NEXTera ENERGY
DUANE ARNOLD

April 2, 2020

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U.S. Nuclear Regulatory Commission
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Washington, DC 20555-0001

Duane Arnold Energy Center
Renewed Facility Operating License No. DPR-49
Docket No. 50-331
Post Shutdown Decommissioning Activities Report

Reference: Letter from NEDA (D. Curtland) to USNRC, "Certification of Permanent Cessation of Power Operations," NG-19-0136, dated March 2, 2020 (ML20062E489)

Pursuant to 10 CFR 50.82(a)(4), NextEra Energy Duane Arnold, LLC (NEDA), on behalf of itself and Central Iowa Power Cooperative and Corn Belt Power Cooperative, is submitting a Post Shutdown Decommissioning Activities Report (PSDAR) for the Duane Arnold Energy Center (DAEC). In the referenced letter, NEDA notified the NRC of its intention to permanently cease power operations at DAEC on October 30, 2020.

The enclosed PSDAR has been developed consistent with Regulatory Guide 1.185, Revision 1, "Standard Format and Content for Post-Shutdown Decommissioning Activities Report." The PSDAR includes a description of the planned decommissioning activities, schedule for their accomplishment, a site-specific decommissioning cost estimate, and a discussion that provides the basis for concluding that the environmental impacts associated with site-specific decommissioning activities will be bounded by appropriate, previously issued, environmental impact statements. The PSDAR also includes a discussion of the schedule and projected costs associated with spent fuel management and site restoration activities. Funding for spent fuel management activities is being addressed in a separate submittal as an update to the DAEC Spent Fuel Management Plan, pursuant to 10 CFR 50.54(bb).

In accordance with 10 CFR 50.82(a)(4)(i), a copy of the DAEC PSDAR is being provided to the designated State of Iowa official.

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

Enclosure

cc: Regional Administrator, USNRC, Region III
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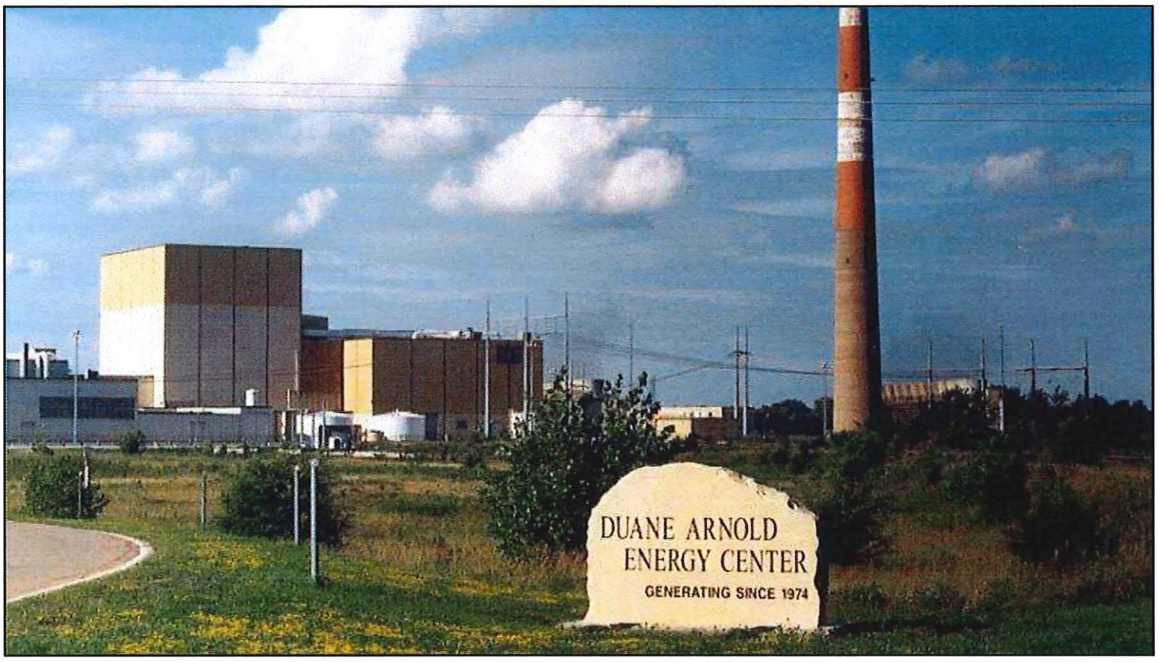

POST-SHUTDOWN DECOMMISSIONING ACTIVITIES REPORT

DUANE ARNOLD ENERGY CENTER

April 2, 2020

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ACRONYMS

ALARA	As Low As Reasonably Achievable
D&D	Decontamination and Dismantlement activities
DAEC	Duane Arnold Energy Center. Also see NEDA.
DCE	Decommissioning Cost Estimate
DOE	Department of Energy
DTF	Decommissioning Trust Fund
EPA	Environmental Protection Agency
FSS	Final Status Survey, also referred to as Final Status (radiation) Survey
GEIS	Generic Environmental Impact Statement (NUREG-0586)
GTCC	Greater Than Class C (waste)
GW	Ground Water
ISFSI	Independent Spent Fuel Storage Installation
LLRW	Low Level Radioactive Waste
LLRWSF	Low Level Radioactive Waste Storage Facility
LTP	License Termination Plan
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
NEDA	NextEra Energy Duane Arnold, LLC. Also see DAEC.
NEI	Nuclear Energy Institute
NRC	Nuclear Regulatory Commission
ODAM	Offsite Dose Assessment Manual
OSHA	Occupational Safety and Health Administration
REMP	Radiological Environmental Monitoring Program
SAFSTOR	Safe Storage
SEIS	Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437), Supplement 42, "Regarding Duane Arnold Energy Center" (referred to as the "Supplemental Environmental Impact Statement")
SHPO	State Historical Preservation Office
TS	Technical Specifications
UFSAR	Updated Final Safety Analysis Report

1.0 INTRODUCTION AND SUMMARY

1.1 INTRODUCTION

In accordance with the requirements of Title 10 of the Code of Federal Regulations (CFR) 50.82, "Termination of license," paragraph (a)(4)(i), this report constitutes the Post-Shutdown Decommissioning Activities Report (PSDAR) for the Duane Arnold Energy Center (DAEC). This PSDAR contains the following:

1. A description of the planned decommissioning activities along with a schedule for their accomplishment.

2. A discussion that provides the reasons for concluding that the environmental impacts associated with site-specific decommissioning activities will be bounded by appropriate previously issued environmental impact statements.

3. A site-specific decommissioning cost estimate (DCE), including the projected cost of managing irradiated fuel and the post-decommissioning site restoration cost.

The PSDAR has been developed consistent with Regulatory Guide 1.185, "Standard Format and Content for Post-Shutdown Decommissioning Activities Report," (Reference 1). This report is based on currently available information and the plans discussed herein may be modified as additional information becomes available or conditions change. As required by 10 CFR 50.82(a)(7), NextEra Energy Duane Arnold (NEDA) will notify the Nuclear Regulatory Commission (NRC) in writing, with copies sent to the State of Iowa, before performing any decommissioning activity inconsistent with, or making any significant schedule change from, those actions and schedules described in the PSDAR, including changes that significantly increase the decommissioning cost.

1.2 BACKGROUND

DAEC is located adjacent to the Cedar River approximately 2.5 miles northeast of the town of Palo, Iowa. The closest major city is Cedar Rapids with its outer boundary 8 miles to the southeast. The site, containing approximately 500 acres, is entirely owned by NEDA.

DAEC employs a General Electric boiling water reactor nuclear steam supply system licensed to generate 1,912 megawatts - thermal (MWth). The principal structures of DAEC are the reactor and turbine buildings, radwaste building, low-level radwaste storage facility, intake structure, switchyard, offgas stack, pump house, cooling towers, and administration buildings.

On January 27, 2006, FPL Energy Duane Arnold, LLC (a wholly owned subsidiary of FPL Energy) purchased 70% ownership of DAEC from Interstate Power & Light company. Operating authority was also transferred from Nuclear Management Company to FPL Duane Arnold, LLC. On April 16, 2009, the name "FPL Energy Duane Arnold, LLC" was legally changed to "NextEra Energy Duane Arnold, LLC." The current operating license for DAEC will expire on midnight February 21, 2034.

On July 27, 2018, NextEra Energy Duane Arnold (NEDA) announced its plans to cease operation of DAEC in the fourth quarter of 2020. On January 18, 2019, NEDA formally notified the Nuclear Regulatory Commission of its intent to cease operation (Reference 2).

1.3 SUMMARY OF DECOMMISSIONING ALTERNATIVES

The NRC has evaluated the environmental impacts of three general methods for decommissioning power reactor facilities in NUREG-0586, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors," (GEIS) (Reference 3). The three general methods evaluated are summarized as follows:

- 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 shortly after cessation of operations.

- SAFSTOR: After the plant is shut down and defueled, 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. During SAFSTOR, a facility is left intact or may be partially dismantled, but the fuel is removed from the reactor vessel and radioactive liquids are drained from systems and components and then processed. Radioactive decay occurs during the SAFSTOR period, thereby reducing the quantity of contamination and radioactivity that must be disposed of during decontamination and dismantlement.

- ENTOMB: Radioactive structures, systems and components (SSCs) are encased in a structurally long-lived substance, such as concrete. The entombed structure is appropriately maintained, and continued surveillance is carried out until the radioactivity decays to a level that permits termination of the license.

2.0 DESCRIPTION OF PLANNED DECOMMISSIONING ACTIVITIES

2.1 DETAILED DESCRIPTION

NEDA will commence decommissioning of the DAEC after final plant shutdown on October 30, 2020. A list of milestone events in the decommissioning process is shown in Table 2.1. NEDA currently plans to decommission the DAEC using the SAFSTOR method. SAFSTOR is broadly defined in Section 1.3 of this report. Use of the SAFSTOR method will include management of the spent fuel on site. This is necessary because the DOE has not, yet, met its obligations to remove and take possession of the spent fuel. To explain the basis for projecting the cost of managing spent nuclear fuel, a discussion of spent fuel management activities for the site is included herein.

The initial decommissioning activities to be performed after plant shutdown will entail preparing the plant for a period of safe-storage (also referred to as dormancy). This will include de-fueling the reactor and transferring the fuel into the Spent Fuel Pool; draining fluids and de-energizing systems; reconfiguring the electrical distribution, ventilation, heating, and fire protection systems; and minor deconstruction activities. Systems needed for continued operation of the Spent Fuel Pool may be reconfigured for operational efficiency. The dormancy period will begin when the buildings and systems have been sufficiently prepared for long-term safe storage and all spent fuel has been transferred to the Independent Spent Fuel Storage Installation (ISFSI) for dry storage.

During dormancy, the DAEC will be staffed with personnel that will monitor, maintain, and provide security for the ISFSI and plant facilities. Staffing and configuration requirements are expected to change during the phases of the decommissioning process for transitioning to dormancy. The required staffing levels during this transition period are principally dependent upon the status of the spent fuel being stored on-site. This can be characterized as one of three spent fuel conditions, as follows:

- Wet and dry storage of spent fuel
- On-site dry storage of all spent fuel
- No fuel on site

Spent fuel will remain in the Spent Fuel Pool until it meets the criteria for transfer, and the spent fuel can be transferred in an efficient manner to the ISFSI. After all fuel has been transferred to the ISFSI, the pool and supporting systems will be drained and de-energized for the remainder of the dormancy period. The spent fuel will be stored in the ISFSI until transfer to the DOE.

Decontamination and dismantlement (D&D) activities will be scheduled to enable the license to be terminated within 60 years after permanent cessation of operations. Following completion of the D&D activities and termination of the NRC license, site restoration will be performed to a condition such that the site may be re-used for beneficial purposes.

For the purposes of a current decommissioning cost estimate, it is assumed that remaining structures are to be demolished and the site restored to an appropriately graded and vegetated condition (green field).

Decommissioning activities will be performed in accordance with written, reviewed, and approved site procedures. There are no identified or anticipated decommissioning activities that are unique to the DAEC site outside the bounds considered in the GEIS.

Radiological and environmental programs will be maintained throughout the decommissioning process to ensure occupational, public health and safety, and environmental compliance. Radiological programs will be conducted in accordance with the facility's revised Technical Specifications, Facility Operating License, Updated Final Safety Analysis Report (UFSAR), Radiological Environmental Monitoring Program (REMP), and the Offsite Dose Assessment Manual (ODAM). Non-radiological Environmental Programs will be conducted in accordance with applicable requirements and permits.

Tables 2.1 and 2.2 provide summaries of the schedule/plant status and costs for decommissioning the DAEC. The major decommissioning activities and the general sequence of activities are discussed in more detail in the sections that follow.

Table 2.1

Decommissioning Schedule and Plant Status Summary

Plant Status/Decommissioning Activities	Start	End	Approximate Duration (Years)
Pre-Shutdown			
Pre-Shutdown Planning	Early 2019	October 2020	
Preparations for Dormancy			
Plant Shutdown/Defueling Outage	October 2020	December 2020	0.17
Preparations for Dormancy (completion of SAFSTOR preparations)	January 2020	August 2024	4.56
Fuel Status			
Wet and Dry Fuel Storage	October 2020	August 2023	2.82
Dry Fuel Storage	August 2023	October 2059	36.15
Dormancy With No Fuel On Site	November 2059	September 2080	20.83
Dismantling & Decontamination (D&D)			
Decommissioning Planning	September 2073	March 2075	1.44
Internals Segmentation and Site Preparations	March 2075	July 2076	1.36
Major Components and Systems Removal	July 2076	May 2078	1.83
Building Decontamination	May 2078	January 2080	1.62
License Termination	January 2080	September 2080	0.71
Site Restoration			
Site Restoration	January 2080	May 2080	0.34

Table 2.2
Decommissioning Costs Summary
(Thousands of 2018 dollars)

Decommissioning Periods	License Termination	Spent Fuel Management	Site Restoration
Pre-Shutdown			
Pre-Shutdown Planning	11,509	443	
Transition to Dormancy			
Wet and Dry Fuel Storage	91,762	129,601	
Dry Fuel Storage	19,315	2,941	
Dormancy			
Dormancy Period	102,171	121,582	
Decommissioning Preparations			
Planning for D&D	50,840	1,640	
Decommissioning Operations			
Internals Segmentation and Site Preparations	120,283		
Major Component and Systems Removal and ISFSI demolition	221,117	4,898	
Building Decontamination	103,240		
License Termination	4,451		
Site Restoration			
Site Restoration			36,447
Totals[a]	724,688	261,106	36,447

[a] Columns may not add due to rounding.

2.2 DISCUSSION OF DECOMMISSIONING ACTIVITIES

The following narrative describes the basic activities associated with decommissioning the DAEC. The site specific DCE (Attachment 1) is divided into phases or periods based upon major milestones within the project or significant changes in the annual projected expenditures. The following sub-sections correspond to the five major decommissioning periods within the estimate.

2.2.1 Preparations for Dormancy

The NRC defines SAFSTOR as, "A method of decommissioning in which a nuclear facility is placed and maintained in a condition that allows the facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use." The facility is left largely intact (during the dormancy period), with most structures maintained in a stable condition. Some outbuildings not related to power production may be removed. While fuel remains in the Fuel Pool, systems that support required functions (such as, spent fuel cooling, HVAC, Emergency Plan, or site security) are maintained operational. Systems that are not required to support required functions are drained, de-energized, and secured. Some cleaning/removal of loose contamination and/or fixation and sealing of remaining contamination is performed and access to contaminated areas is maintained secure to provide controlled access for inspection and maintenance.

The process of placing the plant in safe-storage will include, but is not limited to, the following activities:

- Creation of an organizational structure to support the decommissioning plan and evolving emergency planning and site security requirements.
- Revision of technical specifications, plans and operating procedures appropriate to the operating conditions and requirements.
- Characterization of the facility and major components as may be necessary to plan and prepare for the dormancy phase.
- Management of the Spent Fuel Pool and reconfiguring Fuel Pool support systems so that draining and de-energizing may commence in other areas of the plant.
- Deactivation (de-energizing and or draining) of systems that are no longer required during the dormancy period.
- Processing and disposal of water and water filter and treatment media (resins) not required to support dormancy operation.
- Removal of select structures to improve safety and monitoring.
- Disposition of incidental waste that may be present and is ready to ship prior to the start of the dormancy period, such as excess tools and equipment and waste produced while deactivating systems and preparing the facility for dormancy.
- Reconfiguration of power, lighting, heating, ventilation, fire protection, and any other services needed to support long-term storage and periodic plant surveillance and maintenance.
- Stabilization by fixing or removing loose incidental surface contamination to facilitate future building access and plant maintenance

The following is a general discussion of the planned reconfiguration expected after plant shutdown.

2.2.1.1 Electrical Systems

The electrical systems will undergo a series of reconfigurations between shutdown and the time all spent fuel has been transferred to dry storage. The reconfigurations will be performed to reduce operating and maintenance expenses, while maintaining adequate power for station loads, and backup power for Spent Fuel Pool-related systems and critical security equipment.

2.2.1.2 Mechanical Systems

Following shutdown, as applicable, fluid filled systems will be drained and abandoned, and resins removed based on an evaluation of system category, functionality, and plant configuration. The plant configuration and functionality of each system within the plant configuration as it evolves will determine when a system can be drained and abandoned.

2.2.1.3 Ventilation and Heating Systems

Ventilation will be reconfigured to support remaining systems and habitability. Fluid filled systems will either be drained or have freeze protection installed, with the building heating system secured. The ventilation system will be reconfigured to maintain building temperature to support habitability and to support the function of Fuel Pool Cooling systems, Fire Protection systems, and Security systems while they are required.

2.2.1.4 Fire Protection Systems

Fire Protection systems will be reconfigured based on a fire risk analysis. The fire risk analysis provides a comprehensive evaluation of the facility's fire risk, the fire protection capability to mitigate hazards that pose a risk, and the ability to protect spent fuel and other radioactive materials from potential fire induced releases. The fire risk analysis will be reevaluated and revised as necessary to reflect the unique or different fire protection issues and strategies associated with decommissioning. It is expected that as the plant's systems are drained and the combustible loading footprint shrinks, the Fire Protection requirements will be reduced.

2.2.1.5 Maintenance of Systems Critical to Decommissioning

There are no mechanical systems that will be critical to the final decommissioning process. As such, mechanical systems will be abandoned after all spent fuel has been transferred to Dry Fuel Storage, with the exception of systems required to maintain habitability during dormancy. The site power distribution system will be abandoned with some exceptions, such as motor control centers that are required to support ventilation and lighting.

In order to support final dismantlement of the plant, temporary services, including but not limited to electrical and cranes, will be required.

2.2.2 Dormancy

Activities required during transition to the dormancy period while spent fuel is stored in the Fuel Pool will be substantially different than those activities required during dormancy, when all fuel is in dry fuel storage.

Early activities include operating and maintaining the Spent Fuel Pool and its associated systems, and transferring spent fuel from the pool to the ISFSI. Spent fuel transfer is expected to be complete in 2023. After the fuel transfer is completed, the Spent Fuel Pool and systems will be drained and de-energized for long-term storage.

Dormancy activities will include a 24-hour security force, preventive and corrective maintenance on security systems, area lighting, general maintenance of buildings, freeze protection heating, ventilation of buildings for periodic habitability, routine radiological inspections of contaminated structures, maintenance of structural integrity, and a site environmental and radiation monitoring program.

Security during the dormancy period will be conducted primarily to safeguard the spent fuel on site and prevent unauthorized entry. Security barriers, sensors, alarms, and other surveillance equipment will be maintained as required to provide security. Additionally, an environmental surveillance program will be carried out during the dormancy period to monitor for radioactive material in the environment. Appropriate procedures will be established and initiated for potential releases that exceed prescribed limits. The on-going environmental surveillance program will consist of a version of the program in effect during normal plant operations that will be modified to reflect the plant's conditions and risks at the time.

During the dormancy period, additional activities will include transferring the spent fuel from the ISFSI to the DOE. NEDA will seek to remove fuel from the site when the DOE commences performance. Following the spent fuel removal, the ISFSI pad and associated facilities will be decommissioned along with the power block structures during the decontamination and dismantlement phases.

2.2.3 Decommissioning Preparations

Prior to the commencement of decommissioning operations, preparations may be undertaken to reactivate site services and prepare for decommissioning. Preparations include engineering and planning, a site characterization, and the assembly of a decommissioning management organization. This would likely include the development of work plans, specifications and procedures.

2.2.4 Decommissioning Operations (Decontamination and Dismantlement)

Following the preparations for decommissioning, physical decommissioning activities will take place. This includes the removal and disposal of contaminated and activated components and structures, leading to the termination of the 10 CFR 50 operating license. Although much of the radioactivity will decrease during the dormancy period due to decay of radionuclides, the internal components of the reactor vessel will still exhibit radiation dose rates that will likely

require remote sectioning under water due to the presence of long-lived radionuclides. Portions of the biological shield wall may also be radioactive due to the presence of activated trace elements. It is assumed that radioactive contamination on SSC surfaces will not have decayed to levels that will permit unrestricted release. These surfaces will be surveyed and items dispositioned in accordance with the license termination release criteria.

Significant decommissioning activities in this phase include, but not limited to:

- Reconfiguration and modification of site structures and facilities, as needed, to support decommissioning operations. Modifications may also be required to the reactor or other buildings to facilitate movement of equipment and materials, support the segmentation of the reactor vessel and reactor vessel internals, and for large component removal.
- Design and fabrication of temporary and longer-term shielding to support removal and transportation activities, construction of contamination control envelopes, and the procurement of specialty tooling.
- Procurement or leasing of shipping cask, cask liners, and industrial packages for the disposition of low-level radioactive waste.
- Decontamination of components and piping systems, as required, to control (minimize) worker exposure.
- Removal of piping and components no longer essential to support decommissioning operations.
- Removal of reactor head and segmentation as necessary.
- Removal and segmentation of the dryer, separator, and top guide. Segmentation will maximize the loading of the shielded transport casks, i.e., by weight and activity. The operations are conducted under water using remotely operated tooling and contamination controls.
- Disassembly and segmentation of the remaining reactor internals, including the core materials left above the core support guide, core shroud, fuel support castings, core support guide, and control rod drive guide tubes. Some material is expected to exceed Class C disposal requirements. As such, the segments will be packaged in modified fuel storage canisters for future geologic disposal.
- Segmentation of the reactor vessel as necessary. Cutting operations will likely be performed using remotely operated equipment within a contamination control envelope. The water level is maintained to minimize the working area dose rates.
- Removal of the steel liners from the drywell, torus, refueling pool and Spent Fuel Pool, disposing of the activated and/or contaminated sections as radioactive waste.
- Removal of the activated portions of the concrete biological shield and accessible contaminated concrete surfaces. Removal of the recirculation piping and pumps for material recovery and controlled disposal.
- Surface soil, sub-surface media and groundwater will meet the unrestricted use criteria in 10 CFR 20.1402.
- Underground piping (or similar items) and associated soil will be removed as necessary to meet license termination criteria.

At least two years prior to the anticipated date of license termination, a License Termination Plan (LTP) will be submitted to the NRC. That plan will include: a site characterization,

description of the remaining dismantling / removal activities, plans for remediation of remaining radioactive materials, developed site-specific Derived Concentration Guideline Levels, methodology and criteria for the final status (radiation) survey (FSS), designation of the end use of the site, an updated cost estimate to complete the decommissioning, and associated environmental concerns.

The FSS plan will identify the radiological surveys to be performed once the decontamination activities are completed and will be developed using the guidance provided in the "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)" (Reference 6). The MARSSIM "provides information on planning, conducting, evaluating, and documenting building and surface soil final status radiological surveys for demonstrating compliance with dose or risk-based regulations or standards." The MARSSIM uses the Data Quality Objective/Analysis processes tool for data collection activities and provides a basis for balancing decision uncertainty with available resources. This document incorporates statistical approaches to survey design and data evaluation. It also identifies commercially available instrumentation and procedures for conducting radiological surveys. Use of this guidance ensures that the surveys are conducted in a manner that provides a high degree of confidence that applicable NRC criteria are satisfied.

Once the FSS is complete, the results will be submitted to the NRC, along with a request for termination of the NRC license.

NEDA may release unaffected portions of the site on a partial site release basis, as they become available, before all site decommissioning work has been completed.

2.2.5 Site Restoration

After the NRC terminates the license, site restoration activities will be performed, at the licensee's discretion. NEDA currently assumes that remaining structures will be removed to restore the site to an appropriately graded and vegetated condition (green field). Suitable backfill material will be used where necessary and appropriate erosion controls established.

Non-contaminated concrete remaining after the demolition activities may be used for backfilling subsurface voids or may be transported to an offsite area for appropriate disposal as construction debris.

2.3 GENERAL DECOMMISSIONING CONSIDERATIONS

2.3.1 Major Decommissioning Activities

As defined in 10 CFR 50.2, "Definitions," a "major decommissioning activity" is "any activity that results in permanent removal of major radioactive components, permanently modifies the structure of the containment, or results in dismantling components for shipment containing greater than class C waste in accordance with § 61.55 of this chapter." The following discussion provides a summary of the major decommissioning activities currently planned for decommissioning of the DAEC. These activities are envisioned to occur in the Dismantling and Decontamination Period. The schedule may be modified as conditions dictate.

Prior to starting a major decommissioning activity, the affected components will be surveyed and decontaminated, as required in order to minimize worker exposure, and a plan will be developed for the activity. Shipping casks and other equipment necessary to conduct major decommissioning activities will be procured.

The initial major decommissioning activity inside the containment building will be the removal, packaging, and disposal of systems and components attached to the reactor in order to provide access and allow it to be removed.

The reactor vessel internals will be removed from the reactor vessel and segmented, if necessary, for packaging, transport, and disposal, or to separate greater than Class C (GTCC) waste. Internals classified as GTCC waste will be segmented and packaged into containers similar to spent fuel canisters for transfer to the DOE. Removal of the reactor vessel follows the removal of the reactor internals. Industry experience indicates that there may be several options available for the removal and disposal of the reactor vessel (i.e., segmentation or disposal as an intact package). The viability of these options will be analyzed as a part of future planning and preparation activities. If segmented, it is likely that the work would be performed remotely, using a contamination control envelope.

Other major decommissioning activities that would be conducted include the removal and disposal of the turbine, condenser, main steam piping, feed water piping, pumps and heaters, Spent Fuel Pool support equipment, and neutron activated/contaminated concrete or metals.

In addition to the reactor and large components discussed above, all other plant components will be removed from the Reactor, Turbine, and associated support buildings, radiologically surveyed, and dispositioned appropriately.

2.3.2 Decontamination and Dismantlement Activities

The overall objective of D&D is to ensure that radioactively contaminated or activated materials will be removed from the site to allow the site to be released for unrestricted use. This is achieved in part by radioactive decay during the SAFSTOR (dormancy) period which will significantly reduce the quantity of contamination and radioactivity that must be disposed of during decontamination and dismantlement. The disposition of remaining radioactive materials will be accomplished by the decontamination and/or dismantlement of contaminated structures. This may be accomplished by decontamination in place, off-site processing of the materials, or direct disposal of the materials as radioactive waste. A combination of these methods may be utilized. The methods chosen will be those deemed most appropriate for the particular circumstances. Low-level radioactive waste (LLRW) will be managed in accordance with approved procedures and commercial disposal facility requirements. This includes characterizing contaminated materials, packaging, transporting and disposal at a licensed LLRW disposal facility.

2.3.3 Radioactive Waste Management

A major component of the decommissioning work scope for the DAEC is the packaging, transportation and disposing of primarily contaminated/activated equipment, piping, concrete,

and in some cases soil. A waste management plan will be developed to incorporate the most prudent disposal strategy, consistent with regulatory requirements and disposal/processing options for each waste type at the time of the D&D activities. Decommissioning wastes from the DAEC may be disposed of at any available licensed LLRW facilities that engage in an agreement with NEDA. Radioactive wastes from the DAEC will be transported by licensed transporters.

The waste management plan will be based on the evaluation of available methods and strategies for processing, packaging, and transporting radioactive waste in conjunction with the available disposal facility options and associated waste acceptance criteria.

2.3.4 Removal of Mixed Wastes

If mixed wastes are generated, they will be managed in accordance with applicable Federal and State regulations.

If generated, mixed wastes will be transported by authorized and licensed transporters and shipped to authorized and licensed facilities. If technology, resources, and approved processes are available, the processes will be evaluated to render the mixed waste non-hazardous.

2.3.5 Site Characterization

During the decommissioning process, site characterization will be performed in which radiological, regulated, and hazardous wastes will be identified, categorized, and quantified. Surveys will be conducted to establish the contamination and radiation levels throughout the site. This information will be used in developing procedures, surveys and sampling plans to ensure that hazardous, regulated, and radiologically contaminated areas are remediated and to ensure that worker exposure is controlled. As decontamination and dismantlement work proceeds, surveys will be conducted to maintain a current site characterization and to ensure that decommissioning activities are adjusted accordingly.

As part of the site characterization process, a neutron activation analysis calculation study of the reactor internals and the reactor vessel will be performed. Using the results of this analysis (along with benchmarking surveys), neutron irradiated components will be classified (projected for the future D&D time-frame) in accordance with 10 CFR 61, "Licensing requirements for land disposal of radioactive waste." The results of the analysis form the basis of the plans for removal, segmentation, packaging and disposal.

2.3.6 Groundwater Protection and Radiological Decommissioning Records Program

A groundwater (GW) protection program currently exists at the DAEC in accordance with the Nuclear Energy Institute (NEI) Technical Report 07-07, "Industry Groundwater Protection Initiative - Final Guidance Document" (Reference 10). This program is directed by procedures and will continue during decommissioning.

A site hydrology study was completed as part of the ongoing monitoring program. Groundwater monitoring wells were installed at the plant to identify any radiological contaminants. In 2012,

measureable amounts of tritium began to be detected in some of the groundwater monitoring wells in an area immediately adjacent to the south side of the Turbine and Reactor buildings, continuing for a short distance to the southeast on the plant property. This area has been and continues to be mitigated through mitigation wells.

As a result of the ongoing mitigation and given a tritium half-life of 12.3 years, no tritium mitigation is expected to be required at the end of the SAFSTOR period. NEDA will also continue to maintain the existing radiological decommissioning records program required by 10 CFR 50.75(g). The program is directed by procedures. None of the events noted in records required by 10 CFR 50.75(g) indicate the presence of long-lived radionuclides in sufficient concentrations to preclude unrestricted release under 10 CFR 20.1402, "Radiological Criteria for Unrestricted Use", at the end of the SAFSTOR period.

2.3.7 Changes to Management and Staffing

Throughout the decommissioning process, plant management and staffing levels will be adjusted to reflect the ongoing transition of the site organization. Staffing levels and qualifications of personnel used to monitor and maintain the plant during the various periods after plant shutdown will be subject to appropriate Technical Specification and Emergency Plan requirements. Some of the staffing requirements may be filled by contract personnel used to provide general services, staff augmentation or replace permanent staff. These staffing levels, however, do not include contractor staffing that may be used to carry out the future fuel movements, plant modifications in preparation for SAFSTOR, and the D&D/license termination/site restoration work. The monitoring and maintenance staff will be comprised of radiation protection, radiological environmental monitoring program, plant engineering and craft workers as appropriate for the anticipated work activities.

3.0 SCHEDULE OF PLANNED DECOMMISSIONING ACTIVITIES

3.1 DESCRIPTION OF PLANNED DECOMMISSIONING ACTIVITIES

NEDA intends to pursue the decommissioning of DAEC utilizing a SAFSTOR methodology and will make appropriate filings with the NRC to obtain authority prior to beginning radiological decommissioning. The SAFSTOR method involves removal of radioactively contaminated or activated material from the site following an extended period of dormancy. Work activities associated with the planning and preparation period have begun during the final operating cycle of the plant and will continue through 2023. The schedule of spent fuel management and major decommissioning activities is provided in Table 2.1. Additional detail is provided in the site-specific DCE (Attachment 1). Dates in the site-specific DCE are based on the October 30, 2020, shutdown date and have been adjusted as reflected in Table 2.1.

The schedule accounts for spent fuel being stored in the ISFSI until the assumed date of transfer to the DOE.

4.0 ESTIMATE OF EXPECTED DECOMMISSIONING AND SPENT FUEL MANAGEMENT COSTS

10 CFR 50.82(a)(8)(iii) requires that a site-specific decommissioning cost estimate be prepared and submitted within two years following permanent cessation of operations. 10 CFR 50.82(a)(4)(i) requires that the PSDAR contain a site-specific decommissioning cost estimate including the projected costs of managing irradiated fuel. A site-specific decommissioning cost analysis has been prepared for DAEC, which also provides projected costs of managing spent fuel, as well as non-radiological decommissioning and site restoration costs, accounted for separately.

The site-specific decommissioning cost analysis is provided in Attachment 1 and fulfills the requirements of 10 CFR 50.82(a)(4)(i) and 10 CFR 50.82(a)(8)(iii). A summary of the site-specific decommissioning cost analysis and projected cost of managing spent fuel is provided in Table 2-1. A summary of the annual costs, earnings, and trust balances associated with decommissioning, spent fuel management, and site restoration will be provided in an update to the Irradiated Fuel Management Plan being submitted as a separate document in accordance with 10 CFR 50.54(bb).

The methodology used to develop the site-specific decommissioning cost analysis follows the basic approach originally advanced by the Atomic Industrial Forum in their program to develop a standardized model for decommissioning cost estimates. The results of this program were published as AIF/NESP-036, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," (Reference 12). This document presents a unit cost factor method for estimating direct activity costs, simplifying the estimating process. The unit cost factors used in the study reflect the latest available data at the time of the study concerning worker productivity during decommissioning.

10 CFR 50.82(c) states that for a facility that has permanently ceased operation before the expiration of its license, the collection period for any shortfall of funds will be determined, upon application by the licensee, on a case-by-case basis taking into account the specific financial situation of each licensee. At the time that operations cease at DAEC, sufficient funds will be available in the plant decommissioning fund to complete the planned decommissioning activities.

10 CFR 50.82(a)(6)(ii) states that licensees shall not perform any decommissioning activities, as defined in 10 CFR 50.2, that would result in there no longer being reasonable assurance that adequate funds will be available for decommissioning. No such activities have been identified, since adequate funding exists based on the site-specific decommissioning cost analysis in Attachment 1.

4.1 COST ESTIMATE ADJUSTMENTS

The DAEC SAFSTOR schedule and the associated site-specific cost estimate summarized in Tables 2.1 and 2.2 and detailed in the DCE (Attachment 1) is reported in 2018 dollars using current pricing. NEDA will update the DAEC DCE as required by procedure and regulation. In calculating projected earnings, NEDA will apply a compounded 2% real rate of return on the trust fund per 10 CFR 50.75 (e). In accordance with 10 CFR 50.82(a)(8)(v)-(vii), NEDA will provide annual reports projecting the cost to complete decommissioning and spent fuel management costs.

4.2 MEANS OF ADJUSTING ASSOCIATED FUNDING LEVELS

During the SAFSTOR period, the site-specific DCE will be periodically updated in compliance with NEDA procedures and applicable regulatory requirements. In accordance with 10 CFR 50.82(a)(8)(v), decommissioning funding assurance will be reviewed and reported to the NRC annually during the SAFSTOR period. The latest site-specific 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 report in accordance with the applicable regulatory requirements. 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 11) will be put in place.

5.0 ENVIRONMENTAL IMPACTS

To support the PSDAR environmental impacts review, the environmental effects of decommissioning activities planned for DAEC, as currently understood, were evaluated to determine if potential environmental impacts are bounded by previously issued environmental impact statements. 10 CFR 50.82(a)(4)(i) requires that the PSDAR include "...a discussion that provides the reasons for concluding that the environmental impacts associated with site-specific decommissioning activities will be bounded by appropriate previously issued environmental impact statements." To determine if the estimated potential environmental impacts associated with DAEC decommissioning activities are bounded, the potential environmental impacts were compared to those in:

- NUREG-0586, Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors (Reference 3) (Referred to as the GEIS).
- Atomic Energy Commission, Final Environmental Statement related to the Operation of Duane Arnold Energy Center (Reference 7).
- NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 42, Regarding Duane Arnold Energy Center (Reference 4) (Referred to as the SEIS).

As required, site-specific assessments were conducted for threatened and endangered species and environmental justice. Site-specific assessments were also performed for offsite land use and impacts to aquatic ecology, terrestrial ecology, and cultural and historic resources for decommissioning activities beyond the operational area. For the purpose of assessing decommissioning environmental impacts, the operational area at DAEC consists of roughly the southern half of the approximately 500 acres on the west bank of a north-south reach of the Cedar River, approximately 2.5 miles north-northeast of the town of Palo. DAEC uses only a small portion of the area for power production.

The levels of significance assigned to site-specific environmental impacts are classified as small, moderate, or large, as defined by NRC in the Decommissioning GEIS (Reference 3, pgs. 4-1 and 4-2). NEDA has concluded that the environmental impacts associated with planned DAEC decommissioning activities are bounded by the impacts addressed by previously issued environmental impact statements. NEDA's decommissioning plans are consistent with the methods assumed by NRC in the GEIS. No unique site-specific features or unique aspects of the planned decommissioning have been identified.

5.1 ENVIRONMENTAL IMPACT OF DAEC DECOMMISSIONING

The following is a summary of the reasons for reaching the conclusion that the environmental impacts of decommissioning DAEC are bounded by the GEIS. Each environmental impact standard in the GEIS is listed along with an explanation as to why NEDA concludes the GEIS analysis bounds the impacts of DAEC decommissioning on that standard. As a general matter, DAEC is smaller than the reference boiling water reactor used in the GEIS to evaluate the environmental impacts of decommissioning, and is therefore bounded by those assessments.

Further, no unique site-specific features or unique aspects of the planned decommissioning have been identified.

5.1.1 Onsite and Offsite Land Use

As part of decommissioning activities, NEDA will utilize onsite land for laydown, staging, or handling of equipment. The DAEC has sufficient area onsite that has been previously disturbed (due to construction or operations activities) upon which to conduct all of these decommissioning activities. Section 4.3.1 of the GEIS concluded that the impacts on land use are not detectable or small for facilities having only onsite land use changes as a result of large component removal, structure dismantlement, and low-level waste packaging and storage.

NEDA will not require addition or modification to existing transportation links that could impact offsite land use. Based on the GEIS, the experience of plants that are being decommissioned has not included any needs for additional land offsite. Consistent with this determination, NEDA does not anticipate any changes in land use beyond the site boundary during decommissioning.

Therefore, NEDA concludes that the impacts of DAEC decommissioning on onsite/offsite land use are bounded by the GEIS.

5.1.2 Water Use

After plant shutdown, the operational demand for cooling water and makeup water will dramatically decrease. Additionally, after the plant is shut down and defueled, the amount of water used by the service water system will be much less than during normal operation of the plant. The need for cooling water will continue to decrease as the heat load of spent fuel in the Spent Fuel Pool declines due to radioactive decay and as spent fuel is relocated from the Spent Fuel Pool to the ISFSI. During plant shutdown, the use of potable water will decrease commensurate with the expected decrease in plant staffing levels. For these reasons, Section 4.3.2.2 of the GEIS concluded that water use at decommissioning nuclear reactor facilities is significantly smaller than water use during operation.

The GEIS also concluded that water use during the decontamination and dismantlement phase will be greater than that during the storage phase. However, there are no unique aspects associated with the decommissioning of DAEC and water use for such activities as flushing piping, dust abatement, etc. Consequently, DAEC water use impacts were addressed by the evaluation of the reference facility in the GEIS.

Therefore, NEDA concludes that the impacts of DAEC decommissioning on water use are bounded by the GEIS.

5.1.3 Water Quality

This section considers water quality impacts of nonradioactive material for both surface and groundwater during the decommissioning process. Table E-3 of the GEIS identifies decommissioning activities that may affect water quality. These activities include system deactivation activities (draining, flushing, and liquid processing) as well as facility decontamination and dismantlement activities (water spraying for dust suppression). The GEIS also emphasizes the need to minimize water infiltration during the SAFSTOR period.

NEDA has chosen to decommission DAEC using the SAFSTOR method. During the SAFSTOR planning and actual storage periods, storm water runoff and drainage paths will be maintained in their current configuration. Regulatory mandated programs and processes designed to minimize, detect, and contain spills will be maintained throughout the decommissioning process. Federal, state and local regulations and permits pertaining to water quality will remain in effect and no significant changes to water supply reliability are expected. The National Pollutant Discharge Elimination System (NPDES) permit, which regulates surface water discharges from the site will remain in place as will the Groundwater Discharge Permit for the DAEC Wastewater Treatment Facility. The GEIS makes a generic conclusion that for all facilities, the impacts on nonradioactive aspects of water quality are small. NEDA concludes that the impacts of DAEC decommissioning on water quality are bounded by the GEIS.

5.1.4 Air Quality

There are many types of decommissioning activities listed in Section 4.3.4 of the GEIS that have the potential to affect air quality. NRC considered the potential for adverse impacts from these activities, the greatest of which would be fugitive dust, for the range of decommissioning plants and generically determined air quality impacts to be small. For those activities applicable to the SAFSTOR option, NEDA does not anticipate any activities beyond those listed in the GEIS that could potentially affect air quality. Also, reasonable and appropriate control measures such as wetting down unpaved areas, wetting of soil piles, covering loads and staging areas, and seeding of bare areas would be implemented to minimize fugitive dust. In addition, federal, state and local regulations pertaining to air quality will remain in effect to regulate emissions associated with criteria air pollutants, hazardous air pollutants, ozone-depleting gases and fugitive dust. Therefore, NEDA concludes that the impacts of DAEC decommissioning on air quality are bounded by the GEIS.

5.1.5 Aquatic Ecology

Aquatic ecology encompasses the plants and animals in the Cedar River and wetlands near DAEC. Aquatic ecology also includes the interaction of those organisms with each other and the environment. Section 4.3.5 of the GEIS evaluates both the direct and indirect impacts from decommissioning on aquatic ecology.

Direct impacts can result from activities such as the removal of shoreline structures or active river dredging. The DAEC shoreline structures are similar to those of sites listed in Table E-2 of the GEIS, and there are no apparent discriminators based on characteristics (size and location) listed in Table E-5 of the GEIS. Removal of the intake structure and discharge canal will be conducted in accordance with best management practices outlined in government permits. Intake structure dredging will be greatly reduced due to the diminished residual heat removal requirements.

As previously discussed in Section 5.1.2, the amount of cooling water withdrawn from the Cedar River will significantly decrease thus reducing the potential impacts from impingement and entrainment of aquatic species. Additionally, any significant potential for sediment runoff or erosion on disturbed areas will be controlled in accordance with best management practices outlined in the storm water permit. The GEIS concluded that impacts on aquatic ecology would be small if disturbance of lands beyond the operational areas of the plant. NEDA does not anticipate disturbance of lands beyond the current operational areas of the plant, so there

should not be any new impacts to aquatic ecology from runoff associated with land disturbance activities. Therefore, NEDA concludes that the impacts of DAEC decommissioning on aquatic ecology are consistent with the GEIS.

5.1.6 Terrestrial Ecology

Terrestrial ecology considers the plants and animals in the vicinity of DAEC as well as the interaction of those organisms with each other and the environment. Evaluations of impacts to terrestrial ecology are usually directed at important habitats and species, including plant and animals that are important to industry, recreational activities, the area ecosystems, and those protected by endangered species regulations and legislation. Section 4.3.6 of the GEIS evaluates the potential impacts from both direct and indirect disturbance of terrestrial ecology.

Direct impacts can result from activities such as clearing native vegetation or filling a wetland. NEDA does not anticipate any decommissioning activities will disturb habitat beyond the industrial area of the plant. All dismantlement, demolition, and waste staging activities are expected to be conducted within this industrial area of the site. Also the EPA controls significant impacts to the environment through regulation of construction activities.

Indirect impacts may result from effects such as erosional runoff, dust or noise. Any construction activities that would disturb one acre or greater of soil would require a permit from the EPA prior to proceeding with the activity. The storm water permit would contain best management practices to control sediment and the effects of erosion associated with the construction activity. Fugitive dust emissions would be controlled through the judicious use of water spraying.

The GEIS concluded that impacts to terrestrial ecology would be small if habitat was not disturbed beyond the operational area of the plant. NEDA, therefore, concludes that decommissioning of DAEC is consistent with the GEIS.

5.1.7 Threatened and Endangered Species

The GEIS lists stabilization, large component removal, decontamination and dismantlement (removal of contaminated soil), and structure dismantlement as activities with potential to impact threatened and endangered species.

Section 4.3.7 in the GEIS did not make a generic determination on the impact of decommissioning on threatened and endangered species, noting that impacts to these species are expected to be minor and non-detectable when activities are confined to the site operational area.

Impacts are to be determined on a site-specific basis, paying particular attention to activities outside of the developed operational area. Noise and dust generation from construction activity and increased truck traffic, rather than direct impacts such as habitat destruction, are the primary concerns.

With respect to the threatened and endangered aquatic species, the environmental impacts during decommissioning are expected to be minimal. Removal of the intake and discharge facilities as well as other shoreline structures will be conducted in accordance with best management practices outlined in permits issued by Linn County, the Iowa Department of Sovereign Lands, and the U.S. Army Corps of Engineers.

Attachment 2, Table 1 identifies state and federally listed species potentially occurring in the vicinity of DAEC based on site-specific assessments conducted in support of license renewal, information collected from the Iowa DNR Iowa Natural Areas Inventory (INAI) interactive website. The Iowa Natural Areas Inventory (INAI) interactive website combines current technologies to bring threatened, endangered, special concern, and selected rare species data and maps to professional natural resource managers as well as to the public.

Section 4.3.7 of the GEIS also suggests that care be exercised in conducting decommissioning activities after an extended SAFSTOR period because there is a greater potential for rare species to colonize the disturbed portion of the site. However as previously discussed, administrative controls and federal and state regulations that will remain in effect would ensure that mitigation measures are implemented as appropriate to protect wildlife.

Based on the site-specific findings summarized above, NEDA concludes that DAEC decommissioning activities are unlikely to adversely affect any threatened or endangered species. Therefore, additional mitigation is not warranted. However, as decommissioning plans mature, if changes in threatened and endangered species listings or critical habitat designations occur that affect this conclusion, NEDA will update the PSDAR in accordance with applicable NRC regulations.

5.1.8 Radiological

The GEIS considered radiological doses to workers and members of the public when evaluating the potential consequences of decommissioning activities.

Occupational Dose

The occupational radiation exposure to DAEC plant personnel will be maintained As Low as Reasonably Achievable (ALARA) and below the occupational dose limits in 10 CFR Part 20 during decommissioning. The need for plant personnel to routinely enter radiological areas to conduct maintenance, calibration, inspection, and other activities associated with an operating plant will be reduced, thus it is expected that the occupational dose to plant personnel will significantly decrease after the plant is shut down and defueled.

NEDA has elected to decommission DAEC using the SAFSTOR alternative. It is expected that the occupational dose required to complete the decommissioning activities at DAEC will be within the range of SAFSTOR dose estimates (326 - 834 person-rem) provided in Table 4-1 of the GEIS. This is based on the fact that DAEC is bounded by the BWRs evaluated in the GEIS as discussed in Appendix G, and because the ALARA program will be maintained to ensure that occupational dose is maintained ALARA and well within 10 CFR Part 20 limits.

Public Dose

Section 4.3.8 of the GEIS considered doses from liquid and gaseous effluents when evaluating the potential impacts of decommissioning activities on the public. Table G-15 of the GEIS compared effluent releases between operating facilities and decommissioning facilities and concluded that decommissioning releases are lower. The GEIS also concluded that the collective dose and the dose to the maximally exposed individual from decommissioning activities are expected to be well within the regulatory standards in 10 CFR Part 20 and Part 50.

The expected radiation dose to the public from DAEC decommissioning activities will be maintained within regulatory limits and below comparable levels when the plant was operating through the continued application of radiation protection and contamination controls combined with the reduced source term available in the facility. Therefore, NEDA concludes that the impacts of DAEC decommissioning on public dose are small and are bounded by the GEIS.

5.1.9 Radiological Accidents

The likelihood of a large offsite radiological release that impacts public health and safety after DAEC is shut down and defueled is considerably lower than the likelihood of a release from the plant during power operation. This is because the majority of the potential releases associated with power operation are not relevant after the fuel has been removed from the reactor. Furthermore, handling of spent fuel assemblies will continue to be controlled under work procedures designed to minimize the likelihood and consequences of a fuel handling accident. In addition, emergency plans and procedures will remain in place to protect the health and safety of the public while the possibility of significant radiological releases exists.

Section 4.3.9 of the GEIS assessed the range of possible radiological accidents during decommissioning and separated them into two general categories; fuel related accidents and non-fuel related accidents. Fuel related accidents have the potential to be more severe and zirconium fire accidents, in particular, could produce offsite doses that exceed EPA's protective action guides (Reference 5). As part of its effort to develop generic, risk-informed requirements for decommissioning, the NRC staff performed analysis of the offsite radiological consequences of beyond-design-basis Spent Fuel Pool accidents using fission product inventories at 30 and 90 days and 2, 5, and 10 years. The results of the study indicate that the risk at Spent Fuel Pools is low and well within the Commission's Quantitative Health Objectives. The generic risk is low primarily due to the very low likelihood of a zirconium fire.

The potential for decommissioning activities to result in radiological releases not involving spent fuel (i.e., releases related to decontamination, dismantlement, and waste handling activities) will be minimized by use of procedures designed to minimize the likelihood and consequences of such releases.

Therefore, NEDA concludes that the impacts of DAEC decommissioning on radiological accidents are small and are bounded by the previously issued GEIS.

5.1.10 Occupational Issues

Occupational issues are related to human health and safety. Section 4.3.10 of the GEIS evaluated physical, chemical, ergonomic, and biological hazards and concluded that impacts due to occupational issues would be small for all plants based on strict adherence to NRC and Occupational Safety and Health Administration (OSHA) safety standards, practices and procedures. NEDA has reviewed these occupational hazards in the GEIS and concluded that the decommissioning approach chosen for DAEC poses no unique hazards from those evaluated in the GEIS. NEDA will continue to maintain appropriate administrative controls and requirements to ensure occupational hazards are minimized and that applicable federal, state and local occupational safety standards and requirements continue to be met. Therefore, NEDA concludes that the impacts of DAEC decommissioning on occupational issues are bounded by the GEIS.

5.1.11 Cost

Decommissioning costs for DAEC are discussed in Section 4.0 and in Attachment 1 to this report.

Section 4.3.11 of the GEIS recognizes that an evaluation of decommissioning cost is not a National Environmental Policy Act requirement. Therefore, a bounding analysis is not applicable.

5.1.12 Socioeconomics

Decommissioning of DAEC is expected to result in minor socioeconomic impacts. As DAEC transitions from an operating plant to a shutdown plant and into the different phases of decommissioning, an overall decrease in plant staff will occur. The lost wages of these plant staff will result in decreases in revenues available to support the local economy and local tax authorities. Some employee relocation will occur. In 2018, there were approximately 600 employees working at DAEC. The majority of DAEC employees live in Linn County (2017 population: 224,115). These relocations are not expected to impact the local cost of housing or availability of public services.

Section 4.3.12 of the GEIS evaluated changes in workforce and population, changes in local tax revenues, and changes in public services. The evaluation also examined plants that permanently shut down early and selected the SAFSTOR option. The GEIS determined that this situation is likely to have negative impacts. However, the GEIS concluded that socioeconomic impacts are neither detectable nor destabilizing and that mitigation measures are not warranted. Therefore, after review of the GEIS, NEDA concludes that the impacts of DAEC decommissioning on socioeconomic impacts are bounded by the GEIS analysis.

5.1.13 Environmental Justice

Executive Order 12898, dated February 16, 1994, directs Federal executive agencies to consider environmental justice under the National Environmental Policy Act. It is designed to ensure that low-income and minority populations do not experience disproportionately high and adverse human health or environmental effects because of Federal actions.

Section 4.9.7 of the SEIS (Reference 4) analyzed 2000 census data within 50 miles of DAEC to identify minority and low income populations. The SEIS analysis determined there were 25 block groups having minority population percentages that exceeded the State percentage by 20 percentage points or more, or that were more than 50 percent minority. The majority of these block groups are concentrated in urban areas with high population densities in Black Hawk County, Linn County, and Johnson County. There are also minority population groups in Muscatine County and Tama County. The closest high density minority population to DAEC is located in the city of Cedar Rapids, Iowa.

There were also 15 block groups within the 50-mile radius of DAEC that exceeded the State average for low income households by 20 percentage points or more, or that were more than 50 percent low-income. The majority of census block groups with low-income populations were located in urban areas with high population densities in Black Hawk County, Johnson County,

and Linn County. The nearest high density low-income population to DAEC is located in Cedar Rapids, Iowa.

Section 4.13.3 of the GEIS reviewed environmental justice decommissioning impacts related to land use, environmental and human health, and socioeconomics. NEDA does not anticipate any offsite land disturbances during decommissioning, thus the land use impacts are not applicable for DAEC. In addition, as previously discussed in Section 5.1.12, it was determined that socioeconomic impacts from decommissioning are bounded by the GEIS. Potential impacts to minority and low-income populations would mostly consist of radiological effects. Based on the radiological environmental monitoring program data from DAEC, the SEIS determined that the radiation and radioactivity in the environmental media monitored around the plant has no significant or measurable radiological impact on the environment. As a result, the SEIS found that no disproportionately high and adverse human health impacts would be expected in special pathway receptor populations (i.e., minority and/or low income populations) in the region as a result of subsistence consumption of water, local food, fish, and wildlife.

Therefore, NEDA concludes that the impacts of DAEC decommissioning on environmental justice are small and are bounded by the GEIS.

5.1.14 Cultural, Historical, and Archeological Resources

The GEIS states that "[i]n most cases, the amount of land required to support the decommissioning process is relatively small and is a small portion of the overall plant site. Usually, the areas disturbed or utilized to support decommissioning are within the operational areas of the site and typically are within the protected area." It goes on to state that "[a]ctivities conducted within the operational areas are not expected to have a detectable effect on important cultural resources because these areas have normally been highly degraded during facility construction and operation. Activities conducted outside of the operational areas may have detectable impacts, depending on the size and type of impact, and the cultural resources potentially affected."

NEDA anticipates the decommissioning activities at DAEC will be confined to the operational area. Therefore, there would be no impact to cultural, historical, or archeological resources because this area was degraded during site construction. As a result, the impacts of DAEC decommissioning are small and are bounded by the GEIS.

As noted above, NEDA does not anticipate decommissioning activities outside the operational area. If NEDA's decommissioning plans change to involve significant activities with a potential for impacts outside the operational are, NEDA will notify the NRC in writing, in accordance with 10 CFR 50.82(a)(7). The following information would be relevant to an evaluation of impacts in that circumstance.

In the SEIS for the DAEC license renewal, the NRC concluded that "due to the dense concentration of cultural material in the area, there remains a high potential for undiscovered resources. Additionally, many of the resources found in the region are of high importance (e.g., mound groups)." As a result, the NRC concluded that "[i]f resources were encountered during plant activities, the effect would be expected to be MODERATE." This license renewal SEIS finding was based on a 2008 report by the Louis Berger Group, Inc. (ML092450278), which

covered the entire 500-acre DAEC property and identified nine locations on the DAEC property that could contain historic and archaeological remains. None of the nine sites were located within the operational area of the site. (See 2008 Berger report, App. A, Figure 2).

Section 4.9.6 of the SEIS determined that potential impacts to historic and archaeological resources were possible during the period of extended operations due to the potential richness of archaeological resources on the DAEC property. It stated that most impacts to historic and archaeological resources occur during ground disturbing activities. The SEIS acknowledged that, while known resources are considered in the excavation and trenching procedures, undiscovered historic and archaeological sites could be affected by plant activities. In coordination with the SHPO, NEDA developed and maintains excavation and trenching procedures for the DAEC which address potential impacts to both known and undiscovered resources. These procedures also include an inadvertent discovery (stop work) provision. The SEIS concluded that the any land disturbing activities would be considered through the DAEC revised excavation and trenching procedures and, although the potential impacts on historic and archaeological resources could be moderate, these impacts would be addressed through application of the mitigation measures.

As noted above, the decommissioning activities for DAEC are expected to be confined to the current DAEC operational area with no offsite impact and so are bounded by the GEIS. Based on the discussion in the SEIS, NEDA concludes that potential impacts on historic and archaeological resources from decommissioning activities outside the operational area at DAEC, which are not currently anticipated, could be MODERATE and that if necessary these potential impacts would be mitigated through application of controls for ground disturbance, as is fully described in the SEIS.

Therefore, NEDA has concluded that the environmental impacts associated with the DAEC decommissioning activities are bounded by the impacts addressed by previously issued environmental impact statements.

5.1.15 Aesthetic Issues

Section 4.3.15 in the GEIS singles out structure dismantlement and entombment as the only activities that may have impacts on aesthetic resources. NEDA does not plan to utilize entombment for decommissioning any structures at DAEC. The aesthetic impacts of decommissioning fall into two categories: (a) impacts, such as noise, associated with decommissioning activities that are temporary and cease when decommissioning is complete and (b) the changed appearance of the site when decommissioning is complete. The NRC drew the generic conclusion that for all plants, the potential impacts from decommissioning on aesthetics are small and that the removal of structures is generally considered beneficial to the aesthetics of the site.

The GEIS concluded that the retention of structures during a SAFSTOR period or the retention of structures onsite at the time the license is terminated is likewise not an increased visual impact, but instead a continuation of the visual impact analyzed in the facility construction or operations final environmental statement.

During DAEC decommissioning, the impact of noise and dust would be temporary and controlled to minimize impacts. The appearance of DAEC will be altered as the buildings and structures are dismantled. The visual intrusion during dismantlement would be temporary and would serve to reduce the aesthetic impact of the site. Therefore, NEDA concludes that the impacts of DAEC decommissioning on aesthetics are small and generally considered beneficial. Thus, such impacts are bounded by the analysis in the GEIS.

5.1.16 Noise

Section 4.3.16 in the GEIS generically examined noise during decommissioning, concluding that noise impacts would be small. The NRC considered noise impacts for operation of DAEC in the SEIS for license renewal (Reference 4) and concluded the noise impact of plant operation would be small. The noise levels associated with the decommissioning activities are not expected to be any more severe than those that occur as a result of plant operational activities and are not expected to present an audible intrusion on the surrounding community and environment. Decommissioning activities will be primarily limited to previously disturbed land surrounding the power block and isolated from both wildlife and members of the public. Therefore, because DAEC decommissioning activities are of the type previously considered by the NRC and DAEC has no site-specific conditions that would alter the NRC's prior findings, NEDA concludes that the noise impacts from decommissioning activities would be small and thus bounded by the analysis in the GEIS.

5.1.17 Transportation

The transportation impacts of decommissioning are dependent on the number of shipments to and from the plant, the types of shipments, the distance the material is shipped, and the radiological waste quantities and disposal plans. The shipments to and from the plant would primarily result from construction activities associated with relocation of the fuel to the ISFSI and shipments of radioactive wastes and non-radioactive wastes associated with dismantlement and disposal of structures, systems and components.

The estimated cubic feet of radioactive waste associated with DAEC decommissioning that will either be processed, destined for land disposal (Class A, B and C), or placed in a geologic repository (Greater than Class C) is summarized as follows:

- Class A: 503,709 cubic feet
- Class B: 1,203 cubic feet
- Class C: 226 cubic feet
- Greater than Class C (GTCC): 128 cubic feet

Table 4-7 of the GEIS estimated that the volume of land needed for LLRW (Class A, B and C) disposal from the referenced BWR was 636,000 cubic feet under the SAFSTOR alternative. NEDA presently estimates the LLRW volume of Class A, B, and C for DAEC that is destined for shallow land disposal is approximately 505,138 cubic feet using the SAFSTOR alternative which is below the GEIS bounding volume.

The quantity of recycle/potentially contaminated waste reflects the volume of bulk material such as ductwork before it is processed. This recycle/potentially contaminated waste is shipped off-site to a licensed waste processing vendor for volume reduction, survey and release, decontamination, segregation, or other appropriate methods of waste minimization.

The NRC has concluded in Section 4.3.17 of the GEIS that these regulations are adequate to protect the public against unreasonable risk from the transportation of radioactive materials. The number of GTCC waste shipments during decommissioning is expected to be below the number referenced in Table 4-6 of the GEIS. These shipments will occur over an extended period of time and will not result in significant changes to local traffic density or patterns, the need for construction of new methods of transportation, or significant dose to workers or the public. In addition, shipments of non-radioactive wastes from the site are not expected to result in measurable deterioration of affected roads or a destabilizing increase in traffic density.

Therefore, NEDA concludes that the impacts of DAEC decommissioning on transportation are bounded by the GEIS.

5.1.18 Irreversible and Irretrievable Commitment of Resources

Irreversible commitments are commitments of resources that cannot be recovered, and irretrievable commitments of resources are those that are lost for only a period of time.

Uranium is a natural resource that is irretrievably consumed during power operation. After the plant is shutdown, uranium is no longer consumed. The use of the environment (air, water, land) is not considered to represent a significant irreversible or irretrievable resource commitment, but rather a relatively short-term investment. Since the DAEC site will be decommissioned under the provisions of 10 CFR 20 Subpart E, the land is not considered an irreversible resource. The only irretrievable resources that would occur during decommissioning would be materials used to decontaminate the facility (e.g., rags, solvents, gases, and tools), and the fuel used for decommissioning activities and transportation of materials to and from the site. However, the use of these resources is minor.

While the GEIS does not specify quantitative bounds for commitment of irreversible and irretrievable resources, NEDA concludes that the impacts of DAEC decommissioning on these resources are negligible and consistent with the conclusions of the GEIS.

5.2 ENVIRONMENT IMPACTS OF LICENSE TERMINATION – NUREG-1496

As stated in the schedule provided in Table 2.1 of this report, a license termination plan for DAEC will not be developed until approximately five years prior to the final site decontamination which is currently assumed to be approximately the year 2080. At that time, a supplemental environmental report will be submitted as required by 10 CFR 50.82(a)(9). While detailed planning for license termination activities will not be performed until after the SAFSTOR dormancy period, the absence of any unique site-specific factors, significant groundwater contamination, unusual demographics, or impediments to achieving unrestricted release support an expectation that impacts resulting from license termination will be similar to those evaluated in NUREG-1496 (Reference 8).

5.3 DISCUSSION OF DECOMMISSIONING IN THE SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (SEIS)

As part of the DAEC license renewal process, decommissioning was discussed in Section 7.0 of the SEIS (Reference 4). Identified were six issues related to decommissioning as follows:

- Radiation Doses
- Waste Management
- Air Quality
- Water Quality
- Ecological Resources
- Socioeconomic Impacts

The NRC staff did not identify any new and significant information during their independent review of the DAEC license renewal environmental report (Reference 4), the site audit, or the scoping process for license renewal. The NRC concluded that there are no impacts related to these issues beyond those discussed in the SEIS for license renewal (Reference 4) or the GEIS for decommissioning (Reference 3). For the issues identified above, the license renewal and decommissioning GEISs both concluded the impacts are small. The NRC found no site-specific issues related to decommissioning. There are no contemplated decommissioning activities that would alter that conclusion.

5.4 ADDITIONAL CONSIDERATIONS

The following considerations are relevant to concluding that decommissioning activities will not result in significant environmental impacts not previously reviewed:

- The release of effluents will continue to be controlled by plant license requirements and plant procedures.
- NEDA will continue to comply with the Offsite Dose Assessment Manual, Radiological Environmental Monitoring Program, and the Groundwater Protection Initiative Program during decommissioning.
- Releases of non-radiological effluents will continue to be controlled per the requirements of the NPDES permit and applicable State of Iowa permits. Systems used to treat or

control effluents during power operation will either be maintained or replaced by temporary or mobile systems for the decommissioning activities.

- Radiation protection principles used during plant operations will remain in effect during decommissioning.
- Sufficient decontamination and source term reduction prior to dismantlement will be performed to ensure that occupational dose and public exposure will be maintained below applicable limits.
- Transport of radioactive waste will be in accordance with plant procedures, applicable Federal regulations, and the requirements of the receiving facility.
- Site access control during decommissioning will minimize or eliminate radiation release pathways to the public.

Additionally, NUREG-2157, Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel, found that the generic environmental impacts of ongoing spent fuel storage are small (Reference 9).

5.5 CONCLUSIONS

Based on the above discussions, NEDA concludes that the environmental impacts associated with planned DAEC site-specific decommissioning activities are less than and bounded by the impacts addressed by previously issued environmental impact statements. Specifically, the environmental impacts are bounded by the GEIS (Reference 3) and SEIS (Reference 4).

1. The postulated impacts associated with the decommissioning method chosen, SAFSTOR, have already been considered in the SEIS and GEIS.
2. There are no unique aspects of DAEC or of the decommissioning techniques to be utilized that would invalidate the conclusions reached in the SEIS and GEIS.
3. The methods assumed to be employed to dismantle and decontaminate DAEC are standard construction-based techniques fully considered in the SEIS and GEIS.

Therefore, it can be concluded that the environmental impacts associated with the site-specific decommissioning activities for DAEC will be bounded by appropriate previously issued environmental impact statements.

10 CFR 50.82(a)(6)(ii) states that licensees shall not perform any decommissioning activities, as defined in 10 CFR 50.2, that result in significant environmental impacts not previously reviewed. No such impacts have been identified.

6.0 REFERENCES

1. Regulatory Guide 1.185, Standard Format and Content for Post-Shutdown Decommissioning Activities Report, Revision 1. June 2013. (ML13143A259)

2. Letter, NextEra Energy Duane Arnold to USNRC, Certification of Permanent Cessation of Power Operations, January 18, 2019. (ML19023A196)

3. NUREG-0586, Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors, Final Report. November 2002. (ML18057B048)

4. NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 42, Regarding Duane Arnold Energy Center, October 2010. (ML102790308)

5. PAG Manual, Protective Action Guides and Planning Guidance for Radiological Incidents, EPA-400/R-17/001, January 2017. (ML17129A150)

6. NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual. August 2000. (ML003761445)

7. Atomic Energy Commission, Final Environmental Statement related to the Operation of Duane Arnold Energy Center, March 1973 (ML091200609)

8. NUREG-1496, Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities, July 1997. (ML042310492)

9. NUREG-2157, Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel, Final Report, September 2014. (ML14196A105)

10. NEI 07-07, Industry Ground Water Protection Initiative – Final Guidance Document, August 2007. (ML072600290)

11. Regulatory Guide 1.159, Assuring the Availability of Funds for Decommissioning Nuclear Reactors, Revision 2. October 2011. (ML112160012)

12. Atomic Industrial Forum, Inc., Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, AIF/NESP-036, May 1986

Duane Arnold Energy Center

Post-Shutdown Decommissioning Activities Report

Attachment 1

2018 Decommissioning Cost Estimate for the Duane Arnold Energy Center

ENERGYSOLUTIONS

Document No. 164053-DCE-021

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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Approved By: Michael A. 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
- [X] Report Revision
- [ ] Report Rewrite

Effective Date January 27, 2020

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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). Energy*Solutions* 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)

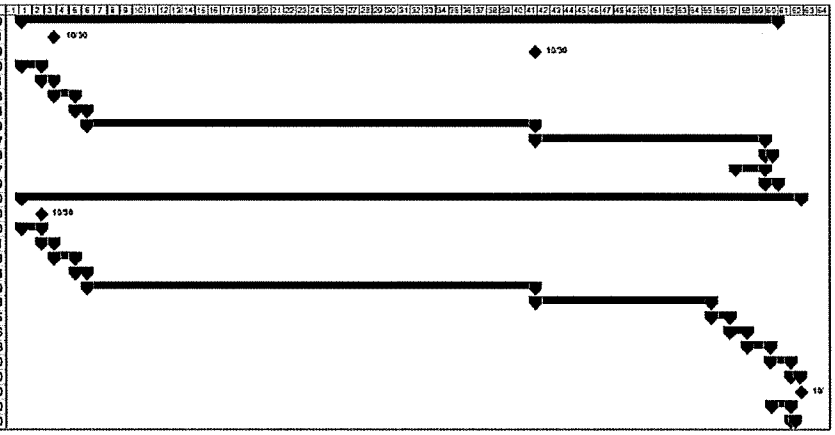
Account	Total
License Termination – 50.75 (c)	$724,688
Spent Fuel – 50.54 (bb)	$259,466
Greenfield	$36,447
ISFSI D&D 72.30	$1,640
Total	**$1,022,240**

Note: Numbers may not add due to rounding.

The estimate is based on site-specific plant systems and buildings inventories. These inventories, and Energy*Solutions*' 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 1-1
Summary SAFSTOR Schedule

Task Name	Start	Finish
Spent Fuel Management	04/01/2019	01/12/2079
Zirconium Fire Window Closes	10/30/2021	10/30/2021
Spent Fuel Shipping Complete	10/30/2059	10/30/2059
SNF Pd 1 - Spent Fuel Planning	04/01/2019	10/30/2020
SNF Pd 2 - Spent Fuel Cooling During Zirc Fire Window	10/30/2020	10/30/2021
SNF Pd 3 - Spent Fuel Transfer to Dry Storage	10/30/2021	08/31/2023
SNF Pd 3 - Dry Storage During Completion of SAFSTOR Preparations	08/31/2023	08/1/2024
SNF Pd 4 - Dry Storage During Dormancy	08/1/2024	10/30/2059
SNF Pd 5 - ISFSI Demolition Delay	10/30/2059	12/31/2077
SNF Pd 6 - ISFSI and Support Structure Clean Demolition	12/31/2077	07/28/2078
ISFSI D&D Pd 1 - ISFSI D&D Planning	08/22/2076	12/30/2077
ISFSI D&D Pd 2 - ISFSI Final Status Survey	12/30/2077	01/12/2079
License Termination	04/01/2019	10/29/2080
Unit 1 Shutdown	10/30/2020	10/30/2020
Decon Pd 1 - SAFSTOR Planning Prior to Shutdown	04/01/2019	10/30/2020
Decon Pd 2 - Transition Following Shutdown	10/30/2020	10/30/2021
Decon Pd 3 - SAFSTOR Preparations Delay During Fuel Transfer	10/30/2021	08/31/2023
Decon Pd 4 - Completion of SAFSTOR Preparations	08/31/2023	08/1/2024
Decon Pd 5 - Dormancy During Dry Storage	08/1/2024	10/30/2059
Decon Pd 6 - Dormancy Only	10/30/2059	09/26/2073
Decon Pd 7 - Decommissioning Planning During Dormancy	09/26/2073	03/07/2075
Decon Pd 8 - Internals Segmentation and Site Preparations	03/07/2075	07/16/2076
Decon Pd 9 - Major Component and Systems Removal	07/16/2076	05/19/2078
Decon Pd 10 - Building Decontamination	05/19/2078	01/03/2080
Decon Pd 11 - License Termination	01/03/2080	09/19/2080
End 60 year SAFSTOR	10/29/2080	10/29/2080
Grn Pd 1 - Clean Building Demolition During Decommissioning	06/22/2078	01/03/2080
Grn Pd 2 - Site Restoration	01/03/2080	05/08/2080



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.

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

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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

Energy*Solutions* 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, Energy*Solutions* 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 Energy*Solutions* 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 Energy*Solutions* 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

Energy*Solutions* 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." Energy*Solutions* 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:

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

Energy*Solutions'* 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.

Category	Labor	Material & Equipment	Package Ship & Bury	Other
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 Energy*Solutions* 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 Energy*Solutions*' 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 Energy*Solutions*' facility in Clive, Utah, in accordance with the existing LOP Disposal Agreement between Energy*Solutions* 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 Energy*Solutions* and represent Energy*Solutions*' 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.

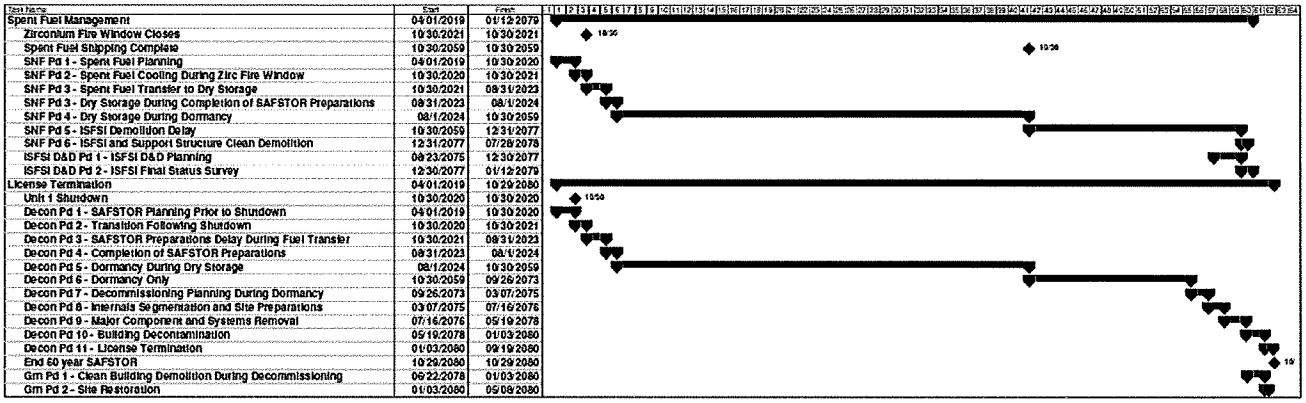
Waste Disposal Volumes

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.

Figure 6-1
Summary SAFSTOR Schedule



Task Name	Start	Finish
Spent Fuel Management	04/01/2019	01/12/2079
Zirconium Fire Window Closes	10/30/2021	10/30/2021
Spent Fuel Shipping Complete	10/30/2059	10/30/2059
SNF Pd 1 - Spent Fuel Planning	04/01/2019	10/30/2020
SNF Pd 2 - Spent Fuel Cooling During Zirc Fire Window	10/30/2020	10/30/2021
SNF Pd 3 - Spent Fuel Transfer to Dry Storage	10/30/2021	08/31/2023
SNF Pd 3 - Dry Storage During Completion of SAFSTOR Preparations	08/31/2023	08/1/2024
SNF Pd 4 - Dry Storage During Dormancy	08/1/2024	10/30/2059
SNF Pd 5 - ISFSI Demolition Delay	10/30/2059	12/31/2077
SNF Pd 6 - ISFSI and Support Structure Clean Demolition	12/31/2077	07/28/2078
ISFSI D&D Pd 1 - ISFSI D&D Planning	04/23/2075	12/30/2077
ISFSI D&D Pd 2 - ISFSI Final Status Survey	12/30/2077	01/12/2079
License Termination	04/01/2019	10/29/2080
Unit 1 Shutdown	10/30/2020	10/30/2020
Decon Pd 1 - SAFSTOR Planning Prior to Shutdown	04/01/2019	10/30/2020
Decon Pd 2 - Transition Following Shutdown	10/30/2020	10/30/2021
Decon Pd 3 - SAFSTOR Preparations Delay During Fuel Transfer	10/30/2021	08/31/2023
Decon Pd 4 - Completion of SAFSTOR Preparations	08/31/2023	08/1/2024
Decon Pd 5 - Dormancy During Dry Storage	08/1/2024	10/30/2059
Decon Pd 6 - Dormancy Only	10/30/2059	09/26/2073
Decon Pd 7 - Decommissioning Planning During Dormancy	09/26/2073	03/07/2075
Decon Pd 8 - Internals Segmentation and Site Preparations	03/07/2075	07/16/2076
Decon Pd 9 - Major Component and Systems Removal	07/16/2076	05/19/2078
Decon Pd 10 - Building Decontamination	05/19/2078	01/03/2080
Decon Pd 11 - License Termination	01/03/2080	09/19/2080
End 60 year SAFSTOR	10/29/2080	10/29/2080
Grn Pd 1 - Clean Building Demolition During Decommissioning	06/22/2078	01/03/2080
Grn Pd 2 - Site Restoration	01/03/2080	09/08/2080

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 Levels[1]

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
Energy*Solutions*			
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.

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3. U.S. Nuclear Regulatory Commission, "Standard Format and Content of Decommissioning Cost Estimates for Nuclear Power Reactors," Regulatory Guide 1.202, February 2005.

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.

5. U.S. Department of Energy, "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," January 26, 2013.

6. U.S. Department of Energy, "Acceptance Priority Ranking & Annual Capacity Report," DOE/RW-0567, July 2004.

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 Energy*Solutions* 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 Transfered 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

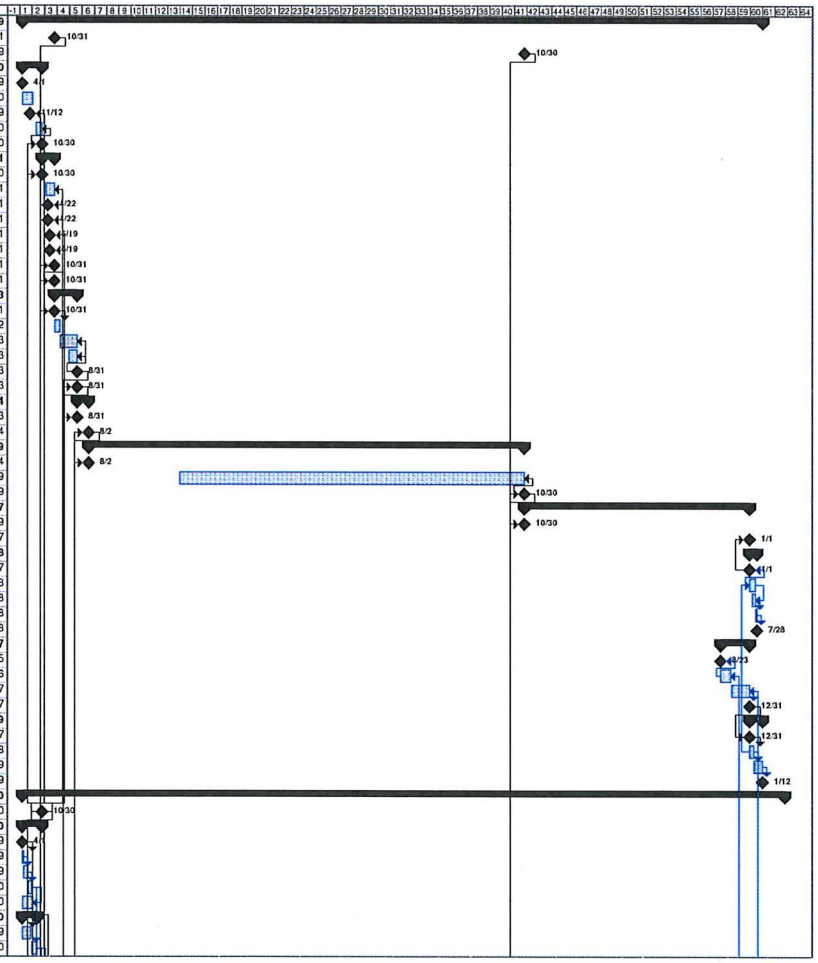
Appendix C

Detailed Project Schedule

Duane Arnold Energy Center

Project Schedule for SAFSTOR, 2030 DOE Acceptance, Dry Storage

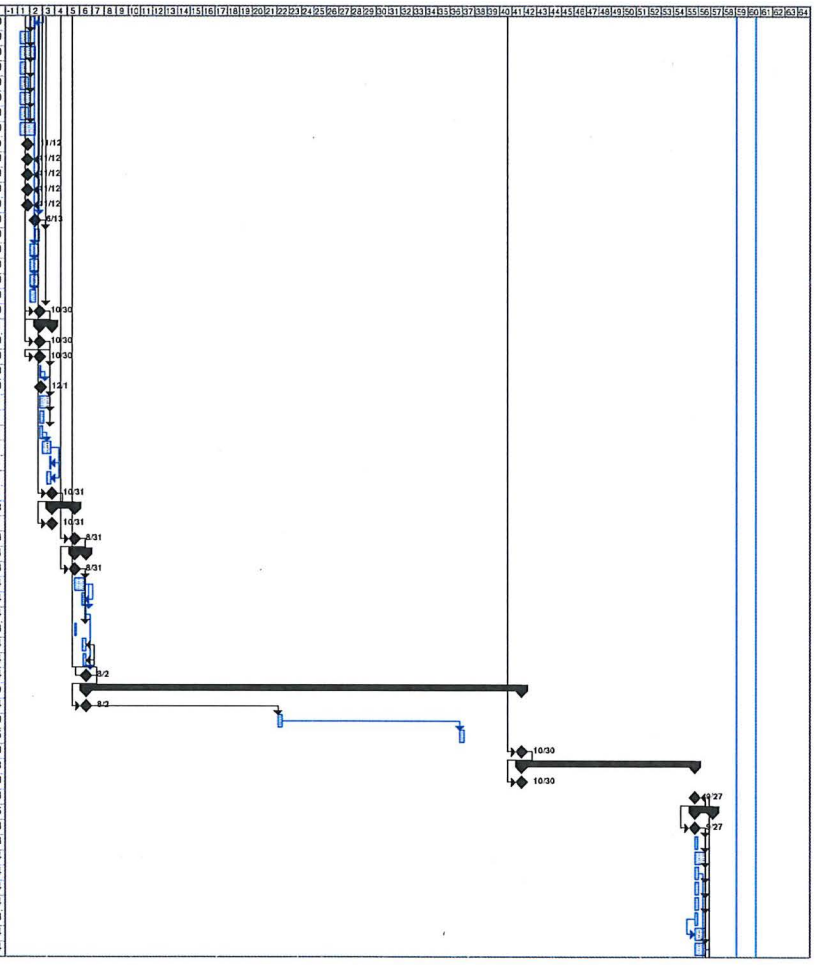
ID	Task Name	Duration	Start	Finish
1	**Spent Fuel Management**	**15600 days**	**04/01/2019**	**01/12/2079**
2	Zirconium Fire Window Closes	0 days	10/30/2021	10/30/2021
3	Spent Fuel Shipping Complete	0 days	10/30/2059	10/30/2059
4	**SNF Pd 1 - Spent Fuel Planning**	**413 days**	**04/01/2019**	**10/30/2020**
5	SNF Pd 1 Begins	0 days	04/01/2019	04/01/2019
6	Prepare Irradiated Fuel Management Plan	220 days	04/01/2019	01/31/2020
7	Submit ER to Allow Spent Fuel Costs to Taken From DTF	0 days	11/12/2019	11/12/2019
8	Design Spent Fuel Pool Security Modifications	125 days	05/07/2020	10/29/2020
9	SNF Pd 1 Ends	0 days	10/29/2020	10/29/2020
10	**SNF Pd 2 - Spent Fuel Cooling During Zirc Fire Window**	**263 days**	**10/30/2020**	**10/30/2021**
11	SNF Pd 2 Begins	0 days	10/29/2020	10/29/2020
12	Implement Spent Fuel Pool Security Modifications	180 days	02/22/2021	10/30/2021
13	Submit Irradiated Fuel Management Plan	0 days	04/21/2021	04/21/2021
14	Submit Cask Vendor Revised Certificate of Compliance (CoC)	0 days	04/21/2021	04/21/2021
15	Submit LAR for ISFSI only Emergency Plan	0 days	06/18/2021	06/18/2021
16	Submit LAR for ISFSI Only Tech Specs and Revised QA Plan	0 days	06/18/2021	06/18/2021
17	Submit LAR for Permanently Defueled Security Plan	0 days	10/30/2021	10/30/2021
18	SNF Pd 2 Ends	0 days	10/30/2021	10/30/2021
19	**SNF Pd 3 - Spent Fuel Transfer to Dry Storage**	**479 days**	**10/30/2021**	**08/31/2023**
20	SNF Pd 3 Begins	0 days	10/30/2021	10/30/2021
21	Construct ISFSI Phase 2 and 3 Pad Expansion	120 days	11/01/2021	04/15/2022
22	Spent Fuel Pool to Pad Transfer	360 days	04/15/2022	08/31/2023
23	Construct ISFSI Monitoring Building	180 days	12/23/2022	08/31/2023
24	Spent Fuel Pool Empty	0 days	08/31/2023	08/31/2023
25	SNF Pd 3 Ends	0 days	08/31/2023	08/31/2023
26	**SNF Pd 3 - Dry Storage During Completion of SAFSTOR Preparations**	**240 days**	**08/31/2023**	**08/01/2024**
27	SNF Pd 3 Begins	0 days	08/31/2023	08/31/2023
28	SNF Pd 3 Ends	0 days	08/01/2024	08/01/2024
29	**SNF Pd 4 - Dry Storage During Dormancy**	**9195 days**	**08/01/2024**	**10/30/2059**
30	SNF Pd 4 Begins	0 days	08/01/2024	08/01/2024
31	Spent Fuel Transfer to DOE	7258 days	01/06/2032	10/30/2059
32	SNF Pd 4 Ends	0 days	10/30/2059	10/30/2059
33	**SNF Pd 5 - ISFSI Demolition Delay**	**4740 days**	**10/30/2059**	**12/31/2077**
34	SNF Pd 5 Begins	0 days	10/30/2059	10/30/2059
35	SNF Pd 5 Begins	0 days	12/31/2077	12/31/2077
36	**SNF Pd 6 - ISFSI and Support Structure Clean Demolition**	**150 days**	**12/31/2077**	**07/28/2078**
37	SNF Pd 6 Begins	0 days	12/31/2077	12/31/2077
38	Clean Demolition of ISFSI	120 days	12/31/2077	06/16/2078
39	Demolish ISFSI Support Structures	60 days	03/25/2078	06/16/2078
40	Backfill and Grade ISFSI Site	30 days	06/17/2078	07/28/2078
41	SNF Pd 5 Ends	0 days	07/28/2078	07/28/2078
42	**ISFSI D&D Pd 1 - ISFSI D&D Planning**	**615 days**	**08/23/2075**	**12/30/2077**
43	ISFSI D&D Pd 1 Begins	0 days	08/23/2075	08/23/2075
44	Preparation of ISFSI Portion of LTP	220 days	08/23/2075	06/25/2076
45	NRC Review of ISFSI Portion LTP	380 days	07/17/2076	12/30/2077
46	ISFSI D&D Pd 1 Ends	0 days	12/30/2077	12/30/2077
47	**ISFSI D&D Pd 2 - ISFSI Final Status Survey**	**270 days**	**12/30/2077**	**01/12/2079**
48	ISFSI D&D Pd 2 Begins	0 days	12/30/2077	12/30/2077
49	Final Status Survey of ISFSI	90 days	12/31/2077	05/05/2078
50	Preparation of FSS Report and NRC Review	180 days	05/06/2078	01/12/2079
51	ISFSI D&D Pd 2 Begins	0 days	01/12/2079	01/12/2079
52	**License Termination**	**16067 days**	**04/01/2019**	**10/29/2080**
53	Unit 1 Shutdown	0 days	10/30/2020	10/30/2020
54	**Decon Pd 1 - SAFSTOR Planning Prior to Shutdown**	**413 days**	**04/01/2019**	**10/30/2020**
55	Decon Pd 1 Begins	0 days	04/01/2019	04/01/2019
56	Planning of Historical Site Assessment (HSA) and Scoping Survey	30 days	04/01/2019	05/10/2019
57	Perform HSA	90 days	05/13/2019	09/13/2019
58	Perform Scoping Survey	90 days	09/16/2019	01/17/2020
59	Perform SAFSTOR Planning and Design	220 days	04/08/2019	02/07/2020
60	**Preparation of SAFSTOR License Documents**	**320 days**	**04/01/2019**	**06/19/2020**
61	Perform Site Environmental Review and Environmental Assessm	180 days	04/01/2019	12/06/2019
62	Prepare Decommissioning Cost Estimate	120 days	12/30/2019	06/12/2020



Duane Arnold Energy Center

Project Schedule for SAFSTOR, 2030 DOE Acceptance, Dry Storage

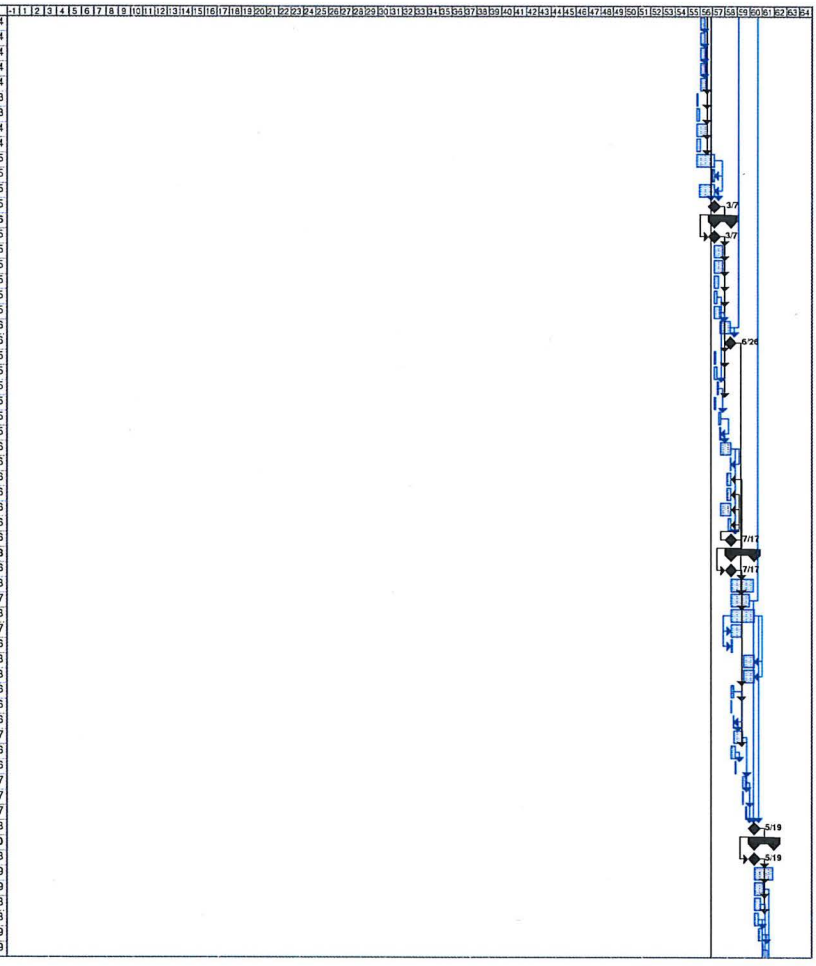
ID	Task Name	Duration	Start	Finish
63	Prepare Post-Shutdown Decommissioning Activities Report	120 days	12/30/2019	06/12/2020
64	Prepare Post-Shutdown Technical Specification (TS) Modification	180 days	04/01/2019	12/06/2019
65	Prepare Defuel Safety Analysis Report (DSAR)	320 days	04/01/2019	06/19/2020
66	Perform Emergency Plan Supporting Calculations	120 days	04/01/2019	09/13/2019
67	Prepare Post-Shutdown Emergency Plan	180 days	04/01/2019	12/06/2019
68	Prepare Post-Shutdown Security and Cyber Security Plans	220 days	04/01/2019	01/31/2020
69	Develop Certified Fuel Handlers (CFH) Training Program	180 days	04/01/2019	12/06/2019
70	Revise Plant Programs and Procedures for Shutdown	320 days	04/01/2019	06/19/2020
71	**Submit License Amendment and Exemption Requests**	**0 days**	**11/12/2019**	**11/12/2019**
72	Submit LAR for Permanently Defueled Technical Specifications	0 days	11/12/2019	11/12/2019
73	Submit CFH LAR to Replace Licensed Operators with CFHs	0 days	11/12/2019	11/12/2019
74	Submit Defueled Security Plan and Exemptions to 10 CFR 73.55	0 days	11/12/2019	11/12/2019
75	Submit ER to Revise Records Retention Requirements	0 days	11/12/2019	11/12/2019
76	Submit PSDAR and DCE to NRC	0 days	06/12/2020	06/12/2020
77	NRC Review of PSDAR and DCE	90 days	06/15/2020	10/16/2020
78	Prepare SAFSTOR Integrated Work Schedule	180 days	01/20/2020	09/25/2020
79	Prepare SAFSTOR Activity Specifications	180 days	01/20/2020	09/25/2020
80	Prepare Detailed SAFSTOR Work Procedures	180 days	01/20/2020	09/25/2020
81	Perform Part 37 and SNM Assessment	120 days	01/20/2020	07/03/2020
82	Decon Pd 1 Ends	0 days	10/29/2020	10/29/2020
83	**Decon Pd 2 - Transition Following Shutdown**	**263 days**	**10/30/2020**	**10/30/2021**
84	Decon Pd 2 Begins	0 days	10/29/2020	10/29/2020
85	Submit Notification of Cessation of Operations	0 days	10/29/2020	10/29/2020
86	Defuel Reactor	21 days	11/02/2020	11/30/2020
87	Submit Notification of Fuel Removal from Vessel	0 days	11/30/2020	11/30/2020
88	NRC Review of Post-Shutdown LARs and ERs	220 days	10/29/2020	08/31/2021
89	Perform Activation Analyses of Reactor and Internals	90 days	10/29/2020	03/02/2021
90	Volume Reduce Control Rod Blades, Fuel Channels, & LPRMs	60 days	10/29/2020	01/20/2021
91	Flush and Drain Non-Essential Systems	180 days	01/21/2021	09/28/2021
92	Remove and Dispose of Hazardous Waste	30 days	08/18/2021	09/28/2021
93	Drain and Process Suppression Pool Water and Hydrolase Torus Wa	90 days	05/26/2021	09/28/2021
94	Decon Pd 2 Ends	0 days	10/30/2021	10/30/2021
95	**Decon Pd 3 - SAFSTOR Preparations Delay During Fuel Transfer**	**479 days**	**10/30/2021**	**08/31/2023**
96	Decon Pd 3 Begins	0 days	10/30/2021	10/30/2021
97	Decon Pd 3 Ends	0 days	08/31/2023	08/31/2023
98	**Decon Pd 4 - Completion of SAFSTOR Preparations**	**240 days**	**08/31/2023**	**08/01/2024**
99	Decon Pd 4 Begins	0 days	08/31/2023	08/31/2023
100	Drain Spent Fuel Pool and Process Liquid Waste	210 days	09/01/2023	06/20/2024
101	Flush and Drain Essential Systems Following Fuel Pool Closure	60 days	03/29/2024	06/20/2024
102	Removal and Disposal of Spent Resins, Filter Media and Tank Sludge	30 days	06/21/2024	08/01/2024
103	Segment, Package and Dispose of Spent Fuel Pool Island Equipment	30 days	09/01/2023	10/12/2023
104	General Area Cleanup	80 days	04/12/2024	08/01/2024
105	Secure Site for Dormancy	60 days	05/10/2024	08/01/2024
106	Decon Pd 4 Ends	0 days	08/01/2024	08/01/2024
107	**Decon Pd 5 - Dormancy During Dry Storage**	**9195 days**	**08/01/2024**	**10/30/2059**
108	Decon Pd 5 Begins	0 days	08/01/2024	08/01/2024
109	Bituminous Roof Replacement - 20 year	90 days	02/17/2040	06/21/2040
110	Bituminous Roof Replacement - 40 year	90 days	11/06/2054	03/11/2055
111	Decon Pd 5 Ends	0 days	10/30/2059	10/30/2059
112	**Decon Pd 6 - Dormancy Only**	**3627 days**	**10/30/2059**	**09/26/2073**
113	Decon Pd 6 Begins	0 days	10/30/2059	10/30/2059
114	Decon Pd 6 Ends	0 days	09/26/2073	09/26/2073
115	**Decon Pd 7 - Decommissioning Planning During Dormancy**	**378 days**	**09/26/2073**	**03/07/2075**
116	Decon Pd 7 Begins	0 days	09/26/2073	09/26/2073
117	Install Office Trailer Complex	60 days	09/26/2073	12/18/2073
118	Select Decommissioning General Contractor	220 days	09/26/2073	07/30/2074
119	Post SAFSTOR Decommissioning Planning	90 days	09/26/2073	01/29/2074
120	Planning of Post SAFSTOR Site Characterization	90 days	09/26/2073	01/29/2074
121	Planning for Asbestos Abatement	90 days	09/26/2073	01/29/2074
122	Prepare Integrated Work Sequence and Schedule for Decommissioni	60 days	09/26/2073	12/18/2073
123	Prepare Decommissioning Activity Specifications	220 days	09/26/2073	07/30/2074
124	Prepare Detailed Work Procedures for Decommissioning	220 days	09/26/2073	07/30/2074



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 Systen	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 mons	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 GTCC 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 Segementation	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 GTCC 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**	**480 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 Pedesta	60 days	06/18/2077	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



Duane Arnold Energy Center

Project Schedule for SAFSTOR, 2030 DOE Acceptance, Dry Storage

ID	Task Name	Duration	Start	Finish
187	Decon Off-Gas Retention Building	10 days	02/10/2079	02/23/2079
188	Decon LLRW Storage and Processing Building	20 days	02/24/2079	03/23/2079
189	Decon Off-Gas Stack	30 days	02/24/2079	04/06/2079
190	Segment, Package and Dispose of Contaminated Decon Equipment a	10 days	04/07/2079	04/20/2079
191	Remove Underground Storm Drains and Manholes	90 days	09/23/2078	01/26/2079
192	Transportation and Disposal of Liquid Radwaste Filters and Resins	15 days	04/21/2079	05/11/2079
193	Demolish Waste Staging Area	20 days	04/21/2079	05/18/2079
194	Final Status Survey for Structures	320 days	10/12/2078	01/03/2080
195	Final Status Survey for Land Areas	320 days	10/12/2078	01/03/2080
196	Decon Pd 10 Ends	0 days	01/03/2080	01/03/2080
197	**Decon Pd 11 - License Termination**	**186 days**	**01/03/2080**	**09/19/2080**
198	Decon Pd 11 Begins	0 days	01/03/2080	01/03/2080
199	Prepare FSS Report	60 days	01/03/2080	03/27/2080
200	NRC Review and Approval of FSS Report	6 mons	03/27/2080	09/19/2080
201	Decon Pd 11 Ends	0 days	09/19/2080	09/19/2080
202	End 60 year SAFSTOR	0 days	10/29/2080	10/29/2080
203	**Grn Pd 1 - Clean Building Demolition During Decommissioning**	**400 days**	**06/22/2078**	**01/03/2080**
204	Grn Pd 1 Begins	0 days	06/22/2078	06/22/2078
205	Prepare Site Restoration Demolition Plan and Schedule	60 days	06/22/2078	09/14/2078
206	Obtain Required Demolition Permits	90 days	09/14/2078	01/18/2079
207	Clean Building Demolition Equipment	400 days	06/22/2078	01/03/2080
208	Perform Pre-Demolition Asbestos Abatement	60 days	06/22/2078	09/14/2078
209	Remove and Dispose of Underground Storage Tanks	15 days	06/22/2078	07/13/2078
210	Demolish Non-Essential Structures	90 days	09/14/2078	01/18/2079
211	Demolish Training Center	20 days	01/18/2079	02/15/2079
212	Demolish Plant Support Center and New Site Support Building	30 days	02/15/2079	03/29/2079
213	Demolish Cooling Towers and Related Structures	30 days	03/29/2079	05/10/2079
214	Demolish Existing Waste Water Treatment	20 days	05/10/2079	06/07/2079
215	Demolish Intake and Discharge Structures	60 days	06/07/2079	08/30/2079
216	Demolish Data Acquisition and Technical Support Building	30 days	01/18/2079	03/01/2079
217	Demolish Guard Facility	15 days	03/01/2079	03/22/2079
218	Demolish Control and Administrative Buildings	30 days	03/01/2079	04/12/2079
219	Demolish Turbine Building	80 days	04/12/2079	08/02/2079
220	Demolish Low-Level Radwaste Building	80 days	04/12/2079	08/02/2079
221	Demolish HPCI and RCIC Building	20 days	08/02/2079	08/30/2079
222	Demolish Reactor Building	110 days	08/02/2079	01/03/2080
223	Demolish Off-Gas Stack	30 days	11/22/2079	01/03/2080
224	Demolish Misc Foundations	30 days	11/22/2079	01/03/2080
225	Grn Pd 1 Ends	0 days	01/03/2080	01/03/2080
226	**Grn Pd 2 - Site Restoration**	**90 days**	**01/03/2080**	**05/08/2080**
227	Grn Pd 2 Begins	0 days	01/03/2080	01/03/2080
228	Site Restoration Equipment	90 days	01/03/2080	05/08/2080
229	Remove Temporary Structures	25 days	01/03/2080	02/07/2080
230	Finish Grading and Re-Vegetate Site	90 days	01/03/2080	05/08/2080
231	Grn Pd 2 Ends	0 days	05/08/2080	05/08/2080

Appendix D

Detailed Cost Table

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

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

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

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

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

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

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

		License Status	Early Shutdown	Unit 1Shut Down:	10/30/2020
Decommissioning Alternative	SAFSTOR	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
Spent Fuel Alternative	Dry	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 Revitilization	$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

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

		License Status	Early Shutdown	Unit 1Shut Down:	10/30/2020
Decommissioning Alternative	SAFSTOR	Fuel Pool Systems	Modified	Unit 2 Shut Down:	
Spent Fuel Alternative	Dry	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 Segementation	$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

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

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

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

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

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

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

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

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

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

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

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

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

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

Attachment 2

Table 5.1 State and Federally Listed Species Potentially Occurring in the Vicinity of DAEC

Table 5.1 State and Federally Listed Species Potentially Occurring in the Vicinity of DAEC

Common Name	Scientific Name	Class	State Status*	Federal Status
Blue-spotted Salamander	Ambystoma laterale	AMPHIBIANS	E	
Central Newt	Notophthalmus viridescens	AMPHIBIANS	T	
Bald Eagle	Haliaeetus leucocephalus	BIRDS	S	
Barn Owl	Tyto alba	BIRDS	E	
Henslow's Sparrow	Ammodramus henslowii	BIRDS	T	
American Brook Lamprey	Lampetra appendix	FISH	T	
Black Redhorse	Moxostoma duquesnei	FISH	T	
Blacknose Shiner	Notropis heterolepis	FISH	T	
Grass Pickerel	Esox americanus	FISH	T	
Lake Sturgeon	Acipenser fulvescens	FISH	E	
Orangethroat Darter	Etheostoma spectabile	FISH	T	
Weed Shiner	Notropis texanus	FISH	E	
Western Sand Darter	Ammocrypta clara	FISH	T	
Creek Heelsplitter	Lasmigona compressa	FRESHWATER MUSSELS	T	
Creeper	Strophitus undulatus	FRESHWATER MUSSELS	T	
Cylindrical Papershell	Anodontoides ferussacianus	FRESHWATER MUSSELS	T	
Ellipse	Venustaconcha ellipsiformis	FRESHWATER MUSSELS	T	
Higgin's-eye Pearly Mussel	Lampsilis higginsii	FRESHWATER MUSSELS	E	E

*E: Endangered, T: Threatened, S: Special concern

Table 5.1 State and Federally Listed Species Potentially Occurring in the Vicinity of DAEC

Common Name	Scientific Name	Class	State Status*	Federal Status
Pistolgrip	Tritogonia verrucosa	FRESHWATER MUSSELS	E	
Slippershell Mussel	Alasmidonta viridis	FRESHWATER MUSSELS	E	
Yellow Sandshell	Lampsilis teres	FRESHWATER MUSSELS	E	
Baltimore	Euphydryas phaeton	INSECTS	T	
Byssus Skipper	Problema byssus	INSECTS	T	
Pipevine Swallowtail	Battus philenor	INSECTS	S	
Swamp Metalmark	Calephelis mutica	INSECTS	S	
Wild Indigo Dusky Wing	Erynnis baptisiae	INSECTS	S	
Zabulon Skipper	Poanes zabulon	INSECTS	S	
Zebra Swallowtail	Eurytides marcellus	INSECTS	S	
Northern Long-eared Bat	Myotis septentrionalis	MAMMALS		T
Plains Pocket Mouse	Perognathus flavescens	MAMMALS	E	
Southern Flying Squirrel	Glaucomys volans	MAMMALS	S	
Bent Milk-vetch	Astragalus distortus	PLANTS (DICOTS)	S	
Black Huckleberry	Gaylussacia baccata	PLANTS (DICOTS)	T	
Buckbean	Menyanthes trifoliata	PLANTS (DICOTS)	T	
Cleft Phlox	Phlox bifida	PLANTS (DICOTS)	S	
Flat Top White Aster	Aster pubentior	PLANTS (DICOTS)	S	
Hill's Thistle	Cirsium hillii	PLANTS (DICOTS)	S	
Kitten Tails	Besseya bullii	PLANTS (DICOTS)	T	
Lance-leaved Violet	Viola lanceolata	PLANTS (DICOTS)	S	

*E: Endangered, T: Threatened, S: Special concern

Table 5.1 State and Federally Listed Species Potentially Occurring in the Vicinity of DAEC

Common Name	Scientific Name	Class	State Status*	Federal Status
Large-leaf White Violet	Viola incognita	PLANTS (DICOTS)	E	
Northern St. John's-wort	Hypericum boreale	PLANTS (DICOTS)	E	
Pearly Everlasting	Anaphalis margaritacea	PLANTS (DICOTS)	S	
Pink Milkwort	Polygala incarnata	PLANTS (DICOTS)	T	
Prairie Bush Clover	Lespedeza leptostachya	PLANTS (DICOTS)	T	T
Pretty Dodder	Cuscuta indecora	PLANTS (DICOTS)	S	
Prince's Pine	Chimaphila umbellata	PLANTS (DICOTS)	T	
Purple Cress	Cardamine douglassii	PLANTS (DICOTS)	S	
Racemed Milkwort	Polygala polygama	PLANTS (DICOTS)	E	
Sage Willow	Salix candida	PLANTS (DICOTS)	S	
Scarlet Hawthorn	Crataegus coccinea	PLANTS (DICOTS)	S	
Shrubby Cinquefoil	Potentilla fruticosa	PLANTS (DICOTS)	T	
Small Sundrops	Oenothera perennis	PLANTS (DICOTS)	T	
Smooth Black-haw	Viburnum prunifolium	PLANTS (DICOTS)	S	
Spring Avens	Geum vernum	PLANTS (DICOTS)	S	
Tunnel-formed Penstemon	Penstemon tubiflorus	PLANTS (DICOTS)	S	
Veined Skullcap	Scutellaria nervosa	PLANTS (DICOTS)	S	
Violet	Viola macloskeyi	PLANTS (DICOTS)	S	
Water Shield	Brasenia schreberi	PLANTS (DICOTS)	S	
Water Starwort	Callitriche heterophylla	PLANTS (DICOTS)	S	
Winterberry	Ilex verticillata	PLANTS (DICOTS)	E	

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Table 5.1 State and Federally Listed Species Potentially Occurring in the Vicinity of DAEC

Common Name	Scientific Name	Class	State Status*	Federal Status
Yellow Monkey Flower	Mimulus glabratus	PLANTS (DICOTS)	T	
Deep Green Sedge	Carex tonsa	PLANTS (MONOCOTS)	S	
Eastern Prairie Fringed Orchid	Platanthera leucophaea	PLANTS (MONOCOTS)	E	T
Field Sedge	Carex conoidea	PLANTS (MONOCOTS)	S	
Fringed Sedge	Carex crinita	PLANTS (MONOCOTS)	S	
Glomerate Sedge	Carex aggregata	PLANTS (MONOCOTS)	S	
Grass Pink	Calopogon tuberosus	PLANTS (MONOCOTS)	S	
Great Plains Ladies'-tresses	Spiranthes magnicamporum	PLANTS (MONOCOTS)	S	
Green's Rush	Juncus greenei	PLANTS (MONOCOTS)	S	
Hidden Sedge	Carex umbellata	PLANTS (MONOCOTS)	S	
Northern Panic-grass	Dichanthelium boreale	PLANTS (MONOCOTS)	E	
Oval Ladies'-tresses	Spiranthes ovalis	PLANTS (MONOCOTS)	T	
Pale Green Orchid	Platanthera flava	PLANTS (MONOCOTS)	E	
Purple Fringed Orchid	Platanthera psycodes	PLANTS (MONOCOTS)	T	
Richardson Sedge	Carex richardsonii	PLANTS (MONOCOTS)	S	

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Table 5.1 State and Federally Listed Species Potentially Occurring in the Vicinity of DAEC

Common Name	**Scientific Name**	**Class**	**State Status***	**Federal Status**
Showy Lady's Slipper	Cypripedium reginae	PLANTS (MONOCOTS)	T	
Slender Sedge	Carex tenera	PLANTS (MONOCOTS)	S	
Small Green Woodland Orchid	Platanthera clavellata	PLANTS (MONOCOTS)	S	
Small White Lady's Slipper	Cypripedium candidum	PLANTS (MONOCOTS)	S	
Soft Rush	Juncus effusus	PLANTS (MONOCOTS)	S	
Tall Cotton Grass	Eriophorum angustifolium	PLANTS (MONOCOTS)	S	
Vasey Pondweed	Potamogeton vaseyi	PLANTS (MONOCOTS)	S	
Western Prairie Fringed Orchid	Platanthera praeclara	PLANTS (MONOCOTS)	T	T
Yellow-eyed Grass	Xyris torta	PLANTS (MONOCOTS)	E	
Crowfoot Clubmoss	Lycopodium digitatum	PLANTS (PTERIODOPHYTES)	S	
Leathery Grape Fern	Botrychium multifidum	PLANTS (PTERIODOPHYTES)	T	
Ledge Spikemoss	Selaginella rupestris	PLANTS (PTERIODOPHYTES)	S	
Little Grape Fern	Botrychium simplex	PLANTS (PTERIODOPHYTES)	T	
Northern Adder's-tongue	Ophioglossum pusillum	PLANTS (PTERIODOPHYTES)	S	
Prairie Moonwort	Botrychium campestre	PLANTS (PTERIODOPHYTES)	S	

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Table 5.1 State and Federally Listed Species Potentially Occurring in the Vicinity of DAEC

Common Name	**Scientific Name**	**Class**	**State Status***	**Federal Status**
Woodland Horsetail	Equisetum sylvaticum	PLANTS (PTERIODOPHYTES)	T	
Blanding's Turtle	Emydoidea blandingii	REPTILES	T	
Bullsnake	Pituophis catenifer sayi	REPTILES	S	
Ornate Box Turtle	Terrapene ornata	REPTILES	T	
Smooth Green Snake	Liochlorophis vernalis	REPTILES	S	
Bluff Vertigo	Vertigo meramecensis	SNAILS	E	

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