments	16
5.0 BASES OF ESTIMATE AND KEY ASSUMPTIONS	17
6.0 STUDY RESULTS	22
6.1 SAFSTOR, 2030 DOE Acceptance, Dry Fuel Storage.....	22
7.0 REFERENCES	30

FIGURES

Figure 1-1	Summary SAFSTOR Schedule.....	3
Figure 6-1	Summary SAFSTOR Schedule.....	23

TABLES

Table 1-1	Decommissioning Cost Summary.....	2
Table 6-1	Cost and Schedule Summary	24
Table 6-2	Utility Staff Levels	25
Table 6-3	Decommissioning General Contractor Staff Levels	27
Table 6-4	Waste Disposal Volumes	29

APPENDICES

Appendix A	List of Systems and Structures
Appendix B	Spent Fuel Shipping Schedule
Appendix C	Detailed Project Schedule
Appendix D	Detailed Cost Table
Appendix E	Annual Cost By Account Table

ACRONYMS AND ABBREVIATIONS

AIF	Atomic Industrial Forum
ALARA	As Low As Reasonably Achievable
BWR	Boiling Water Reactor
CFR	Code of Federal Regulations
CPM	Critical Path Method
DAEC	Duane Arnold Energy Center
D&D	Decontamination and Demolition
DGC	Decommissioning General Contractor
DOE	U.S. Department of Energy
DSC	Dry Shielded Canister
FEMA	Federal Emergency Management Agency
FSS	Final Status Survey
GSA	U.S. General Services Administration
GTCC	Greater Than Class C
HP	Health Physics
HSM	Horizontal Storage Modules
ISFSI	Independent Spent Fuel Storage Installation
LLRW	Low-Level Radioactive Waste
LLW	Low Level Waste
LLWPA	Low-Level Waste Policy Act
LOP	Life-of-Plant
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MPC	Multi-Purpose Canister
MWt	Megawatt thermal
NRC	Nuclear Regulatory Commission
NSSS	Nuclear Steam Supply System
ORISE	Oak Ridge Institute for Science and Education
PCB	Polychlorinated Biphenyl
PSDAR	Post-Shutdown Decommissioning Activities Report
PWR	Pressurized Water Reactor
RCRA	Resource Conservation and Recovery Act
TCEQ	Texas Commission on Environmental Quality
WBS	Work Breakdown Structure
UCF	Unit Cost Factor

1.0 EXECUTIVE SUMMARY

This report presents an update to “Decommissioning Cost Estimate Study for the Duane Arnold Energy Center”, Revision 1 (Ref. No. 1). The Duane Arnold Energy Center (DAEC) is 70% owned by NextEra Energy Duane Arnold, LLC. The other owners of DAEC are Central Iowa Power Cooperative (20%) and Corn Belt Power Cooperative (10%). All numbers presented in this report are on a 100% basis.

This Decommissioning Cost Estimate (DCE) has been performed for financial planning purposes to determine costs for (1) decommissioning DAEC to the extent required to terminate the plant’s operating license pursuant to 10 Code of Federal Regulations (CFR) 50.75(c), (2) post-shutdown management of spent fuel until acceptance by the U.S. Department of Energy (DOE) pursuant to 10 CFR 50.54(bb), (3) clean demolition of structures or Greenfield, and (4) Independent Spent Fuel Storage Installation (ISFSI) decommissioning pursuant to 10 CFR 72.30.

The DCE methodology follows the basic approach originally presented in the Atomic Industrial Forum/National Environmental Studies Project Report AIF/NESP-036, “Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates,” (Ref. No. 2). The report was prepared in accordance with Nuclear Regulatory Commission (NRC) Regulatory Guide 1.202, “Standard Format and Content of Decommissioning Cost Estimates for Nuclear Power Reactors,” (Ref. No. 3). The estimate is based on compliance with current regulatory requirements and proven decommissioning technologies.

NRC requirements, set forth in Title 10 of the CFR, differentiate between the post-shutdown costs associated with storage of spent fuel on site and those associated with the decommissioning of the facility. 10 CFR 50.75(c) requires funding by the licensee of the facility for the decommissioning program, but specifically excludes the cost of removal and disposal of spent fuel and the removal of clean structures. 10 CFR 50.75(c) also excludes the cost of site restoration activities that do not involve the removal of residual radioactivity necessary to terminate the NRC license, which restores the site to either “Brownfield” or “Greenfield” conditions depending on the desired end-state. 10 CFR 50.54 (bb) requires funding by the licensee “for the management of all irradiated fuel at the reactor upon expiration of the reactor operating license until title to the irradiated fuel and possession of the fuel is transferred to the Secretary of Energy for its ultimate disposal in a repository.”

Accordingly, the costs and schedules for all activities are segregated for regulatory purposes as follows: costs for “License Termination” (10 CFR 50.75(c)), costs for “Spent Fuel Management,” (10 CFR 50.54(bb)), costs for “Greenfield” (clean removal and site restoration) final site conditions, and Independent Spent Fuel Storage (ISFSI) Decontamination and Demolition (D&D) (10 CFR 72.30). EnergySolutions has established a Work Breakdown Structure (WBS) and cost accounting system to differentiate between these four project accounts.

This DCE analyzes the following scenario, as defined by DAEC:

60 Year SAFSTOR, 2030 DOE Acceptance, Dry Fuel Storage

- Shutdown on October 30, 2020.
- DAEC’s spent fuel shipping schedules based on a 2030 start date for DOE’s acceptance of spent fuel.
- Termination of spent fuel pool operation approximately three years after permanent shutdown.
- Following shutdown Phase II and III of the ISFSI will be constructed and all spent fuel will be transferred to Multi-Purpose Canisters (MPCs) for interim storage.
- SAFSTOR methodology, with decommissioning completed within 60 years of shutdown.
- Decommissioning will be performed by the utility staff and a Decommissioning General Contractor (DGC).

The cost estimate results are provided in 2018 dollars in Table 1-1. Table 1-1 gives License Termination costs (which correspond to 10 CFR 50.75 (c) requirements), Spent Fuel Management costs (which correspond to 10 CFR 50.54 (bb) requirements), Greenfield costs (which correspond to activities such as clean building demolition and site grading and re-seeding), and ISFSI D&D (which correspond to 10 CFR 72.30).

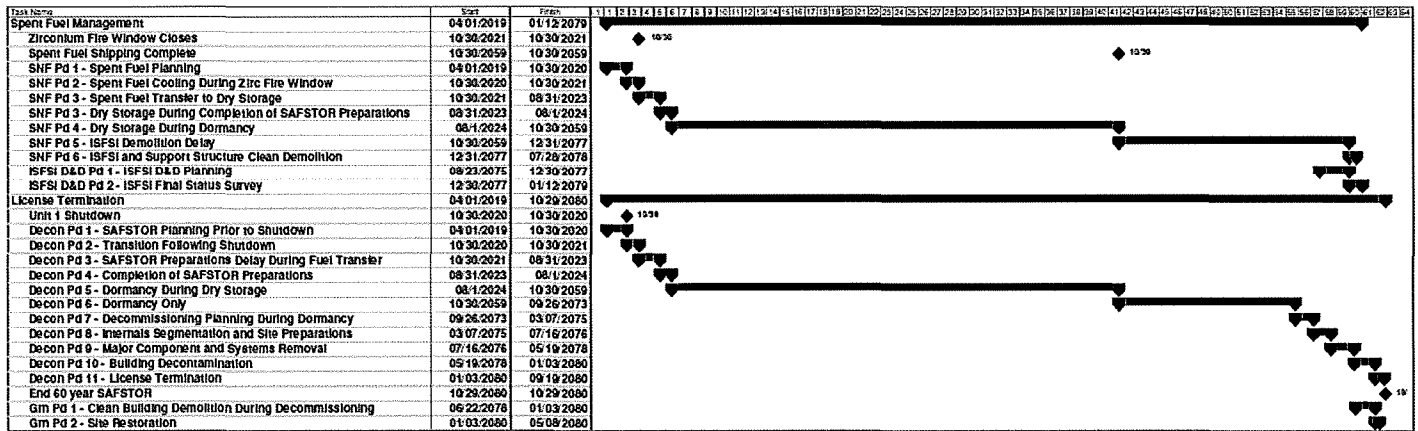
**Table 1-1
Decommissioning Cost Summary
(2018 Dollars in Thousands)**

Account	Total
License Termination – 50.75 (c)	\$724,688
Spent Fuel – 50.54 (bb)	\$259,466
Greenfield	\$36,447
ISFSI D&D 72.30	\$1,640
Total	\$1,022,240

Note: Numbers may not add due to rounding.

The estimate is based on site-specific plant systems and buildings inventories. These inventories, and EnergySolutions’ proprietary Unit Cost Factors (UCFs), were used to generate required manhours, activity schedule hours and costs, and waste volume, weight, and classification. Based on the activity schedule hours and a decommissioning activities analysis, a Critical Path Method (CPM) analysis was performed to determine the decommissioning schedules. These schedules reflect the effects of sequenced activity-dependent or distributed decommissioning elements such as planning and preparations, major component removal, building decontamination, and spent fuel shipping. The schedules are divided into project phases (periods) and presented, as noted previously, by cost account “License Termination,” “Spent Fuel Management,” “ISFSI D&D,” or “Greenfield.” The summary schedule is shown in Figure 1-1 and may also be found in Section 6.0 of this report.

Figure I-1
Summary SAFSTOR Schedule



2.0 INTRODUCTION

2.1 Study Objective

This report presents an update to “Decommissioning Cost Estimate Study for the Duane Arnold Energy Center”, Revision 1 (Ref. No. 1). The Duane Arnold Energy Center (DAEC) is 70% owned by NextEra Energy Duane Arnold, LLC. The other owners of DAEC are Central Iowa Power Cooperative (20%) and Corn Belt Power Cooperative (10%). All numbers presented in this report are on a 100% basis.

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The DCE methodology follows the basic approach originally presented in the Atomic Industrial Forum/National Environmental Studies Project Report AIF/NESP-036, “Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates,” (Ref. No. 2). The report was prepared in accordance with Nuclear Regulatory Commission (NRC) Regulatory Guide 1.202, “Standard Format and Content of Decommissioning Cost Estimates for Nuclear Power Reactors,” (Ref. No. 3). The estimate is based on compliance with current regulatory requirements and proven decommissioning technologies.

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- Termination of spent fuel pool operation approximately three years after permanent shutdown.
- Following shutdown Phase II and III of the ISFSI will be constructed and all spent fuel will be transferred to Multi-Purpose Canisters (MPCs) for interim.
- SAFSTOR methodology, with decommissioning completed within 60 years of shutdown.
- Decommissioning will be performed by the utility staff and a Decommissioning General Contractor (DGC).

2.2 Regulatory Framework

Provisions of current laws and regulations affecting decommissioning, waste management, and spent fuel management are as follows:

1. NRC regulations require a license for on-site storage of spent fuel. Wet storage in a spent fuel pool is authorized by a facility’s 10 CFR Part 50 license. On-site dry

storage of spent fuel at an Independent Spent Fuel Storage Installation (ISFSI) is licensed by either: (a) the general license set forth in 10 CFR 72.210, which requires that a Part 50 license be in place; or (b) a site-specific ISFSI license issued pursuant to 10 CFR Part 72.

2. 10 CFR 50.75 (c) requires funding by the licensee of the facility for the decommissioning program, but specifically excludes the cost of removal and disposal of spent fuel and the removal of clean structures.
3. 10 CFR 50.54 (bb) requires the licensee, within two years following permanent cessation of operation of the reactor or five years before expiration of the operating license, whichever occurs first, to submit written notification to the NRC for its review and preliminary approval of the program by which the licensee intends to manage and provide funding “for the management of all irradiated fuel at the reactor upon expiration of the reactor operating license until title to the irradiated fuel and possession of the fuel is transferred to the Secretary of Energy for its ultimate disposal in a repository.” However, the NRC does not currently consider post-shutdown spent fuel management costs to be decommissioning costs.
4. 10 CFR 72.30 (b) requires that a licensee under Part 72 must submit a decommissioning funding plan that contains information that provides assurance that funds will be available to decommission the ISFSI.

Decommissioning Alternatives

The three methods for decommissioning are DECON, SAFSTOR, and ENTOMB, which are summarized as follows:

1. DECON: The equipment, structures, and portions of the facility and site that contain radioactive contaminants are promptly removed or decontaminated to a level that permits termination of the license after cessation of operations.
2. SAFSTOR: The facility is placed in a safe, stable condition and maintained in that state (safe storage). The facility is decontaminated and dismantled at the end of the storage period to levels that permit license termination. NRC regulations require decommissioning to be completed within 60 years of cessation of operation.
3. ENTOMB: Radioactive structures, systems, and components are encased in a structurally long-lived substance, such as concrete. The entombed structure is appropriately maintained and monitored until radioactivity decays to a level that permits termination of the license. Since entombment will exceed the requirement for decommissioning to be completed within 60 years of cessation of operation, NRC handles entombment requests on a case-by-case basis.

The selection of a preferred decommissioning alternative is influenced by a number of factors pertinent at the time of final plant shutdown. These factors include the cost of each decommissioning alternative, minimization of occupational radiation exposure, availability of a

low-level waste disposal facility, availability of a high-level waste (spent fuel) repository, regulatory requirements, and public comments.

Post-Shutdown Spent Fuel Management Alternatives

Selection of a decommissioning strategy and the associated schedule for completion is in part contingent upon an assumed start date for DOE acceptance of spent fuel and an assumed end date for completion of the transfer of all spent fuel assemblies projected to be generated during a power reactor's operating life. The basic options for long-term post-shutdown spent fuel management currently available to power plant operators are (1) wet storage consisting of continued maintenance and operation of the spent fuel pool, and (2) dry storage consisting of transfer of spent fuel from the fuel pool to on-site dry storage modules after a cooling period. Maintaining the spent fuel pool for an extended duration following cessation of operations prevents termination of the Part 50 license and typically has a higher annual maintenance and operating cost than the dry storage alternative. Transfer of spent fuel to an ISFSI requires additional capital expenditures for purchase and construction of the ISFSI and dismantlement and disposal of the ISFSI following completion of spent fuel transfer to DOE. In both cases the decommissioning and spent fuel management costs are significantly affected by the assumed start and end dates for DOE acceptance of spent fuel.

In January 2013, DOE released its "Strategy for Management and Disposal of Used Nuclear Fuel and High Level Radioactive Waste" (Ref. No. 5). The DOE Strategy contemplates building the capability to begin executing DOE's commitment to address waste disposal within the next ten years. Under this Strategy, by 2021, operation would begin of a "pilot storage facility" with an "initial focus on accepting spent fuel from shutdown reactor sites." By 2025, a "larger interim storage facility" would be available, and by 2048, a geologic repository would commence operations.

For purposes of this DCE, DAEC has conservatively assumed that the larger interim storage facility is delayed five years and commences operations in 2030. DAEC has further assumed that the DOE acceptance rate is consistent with the 2004 "Acceptance Priority Ranking & Annual Capacity Report" (Ref. No. 6), which is the most current information regarding acceptance of fuel.

3.0 STUDY METHODOLOGY

3.1 General Description

EnergySolutions maintains a proprietary decommissioning cost model based upon the fundamental technical approach established in AIF/NESP-036, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," dated May 1986 (Ref. No. 2). The cost model has been updated in accordance with regulatory requirements and industry experience. The cost model includes elements for estimating distributed and undistributed costs. Distributed costs are activity specific and include planning and preparation costs as well as the decontamination, packaging, disposal, and removal of major components and systems. For example, the segmentation, packaging, and disposal of the reactor internals is a distributed cost. Undistributed costs, sometimes referred to as collateral costs, are typically time dependent costs such as utility and DGC staff, property taxes, insurance, regulatory fees and permits, energy costs, and security staff.

The methodology for preparing cost estimates for a selected decommissioning alternative requires development of a site-specific detailed work activity sequence based upon the plant inventory. The activity sequence is used to define the labor, material, equipment, energy resources, and duration required for each activity. In the case of major components, individual work sequence activity analyses are performed based on the physical and radiological characteristics of the component and the packaging, transportation, and disposal options available.

In the case of structures and small components and equipment such as piping, pumps, and tanks, the work durations and costs are calculated based on Unit Cost Factors (UCFs). UCFs are economic parameters developed to express costs per unit of work output, piece of equipment, or time. They are developed using decommissioning experience, information on the latest technology applicable to decommissioning, and engineering judgment. The total cost of a specific decommissioning activity can be determined by multiplying the total number of units associated with that activity by the UCF, expressed as \$/unit, for that activity. For example, the estimated demolition cost of a non-contaminated concrete structure can be obtained by multiplying the volume of concrete in the structure by the UCF for non-contaminated reinforced concrete demolition, expressed in \$/unit volume. Each UCF has associated with it a man-hours/unit and schedule-hours/unit. From these values, total man-hours and total schedule-hours can be determined for a particular activity.

3.2 Schedule Analysis

Once the work activity durations are calculated for all distributed activities, a critical path schedule analysis is performed using Microsoft Project. The schedule accounts for constraints such as spent fuel cooling periods and regulatory reviews. The schedule is typically delineated into phases or time periods (hereinafter referred to as period or periods) that differentiate manpower requirements and undistributed costs.

In order to differentiate between License Termination, Spent Fuel, Greenfield, and ISFSI D&D elements of the entire decommissioning scope of work, EnergySolutions has established a Work Breakdown Schedule (WBS) and cost accounting system to treat each element as a subproject.

Accordingly, the overall project schedule is divided into interrelated periods with major milestones defining the beginning and ending of each period. The major milestones also serve as the basis for integrating the periods of the four subprojects.

3.3 Decommissioning Staff

A site-specific staffing plan was developed by DAEC and EnergySolutions based on the existing DAEC operational staff and the assumption that the decommissioning will be performed by a DGC, with oversight and management of the DGC performed by DAEC staff. It was also assumed that DAEC staff would be supplemented by professional consulting engineering, particularly in the planning and preparation phase. The DAEC existing salary structure serves as the basis for calculating DAEC staff labor costs. The DGC salary costs are based on industry data.

Staffing levels for each project period are based on the AIF guidelines and industry experience. The sizes of the DAEC and DGC staffs are varied in each period in accordance with regulatory requirements and work activities.

3.4 Waste Disposal

Waste management costs comprise a significant portion of the decommissioning cost estimate. Additionally, limited future access to disposal sites licensed for receipt of Class B and C wastes introduces a significant level of uncertainty with respect to the appropriateness of using existing rate structures to estimate disposal costs of these wastes. The approach used in this DCE to estimate waste disposal costs is discussed in the following paragraphs.

Waste Classification

Regulations governing disposal of radioactive waste are stringent in order to ensure control of the waste and preclude adverse impact on public health and safety. At present, LLRW disposal is controlled by NRC regulation 10 CFR 61, which went into effect December, 1983. This regulation stipulates the criteria for the establishment and operation of shallow-land LLRW burial facilities. Embodied within this regulation are criteria and classifications for packaging LLRW such that it is acceptable for burial at licensed LLRW disposal sites.

For each waste classification, 10 CFR 61 stipulates specific criteria for physical and chemical properties that the LLRW must meet in order to be accepted at a licensed disposal site. The LLRW disposal criteria of 10 CFR 61 require that LLRW generators determine the proportional amount of a number of specific radioactive isotopes present in each container of disposable LLRW. This requirement for isotopic analysis of each container of disposable LLRW is met by employing a combination of analytical techniques such as computerized analyses based upon scaling factors, sample laboratory analyses, and direct assay methods. After performing an isotopic analysis of each container of disposable LLRW, the waste must then be classified according to one of the classifications (Class A, B, C, or Greater Than Class C (GTCC) as defined in 10 CFR 61.

The classification of LLRW resulting from decommissioning activities is based on AIF/NESP-036 (Ref. No. 2) and NUREG/CR-0672 for Boiling Water Reactors (BWRs) (Ref. No. 8), and

recent industry experience. The estimated curie content of the reactor vessel and internals at shutdown is derived from NUREG/CR-0672 and adjusted for the different mass of components as well as the period of decay.

Packaging

Selection of the type and quantity of containers required for Class B and C wastes is based on the most restrictive of the following constraints: curie content, dose-rate, container weight limit, or container volume limit. GTCC waste from segmentation of the reactor vessel internals is packaged in MPCs. The selection of container type for Class A waste is based on the transportation mode (rail, truck, barge, etc.) and waste form. The quantity of Class A waste containers is determined by the most restrictive of either container weight limit or container volume limit. Large components, such as steam generators, pressurizers, and reactor recirculation pumps, are shipped as their own container with shielding as required.

Container costs are obtained from manufacturers. Shielded transport cask and liner costs are obtained from the cask owners and operators.

Transportation

Transportation routes to processing and disposal facilities are determined based on available transportation modes (truck, rail, barge, or combinations). Transportation costs for the selected routes and modes are obtained from vendor quotes or published tariffs whenever possible.

Class A Disposal Options and Rates

In accordance with the existing LOP Disposal Agreement (Ref. No. 9), all Class A waste that meets the Clive facility waste acceptance criteria is to be disposed of at Clive. All reported waste disposal costs include packaging, transportation, and any applicable surcharges.

Class B and C Disposal Options and Rates

Currently, within the United States, there are only three operational commercial disposal facilities licensed to accept Class B and C LLRW: the Barnwell facility, operated by EnergySolutions in Barnwell, South Carolina; the U.S. Ecology facility in Richland, Washington; and the facility in Andrews County, Texas operated by Waste Control Specialists. Barnwell only accepts waste from states within the Atlantic Compact, and U.S. Ecology only accepts waste from states within the Northwest and Rocky Mountain Compacts. However, the WCS facility will accept waste from the Texas Compact (comprised of Texas and Vermont) and non-Compact generators. The Texas Compact Commission on March 23, 2012 approved amendments to rules allowing the import of non-compact generator LLRW for disposal at the Andrews County facility.

Greater Than Class C (GTCC)

Wastes identified as 10 CFR 61 Class A, B, and C may be disposed of at a near-surface disposal facility. Certain components are highly activated and may exceed the radionuclide concentration limitations for 10 CFR 61 Class C waste. In accordance with 10 CFR 61, these components

cannot be disposed of in a near-surface LLRW disposal facility and must be transferred to a geologic repository or a similar site approved by the NRC.

Highly activated sections of the reactor vessel internals will result in GTCC waste. Presently, a facility does not exist for the disposal of wastes exceeding 10 CFR 61 Class C limitations. The courts have held that DOE is obligated to accept and dispose of GTCC and, therefore, this estimate assumes that the DOE will accept this waste along with spent fuel. Although there may be no additional costs for DOE disposal of GTCC, this estimate conservatively assumes a GTCC waste disposal cost. This estimate further assumes that the GTCC waste will be packaged in DSCs and will be shipped to a storage or disposal facility by DOE along with the spent fuel at a shipping costs equivalent to the commercial cost of shipping a Type B licensed, shielded cask such as the CNS 8-120B cask.

LLRW Volume Reduction

Based on current Class A LLRW disposal rates on-site volume reduction techniques such as waste compaction or an aggressive decontamination, survey and release effort are not currently considered to be cost effective over disposal.

Non-Radioactive Non-Hazardous Waste Disposal

EnergySolutions assumes that recyclable, non-radioactive scrap metal resulting from the decommissioning program will be transported to a scrap metal dealer. However, no credit is assumed in the estimate for the value of the scrap metal. Concrete debris is assumed to be processed by size reduction, with removal of structural reinforcing steel, and used on site as engineered fill for voids. Asphalt from parking lots and roadways is assumed to be stockpiled on site and removed, at no cost to the project, by a recycler. All other demolition debris is removed from the site and disposed of at a local construction debris landfill.

Hazardous and Industrial Waste Disposal

Lead shielding remaining after shutdown is assumed to be removed from its installed locations and disposed of as a mixed waste. In accordance with information furnished by DAEC thirty percent of insulated systems in radiologically controlled areas are assumed to contain asbestos, therefore; this DCE includes a line item for asbestos abatement. The decommissioning estimate also includes an estimate for hazardous and industrial waste disposal based on information provided by DAEC. The cost of hazardous and industrial waste disposal includes DAEC's estimated cost for closure of Resource Conservation and Recovery Act (RCRA) storage areas. Additionally, surfaces coated with lead based paint will be remediated as required for demolition.

3.5 Final Status Survey

The cost of performing a final status survey (FSS) is based on NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)" (Ref. No. 10). Estimates of MARSSIM Class I, II, and III survey designations are based on radiological characterization data furnished by DAEC and assumptions regarding contamination resulting from small and large component removal activities. The FSS activity cost calculation includes the in-place remote

survey of underground metal and concrete pipe, soil, and groundwater sampling and analysis. Estimated costs for NRC and Oak Ridge Institute for Science and Education (ORISE) verification are also included, and the NRC review period is incorporated into the project schedule.

3.6 Contingency

Contingencies are applied to cost estimates primarily to allow for unknown or unplanned occurrences during the actual program, e.g. increased radioactive waste materials volumes over that expected, equipment breakdowns, weather delays, labor strikes, etc. This is consistent with the definition provided in the DOE Cost Estimating Guide, DOE G 430.1-1, 3-28-97 (DOE G) (Ref. No. 11): Contingency “Covers costs that may result from incomplete design, unforeseen and unpredictable conditions, or uncertainties within the defined project scope. The amount of contingency will depend on the status of design, procurement, and construction; and the complexity and uncertainties of the component parts of the project. Contingency is not to be used to avoid making an accurate assessment of expected costs.” *EnergySolutions* determines site-specific contingency factors to be applied to each estimate based on industry practices.

The DOE has established a recommended range of contingencies as a function of completeness of program design, DOE G. The ranges are:

<u>Type of Estimate</u>	<u>Contingency Range as a % of Total Estimate</u>
Planning Phase Estimate	20-30
Budget Estimate	15-25
Title I (Preliminary Design Estimate)	10-20
Title II (Definitive Design Estimate)	5-15

EnergySolutions' approach to assigning appropriate contingency rates is based on adaptations of published values for the specific decommissioning activities. One source for such published information is AIF/NESP-036 “Guidelines for Producing Nuclear Plant Decommissioning Cost Estimates” (Ref. No. 2). The AIF guideline identifies contingencies for activities specific to a nuclear power plant decommissioning, such as reactor internals removal. The contingencies presented in the AIF guideline are based on the assumption that the estimated costs are not well known; therefore, the recommended contingencies are greater than they would be if the estimated costs were well known. With the exception of the system decontamination, reactor vessel and reactor internals removal, and disposal, the contingencies presented in the AIF guideline are consistent with the values presented in DOE G 430.1-1 for a Budget/Title I estimate. The system decontamination, reactor vessel and reactor internals removal, and disposal contingencies recommended in the AIF guideline are significantly higher than the ranges identified by the DOE, even for a planning phase document. This is due to the unique nature of these activities and the relatively small amount of historical data available at the time the AIF document was written.

This estimate applies site-specific contingency factors to each WBS element based on industry practices. The contingencies rates applied in this estimate are specific to decommissioning estimates consistent with information presented in AIF guideline and DOE G. The

decommissioning costs generated in the estimate are considered well known and, as such, the contingencies presented in AIF guideline were reduced for each category of costs. There have also been a number of large-scale decommissioning projects since AIF was published, providing some historical information that has been used in preparing this estimate. This allows for additional reduction in contingency costs. The following table provides a summary of contingency values applied in this estimate where the plant structures, systems, and major component material inventories are well defined, as with this study.

<u>Category</u>	<u>Labor</u>	<u>Material & Equipment</u>	<u>Package Ship & Bury</u>	<u>Other</u>
Engineering	13%			
Contaminated components/Concrete	23%	23%	23%	
Clean components	13%	13%	13%	
Reactor Vessel and Reactor Internals	50%	23%	25%	
Other				15%

The above contingency categories address the difference in uncertainty associated with performance of the work. In the case of a power plant decommissioning project, the segmentation of the reactor internals and pressure vessel and removal of radiologically contaminated plant systems and structures have the highest degree of uncertainty and are therefore assigned the higher contingency rates.

3.7 Cost Reporting

Total project costs are aggregated from the distributed activity and undistributed costs into the following categories – Labor, Materials and Equipment, Waste Disposal, and Other costs. Other costs include property taxes, insurance, license fees, permits, and energy. Waste Disposal costs are the summation of packaging, transportation, base disposal rate, and any applicable surcharges. Health physics (HP) supplies and small tool costs are calculated as a component of each distributed activity cost and included in the category of Material and Equipment, with the exception that HP supplies for third party HP staff are calculated and reported as an undistributed line item. A line item specific contingency is then calculated for each activity cost element.

4.0 SITE SPECIFIC TECHNICAL APPROACH

4.1 Facility Description

DAEC is a nuclear powered electrical generating facility consisting of one BWR located on a site near Palo in Linn County, Iowa. The plant site comprises approximately 500 acres adjacent to the Cedar River approximately 2.5 miles northeast of the Village of Palo, Iowa.

The nuclear system includes a single-cycle, forced-circulation, General Electric (GE) BWR producing steam for direct use in the steam turbine. The nuclear steam supply system (NSSS) and the turbine-generator were furnished by GE. The balance of plant was designed and constructed by Bechtel Power Corporation (Bechtel) as architect engineer and constructor.

The unit was originally designed, analyzed, and licensed for a steady-state core power of 1,658 MWt, although the plant Technical Specifications restricted operation to a rated power of 1,593 MWt. In 1985, the Technical Specifications were amended to allow the DAEC to operate at a steady-state power level of 1,658 MWt (License Amendment #115). Then, in 2001, the rated power level was increased again to 1,912 MWt (License Amendment #243). The current shutdown date is October 30, 2020.

Spent fuel assemblies are stored in the spent fuel storage racks in the spent fuel pool or may, after appropriate decay, be transferred to an ISFSI for interim onsite storage. The re-rack project of 1994 increased the spent fuel pool capacity to 2,411 assemblies. In addition, racks were licensed for the cask pit to retain full-core offload capability. The cask pit racks have a storage capacity of 323 assemblies, but are not licensed for long term storage.

There is an ISFSI on site that houses 10 CFR 72 licensed spent fuel storage systems that can provide interim on-site storage of spent fuel and reactor-related GTCC waste.

Appendix A provides a list of the DAEC systems and structures included in the material inventory for this study.

4.2 Decommissioning Periods for SAFSTOR

The project periods for SAFSTOR consist of eleven License Termination periods, seven Spent Fuel Management periods, two Greenfield periods, and two ISFSI D&D periods. The project periods defined for this site-specific study and the major activities performed during each period are as follows:

License Termination Periods

Decon Pd 1 – SAFSTOR Planning Prior to Shutdown

- SAFSTOR Planning and Design
- Preparation of SAFSTOR Plan and License Documents

Decon Pd 2 – Transition Following Shutdown

- Perform Historical Site Assessment and Site Characterization
- Flush, Drain, and De-Energize Non-Essential Systems
- Volume Reduce Control Rod Blades, Fuel Channels, and LPRMs
- General Area Cleanup

Decon Pd 3 – SAFSTOR Preparation Delay During Spent Fuel Pool Operations

- Periodic Maintenance, Surveillance and Inspection of Non-fuel Related Systems and Structures

Decon Pd 4 – Completion of SAFSTOR Preparations

- Flush and Drain Essential Systems Following Fuel Pool Closure
- Secure Site for Dormancy Period
- Drain and De-Energize Remaining Systems and Secure Site

Decon Pd 5 – Dormancy With Dry Storage

- Periodic Maintenance, Surveillance, and Inspection of Non-fuel Related Systems and Structures
- Bituminous Roof Replacement – 20 year
- Bituminous Roof Replacement – 40 year

Decon Pd 6 – Dormancy Only

- Periodic Maintenance, Surveillance and Inspection of Non-fuel Related Systems and Structures

Decon Pd 7 – Decommissioning Planning During Dormancy

- Decommissioning Planning and Design
- Planning and Design of Site Revitalization

Decon Pd 8 – Internals Segmentation and Site Preparations

- Revitalize Infrastructure and Re-Power Site
- Perform Post-SAFSTOR Baseline Radiation Survey
- Remove and Dispose of Spent Fuel Storage Racks
- Segment, Package, and Ship Reactor Internals
- Construct Site Modifications
- Preparation of License Termination Plan

Decon Pd 9 – Major Component and Systems Removal

- Remove, Package, and Dispose of Non-Essential Systems
- Segment, Package, and Dispose of Nuclear Steam Supply System
- Perform Asbestos Abatement on Plant Systems
- Remove and Dispose of Control Rod Drives

- Package and Ship Reactor Pressure Vessel
- Remove, Package, and Dispose of Remaining Active Plant Systems

Decon Pd 10 – Building Decontamination

- Decontaminate Structures
- Remove Underground Storm Drains and Manholes
- Final Status Survey for Structures
- Final Status Survey for Land Areas

Decon Pd 11 – License Termination

- NRC Review and Approval of the Final Status Survey

Spent Fuel Management Periods

SNF Pd 1 – Fuel Pool Island Design

- Design Spent Fuel Support System Modification
- Design Control Room Relocation
- Design Spent Fuel Security Modification

SNF Pd 2 – Spent Fuel Cooling During Zirc Fire Window

- Install Spent Fuel Pool, Control Room, and Security Modifications

SNF Pd 3 – Spent Fuel Transfer to Dry Storage

- Fuel Pool Operation and Maintenance
- Construction of ISFSI Phase II and III Expansion
- Construction of ISFSI Monitoring Building
- Transfer Fuel Assemblies into MPCs

SNF Pd 4 – Dry Storage During Completion SAFSTOR Preparations

SNF Pd 5 – Dry Storage During Dormancy

- Periodic Fuel Shipments to DOE

SNF Pd 6 – ISFSI Demolition Delay

SNF Pd 7 – ISFSI and Support Structure Clean Demolition

- Demolition of HSMs and ISFSI Foundation
- Demolition of ISFSI Security Building and Support Structures
- Site Restoration of ISFSI site

ISFSI D&D Periods (10 CFR 72.30)

ISFSI D&D Pd 1 – ISFSI D&D Planning

- Preparation and NRC Review of License Termination Plan

ISFSI D&D Pd 2 – ISFSI Final Status Survey

- Final Status Survey of ISFSI
- Preparation of FSS Report and NRC Review

Greenfield Periods

Grn Pd 1 – Clean Building Demolition During Decommissioning

- Demolition of Structures

Grn Pd 2 – Site Restoration

- Finish Grading and Re-Vegetate Site

4.3 Decommissioning Staff

A site-specific staffing plan was developed by DAEC and *EnergySolutions* based on the existing DAEC operational staff and the assumption that the decommissioning will be performed by a DGC, with oversight and management of the decommissioning operations performed by DAEC staff. It is also assumed that the DAEC staff will be supplemented by professional consulting engineering, particularly in the planning and preparation phase. The sizes of the staffs are varied in each period in accordance with regulatory requirements and the work activities. Details on the staff levels during each period are provided in Section 6.0.

4.4 Spent Fuel Management Staff

The largest spent fuel staff is in place while the fuel pool is operational during the cooling period and when fuel assemblies are being transferred to dry storage. Once all spent fuel has been removed from the spent fuel pool, the staff is reduced. Details on the staff levels during each period are provided in Section 6.0.

4.5 Spent Fuel Shipments

The spent fuel shipping schedule was provided by DAEC. The spent fuel shipping schedule is based on the DOE 2004 “Acceptance Priority Ranking & Annual Capacity Report” (Ref. No. 6). The spent fuel shipping schedule is provided in Appendix B.

5.0 BASES OF ESTIMATE AND KEY ASSUMPTIONS

The bases of, and key assumptions for, this site-specific decommissioning estimate are presented below.

1. All cost data used in this study is current as of 2018 or has been escalated to 2018 dollars. Totals and subtotals have been rounded to significant figures.
2. The estimate is based on a shutdown date of October 30, 2020.
3. The decommissioning will be performed under the current regulations. These regulations require a Post-Shutdown Decommissioning Activities Report (PSDAR) to be submitted prior to, or within, two years after permanent shutdown. In addition, a certificate of permanent cessation of operations must be submitted to the NRC within 30 days of permanent cessation of operations. Certification of the final core off-load must also be submitted to the NRC upon completion of this activity. 90 days after the NRC receives the PSDAR and after submittal of both certifications, major decommissioning activities that meet the criteria of 10 CFR Part 50.59 may be performed, provided the NRC does not notify DAEC of any deficiencies.
4. The decommissioning will be performed using currently available technologies.
5. The spent fuel shipping schedule assumes DOE begins accepting spent fuel in 2030.
6. The material inventory for this estimate is based on prior EnergySolutions' take-offs and has been updated, based on information furnished by DAEC, to reflect major structural modifications.
7. All transformers on site following shutdown are assumed to be polychlorinated biphenyl (PCB)-free; therefore, this estimate does not include costs for disposition of PCB contaminated transformers.
8. Cost for transportation of clean scrap metal to a recycler is included in the estimate; however, no credit is taken for the value of the scrap metal. A portion of the concrete debris is assumed to be processed by size reduction, with removal of structural reinforcing steel, and used on site as engineered fill for voids. All other concrete and demolition debris is removed from the site and disposed of at a local off-site construction landfill.
9. This estimate is based on final site restoration to Greenfield conditions, in which all existing and proposed structures, with the exception of the switchyard, will be removed. Clean demolition costs are based on structures removal to three feet below grade. Clean topsoil will be imported and placed on the top three feet. The entire disturbed area of the site is to be graded, to restore the natural grade to the extent possible, and seeded.
10. Lead shielding remaining after shutdown is assumed to be disposed of as a mixed waste.

11. A budget for hazardous material is included in the estimate, which is based on information provided by DAEC. All other chemicals and hazardous materials present at shutdown are assumed to be removed and disposed of by the plant staff prior to decommissioning, as a normal part of plant operations.
12. No known areas of radiologically contaminated soil have been identified. Additionally, documented tritium levels in groundwater are below drinking water standards. Therefore, no soil or groundwater remediation costs will be assumed.
13. DAEC provided information on the current amount of asbestos insulation on systems piping. It is assumed that asbestos not replaced during an outage and still remaining at shutdown will be limited to areas with higher dose rates. Therefore, this study considers that 30% of the insulation on contaminated and insulated piping will be asbestos and disposed of as Class A waste.
14. Costs for disposition of greater than Class A LLRW either currently stored on site or anticipated to be on site at the time of decommissioning are included in this estimate. The types and quantities of greater than Class A LLRW were provided by DAEC, and include, but are not limited to the following expected to be stored in the spent fuel pool at the time of shutdown:
 - 27 control blades
 - 24 Local Power Range Monitors
 - 25 blade guides
 - 6 half blade guides
15. All Class A waste is assumed to be disposed of at EnergySolutions' facility in Clive, Utah, in accordance with the existing LOP Disposal Agreement between EnergySolutions and DAEC (Ref. No. 9).
16. DAEC furnished Class B and C waste disposal rates.
17. DAEC provided costs used to estimate the assumed GTCC disposal cost.
18. GTCC waste generated from the segmentation of the reactor internals will be packaged in MPCs. In this estimate, the MPCs are assumed to be accepted by DOE at the time of the deferred decommissioning.
19. Vessel and internals curie estimates were derived from the values for the Reference BWR vessel and internals in NUREG/CR-0672 (Ref. No. 8) and adjusted for mass and the SAFSTOR decay period.
20. The site-specific classification of radioactive wastes for DAEC identified one components within the reactor vessel (the Core Shroud) will exceed Class C limitations. Two NUHOMs MPCs are assumed to be required and DAEC provided the estimated costs.

21. Spent fuel will remain in the spent fuel pool for approximately three years before being transferred to the ISFSI.
22. Spent fuel management costs include the purchase of dry storage MPCs and HSMs required following shutdown. An estimated cost for labor, material, and equipment for the pool to pad transfer of spent fuel to the ISFSI was provided by DAEC.
23. The existing ISFSI will have to be expanded post-shutdown in order to accommodate all spent fuel. The cost for constructing the ISFSI expansion was furnished by DAEC.
24. The ISFSI pad and HSMs are assumed to have no activated concrete or surface contamination.
25. The 10 CFR Part 50 license will be maintained until DOE has taken possession of the spent fuel.
26. State emergency preparedness, Federal Emergency Management Agency (FEMA) fees, and Environmental Permits costs are based on data furnished by DAEC and were adjusted to meet the requirements of each period based on the status of on-site spent fuel.
27. An estimate of the annual property taxes was furnished by DAEC and included in the estimate.
28. Annual NRC 10 CFR 171.15 fees, for reactors in decommissioning, of \$198,000 are included in the estimate.
29. The estimate includes annual NRC inspection fees during each decommissioning period based on the type and level of activities being performed along with NRC review fees for license amendment requests, exemption requests and the License Termination Plan based on NRC's hourly rate of \$275 per hour.
30. Annual operating insurance premiums were supplied by DAEC. The premium amounts were adjusted to meet the requirements of each period based on information provided by DAEC.
31. DAEC provided an annual allowance for miscellaneous materials and services to account for costs such as communications, miscellaneous utilities and services, office supplies, and consumables not captured elsewhere in the estimate.
32. DAEC staff positions and average burdened salary data were supplied by DAEC and account for fringe benefits, overhead and payroll taxes.
33. DGC staff salaries, including overhead and profit, were determined by *EnergySolutions* and represent *EnergySolutions'* standard assumptions for these rates
34. DAEC staff severance and retention costs were supplied by DAEC.

35. The current utility staff size is considered to be sufficiently stable to remain virtually unchanged to end of life. For this reason, the utility staff is assumed to be the same size at the time of shutdown.
36. The professional personnel used for the planning and preparation activities are assumed to be paid per diem at the rate of \$93/day, based on per diem rates from U.S. General Services Administration (GSA) for Cedar Rapids, Iowa.
37. Craft labor rates were furnished by DAEC. Craft labor rates for disciplines not furnished by DAEC have been taken from the 2018 RS Means Labor Rates for the Construction Industry (Ref. No. 12), for Cedar Rapids, Iowa. Since the skilled laborers are assumed to be supplied by the local union hall, they will not be paid per diem.
38. The security guard force included in this DCE is in accordance with NRC security regulations as implemented by an NRC approved security plan and anticipated amendments to that plan applicable during each decommissioning period following shutdown.
39. This study follows the occupational exposure principles of As Low As Reasonably Achievable (ALARA) through the use of productivity loss factors that incorporate such items as the use of respiratory protection and personnel protective clothing. These factors increase the work duration and cost.
40. The costs of all required safety analyses and safety measures for the protection of the general public, the environment, and decommissioning workers are included in the cost estimates. This reflects the requirements of:

10 CFR 20	Standards for Protection Against Radiation
10 CFR 50	Domestic Licensing of Production and Utilization Facilities
10 CFR 61	Licensing Requirements for Land Disposal of Radioactive Waste
10 CFR 71	Packaging of Radioactive Material for Transport
10 CFR 72	Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste
29 CFR 1910	Occupational Safety and Health Standards
49 CFR 170-189	Department of Transportation Regulations Governing the Transport of Hazardous Materials

Regulatory guidance is also provided by Reg. Guide 1.159, Assuring the Availability of Funds for Decommissioning Nuclear Reactors.

41. Activity labor costs do not include any allowance for delays between activities, nor is there any cost allowance for craft labor retained on site while waiting for work to become available.

6.0 STUDY RESULTS

6.1 60-Year SAFSTOR, 2030 DOE Acceptance, Dry Fuel Storage

Based on the following:

- Shutdown on October 30, 2020.
- DOE begins accepting spent fuel in 2030.
- Termination of spent fuel pool operation approximately three years after permanent shutdown.
- Following shutdown Phase II and III of the ISFSI will be constructed and all spent fuel will be transferred to MPCs.
- SAFSTOR methodology, with decommissioning completed within 60 years of shutdown.
- Decommissioning will be performed by an independent Third Party.

Spent Fuel Shipping Schedule

The spent fuel shipping schedule is provided in Appendix B. All spent fuel will be removed from the spent fuel pool by the end of 2023. All spent fuel will be removed from the ISFSI by the end of 2059.

Cost and Schedule

A summary project schedule is shown in Figure 6-1. A detailed schedule is provided in Appendix C. Table 6-1 summarizes the period durations and total costs, including contingency, for License Termination, Spent Fuel, Greenfield and ISFSI D&D activities. A detailed cost table is provided in Appendix D, and a table of annual expenditures is provided in Appendix E.

Project Staffing

Staffing is based on the assumption that decommissioning will be performed by the utility staff and a DGC. Utility staffing levels, by organizational department and function, for each period are provided in Table 6-2. DGC staffing levels, by organizational department and function, for each period are provided in Table 6-3.

Waste Disposal Volumes

The estimated cubic feet of waste are summarized as follows:

Class A	503,709
Class B	1,203
Class C	226
GTCC	128

Waste disposal volumes and costs, itemized by packaging, transportation, surcharges, and disposal costs by waste class and facility, are provided in Table 6-4. The waste disposal costs provided in Table 6-4 do not include contingency.

Table 6-1
Cost and Schedule Summary
(2018 Dollars in Thousands)

Period No.	Period Description	Start	End	Years	Total Cost
License Termination (50.75(c))					
Decon Pd 1	SAFSTOR Planning Prior to Shutdown	4/1/2019	10/30/2020	1.58	\$11,509
Decon Pd 2	Transition Following Shutdown	10/30/2020	10/30/2021	0.99	\$71,649
Decon Pd 3	SAFSTOR Preparation Delay During Spent Fuel Pool Operations	10/30/2021	8/31/2023	1.83	\$20,113
Decon Pd 4	Completion of SAFSTOR Preparations	8/31/2023	8/1/2024	0.91	\$19,315
Decon Pd 5	Dormancy With Dry Storage	8/1/2024	10/30/2059	35.24	\$64,860
Decon Pd 6	Dormancy Only	10/30/2059	9/26/2073	13.90	\$37,311
Decon Pd 7	Decommissioning Planning During Dormancy	9/26/2073	3/7/2075	1.44	\$50,840
Decon Pd 8	Internals Segmentation and Site Preparations	3/7/2075	7/16/2076	1.36	\$120,283
Decon Pd 9	Major Component and Systems Removal	7/16/2076	5/19/2078	1.83	\$221,117
Decon Pd 10	Building Decontamination	5/19/2078	1/3/2080	1.62	\$103,240
Decon Pd 11	License Termination	1/3/2080	9/19/2080	0.71	\$4,451
Account Total				61.41	\$724,688
Spent Fuel (50.54(bb))					
SNF Pd 1	Spent Fuel Planning	4/1/2019	10/30/2020	1.58	\$443
SNF Pd 2	Spent Fuel Cooling During Zirc Fire Window	10/30/2020	10/30/2021	0.99	\$18,432
SNF Pd 3	Spent Fuel Transfer to Dry Storage	10/30/2021	8/31/2023	1.83	\$111,169
SNF Pd 4	Dry Storage During Completion of SAFSTOR Preparations	8/31/2023	8/1/2024	0.91	\$2,941
SNF Pd 5	Dry Storage During Dormancy	8/1/2024	10/30/2059	35.24	\$121,582
SNF Pd 6	ISFSI Demolition Delay	10/30/2059	12/31/2077	18.17	\$0
SNF Pd 7	ISFSI and Support Structure Clean Demolition	12/31/2077	7/28/2078	0.57	\$4,898
Account Total				59.29	\$259,466
Greenfield					
Grn Pd 1	Clean Building Demolition During Decommissioning	6/22/2078	1/3/2080	1.53	\$34,233
Grn Pd 2	Site Restoration	1/3/2080	5/8/2080	0.34	\$2,214
Account Total				1.87	\$36,447
ISFSI D&D (72.30)					
ISFSI D&D Pd 1	ISFSI D&D Planning	8/23/2075	12/30/2077	2.35	\$887
ISFSI D&D Pd 2	ISFSI Final Status Survey	12/30/2077	1/12/2079	1.03	\$754
Account Total				3.38	\$1,640
Scenario Total					\$1,022,240

Note: Numbers may not add due to rounding.

Table 6-2
Utility Staff Levels¹

License Termination – 50.75(c) Utility Staff

Department	Decon Pd 1	Decon Pd 2	Decon Pd 3	Decon Pd 4	Decon Pd 5	Decon Pd 6	Decon Pd 7	Decon Pd 8	Decon Pd 9	Decon Pd 10	Decon Pd 11
Administration and Support	1	22	3	3	0	0	3.50	10	10	8.5	3
Emergency Preparedness	0.5	0	0	0	0	0	0	0	0	0	0
Engineering, Oversight and Licensing	9.75	43	3	3	0	0	12	16.75	15.25	11	2
Executive Management	0.25	10	1	1	2	2	2.50	3	3	3	1
Plant Maintenance	1.5	47	4	4	1	1	1	19	10	5	0
Plant Operations ²	1.25	44.83	3	3	0	0	0	4	4	1	0
Quality Assurance	0	2	0	0	0	0	0	2	3	3	2
Radiation Protection & Chemistry	2.75	26	5	5	2	2	4.5	19	37	37	1
Period Totals	17	194.83	19	19	5	5	23.75	73.75	82.25	68.5	9

Spent Fuel - 50.54(bb) Utility Staff

Department	SNF Pd 1	SNF Pd 2	SNF Pd 3	SNF Pd 4	SNF Pd 5	SNF Pd 6	SNF Pd 7
Administration and Support	0	0	0	0	0	0	0.5
Emergency Preparedness	0	4	4	0	0	0	0
Engineering, Oversight and Licensing	0.75	0	0	0	0	0	1.25
Plant Maintenance	0.25	0	0	0	0	0	0
Radiation Protection & Chemistry	0	0	0	0	0	0	0.5
Spent Fuel Pool Operations	0	45	45	0	0	0	0
Period Total	1	49	49	0	0	0	2.25

¹ Security staff levels are safeguards information and therefore not included.

² Plant Operations staff during Decon Pd 2 includes personnel required to defuel the reactor.

Table 6-2 (Continued)
Utility Staff Levels

Greenfield – Utility Staff

Department	Grn Pd 1	Grn Pd 2
Administration and Support	0.5	0.5
Engineering, Oversight and Licensing	2.5	2
Executive Management	0	0.25
Quality Assurance	0.75	0
Radiation Protection & Chemistry	0	0.25
Period Totals	3.75	3

ISFSI D&D – Utility Staff

Department	ISFSI D&D Pd 1	ISFSI D&D Pd 2
Engineering, Oversight and Licensing	1	1
Quality Assurance	0	0.75
Radiation Protection & Chemistry	0.5	0.5
Period Totals	1.5	2.25

**Table 6-3
Decommissioning General Contractor (DGC) Staff Levels**

License Termination – 50.75(c) DGC Staff

Department	Decon Pd 1	Decon Pd 2	Decon Pd 3	Decon Pd 4	Decon Pd 5	Decon Pd 6	Decon Pd 7	Decon Pd 8	Decon Pd 9	Decon Pd 10	Decon Pd 11
Administration	0	0	0	0	0	0	4	9	9	9	1
Decon Operations	0	0	0	0	0	0	2	6	18	14	0
Engineering	0	0	0	0	0	0	2.5	6	6	4.50	1
Environmental Health & Safety	0	0	0	0	0	0	1.5	5	6	6	0
Executive	0	0	0	0	0	0	3	4	4	4	2
Project Controls Work Planning	0	0	0	0	0	0	4.5	7	7	5	1
Quality Assurance	0	0	0	0	0	0	0.5	1	2	2	1
Radiation Protection	0	0	0	0	0	0	1	13	33	24	1
Site Closure	0	0	0	0	0	0	0.5	2	4	5	3
Waste Operations	0	0	0	0	0	0	1	4	11	10	0
Period Totals	0	0	0	0	0	0	19	57	99.5	84	8

Spent Fuel - 50.54(bb) DGC Staff

Department	SNF Pd 1	SNF Pd 2	SNF Pd 3	SNF Pd 4	SNF Pd 5	SNF Pd 6	SNF Pd 7
Administration	0	0	0	0	0	0	0
Decon Operations	0	0	0	0	0	0	1
Engineering	0	0	0	0	0	0	1
Environmental Health & Safety	0	0	0	0	0	0	1
Executive	0	0	0	0	0	0	0
Project Controls Work Planning	0	0	0	0	0	0	0
Quality Assurance	0	0	0	0	0	0	0
Radiation Protection	0	0	0	0	0	0	0
Site Closure	0	0	0	0	0	0	1
Waste Operations	0	0	0	0	0	0	0
Period Total	0	0	0	0	0	0	4

Table 6-3 (Continued)
Decommissioning General Contractor (DGC) Staff Levels

Greenfield – DGC Staff

Department	Grn Pd 1	Grn Pd 2
Administration	0.5	0.5
Decon Operations	2.5	2
Engineering	0	0.25
Environmental Health & Safety	0.75	0
Executive	0	0.25
Project Controls Work Planning	0	6
Quality Assurance	0	0
Radiation Protection	0	0
Site Closure	0	0
Waste Operations	0	0
Period Totals	3.75	9

ISFSI D&D – DGC Staff

Department	ISFSI D&D Pd 1	ISFSI D&D Pd 2
Engineering, Oversight and Licensing	0	0
Quality Assurance	0	0
Radiation Protection & Chemistry	0	0
Period Totals	0	0

**Table 6-4
Waste Disposal Volumes**

Facility and Waste Class	Waste Weight (LBs)	Waste Volume (CF)	Burial Volume (CF)
Commercial Disposal Facility for B & C Wastes			
Class B - Activated Hardware	47,110	308	384
Class C - Activated Hardware	91,009	226	1,670
Class B - Resin and Filters	54,926	895	1,311
	193,045	1,429	3,365
GTCC	62,590	128	1,018
EnergySolutions			
Class A – Debris	18,599,692	329,908	456,435
Class A – Oversized Debris	7,824,790	112,378	166,355
Class A – Cask Shipment	75,416	154	1,502
Class A – Containerized Waste	207,054	2,307	4,974
Class A – Large Component	4,236,090	58,878	78,614
Mixed Waste (Lead)	30,000	85	288
	30,973,042	503,709	708,169
Other			
Local Construction Debris Landfill	90,303,566	1,031,207	1,306,313
Process for On-Site Fill	193,657,230	2,969,411	2,969,411
Scrap Metal Recycler	26,106,954	310,382	310,382
	310,067,750	4,311,000	4,586,106
Grand Total			

Note: Numbers may not add due to rounding.

7.0 REFERENCES

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4. Federal Register, Vol. 4, "Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste," NRC 10 CFR Part 961 (DOE), January 1, 1999.
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7. U.S. Nuclear Regulatory Commission, "Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station," NUREG/CR-0130, June 1978.
8. U.S. Nuclear Regulatory Commission, "Technology, Safety and Costs of Decommissioning a Reference Boiling Water Reactor Power Station," NUREG/CR-0672, June 1980.
9. Life-of-Plant Disposal Agreement, between EnergySolutions and FPL Energy Duane Arnold, LLC, January 1st, 2007.
10. U.S. Nuclear Regulatory Commission, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," NUREG-1575, Rev. 1, August 2000.
11. U.S. Department of Energy, "Cost Estimating Guide," DOE G 430.1-1, March 1997.
12. RS Means, "Labor Rates for the Construction Industry," 2018

Appendix A

List of Systems and Structures

Duane Arnold Energy Center System and Structure List

Unit 1

Type	System Name or Description
ESS	Area Rad Monitoring
ESS	Breathing Air
ESS	CO2 Fire Protection
ESS	Control Bldg HVAC
ESS	Diesel Generator HVAC
ESS	Diesel Oil System
ESS	Domestic Water
ESS	Drywell Sumps
ESS	Fire Protection
ESS	Fuel Pool Cooling & Cleanup
ESS	Instrument Air
ESS	Liquid Radwaste
ESS	LLRPSF Area HVAC
ESS	LLRPSF Area Sumps
ESS	Offgas Exhaust
ESS	Primary Containment
ESS	Primary Containment HVAC
ESS	Radwaste Bldg HVAC
ESS	Radwaste Bldg Sumps
ESS	Reactor Bldg HVAC
ESS	Reactor Bldg Sumps
ESS	Reliable Hard Pipe Vent Modification
ESS	RW Evaporator & Solid
ESS	SEDS Self Engaging Dewatering System
ESS	Service Air
ESS	Solid Radwaste
ESS	Spent fuel pool instrumentation
ESS	Stack Gas & Bldg Kaman Rad Monitoring
ESS	Standby Diesel Generator
ESS	Training Center & Equipment
ESS	Turbine Bldg HVAC
ESS	Turbine RB Radwaste Bldg Sampling
ESS	Well Water
NON	Admin Bldg Sumps
NON	Administration Bldg HVAC
NON	Aux Heating Sys Boiler
NON	Chlorination & Acid Feed
NON	Circulating Water
NON	Condensate & Demin Water
NON	Condensate Demineralizer
NON	Condenser Air Removal
NON	Containment Atm Dilution
NON	Containment Atmosphere Control
NON	Cooling Tower
NON	Data Acquisition Center HVAC
NON	Drywell Radiation Monitors

Duane Arnold Energy Center System and Structure List

Unit 1

Type	System Name or Description
NON	Electrical
NON	Extract Steam Htr-Vents-Drns
NON	Feedwater
NON	General Service Water
NON	H2 Water Chemistry
NON	Hydrogen Seal Oil
NON	Intake Structure HVAC
NON	Lube Oil Transfer & Storage
NON	Mach Shop & OG Bldg HVAC
NON	Makeup Demineralizer
NON	Misc HVAC
NON	Nitrogen
NON	Offgas Bldg Sumps
NON	Offgas Recombiner
NON	Post Accident Sampling
NON	Pumphouse HVAC
NON	Reactor Bldg Closed Cooling Water
NON	Reactor Water Cleanup
NON	Residual Heat Removal
NON	RHR Service Water
NON	River Water Supply
NON	Sanitary Drains
NON	Standby Gas Treatment
NON	Stator Cooling
NON	Technical Suppor Center HVAC
NON	Torus Vacuum Breakers
NON	Turbine Bldg Sumps
NSSS	Condensate
NSSS	Condenser
NSSS	CRD Hydraulic
NSSS	Emergency Service Water
NSSS	High Pressure Coolant Injection
NSSS	Low Pressure Core Spray
NSSS	Main Steam
NSSS	Nuclear Boiler
NSSS	Reactor Core Isolation Cooling
NSSS	Reactor Vessel Recirculation
NSSS	Standby Liquid Control
NSSS	Traversing Incore Probe Cal
NSSS	Turbine
NSSS	Turbine Steam Seals & Drains
STRUC	Administration Building
STRUC	Badging Center
STRUC	Breathing Air Enclosure
STRUC	Circulating Water Pipe
STRUC	Circulating Water Tower No 1

Duane Arnold Energy Center System and Structure List

Unit 1

Type	System Name or Description
STRUC	Circulating Water Tower No 2
STRUC	Civil Shop
STRUC	Compressor Building
STRUC	Condensate Storage Tank Foundation
STRUC	Construction Support Center
STRUC	Control Building
STRUC	Cooling Tower Control & Valve House 1
STRUC	Cooling Tower Control & Valve House 2
STRUC	Cooling Tower Training
STRUC	Data Acquisition Center
STRUC	Discharge Structure
STRUC	East Warehouse
STRUC	Electrical Equipment Building - ISFSI
STRUC	Electrical Maintenance
STRUC	Existing Concrete Slabs
STRUC	Existing Waste Water Treatment Plant
STRUC	FLEX Storage Building
STRUC	Guard Facility and Security Structures
STRUC	HPCI and RCIC Building
STRUC	Intake Structure
STRUC	ISFSI - Phase 3
STRUC	ISFSI Electrical Equipment Bldg
STRUC	ISFSI Monitoring Building
STRUC	Kelly Building
STRUC	LLRPSF Transformer Foundation
STRUC	Low Level Radwaste Storage and Processing
STRUC	Machine Shop
STRUC	Mechanical Maintenance
STRUC	New Site Support Building
STRUC	Off Gas Retention Building
STRUC	Off Gas Stack
STRUC	Oil Drum Storage Building
STRUC	Plant Support Center
STRUC	Pump House
STRUC	Radwaste Building
STRUC	Railroad Air-Lock
STRUC	Reactor Building
STRUC	Security Mods and Upgrades
STRUC	Site Transformer Foundations
STRUC	Sluice Gate Structure
STRUC	Sulfuric Acid Tank Foundation
STRUC	Support Shop
STRUC	Technical Support Center
STRUC	Trailer Pad
STRUC	Training Center
STRUC	Turbine Building

Duane Arnold Energy Center System and Structure List

Unit 1

Type	System Name or Description
STRUC	Turbine Pedestal
STRUC	Underground Diesel Oil Tank
STRUC	Underground Fuel Oil Tank
STRUC	Waste Staging Area
STRUC	Waste Water Treatment Plant
STRUC	Well Water Pump House 1,2,3,4
STRUC	West Warehouse

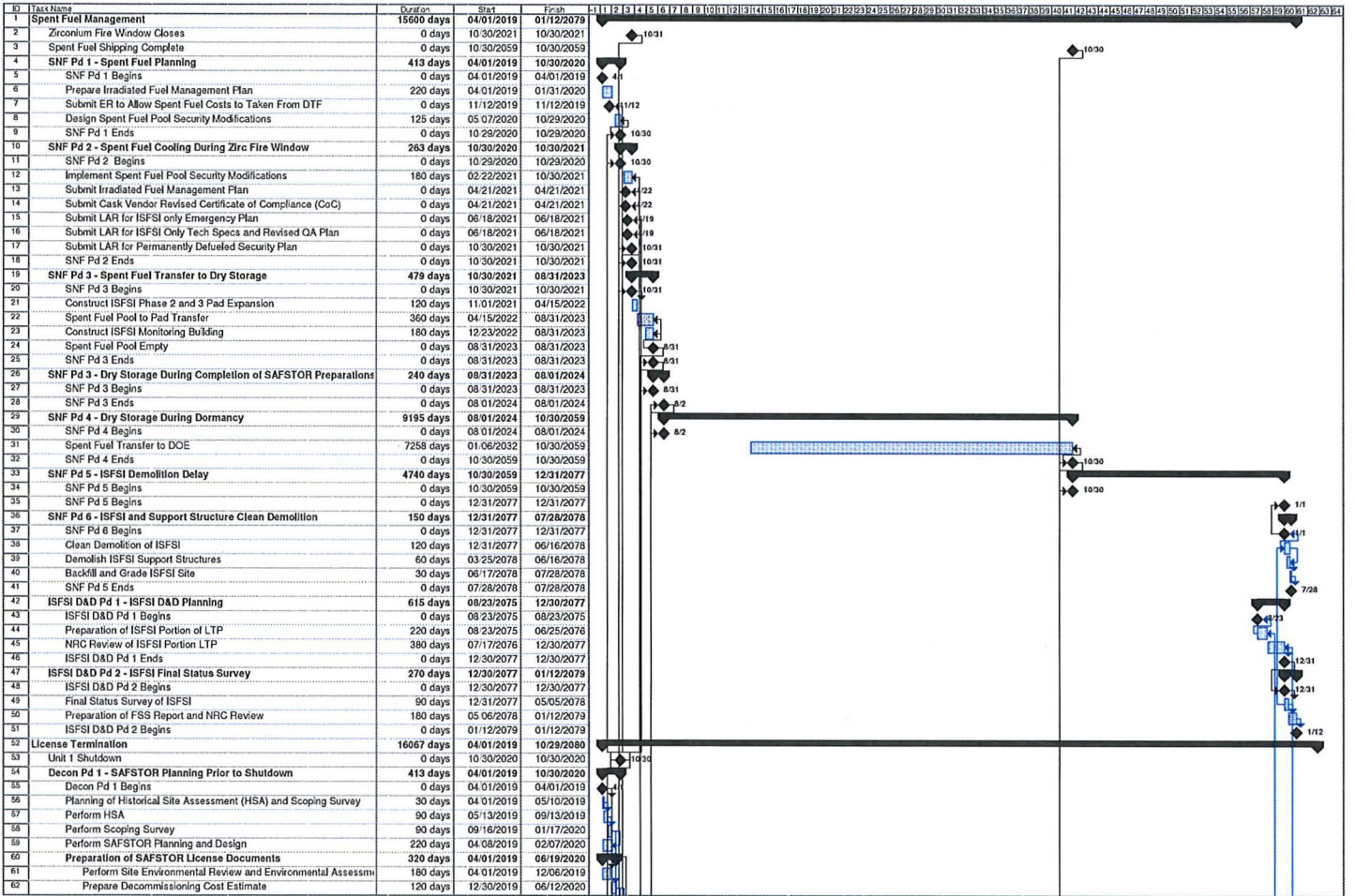
Appendix B
Spent Fuel Shipping Schedule

Duane Arnold Energy Center
Spent Fuel Shipping Schedule for October 30, 2020 Shutdown
Based on 2030 DOE Acceptance

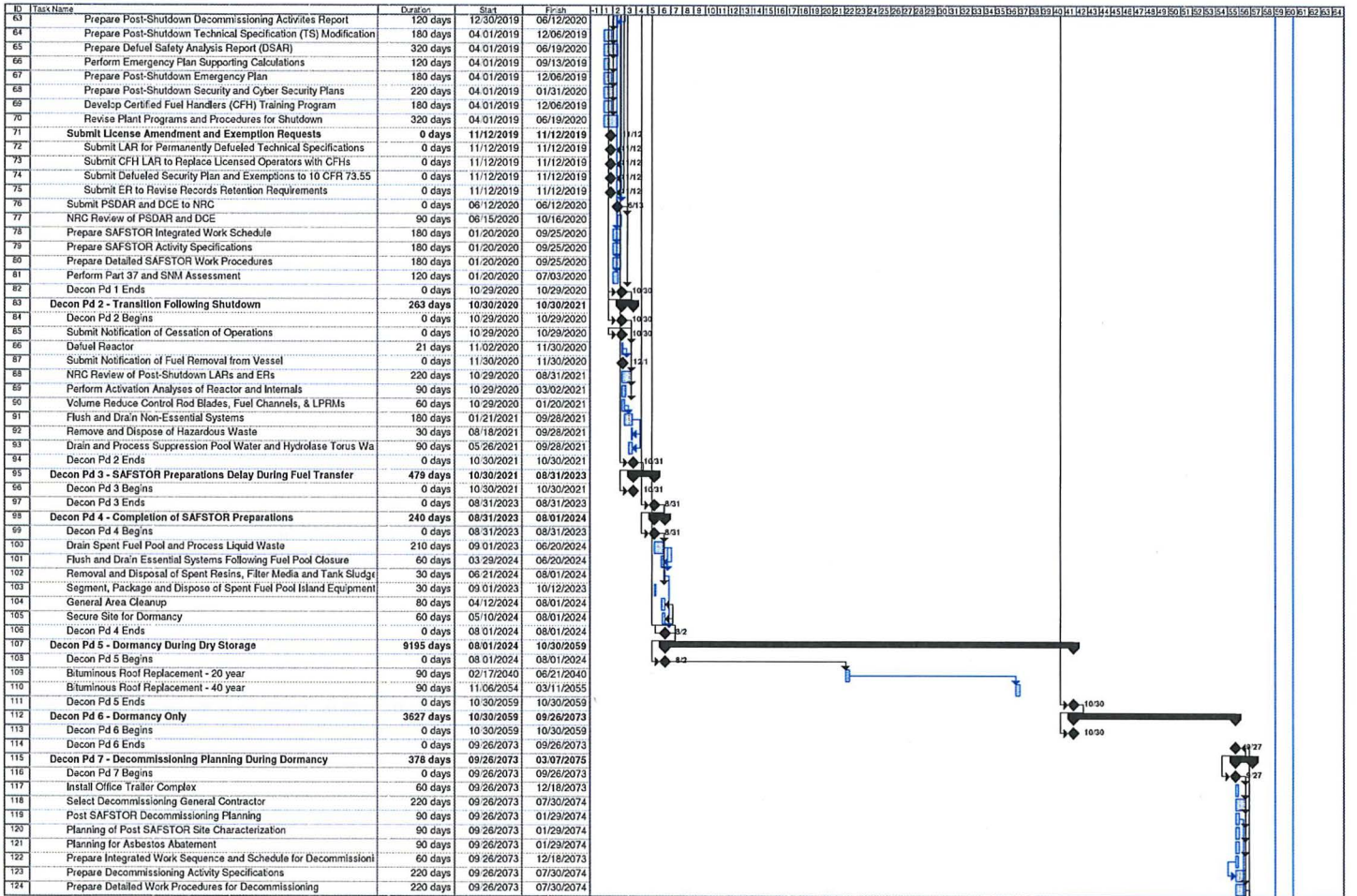
Year	Fuel Discharged	No Dry Modules	Assemblies Transferred from Pool to Dry Storage	Assemblies in Fuel Pool Storage	Assemblies in Dry Storage	Total Assemblies in On Site Storage	Assemblies Shipped to DOE From Pool	Assemblies Shipped to DOE from Dry Storage	Cumulative Assemblies Shipped to DOE
2008	0	10	0	1758	610	2368	0	0	0
2009	152	0	0	1910	610	2520	0	0	0
2010	152	0	0	2062	610	2672	0	0	0
2011	0	10	610	1452	1220	2672	0	0	0
2012	152	0	0	1604	1220	2824	0	0	0
2013	0	0	0	1604	1220	2824	0	0	0
2014	152	0	0	1756	1220	2976	0	0	0
2015	0	0	0	1756	1220	2976	0	0	0
2016	152	0	0	1908	1220	3128	0	0	0
2017	0	0	0	1908	1220	3128	0	0	0
2018	152	0	0	2060	1220	3280	0	0	0
2019	0	0	0	2060	1220	3280	0	0	0
2020	368	10	610	1818	1830	3648	0	0	0
2021	0	0	0	1818	1830	3648	0	0	0
2022	0	0	0	1818	1830	3648	0	0	0
2023	0	30	1818	0	3648	3648	0	0	0
2024	0	0	0	0	3648	3648	0	0	0
2025	0	0	0	0	3648	3648	0	0	0
2026	0	0	0	0	3648	3648	0	0	0
2027	0	0	0	0	3648	3648	0	0	0
2028	0	0	0	0	3648	3648	0	0	0
2029	0	0	0	0	3648	3648	0	0	0
2030	0	0	0	0	3648	3648	0	0	0
2031	0	0	0	0	3648	3648	0	0	0
2032	0	0	0	0	3526	3526	0	122	122
2033	0	0	0	0	3282	3282	0	244	366
2034	0	0	0	0	3099	3099	0	183	549
2035	0	0	0	0	2916	2916	0	183	732
2036	0	0	0	0	2794	2794	0	122	854
2037	0	0	0	0	2611	2611	0	183	1037
2038	0	0	0	0	2489	2489	0	122	1159
2039	0	0	0	0	2367	2367	0	122	1281
2040	0	0	0	0	2245	2245	0	122	1403
2041	0	0	0	0	2062	2062	0	183	1586
2042	0	0	0	0	1879	1879	0	183	1769
2043	0	0	0	0	1757	1757	0	122	1891
2044	0	0	0	0	1635	1635	0	122	2013
2045	0	0	0	0	1635	1635	0	0	2013
2046	0	0	0	0	1513	1513	0	122	2135
2047	0	0	0	0	1330	1330	0	183	2318
2048	0	0	0	0	1269	1269	0	61	2379
2049	0	0	0	0	1147	1147	0	122	2501
2050	0	0	0	0	1025	1025	0	122	2623
2051	0	0	0	0	903	903	0	122	2745
2052	0	0	0	0	781	781	0	122	2867
2053	0	0	0	0	659	659	0	122	2989
2054	0	0	0	0	598	598	0	61	3050
2055	0	0	0	0	476	476	0	122	3172
2056	0	0	0	0	354	354	0	122	3294
2057	0	0	0	0	232	232	0	122	3416
2058	0	0	0	0	110	110	0	122	3538
2059	0	0	0	0	0	0	0	110	3648

**Appendix C
Detailed Project Schedule**

Duane Arnold Energy Center
Project Schedule for SAFSTOR, 2030 DOE Acceptance, Dry Storage

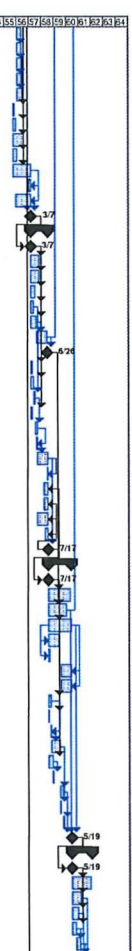


Duane Arnold Energy Center
Project Schedule for SAFSTOR, 2030 DOE Acceptance, Dry Storage



Duane Arnold Energy Center
Project Schedule for SAFSTOR, 2030 DOE Acceptance, Dry Storage

ID	Task Name	Duration	Start	Finish
125	Update Decommissioning Cost Estimate (DCE)	90 days	01/30/2074	06/04/2074
126	Update Post-Shutdown Decommissioning Activities Report (PSDAR)	90 days	01/30/2074	06/04/2074
127	Planning and Design of Site Revitalization	120 days	01/30/2074	07/16/2074
128	Planning and Design Rail Spur Upgrade	120 days	01/30/2074	07/16/2074
129	Planning and Design Cold & Dark Site Repowering	120 days	01/30/2074	07/16/2074
130	Develop Effluent Management Plan	30 days	09/26/2073	11/06/2073
131	Design Liquid Radwaste Treatment and Demin Makeup Water System	60 days	09/26/2073	12/18/2073
132	Prepare and Submit Environmental Permits	220 days	09/26/2073	07/30/2074
133	Design Containment Access Modifications	90 days	09/26/2073	01/29/2074
134	Design and Procure RPV/RVI Segmentation Tooling and Equipment	18 mos	09/26/2073	03/07/2075
135	Select Shipping Casks and Obtain Shipping Permits	40 days	01/11/2075	03/07/2075
136	Purchase Dry Storage Modules for GYCC Waste	320 days	12/15/2073	03/07/2075
137	Decon Pd 7 Ends	0 days	03/07/2075	03/07/2075
138	Decon Pd 8 - Internals Segmentation and Site Preparations	355 days	03/07/2075	07/16/2076
139	Decon Pd 8 Begins	0 days	03/07/2075	03/07/2075
140	Revitalize Site Infrastructure	180 days	03/08/2075	11/14/2075
141	Implement Cold & Dark	180 days	03/08/2075	11/14/2075
142	Install Liquid Radwaste Treatment System	90 days	03/08/2075	07/11/2075
143	Install Demin Makeup Water System for RVI Segmentation	60 days	03/08/2075	05/30/2075
144	Perform Post-SAFSTOR Site Characterization	120 days	03/08/2075	08/22/2075
145	Prepare License Termination Plan (LTP)	220 days	08/23/2075	06/25/2076
146	Submit LTP to NRC for review	0 days	06/25/2076	06/25/2076
147	Remove and Dispose of Spent Fuel Storage Racks	30 days	03/08/2075	04/18/2075
148	Segment and Dispose of Drywell Head	60 days	03/08/2075	05/30/2075
149	Reflood RPV and Steam Separator Pool for RVI Segmentation	30 days	05/31/2075	07/11/2075
150	Remove and Dispose of Rx Head	30 days	03/08/2075	04/18/2075
151	Test Special Cutting and Handling Equipment and Train Operators	45 days	07/12/2075	09/12/2075
152	Finalize Internals and Vessel Segmenting Details	25 days	08/09/2075	09/12/2075
153	Segment, Package and Ship Reactor Internals	220 days	09/13/2075	07/16/2076
154	RVI GYCC Waste Transportation and Disposal	15 days	06/26/2076	07/16/2076
155	Construct New Change Rooms, Hot Laundry, Waste Staging Area	90 days	03/13/2076	07/16/2076
156	Modify Containment Access	90 days	03/13/2076	07/16/2076
157	Upgrade Rail Spur	220 days	09/13/2075	07/16/2076
158	Install Truck Radiological Monitoring System	60 days	04/24/2076	07/16/2076
159	Decon Pd 8 Ends	0 days	07/16/2076	07/16/2076
160	Decon Pd 9 - Major Component and Systems Removal	460 days	07/16/2076	05/19/2078
161	Decon Pd 9 Begins	0 days	07/16/2076	07/16/2076
162	Procure Non-Engineered Standard Equipment	460 days	07/17/2076	04/21/2078
163	NRC Review and Approval of License Termination Plan	380 days	07/17/2076	12/30/2077
164	Remove, Package and Dispose of Non-Essential Systems	480 days	07/17/2076	05/19/2078
165	Perform Asbestos Abatement on Plant Systems	220 days	07/17/2076	05/20/2077
166	Removal and Disposal of Off Gas System Adsorber	30 days	07/17/2076	08/27/2076
167	Segment, Package and Dispose of Nuclear Steam Supply System	220 days	07/16/2077	05/19/2078
168	Remove, Package and Dispose of Remaining Active Plant Systems	220 days	07/16/2077	05/19/2078
169	Remove and Dispose of Control Rod Drives	60 days	07/17/2076	10/08/2076
170	Remove and Dispose of Shield Plugs, Pool Plugs and Stud Tensioner	15 days	07/17/2076	08/06/2076
171	Reactor Vessel Insulation Removal and Disposal	10 days	09/25/2076	10/08/2076
172	Segment, Package and Ship Reactor Pressure Vessel	180 days	10/09/2076	06/17/2077
173	Drain Steam Separator Pool and Process Liquid Waste	90 days	07/17/2076	11/19/2076
174	Transportation and Disposal of Liquid Radwaste Filters and Resins	15 days	11/20/2076	12/10/2076
175	Removal and Disposal of Sacrificial Shield Wall and Reactor Pedestal	60 days	08/18/2077	09/09/2077
176	Segment, Package and Dispose of Refueling Bridge	15 days	06/18/2077	07/08/2077
177	Removal and Disposal of Lead Shielding	30 days	09/10/2077	10/21/2077
178	Decon Pd 9 Ends	0 days	05/19/2078	05/19/2078
179	Decon Pd 10 - Building Decontamination	423.7 days	05/19/2078	01/03/2080
180	Decon Pd 10 Begins	0 days	05/19/2078	05/19/2078
181	Procure Non-Engineered Standard Equipment	400 days	05/20/2078	11/30/2079
182	Decon Reactor Building	200 days	05/20/2078	02/23/2079
183	Decon Turbine Building	130 days	05/20/2078	11/17/2078
184	Decon Radwaste Building	90 days	05/20/2078	09/22/2078
185	Decon HPCI and RCIC Building	90 days	09/23/2078	01/26/2079
186	Decon Administration Building	10 days	01/27/2079	02/09/2079



Appendix D
Detailed Cost Table

Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
A. License Termination							
Decon Pd 1 SAFSTOR Planning Prior to Shutdown							
Distributed							
1.01	Planning of Historical Site Assessment (HSA) and Scoping Survey	\$233	\$4	\$0	\$0	\$31	\$269
1.02	Perform HSA	\$207	\$2	\$0	\$0	\$27	\$236
1.03	Perform Scoping Survey	\$249	\$122	\$0	\$565	\$122	\$1,058
1.04	Perform SAFSTOR Planning and Design	\$481	\$29	\$0	\$0	\$66	\$576
1.05	NRC Review of PSDAR and DCE	\$0	\$0	\$0	\$264	\$34	\$298
1.06	Preparation of SAFSTOR License Documents	\$2,741	\$15	\$0	\$165	\$380	\$3,301
1.07	Prepare SAFSTOR Integrated Work Schedule	\$78	\$9	\$0	\$0	\$11	\$97
1.08	Prepare SAFSTOR Activity Specifications	\$490	\$4	\$0	\$0	\$64	\$558
1.09	Prepare Detailed SAFSTOR Work Procedures	\$764	\$0	\$0	\$0	\$99	\$864
1.10	Perform Part 37 and SNM Assessment	\$0	\$0	\$0	\$50	\$7	\$57
Distributed	Subtotal	\$5,243	\$185	\$0	\$1,044	\$841	\$7,314
Undistributed							
1.01	Utility Staff	\$3,557	\$0	\$0	\$0	\$462	\$4,020
1.03	Security	\$147	\$0	\$0	\$0	\$22	\$169
1.16	Workers Comprehensive Insurance	\$0	\$5	\$0	\$0	\$1	\$6
Undistributed	Subtotal	\$3,705	\$5	\$0	\$0	\$485	\$4,195
Decon Pd 1	Subtotal	\$8,948	\$190	\$0	\$1,044	\$1,327	\$11,509

**Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC**

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
Decon Pd 2	Transition Following Shutdown						
Distributed							
2.01	Submit Notification of Cessation of Operations	\$0	\$0	\$0	\$0	\$0	\$0
2.02	Defuel Reactor	\$1,160	\$0	\$0	\$0	\$151	\$1,311
2.03	Submit Notification of Fuel Removal from Vessel	\$0	\$0	\$0	\$0	\$0	\$0
2.04	NRC Review of Post-Shutdown LARs and ERs	\$0	\$0	\$0	\$564	\$73	\$637
2.05	Perform Activation Analyses of Reactor and Internals	\$49	\$4	\$0	\$308	\$47	\$408
2.06	Volume Reduce Control Rods, Fuel Channels and LPRMS	\$1,744	\$672	\$16,716	\$0	\$4,400	\$23,533
2.07	Flush and Drain Non-Essential Systems	\$44	\$8	\$1,016	\$0	\$246	\$1,313
2.08	Remove and Dispose of Hazardous Waste	\$0	\$0	\$0	\$185	\$28	\$213
2.09	Drain and Process Suppression Pool Water and Hydrolase Torus Walls	\$0	\$0	\$0	\$0	\$0	\$0
Distributed	Subtotal	\$2,996	\$685	\$17,732	\$1,057	\$4,945	\$27,414
Undistributed							
1.01	Utility Staff	\$23,471	\$0	\$0	\$0	\$3,051	\$26,522
1.02	Utility Staff HP Supplies	\$0	\$581	\$0	\$0	\$87	\$668
1.04	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$271	\$41	\$311
1.05	Non-Nuclear Insurance	\$0	\$0	\$0	\$45	\$7	\$52
1.06	Property Taxes	\$0	\$0	\$0	\$100	\$15	\$115
1.07	NRC Annual Fees - LT	\$0	\$0	\$0	\$462	\$69	\$531
1.08	Materials and Services	\$0	\$3,238	\$0	\$0	\$486	\$3,724
1.09	Energy	\$0	\$0	\$0	\$2,408	\$361	\$2,769
1.10	Environmental Permits and Fees	\$0	\$0	\$0	\$8	\$1	\$9
1.13	DAW Disposal	\$0	\$0	\$27	\$0	\$4	\$31
1.14	Severance	\$7,786	\$0	\$0	\$0	\$1,168	\$8,954
1.15	Retention	\$443	\$0	\$0	\$0	\$66	\$509
1.16	Workers Comprehensive Insurance	\$0	\$35	\$0	\$0	\$5	\$40
Undistributed	Subtotal	\$31,699	\$3,853	\$27	\$3,294	\$5,362	\$44,234
Decon Pd 2	Subtotal	\$34,695	\$4,538	\$17,759	\$4,350	\$10,306	\$71,649

Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
Decon Pd 3 SAFSTOR Preparation Delay During Spent Fuel Pool Operations							
Undistributed							
1.01	Utility Staff	\$4,362	\$0	\$0	\$0	\$567	\$4,929
1.02	Utility Staff HP Supplies	\$0	\$199	\$0	\$0	\$30	\$229
1.04	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$170	\$25	\$195
1.05	Non-Nuclear Insurance	\$0	\$0	\$0	\$83	\$13	\$96
1.06	Property Taxes	\$0	\$0	\$0	\$183	\$28	\$211
1.07	NRC Annual Fees - LT	\$0	\$0	\$0	\$508	\$76	\$585
1.08	Materials and Services	\$0	\$604	\$0	\$0	\$91	\$694
1.09	Energy	\$0	\$0	\$0	\$1,879	\$282	\$2,161
1.10	Environmental Permits and Fees	\$0	\$0	\$0	\$14	\$2	\$17
1.13	DAW Disposal	\$0	\$0	\$5	\$0	\$1	\$6
1.14	Severance	\$9,550	\$0	\$0	\$0	\$1,433	\$10,983
1.16	Workers Comprehensive Insurance	\$0	\$6	\$0	\$0	\$1	\$7
Undistributed	Subtotal	\$13,912	\$810	\$5	\$2,839	\$2,548	\$20,113
Decon Pd 3	Subtotal	\$13,912	\$810	\$5	\$2,839	\$2,548	\$20,113

Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
Decon Pd 4	Completion of SAFSTOR Preparations						
Distributed							
4.01	Drain Spent Fuel Pool and Process Liquid Waste	\$0	\$0	\$0	\$0	\$0	\$0
4.02	Flush and Drain Essential Systems Following Fuel Pool Closure	\$27	\$14	\$1,016	\$0	\$243	\$1,300
4.03	Removal and Disposal of Spent Resins, Filter Media and Tank Sludge	\$28	\$28	\$2,540	\$0	\$597	\$3,194
4.04	Segment, Package and Dispose of Spent Fuel Pool Island Equipment	\$7	\$2	\$190	\$0	\$46	\$245
4.05	General Area Cleanup	\$1,511	\$694	\$195	\$0	\$552	\$2,952
4.06	Secure Site for Dormancy Period	\$0	\$0	\$0	\$1,845	\$277	\$2,122
Distributed	Subtotal	\$1,574	\$738	\$3,941	\$1,845	\$1,715	\$9,812
Undistributed							
1.01	Utility Staff	\$2,187	\$0	\$0	\$0	\$284	\$2,472
1.02	Utility Staff HP Supplies	\$0	\$100	\$0	\$0	\$15	\$115
1.04	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$73	\$11	\$84
1.05	Non-Nuclear Insurance	\$0	\$0	\$0	\$42	\$6	\$48
1.06	Property Taxes	\$0	\$0	\$0	\$92	\$14	\$106
1.07	NRC Annual Fees - LT	\$0	\$0	\$0	\$425	\$64	\$489
1.08	Materials and Services	\$0	\$303	\$0	\$0	\$45	\$348
1.09	Energy	\$0	\$0	\$0	\$497	\$75	\$572
1.10	Environmental Permits and Fees	\$0	\$0	\$0	\$7	\$1	\$8
1.13	DAW Disposal	\$0	\$0	\$22	\$0	\$3	\$25
1.14	Severance	\$4,550	\$0	\$0	\$0	\$683	\$5,233
1.16	Workers Comprehensive Insurance	\$0	\$3	\$0	\$0	\$0	\$4
Undistributed	Subtotal	\$6,737	\$406	\$22	\$1,137	\$1,202	\$9,504
Decon Pd 4	Subtotal	\$8,311	\$1,144	\$3,963	\$2,981	\$2,916	\$19,315

Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
Decon Pd 5	Dormancy With Dry Storage						
Distributed							
5.01	Bituminous Roof Replacement - 20 year	\$421	\$106	\$31	\$0	\$84	\$642
5.02	Bituminous Roof Replacement - 40 year	\$421	\$106	\$31	\$0	\$84	\$642
Distributed	Subtotal	\$842	\$212	\$61	\$0	\$167	\$1,283
Undistributed							
1.01	Utility Staff	\$25,720	\$0	\$0	\$0	\$3,344	\$29,063
1.02	Utility Staff HP Supplies	\$0	\$1,607	\$0	\$0	\$241	\$1,848
1.04	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$2,798	\$420	\$3,217
1.05	Non-Nuclear Insurance	\$0	\$0	\$0	\$801	\$120	\$921
1.06	Property Taxes	\$0	\$0	\$0	\$641	\$96	\$737
1.06	Property Taxes	\$0	\$0	\$0	\$1,491	\$224	\$1,715
1.07	NRC Annual Fees - LT	\$0	\$0	\$0	\$9,770	\$1,466	\$11,236
1.08	Materials and Services	\$0	\$3,053	\$0	\$0	\$458	\$3,511
1.09	Energy	\$0	\$0	\$0	\$8,841	\$1,326	\$10,167
1.10	Environmental Permits and Fees	\$0	\$0	\$0	\$279	\$42	\$320
1.13	DAW Disposal	\$0	\$0	\$31	\$0	\$5	\$36
1.14	Severance	\$668	\$0	\$0	\$0	\$100	\$768
1.16	Workers Comprehensive Insurance	\$0	\$33	\$0	\$0	\$5	\$38
Undistributed	Subtotal	\$26,388	\$4,693	\$31	\$24,620	\$7,845	\$63,577
Decon Pd 5	Subtotal	\$27,229	\$4,905	\$93	\$24,620	\$8,013	\$64,860

**Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC**

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
Decon Pd 6	Dormancy Only						
Undistributed							
1.01	Utility Staff	\$10,150	\$0	\$0	\$0	\$1,319	\$11,469
1.02	Utility Staff HP Supplies	\$0	\$634	\$0	\$0	\$95	\$729
1.03	Security	\$5,209	\$0	\$0	\$0	\$781	\$5,991
1.04	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$4,416	\$662	\$5,078
1.05	Non-Nuclear Insurance	\$0	\$0	\$0	\$316	\$47	\$364
1.06	Property Taxes	\$0	\$0	\$0	\$348	\$52	\$400
1.07	NRC Annual Fees - LT	\$0	\$0	\$0	\$3,855	\$578	\$4,434
1.08	Materials and Services	\$0	\$2,651	\$0	\$0	\$398	\$3,048
1.09	Energy	\$0	\$0	\$0	\$4,299	\$645	\$4,944
1.10	Environmental Permits and Fees	\$0	\$0	\$0	\$110	\$16	\$126
1.13	DAW Disposal	\$0	\$0	\$12	\$0	\$2	\$14
1.14	Severance	\$592	\$0	\$0	\$0	\$89	\$681
1.16	Workers Comprehensive Insurance	\$0	\$28	\$0	\$0	\$4	\$33
Undistributed	Subtotal	\$15,951	\$3,313	\$12	\$13,345	\$4,690	\$37,311
Decon Pd 6	Subtotal	\$15,951	\$3,313	\$12	\$13,345	\$4,690	\$37,311

Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
Decon Pd 7	Decommissioning Planning During Dormancy						
Distributed							
7.01	Install Office Trailer Complex	\$0	\$0	\$0	\$3,543	\$532	\$4,075
7.02	Select Decommissioning General Contractor	\$351	\$5	\$0	\$0	\$46	\$403
7.03	Post SAFSTOR Decommissioning Planning	\$225	\$0	\$0	\$0	\$29	\$254
7.04	Planning Post SAFSTOR Site Characterization	\$131	\$2	\$0	\$0	\$17	\$151
7.05	Planning for Asbestos Abatement	\$137	\$2	\$0	\$0	\$18	\$157
7.06	Prepare Integrated Work Sequence and Schedule for Decommissioning	\$179	\$0	\$0	\$0	\$23	\$202
7.07	Prepare Decommissioning Activity Specifications	\$2,201	\$19	\$0	\$0	\$289	\$2,508
7.08	Prepare Detailed Work Procedures for Decommissioning	\$2,154	\$0	\$0	\$0	\$280	\$2,434
7.09	Update Decommissioning Cost Estimate (DCE)	\$281	\$1	\$0	\$0	\$37	\$318
7.10	Update Post-Shutdown Decommissioning Activities Report (PSDAR)	\$229	\$1	\$0	\$0	\$30	\$259
7.11	Planning and Design of Site Revitalization	\$1,038	\$18	\$0	\$0	\$137	\$1,193
7.12	Planning and Design Rail Spur Upgrade	\$252	\$10	\$0	\$0	\$34	\$296
7.13	Planning and Design Cold & Dark Site Repowering	\$593	\$7	\$0	\$0	\$78	\$677
7.14	Develop Effluent Management Plan	\$93	\$0	\$0	\$0	\$12	\$105
7.15	Design Liquid Radwaste Treatment and Demin Makeup Water Systems	\$175	\$0	\$0	\$0	\$23	\$198
7.16	Prepare and Submit Environmental Permits	\$112	\$0	\$0	\$0	\$15	\$126
7.17	Design Containment Access Modifications	\$227	\$3	\$0	\$0	\$30	\$260
7.18	Design and Procure RPV/RVI Segmentation Tooling and Equipment	\$2,068	\$19,000	\$0	\$0	\$2,739	\$23,807
7.19	Select Shipping Casks and Obtain Shipping Permits	\$38	\$0	\$0	\$0	\$5	\$43
7.20	Purchase Canisters for GTCC Waste	\$0	\$1,588	\$0	\$0	\$238	\$1,826
Distributed	Subtotal	\$10,482	\$20,656	\$0	\$3,543	\$4,611	\$39,293
Undistributed							
1.01	Utility Staff	\$4,470	\$0	\$0	\$0	\$581	\$5,051
1.02	Utility Staff HP Supplies	\$0	\$157	\$0	\$0	\$23	\$180
1.03	Security	\$540	\$0	\$0	\$0	\$81	\$621
1.04	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$458	\$69	\$527

Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
1.05	Non-Nuclear Insurance	\$0	\$0	\$0	\$33	\$5	\$38
1.06	Property Taxes	\$0	\$0	\$0	\$36	\$5	\$41
1.07	NRC Annual Fees - LT	\$0	\$0	\$0	\$400	\$60	\$460
1.08	Materials and Services	\$0	\$744	\$0	\$0	\$112	\$855
1.09	Energy	\$0	\$0	\$0	\$661	\$99	\$760
1.10	Environmental Permits and Fees	\$0	\$0	\$0	\$11	\$2	\$13
1.11	Decommissioning General Contractor Staff	\$2,599	\$0	\$0	\$0	\$338	\$2,936
1.12	DGC HP Supplies	\$0	\$43	\$0	\$0	\$6	\$50
1.13	DAW Disposal	\$0	\$0	\$4	\$0	\$1	\$4
1.16	Workers Comprehensive Insurance	\$0	\$8	\$0	\$0	\$1	\$9
Undistributed	Subtotal	\$7,609	\$951	\$4	\$1,600	\$1,383	\$11,547
Decon Pd 7	Subtotal	\$18,091	\$21,607	\$4	\$5,143	\$5,994	\$50,840

Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
Decon Pd 8 Internals Segmentation and Site Preparations							
Distributed							
8.01	Revitalize Infrastructure	\$0	\$0	\$0	\$17,683	\$2,652	\$20,336
8.02	Implement Cold & Dark	\$3,095	\$5,023	\$0	\$0	\$1,218	\$9,336
8.03	Install Liquid Radwaste Treatment System	\$0	\$0	\$0	\$1,750	\$263	\$2,013
8.04	Install Demin Makeup Water System for RVI Segmentation	\$0	\$0	\$0	\$313	\$47	\$360
8.05	Perform Post-SAFSTOR Site Characterization	\$367	\$250	\$0	\$0	\$80	\$698
8.06	Prepare License Termination Plan (LTP)	\$331	\$10	\$0	\$0	\$44	\$385
8.07	Remove and Dispose of Spent Fuel Storage Racks	\$124	\$281	\$1,683	\$0	\$480	\$2,569
8.08	Segment and Dispose of Drywell Head	\$142	\$31	\$49	\$0	\$51	\$274
8.09	Reflood RPV and Steam Separator Pool for RVI Segmentation	\$129	\$80	\$0	\$0	\$48	\$257
8.10	Remove and Dispose of Rx Head	\$151	\$26	\$757	\$0	\$271	\$1,205
8.11	Test Special Cutting and Handling Equipment and Train Operators	\$1,335	\$217	\$0	\$0	\$202	\$1,753
8.12	Finalize Internals and Vessel Segmenting Details	\$23	\$0	\$0	\$0	\$3	\$26
8.13	Segment, Package and Ship Reactor Internals	\$4,247	\$1,449	\$12,486	\$0	\$5,578	\$23,760
8.14	RVI GTCC Waste Transportation and Disposal	\$0	\$0	\$5,674	\$2,288	\$1,648	\$9,610
8.15	Construct New Change Rooms, Hot Laundry, Waste Staging Area	\$0	\$1,192	\$0	\$0	\$179	\$1,371
8.16	Modify Containment Access	\$454	\$837	\$0	\$0	\$194	\$1,484
8.17	Upgrade Rail Spur	\$0	\$0	\$0	\$2,410	\$362	\$2,772
8.18	Install Truck Radiological Monitoring System	\$0	\$0	\$0	\$500	\$75	\$575
Distributed	Subtotal	\$10,397	\$9,397	\$20,649	\$24,944	\$13,395	\$78,782
Undistributed							
1.01	Utility Staff	\$12,716	\$0	\$0	\$0	\$1,653	\$14,369
1.02	Utility Staff HP Supplies	\$0	\$533	\$0	\$0	\$80	\$613
1.03	Security	\$510	\$0	\$0	\$0	\$76	\$586
1.04	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$432	\$65	\$497
1.05	Non-Nuclear Insurance	\$0	\$0	\$0	\$62	\$9	\$71
1.06	Property Taxes	\$0	\$0	\$0	\$34	\$5	\$39

Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
1.07	NRC Annual Fees - LT	\$0	\$0	\$0	\$629	\$94	\$723
1.08	Materials and Services	\$0	\$1,880	\$0	\$0	\$282	\$2,162
1.09	Energy	\$0	\$0	\$0	\$727	\$109	\$836
1.10	Environmental Permits and Fees	\$0	\$0	\$0	\$11	\$2	\$12
1.11	Decommissioning General Contractor Staff	\$18,350	\$0	\$0	\$0	\$2,386	\$20,736
1.12	DGC HP Supplies	\$0	\$598	\$0	\$0	\$90	\$687
1.13	DAW Disposal	\$0	\$0	\$127	\$0	\$19	\$146
1.16	Workers Comprehensive Insurance	\$0	\$20	\$0	\$0	\$3	\$23
Undistributed	Subtotal	\$31,576	\$3,031	\$127	\$1,894	\$4,873	\$41,501
Decon Pd 8	Subtotal	\$41,973	\$12,428	\$20,776	\$26,838	\$18,267	\$120,283

Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
Decon Pd 9 Major Component and Systems Removal Distributed							
9.01	Procure Non-Engineered Standard Equipment	\$0	\$8,303	\$0	\$0	\$1,079	\$9,382
9.02	NRC Review and Approval of License Termination Plan	\$0	\$0	\$0	\$1,078	\$140	\$1,218
9.03	Remove, Package and Dispose of Non-Essential Systems	\$12,884	\$3,111	\$12,412	\$0	\$6,534	\$34,941
9.04	Perform Asbestos Abatement on Plant Systems	\$750	\$319	\$1,096	\$0	\$498	\$2,663
9.05	Removal and Disposal of Off Gas System Adsorber	\$28	\$28	\$3,175	\$0	\$743	\$3,974
9.06	Segment, Package and Dispose of Nuclear Steam Supply System	\$4,432	\$1,445	\$39,047	\$0	\$10,333	\$55,257
9.07	Remove, Package and Dispose of Remaining Active Plant Systems	\$4,379	\$1,359	\$4,451	\$0	\$2,344	\$12,533
9.08	Remove and Dispose of Control Rod Drives	\$330	\$79	\$1,585	\$0	\$458	\$2,452
9.09	Remove and Dispose of Shield Plugs, Pool Plugs and Stud Tensioners	\$82	\$58	\$1,774	\$0	\$440	\$2,354
9.10	Reactor Vessel Insulation Removal and Disposal	\$123	\$21	\$384	\$0	\$122	\$650
9.11	Segment, Package and Ship Reactor Pressure Vessel	\$3,328	\$1,394	\$5,761	\$0	\$3,425	\$13,908
9.12	Drain Dryer Separator Pool and Process Liquid Waste	\$0	\$0	\$0	\$0	\$0	\$0
9.13	Transportation and Disposal of Liquid Radwaste Filters and Resins	\$13	\$103	\$272	\$0	\$89	\$477
9.14	Removal and Disposal of Sacrificial Shield Wall and Reactor Pedestal	\$399	\$606	\$974	\$0	\$455	\$2,433
9.15	Segment, Package and Dispose of Refueling Bridge	\$60	\$13	\$313	\$0	\$89	\$475
9.16	Removal and Disposal of Lead Shielding	\$29	\$8	\$181	\$0	\$50	\$267
Distributed	Subtotal	\$26,836	\$16,847	\$71,426	\$1,078	\$26,799	\$142,987
Undistributed							
1.01	Utility Staff	\$18,319	\$0	\$0	\$0	\$2,381	\$20,701
1.02	Utility Staff HP Supplies	\$0	\$1,648	\$0	\$0	\$247	\$1,895
1.03	Security	\$689	\$0	\$0	\$0	\$103	\$792
1.04	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$584	\$88	\$672
1.05	Non-Nuclear Insurance	\$0	\$0	\$0	\$84	\$13	\$96
1.06	Property Taxes	\$0	\$0	\$0	\$46	\$7	\$53
1.07	NRC Annual Fees - LT	\$0	\$0	\$0	\$850	\$128	\$978
1.08	Materials and Services	\$0	\$2,813	\$0	\$0	\$422	\$3,235

Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
1.09	Energy	\$0	\$0	\$0	\$834	\$125	\$960
1.10	Environmental Permits and Fees	\$0	\$0	\$0	\$15	\$2	\$17
1.11	Decommissioning General Contractor Staff	\$39,987	\$0	\$0	\$0	\$5,198	\$45,186
1.12	DGC HP Supplies	\$0	\$2,807	\$0	\$0	\$421	\$3,228
1.13	DAW Disposal	\$0	\$0	\$247	\$0	\$37	\$284
1.16	Workers Comprehensive Insurance	\$0	\$30	\$0	\$0	\$5	\$35
Undistributed	Subtotal	\$58,995	\$7,298	\$247	\$2,413	\$9,177	\$78,131
Decon Pd 9	Subtotal	\$85,831	\$24,146	\$71,674	\$3,491	\$35,976	\$221,117

Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
Decon Pd 10 Building Decontamination							
Distributed							
10.01	Procure Non-Engineered Standard Equipment	\$0	\$1,453	\$0	\$0	\$189	\$1,642
10.02	Decon Reactor Building	\$4,057	\$3,031	\$9,241	\$0	\$3,756	\$20,085
10.03	Decon Turbine Building	\$745	\$1,046	\$771	\$0	\$589	\$3,151
10.04	Decon Radwaste Building	\$162	\$201	\$253	\$0	\$142	\$758
10.05	Decon HPCI and RCIC Building	\$35	\$53	\$35	\$0	\$29	\$152
10.06	Decon Administration Building	\$13	\$7	\$14	\$0	\$8	\$42
10.07	Decon Off-Gas Retention Building	\$60	\$25	\$29	\$0	\$26	\$141
10.08	Decon Low Level Radwaste Storage and Processing	\$287	\$426	\$361	\$0	\$247	\$1,321
10.09	Decon Off-Gas Stack	\$69	\$53	\$188	\$0	\$71	\$382
10.10	Segment, Package and Dispose of Contaminated Decon Equipment and Tooling	\$24	\$6	\$172	\$0	\$46	\$249
10.11	Remove Underground Storm Drains and Manholes	\$33	\$30	\$45	\$0	\$25	\$133
10.12	Transportation and Disposal of Liquid Radwaste Filters and Resins	\$13	\$3	\$272	\$0	\$66	\$354
10.13	Demolish Waste Staging Area	\$543	\$322	\$2,441	\$0	\$761	\$4,067
10.14	Final Status Survey for Structures	\$4,564	\$4,377	\$0	\$1,087	\$1,304	\$11,332
10.15	Final Status Survey for Land Areas	\$712	\$392	\$0	\$0	\$144	\$1,248
Distributed	Subtotal	\$11,318	\$11,426	\$13,823	\$1,087	\$7,402	\$45,056
Undistributed							
1.01	Utility Staff	\$13,175	\$0	\$0	\$0	\$1,713	\$14,888
1.02	Utility Staff HP Supplies	\$0	\$1,457	\$0	\$0	\$219	\$1,675
1.03	Security	\$609	\$0	\$0	\$0	\$91	\$700
1.04	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$516	\$77	\$594
1.05	Non-Nuclear Insurance	\$0	\$0	\$0	\$74	\$11	\$85
1.06	Property Taxes	\$0	\$0	\$0	\$41	\$6	\$47
1.07	NRC Annual Fees - LT	\$0	\$0	\$0	\$751	\$113	\$864
1.08	Materials and Services	\$0	\$2,099	\$0	\$0	\$315	\$2,414
1.09	Energy	\$0	\$0	\$0	\$690	\$104	\$794

**Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC**

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
1.10	Environmental Permits and Fees	\$0	\$0	\$0	\$13	\$2	\$15
1.11	Decommissioning General Contractor Staff	\$29,651	\$0	\$0	\$0	\$3,855	\$33,506
1.12	DGC HP Supplies	\$0	\$2,071	\$0	\$0	\$311	\$2,382
1.13	DAW Disposal	\$0	\$0	\$168	\$0	\$25	\$194
1.16	Workers Comprehensive Insurance	\$0	\$23	\$0	\$0	\$3	\$26
Undistributed	Subtotal	\$43,435	\$5,650	\$168	\$2,086	\$6,844	\$58,184
Decon Pd 10	Subtotal	\$54,754	\$17,076	\$13,991	\$3,173	\$14,246	\$103,240
Decon Pd 11	License Termination						
Distributed							
11.01	Prepare Final Status Survey Report	\$64	\$2	\$0	\$0	\$9	\$74
11.02	NRC Review and Approval of FSS Report	\$0	\$0	\$0	\$539	\$70	\$609
Distributed	Subtotal	\$64	\$2	\$0	\$539	\$79	\$683
Undistributed							
1.01	Utility Staff	\$828	\$0	\$0	\$0	\$108	\$936
1.03	Security	\$267	\$0	\$0	\$0	\$40	\$307
1.04	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$226	\$34	\$260
1.05	Non-Nuclear Insurance	\$0	\$0	\$0	\$16	\$2	\$19
1.06	Property Taxes	\$0	\$0	\$0	\$18	\$3	\$20
1.07	NRC Annual Fees - LT	\$0	\$0	\$0	\$141	\$21	\$162
1.08	Materials and Services	\$0	\$185	\$0	\$0	\$28	\$213
1.09	Energy	\$0	\$0	\$0	\$4	\$1	\$5
1.11	Decommissioning General Contractor Staff	\$1,632	\$0	\$0	\$0	\$212	\$1,844
1.16	Workers Comprehensive Insurance	\$0	\$2	\$0	\$0	\$0	\$2
Undistributed	Subtotal	\$2,727	\$187	\$0	\$405	\$449	\$3,768
Decon Pd 11	Subtotal	\$2,791	\$189	\$0	\$944	\$527	\$4,451
A. License Termination	Subtotal	\$312,486	\$90,346	\$128,277	\$88,768	\$104,811	\$724,688

**Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC**

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
B. Spent Fuel							
SNF Pd 1 Spent Fuel Planning							
Distributed							
12.01	Prepare Irradiated Fuel Management Plan	\$101	\$1	\$0	\$0	\$13	\$115
12.02	Submit ER to Allow Spent Fuel Costs to Taken From DTF	\$0	\$0	\$0	\$0	\$0	\$0
12.03	Design Spent Fuel Storage Security Modifications	\$50	\$0	\$0	\$0	\$7	\$57
Distributed	Subtotal	\$151	\$1	\$0	\$0	\$20	\$172
Undistributed							
2.01	Utility Staff	\$240	\$0	\$0	\$0	\$31	\$271
2.13	Workers Comprehensive Insurance	\$0	\$0	\$0	\$0	\$0	\$0
Undistributed	Subtotal	\$240	\$0	\$0	\$0	\$31	\$272
SNF Pd 1	Subtotal	\$391	\$1	\$0	\$0	\$51	\$443

Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
SNF Pd 2 Spent Fuel Cooling During Zirc Fire Window							
Distributed							
13.01	Implement Spent Fuel Pool Security Modifications	\$50	\$250	\$0	\$0	\$45	\$345
Distributed	Subtotal	\$50	\$250	\$0	\$0	\$45	\$345
Undistributed							
2.01	Utility Staff	\$524	\$0	\$0	\$0	\$68	\$592
2.02	Utility Staff HP Supplies	\$0	\$171	\$0	\$0	\$26	\$197
2.03	Security	\$5,679	\$0	\$0	\$0	\$852	\$6,531
2.04	Spent Fuel Pool Operations Staff	\$6,084	\$0	\$0	\$0	\$791	\$6,875
2.05	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$812	\$122	\$934
2.09	Materials and Services	\$0	\$576	\$0	\$0	\$86	\$662
2.10	Emergency Preparedness Fees	\$0	\$0	\$0	\$961	\$144	\$1,105
2.11	EPlan On-Call Shift Pay	\$0	\$76	\$0	\$0	\$11	\$88
2.13	Workers Comprehensive Insurance	\$0	\$25	\$0	\$0	\$4	\$28
2.14	Spent Fuel Maintenance	\$0	\$0	\$0	\$500	\$75	\$575
2.15	Energy	\$0	\$0	\$0	\$431	\$65	\$495
2.17	DAW Disposal	\$0	\$0	\$4	\$0	\$1	\$5
Undistributed	Subtotal	\$12,287	\$848	\$4	\$2,704	\$2,244	\$18,087
SNF Pd 2	Subtotal	\$12,337	\$1,098	\$4	\$2,704	\$2,289	\$18,432

Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
SNF Pd 3	Spent Fuel Transfer to Dry Storage						
Distributed							
14.01	Construct ISFSI Phase 2 and 3 Pad Expansion	\$0	\$0	\$0	\$2,250	\$338	\$2,588
14.02	Spent Fuel Pool to Pad Transfer	\$0	\$49,208	\$0	\$16,948	\$9,923	\$76,079
14.03	Construct ISFSI Monitoring Building	\$0	\$0	\$0	\$2,000	\$300	\$2,300
Distributed	Subtotal	\$0	\$49,208	\$0	\$21,198	\$10,561	\$80,967
Undistributed							
2.01	Utility Staff	\$961	\$0	\$0	\$0	\$125	\$1,086
2.02	Utility Staff HP Supplies	\$0	\$315	\$0	\$0	\$47	\$362
2.03	Security	\$10,425	\$0	\$0	\$0	\$1,564	\$11,989
2.04	Spent Fuel Pool Operations Staff	\$11,167	\$0	\$0	\$0	\$1,452	\$12,619
2.05	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$509	\$76	\$585
2.09	Materials and Services	\$0	\$1,057	\$0	\$0	\$159	\$1,215
2.11	EPlan On-Call Shift Pay	\$0	\$140	\$0	\$0	\$21	\$161
2.13	Workers Comprehensive Insurance	\$0	\$45	\$0	\$0	\$7	\$52
2.14	Spent Fuel Maintenance	\$0	\$0	\$0	\$917	\$138	\$1,055
2.15	Energy	\$0	\$0	\$0	\$930	\$139	\$1,069
2.17	DAW Disposal	\$0	\$0	\$8	\$0	\$1	\$9
Undistributed	Subtotal	\$22,554	\$1,557	\$8	\$2,356	\$3,729	\$30,203
SNF Pd 3	Subtotal	\$22,554	\$50,765	\$8	\$23,554	\$14,289	\$111,169

Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
SNF Pd 4 Dry Storage During Completion of SAFSTOR Preparations							
Undistributed							
2.03	Security	\$2,031	\$0	\$0	\$0	\$305	\$2,336
2.05	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$219	\$33	\$252
2.08	NRC Annual Fees - SNF	\$0	\$0	\$0	\$33	\$5	\$38
2.09	Materials and Services	\$0	\$128	\$0	\$0	\$19	\$147
2.13	Workers Comprehensive Insurance	\$0	\$5	\$0	\$0	\$1	\$6
2.14	Spent Fuel Maintenance	\$0	\$0	\$0	\$115	\$17	\$132
2.15	Energy	\$0	\$0	\$0	\$26	\$4	\$30
Undistributed	Subtotal	\$2,031	\$133	\$0	\$393	\$384	\$2,941
SNF Pd 4	Subtotal	\$2,031	\$133	\$0	\$393	\$384	\$2,941
SNF Pd 5 Dry Storage During Dormancy							
Distributed							
16.01	Spent Fuel Transfer to DOE	\$0	\$0	\$0	\$6,628	\$994	\$7,622
Distributed	Subtotal	\$0	\$0	\$0	\$6,628	\$994	\$7,622
Undistributed							
2.03	Security	\$77,828	\$0	\$0	\$0	\$11,674	\$89,502
2.05	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$8,393	\$1,259	\$9,651
2.08	NRC Annual Fees - SNF	\$0	\$0	\$0	\$1,265	\$190	\$1,455
2.09	Materials and Services	\$0	\$4,885	\$0	\$0	\$733	\$5,618
2.13	Workers Comprehensive Insurance	\$0	\$210	\$0	\$0	\$31	\$241
2.14	Spent Fuel Maintenance	\$0	\$0	\$0	\$4,406	\$661	\$5,067
2.15	Energy	\$0	\$0	\$0	\$2,109	\$316	\$2,426
Undistributed	Subtotal	\$77,828	\$5,095	\$0	\$16,172	\$14,864	\$113,959
SNF Pd 5	Subtotal	\$77,828	\$5,095	\$0	\$22,801	\$15,858	\$121,582

Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
SNF Pd 7	ISFSI and Support Structure Clean Demolition						
Distributed							
18.01	Clean Demolition of ISFSI	\$802	\$990	\$1,351	\$0	\$409	\$3,551
18.02	Demolish ISFSI Support Structures	\$137	\$110	\$115	\$0	\$47	\$409
18.03	Backfill and Grade ISFSI Site	\$23	\$18	\$0	\$0	\$5	\$46
Distributed	Subtotal	\$962	\$1,118	\$1,466	\$0	\$461	\$4,006
Undistributed							
2.01	Utility Staff	\$173	\$0	\$0	\$0	\$23	\$196
2.09	Materials and Services	\$0	\$6	\$0	\$0	\$1	\$6
2.13	Workers Comprehensive Insurance	\$0	\$0	\$0	\$0	\$0	\$0
2.15	Energy	\$0	\$0	\$0	\$45	\$7	\$52
2.16	Decommissioning General Contractor Staff	\$564	\$0	\$0	\$0	\$73	\$637
Undistributed	Subtotal	\$737	\$6	\$0	\$45	\$103	\$892
SNF Pd 7	Subtotal	\$1,699	\$1,124	\$1,466	\$45	\$564	\$4,898
B. Spent Fuel	Subtotal	\$116,840	\$58,216	\$1,478	\$49,496	\$33,436	\$259,466

**Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC**

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
C. Greenfield							
Grn Pd 1 Clean Building Demolition During Decommissioning							
Distributed							
19.01	Prepare Site Restoration Demolition Plan and Schedule	\$108	\$15	\$0	\$0	\$16	\$140
19.02	Obtain Required Demolition Permits	\$28	\$5	\$0	\$10	\$6	\$49
19.03	Clean Building Demolition Equipment	\$0	\$1,086	\$0	\$0	\$163	\$1,249
19.04	Perform Pre-Demolition Asbestos Abatement	\$12	\$145	\$0	\$55	\$32	\$244
19.05	Remove and Dispose of Underground Storage Tanks	\$19	\$27	\$0	\$0	\$6	\$53
19.06	Demolish Non-Essential Structures	\$972	\$670	\$682	\$0	\$302	\$2,626
19.07	Demolish Training Center	\$91	\$46	\$47	\$0	\$24	\$208
19.08	Demolish Plant Support Center and New Site Support Building	\$249	\$159	\$162	\$0	\$74	\$644
19.09	Demolish Cooling Towers and Related Structures	\$741	\$450	\$249	\$0	\$187	\$1,627
19.10	Demolish Existing Waste Water Treatment Plant	\$27	\$7	\$4	\$0	\$5	\$43
19.11	Demolish Intake and Discharge Structures	\$128	\$187	\$33	\$0	\$45	\$393
19.12	Demolish Data Acquisition and Technical Support Building	\$212	\$157	\$147	\$0	\$67	\$584
19.13	Demolish Guard Facility and Security Structures	\$545	\$237	\$184	\$0	\$126	\$1,092
19.14	Demolish Control and Administrative Buildings	\$470	\$329	\$284	\$0	\$141	\$1,223
19.15	Demolish Turbine Building	\$2,366	\$1,162	\$206	\$0	\$485	\$4,219
19.16	Demolish Low-Level Radwaste Building	\$1,413	\$1,360	\$826	\$0	\$468	\$4,068
19.17	Demolish HPCI and RCIC Building	\$179	\$79	\$9	\$0	\$35	\$302
19.18	Demolish Reactor Building	\$3,078	\$1,902	\$401	\$0	\$699	\$6,080
19.19	Demolish Off-Gas Stack	\$78	\$96	\$24	\$0	\$26	\$224
19.20	Demolish Misc Foundations	\$61	\$78	\$126	\$0	\$34	\$300
Distributed	Subtotal	\$10,779	\$8,198	\$3,383	\$65	\$2,941	\$25,367
Undistributed							
3.01	Utility Staff	\$768	\$0	\$0	\$0	\$100	\$868
3.03	Energy	\$0	\$0	\$0	\$117	\$17	\$134
3.04	Decommissioning General Contractor Staff	\$6,837	\$0	\$0	\$0	\$1,026	\$7,863

Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
3.06	Workers Comprehensive Insurance	\$0	\$1	\$0	\$0	\$0	\$1
Undistributed	Subtotal	\$7,606	\$1	\$0	\$117	\$1,143	\$8,866
Grn Pd 1	Subtotal	\$18,384	\$8,200	\$3,383	\$181	\$4,084	\$34,233
Grn Pd 2	Site Restoration						
Distributed							
20.01	Site Restoration Equipment	\$0	\$171	\$0	\$0	\$22	\$193
20.02	Remove Temporary Structures	\$11	\$9	\$0	\$0	\$3	\$23
20.03	Finish Grading and Re-Vegetate Site	\$440	\$354	\$0	\$0	\$103	\$898
Distributed	Subtotal	\$452	\$535	\$0	\$0	\$128	\$1,114
Undistributed							
3.01	Utility Staff	\$147	\$0	\$0	\$0	\$19	\$167
3.02	Security	\$129	\$0	\$0	\$0	\$19	\$149
3.04	Decommissioning General Contractor Staff	\$681	\$0	\$0	\$0	\$102	\$783
3.06	Workers Comprehensive Insurance	\$0	\$1	\$0	\$0	\$0	\$1
Undistributed	Subtotal	\$958	\$1	\$0	\$0	\$141	\$1,099
Grn Pd 2	Subtotal	\$1,409	\$535	\$0	\$0	\$269	\$2,214
C. Greenfield	Subtotal	\$19,794	\$8,735	\$3,383	\$181	\$4,353	\$36,447

**Table 1
Duane Arnold SAFSTOR, 2030 DOE Acceptance, Utility and DGC**

Decommissioning Alternative	SAFSTOR	License Status	Early Shutdown	Unit 1 Shut Down:	10/30/2020
Spent Fuel Alternative	Dry	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
		Repository Opening Date:	1/1/2030		

2018 Dollars in Thousands

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
D. ISFSI D&D							
ISFSI D&D Pd 1 ISFSI D&D Planning							
Distributed							
21.01	Preparation of ISFSI Portion of LTP	\$185	\$0	\$0	\$0	\$24	\$209
21.02	NRC Review of ISFSI Portion LTP	\$0	\$0	\$0	\$44	\$6	\$50
Distributed	Subtotal	\$185	\$0	\$0	\$44	\$30	\$259
Undistributed							
4.01	Utility Staff	\$556	\$0	\$0	\$0	\$72	\$628
Undistributed	Subtotal	\$556	\$0	\$0	\$0	\$72	\$628
ISFSI D&D Pd	Subtotal	\$741	\$0	\$0	\$44	\$102	\$887
ISFSI D&D Pd 2 ISFSI Final Status Survey							
Distributed							
22.01	Final Status Survey of ISFSI	\$144	\$50	\$0	\$0	\$25	\$220
22.02	Preparation of FSS Report and NRC Review	\$101	\$0	\$0	\$33	\$17	\$151
Distributed	Subtotal	\$245	\$50	\$0	\$33	\$43	\$371
Undistributed							
4.01	Utility Staff	\$338	\$0	\$0	\$0	\$44	\$382
Undistributed	Subtotal	\$338	\$0	\$0	\$0	\$44	\$382
ISFSI D&D Pd	Subtotal	\$584	\$50	\$0	\$33	\$87	\$754
D. ISFSI D&D	Subtotal	\$1,324	\$50	\$0	\$77	\$189	\$1,640
	Total	\$450,444	\$157,346	\$133,138	\$138,523	\$142,789	\$1,022,240

Appendix E

Annual Cost by Account Table

Duane Arnold Annual Cost By Account

SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Unit No: Unit 1

2018 Dollars in Thousands

Year	License Termination	Spent Fuel	Site Restoration	ISFSI Demolition	Total
2019	\$4,099	\$233	\$0	\$0	\$4,331
2020	\$36,182	\$3,324	\$0	\$0	\$39,506
2021	\$43,735	\$19,105	\$0	\$0	\$62,840
2022	\$15,949	\$57,546	\$0	\$0	\$73,495
2023	\$5,110	\$50,910	\$0	\$0	\$56,020
2024	\$14,895	\$3,222	\$0	\$0	\$18,117
2025	\$5,604	\$3,233	\$0	\$0	\$8,837
2026	\$2,201	\$3,233	\$0	\$0	\$5,434
2027	\$1,827	\$3,233	\$0	\$0	\$5,060
2028	\$1,827	\$3,233	\$0	\$0	\$5,060
2029	\$1,827	\$3,233	\$0	\$0	\$5,060
2030	\$1,884	\$3,233	\$0	\$0	\$5,117
2031	\$1,770	\$3,233	\$0	\$0	\$5,003
2032	\$1,770	\$3,504	\$0	\$0	\$5,274
2033	\$1,770	\$3,507	\$0	\$0	\$5,277
2034	\$1,770	\$3,507	\$0	\$0	\$5,277
2035	\$1,770	\$3,507	\$0	\$0	\$5,277
2036	\$1,770	\$3,507	\$0	\$0	\$5,277
2037	\$1,770	\$3,507	\$0	\$0	\$5,277
2038	\$1,770	\$3,507	\$0	\$0	\$5,277
2039	\$1,770	\$3,507	\$0	\$0	\$5,277
2040	\$2,411	\$3,507	\$0	\$0	\$5,918
2041	\$1,770	\$3,507	\$0	\$0	\$5,277
2042	\$1,770	\$3,507	\$0	\$0	\$5,277
2043	\$1,770	\$3,507	\$0	\$0	\$5,277
2044	\$1,770	\$3,507	\$0	\$0	\$5,277
2045	\$1,770	\$3,507	\$0	\$0	\$5,277
2046	\$1,770	\$3,507	\$0	\$0	\$5,277
2047	\$1,770	\$3,507	\$0	\$0	\$5,277
2048	\$1,770	\$3,507	\$0	\$0	\$5,277
2049	\$1,770	\$3,507	\$0	\$0	\$5,277
2050	\$1,770	\$3,507	\$0	\$0	\$5,277
2051	\$1,770	\$3,507	\$0	\$0	\$5,277
2052	\$1,770	\$3,507	\$0	\$0	\$5,277
2053	\$1,770	\$3,507	\$0	\$0	\$5,277
2054	\$2,055	\$3,507	\$0	\$0	\$5,562

Duane Arnold Annual Cost By Account

SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Unit No: Unit 1

2018 Dollars in Thousands

Year	License Termination	Spent Fuel	Site Restoration	ISFSI Demolition	Total
2055	\$2,126	\$3,507	\$0	\$0	\$5,633
2056	\$1,770	\$3,507	\$0	\$0	\$5,277
2057	\$1,770	\$3,507	\$0	\$0	\$5,277
2058	\$1,770	\$3,507	\$0	\$0	\$5,277
2059	\$2,159	\$2,909	\$0	\$0	\$5,069
2060	\$3,077	\$0	\$0	\$0	\$3,077
2061	\$2,634	\$0	\$0	\$0	\$2,634
2062	\$2,634	\$0	\$0	\$0	\$2,634
2063	\$2,634	\$0	\$0	\$0	\$2,634
2064	\$2,634	\$0	\$0	\$0	\$2,634
2065	\$2,634	\$0	\$0	\$0	\$2,634
2066	\$2,634	\$0	\$0	\$0	\$2,634
2067	\$2,634	\$0	\$0	\$0	\$2,634
2068	\$2,634	\$0	\$0	\$0	\$2,634
2069	\$2,634	\$0	\$0	\$0	\$2,634
2070	\$2,634	\$0	\$0	\$0	\$2,634
2071	\$2,634	\$0	\$0	\$0	\$2,634
2072	\$2,634	\$0	\$0	\$0	\$2,634
2073	\$15,440	\$0	\$0	\$0	\$15,440
2074	\$32,608	\$0	\$0	\$0	\$32,608
2075	\$78,197	\$0	\$0	\$184	\$78,381
2076	\$94,001	\$0	\$0	\$403	\$94,404
2077	\$118,359	\$25	\$0	\$303	\$118,688
2078	\$101,052	\$4,873	\$6,212	\$731	\$112,868
2079	\$57,385	\$0	\$27,813	\$19	\$85,217
2080	\$4,828	\$0	\$2,422	\$0	\$7,250
Total	\$724,688	\$259,466	\$36,447	\$1,640	\$1,022,240