



MAR 25 2019

L-2019-045  
10 CFR 50.75(f)(1)  
10 CFR 72.30(c)

Nuclear Regulatory Commission  
Attn: Document Control Desk  
Washington, DC 20555-0001

RE: NextEra Energy Duane Arnold, LLC  
Duane Arnold Energy Center  
Docket No. 50-331  
Docket No. 72-32

Decommissioning Funding Status Reports / Independent Spent Fuel Storage Installation (ISFSI)  
Financial Assurance Update

Pursuant to 10 CFR 50.75(f)(1) and 10 CFR 72.30(c), enclosed are the Decommissioning Funding Status (DFS) Report and Independent Spent Fuel Storage Installation Financial Assurance Update for Duane Arnold.

NextEra Energy Duane Arnold, LLC (NextEra), Central Iowa Power Cooperative, and Corn Belt Power Cooperative own the Duane Arnold Energy Center. The report for Duane Arnold Energy Center provides the status of decommissioning funding for all three owners.

This letter contains no new commitments and no revisions to existing commitments.

Should there be any questions, please contact Steve Catron at (561) 304-6206.

A handwritten signature in black ink, appearing to read 'W. Parks'.

William Parks  
Nuclear Licensing and Regulatory Compliance Director

Enclosures (2)

ADD1  
NMSS26  
NRR  
NMSS

## **Enclosure 1**

Decommissioning Funding Status Reports  
10 CFR 50.75(f)(1)

- Duane Arnold Energy Center

**Duane Arnold Energy Center  
NextEra Energy Duane Arnold, LLC (NextEra),  
Central Iowa Power Cooperative (CIPCO),  
Corn Belt Power Cooperative (Corn Belt)  
Decommissioning Funding Status Report**

1. Duane Arnold Energy Center has performed a site specific decommissioning cost study that has estimated license termination costs of \$740,099,000 (2018 dollars) which is higher than the minimum decommissioning fund estimate pursuant to 10 CFR 50.75(b) and (c) of \$612,367,058.

2. The amount accumulated at the end of the calendar year preceding the date of the report. (Trust fund balances are net of taxes)

Plant Owner (% Ownership)	Total
NextEra (70%)	377,863,154
CIPCO (20%)	62,355,498
Corn Belt (10%)	31,610,394
<b>Total</b>	<b>471,829,046</b>

3. Refer to Attachment 1 for Decommissioning Funding Plan, SAFSTOR Alternative and Attachment 2 for a License Termination Site Specific Decommissioning Cost Estimate for Duane Arnold.

4. Assumptions used regarding escalation in decommissioning costs, rate of earnings on decommissioning funds and rates of other factors used in funding projections.

Plant Owner (% Ownership)			<i>Real Rate of Return</i>
NextEra (see note (c)) (70%)			2%
CIPCO (see note (d)) (20%)			4%
Corn Belt (see note (e)) (10%)			4%

**Basis for Allowance:**

(c) 10 CFR 50.75 allows licensees to assume up to a 2% real rate of return unless the licensee's rate-setting authority has specifically authorized a higher rate.

**Duane Arnold Energy Center  
NextEra Energy Duane Arnold, LLC (NextEra),  
Central Iowa Power Cooperative (CIPCO),  
Corn Belt Power Cooperative (Corn Belt)  
Decommissioning Funding Status Report**

- (d) **Central Iowa Power Cooperative (CIPCO) is a public corporation incorporated under Chapter 499 Iowa Code (2009). CIPCO has the authority and is required to fix, establish, and collect adequate rates and other charges for electrical energy or services sold or furnished by it. CIPCO is accordingly authorized to establish its own rates and other charges through which it can recover its cost of service. CIPCO is governed by a 13 member Board of Directors that are elected by the CIPCO members. The Board of Directors is the rate making authority for CIPCO. CIPCO rates are not regulated by any state or federal authority. In a Board Resolution dated October 27, 2009, the CIPCO Board of Directors resolved that the rates and other charges for electrical energy services and the decommissioning fund be established assuming a real rate of return on the decommissioning fund of four percent.**
- (e) **Corn Belt Power Cooperative is a public corporation incorporated under Chapter 499 Iowa Code (2009). Corn Belt has the authority and is required to fix, establish, and collect adequate rates and other charges for electrical energy or services sold or furnished by it. Corn Belt is governed by an 11 member Board of Directors who are elected by its members. The Corn Belt Board of Directors is accordingly authorized to establish its own rates and other charges through which it can recover its cost of service and is the rate making authority for the Cooperative. The Cooperative's rates are not regulated by any state or federal authority. In a Board Resolution dated May 2, 2014, the Corn Belt Board of Directors resolved that the rates and other charges for electrical energy services and the decommissioning fund be established assuming a real rate of return on the decommissioning fund of four percent.**

5. **Any contracts upon which the licensee is relying pursuant to 10 CFR 50.75(e)(1)(v).** None
6. **Any modifications to a licensee's method of providing financial assurance occurring since the last submitted report.** None
7. **Any material changes to trust agreements.** None

**Attachment 1  
Duane Arnold Energy Center  
Decommissioning Funding Plan  
2020 Shutdown, SAFSTOR Alternative  
(Thousands of Dollars)**

Basis Year 2018					
Fund Balance as of 12/31/18: (Thousands of Dollars)					
NextEra Energy Duane Arnold		377,863	70% ownership		
CIPCO		62,355	20% ownership		
Corn Belt		31,610	10% ownership		
<b>Total Trust Fund Balance</b>		<b>471,829</b>			
Annual Earnings - NextEra		2.0%			
Annual Earnings - CIPCO		4.0%			
Annual Earnings - Corn Belt		4.0%			
A	B	C	D	E	F
Year	2018 Cost	NextEra Decommissioning Trust Fund Balance escalated at 2% minus 70% of expenses	CIPCO Decommissioning Trust Fund Balance escalated at 4% minus 20% of expenses + Contributions	Corn Belt Decommissioning Trust Fund Balance escalated at 4% minus 10% of expenses + Contributions	Total Decommissioning Trust Fund minus expenses
2018		377,863	62,355	31,610	471,829
2019	4,099	382,551	64,030	32,465	479,046
2020	29,127	369,814	60,766	30,851	461,431
2021	61,198	334,372	50,957	25,965	411,294
2022	24,100	324,189	48,175	24,594	396,958
2023	4,969	327,195	49,109	25,081	401,384
2024	9,600	327,019	49,153	25,124	401,296
2025	17,270	321,470	47,665	24,402	393,537
2026	2,201	326,359	49,131	25,158	400,648
2027	1,827	331,607	50,731	25,981	408,319
2028	1,827	336,960	52,395	26,838	416,193
2029	1,827	342,420	54,125	27,729	424,274
2030	1,884	347,949	55,913	28,649	432,512
2031	1,770	353,670	57,796	29,618	441,084
2032	1,770	359,504	59,754	30,626	449,884
2033	1,770	365,455	61,790	31,674	458,920
2034	1,770	371,525	63,908	32,764	468,197
2035	1,770	377,717	66,110	33,898	477,725
2036	1,770	384,033	68,401	35,077	487,510
2037	1,770	390,474	70,783	36,303	497,560
2038	1,770	397,045	73,260	37,578	507,883
2039	1,770	403,747	75,836	38,904	518,487
2040	2,411	410,134	78,388	40,219	528,740
2041	1,770	417,098	81,169	41,651	539,918
2042	1,770	424,201	84,062	43,140	551,402
2043	1,770	431,446	87,070	44,689	563,205
2044	1,770	438,836	90,199	46,299	575,334
2045	1,770	446,374	93,453	47,974	587,801
2046	1,770	454,062	96,837	49,716	600,616
2047	1,770	461,905	100,357	51,528	613,789
2048	1,770	469,904	104,017	53,412	627,333
2049	1,770	478,063	107,824	55,371	641,258
2050	1,770	486,385	111,783	57,409	655,577
2051	1,770	494,874	115,900	59,529	670,303
2052	1,770	503,533	120,182	61,733	685,448
2053	1,770	512,364	124,636	64,025	701,025
2054	2,065	521,166	129,208	66,380	716,754
2055	2,116	530,108	133,953	68,823	732,884
2056	1,770	539,471	138,957	71,399	749,828
2057	1,770	549,022	144,162	74,078	767,262
2058	1,770	558,764	149,574	76,864	785,202
2059	2,159	568,427	155,125	79,723	803,275
2060	3,077	577,642	160,715	82,604	820,960
2061	2,634	587,351	166,616	85,645	839,612
2062	2,634	597,254	172,754	88,807	858,816
2063	2,634	607,356	179,138	92,096	878,590
2064	2,634	617,659	185,777	95,517	898,953
2065	2,634	628,169	192,681	99,074	919,924
2066	2,634	638,889	199,861	102,773	941,524
2067	2,634	649,823	207,329	106,621	963,774
2068	2,634	660,976	215,096	110,623	986,694
2069	2,634	672,352	223,173	114,784	1,010,309
2070	2,634	683,956	231,573	119,112	1,034,641
2071	2,634	695,791	240,309	123,613	1,059,714
2072	2,634	707,864	249,395	128,294	1,085,553
2073	15,319	711,298	256,307	131,894	1,099,499
2074	32,572	702,723	260,045	133,913	1,096,681

A	B	C	D	E	F
Year	2018 Cost	NextEra Decommissioning Trust Fund Balance escalated at 2% minus 70% of expenses	CIPCO Decommissioning Trust Fund Balance escalated at 4% minus 20% of expenses + Contributions	Corn Belt Decommissioning Trust Fund Balance escalated at 4% minus 10% of expenses + Contributions	Total Decommissioning Trust Fund minus expenses
2068	2,634	660,976	215,096	110,623	986,694
2069	2,634	672,352	223,173	114,784	1,010,309
2070	2,634	683,956	231,573	119,112	1,034,641
2071	2,634	695,791	240,309	123,613	1,059,714
2072	2,634	707,864	249,395	128,294	1,085,553
2073	15,319	711,298	256,307	131,894	1,099,499
2074	32,572	702,723	260,045	133,913	1,096,681
2075	75,626	663,839	255,321	131,707	1,050,867
2076	88,570	615,117	247,820	128,118	991,055
2077	117,141	545,421	234,305	121,529	901,254
2078	101,050	485,594	223,467	116,285	825,346
2079	57,385	455,137	220,929	115,198	791,263
2080	4,828	460,860	228,800	119,323	808,983
<b>Total</b>	<b>740,099</b>				
Calculations:					
Column C = (Column C (Previous year's fund balance) x (1+0.02)) - (Column B x 0.70) (70% of current year's decommissioning expenditures)					
Column D = (Column D (Previous year's fund balance) x (1+0.04)) - (Column B x 0.20) (20% of current year's decommissioning expenditures)					
Column E = (Column E (Previous year's fund balance) x (1+0.04)) - (Column B x 0.10) (10% of current year's decommissioning expenditures)					
Column F = Column C + Column D + Column E					

## **Enclosure 2**

Independent Spent Fuel Storage Installation (ISFSI)  
Decommissioning Financial Assurance Update  
10 CFR 72.30(c)

**ISFSI Decommissioning Financial Assurance Update  
10 CFR 72.30(c)**

The Duane Arnold Energy Center has included a site-specific decommissioning cost estimate which identifies the ISFSI decommissioning cost estimate in 2018 dollars. The following table summarizes the current trust balance, projected fund balance remaining after decommissioning and ISFSI decommissioning cost estimate.

<b>Site</b>	<b>Trust Balance as of 12/31/18 (\$Thousands)</b>	<b>Projected Trust Fund Balance Remaining After Decommissioning (\$Thousands)</b>	<b>ISFSI Decommissioning Cost Estimate (\$Thousands)</b>
Duane Arnold - NextEra	377,863	460,860	1,148
Duane Arnold - Corn Belt	31,610	228,800	164
Duane Arnold - CIPCO	62,355	119,323	328

The following table supplements the current ISFSI decommissioning funding plan to address new information that may affect the previously submitted reports in accordance with 10 CFR 72.30(c)(1-4).

<b>Duane Arnold (NextEra Energy Duane Arnold, LLC)</b>	
Spills of radioactive material producing additional residual radioactivity in onsite subsurface material	None
Facility modifications	None
Changes in authorized possession limits	None
Actual remediation costs that exceed previous cost estimate	None



**Attachment 2**

Duane Arnold License Termination Site Specific Decommissioning Cost Estimate



# 2018 License Termination and ISFSI D&D Cost Estimate for the Duane Arnold Energy Center

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Project No. 164053

Revision 0

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

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**Prepared by:**  
EnergySolutions, LLC  
121 W. Trade Street, Suite 2700  
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Approved By: Michael S. Williams March 15, 2019  
Mike Williams, Project Manager Date

Prepared By: Barry Sims March 15, 2019  
Barry Sims, Senior Technical Advisor Date

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

Effective  
Date March 15, 2019

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**APPENDICES**

Appendix A	List of Systems and Structures
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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
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 the costs for (1) decommissioning Duane Arnold Energy Center (DAEC) to the extent required to terminate the plant's operating license pursuant to 10 Code of Federal Regulations (CFR) 50.75(c), and (2) Independent Spent Fuel Storage Installation (ISFSI) Decontamination and Demolition (D&D) pursuant to 10 CFR 72.30.

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.

The estimate 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. 1). 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. 2). 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."

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 four 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) and ISFSI D&D (which correspond to 10 CFR 72.30).

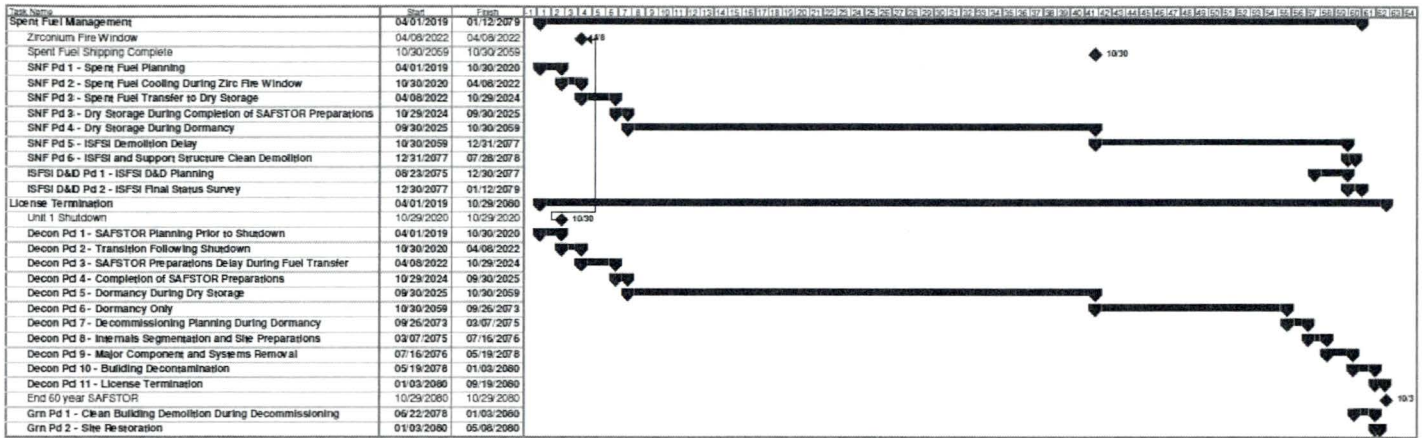
**Table 1-1  
Decommissioning Cost Summary  
(2018 Dollars in Thousands)**

<b>Account</b>	<b>Total</b>
License Termination – 50.75 (c)	\$740,099
ISFSI D&D 72.30	\$1,640
<b>Total</b>	<b>\$741,739</b>

Note: Numbers may not add due to rounding.

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





## 2.0 INTRODUCTION

### 2.1 Study Objective

This report presents the costs for (1) decommissioning Duane Arnold Energy Center (DAEC) to the extent required to terminate the plant's operating license pursuant to 10 Code of Federal Regulations (CFR) 50.75(c), and (2) Independent Spent Fuel Storage Installation (ISFSI) Decontamination and Demolition (D&D) pursuant to 10 CFR 72.30.

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.

The estimate 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. 1). 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. 2). The estimate is based on compliance with current regulatory requirements and proven decommissioning technologies.

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

60 Year SAFSTOR, 2030 DOE Acceptance, Dry Fuel Storage

- Shutdown on October 30, 2020.
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- Termination of spent fuel pool operation approximately four 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. 4). 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. 5), which is the most current information regarding acceptance of fuel.

### 3.0 STUDY METHODOLOGY

#### 3.1 General Description

EnergySolutions maintains a proprietary decommissioning cost model based upon the fundamental technical approach established in AIF/NESP-036, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," dated May 1986 (Ref. No. 1). The cost model has been updated in accordance with regulatory requirements and industry experience. The cost model includes elements for estimating distributed and undistributed costs. Distributed costs are activity specific and include planning and preparation costs as well as the decontamination, packaging, disposal, and removal of major components and systems. For example, the segmentation, packaging, and disposal of the reactor internals is a distributed cost. Undistributed costs, sometimes referred to as collateral costs, are typically time dependent costs such as utility and DGC staff, property taxes, insurance, regulatory fees and permits, energy costs, and security staff.

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

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

#### 3.2 Schedule Analysis

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

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

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

### **3.3 Decommissioning Staff**

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

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

### **3.4 Waste Disposal**

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

#### Waste Classification

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

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

The classification of LLRW resulting from decommissioning activities is based on AIF/NESP-036 (Ref. No. 1) and NUREG/CR-0672 for Boiling Water Reactors (BWRs) (Ref. No. 7), 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. 8), all Class A waste that meets the Clive facility waste acceptance criteria is to be disposed of at Clive. All reported waste disposal costs include packaging, transportation, and any applicable surcharges.

#### Class B and C Disposal Options and Rates

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

#### Greater Than Class C (GTCC)

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

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

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

#### LLRW Volume Reduction

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

#### Non-Radioactive Non-Hazardous Waste Disposal

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

#### Hazardous and Industrial Waste Disposal

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

### **3.5 Final Status Survey**

The cost of performing a final status survey (FSS) is based on NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)" (Ref. No. 9). 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. 10): Contingency “Covers costs that may result from incomplete design, unforeseen and unpredictable conditions, or uncertainties within the defined project scope. The amount of contingency will depend on the status of design, procurement, and construction; and the complexity and uncertainties of the component parts of the project. Contingency is not to be used to avoid making an accurate assessment of expected costs.” *EnergySolutions* determines site-specific contingency factors to be applied to each estimate based on industry practices.

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

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

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

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



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

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

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

### **3.7 Cost Reporting**

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

## 4.0 SITE SPECIFIC TECHNICAL APPROACH

### 4.1 Facility Description

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

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

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

Spent fuel assemblies are stored in the spent fuel storage racks in the fuel pool or may, after appropriate decay, be transferred to an ISFSI for interim onsite storage. The DAEC has been authorized by NRC to increase the storage capacity of the DAEC spent fuel pool to 2829 assemblies. In addition, a Cask Pit is also licensed to contain a rack with storage capacity of 323 assemblies. The Cask Pit rack is used as a means to retain full-core offload capability after such capacity is exhausted in the spent fuel pool. The DAEC may or may not exercise this option in the future. The re-rack project of 1994 increased the spent fuel pool capacity to 2,411 assemblies.

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
- Perform Asbestos Abatement
- 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
- Volume Reduce Control Rod Blades, Fuel Channels, and LPRMs
- Remove and Dispose of Spent Fuel Storage Racks
- 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
- 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
- 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

**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

**4.3 Decommissioning Staff**

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

**4.4 Spent Fuel 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. 5). The spent fuel shipping schedule is provided in Appendix B.

## 5.0 BASES OF ESTIMATE AND KEY ASSUMPTIONS

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

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

11. 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.
12. 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.
13. 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
14. All Class A waste is assumed to be disposed of at EnergySolutions' facility in Clive, Utah, in accordance with the existing LOP Disposal Agreement between EnergySolutions and DAEC (Ref. No. 8).
15. DAEC furnished Class B and C waste disposal rates.
16. DAEC provided costs used to estimate the assumed GTCC disposal cost.
17. 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.
18. Vessel and internals curie estimates were derived from the values for the Reference BWR vessel and internals in NUREG/CR-0672 (Ref. No. 7) and adjusted for mass and the SAFSTOR decay period.
19. 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.
20. Spent fuel will remain in the spent fuel pool for approximately four years before being transferred to the ISFSI.
21. The ISFSI pad and HSMs are assumed to have no activated concrete or surface contamination.

22. The 10 CFR Part 50 license will be maintained until DOE has taken possession of the spent fuel.
23. Environmental Permits costs are based on data furnished by DAEC and were adjusted to meet the requirements of each period.
24. An estimate of the annual property taxes was furnished by DAEC and included in the estimate.
25. Annual NRC 10 CFR 171.15 fees, for reactors in decommissioning, of \$198,000 are included in the estimate.
26. 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.
27. 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.
28. 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.
29. DAEC staff positions and average burdened salary data were supplied by DAEC and account for fringe benefits, overhead and payroll taxes.
30. DGC staff salaries, including overhead and profit, were determined by *EnergySolutions* and represent *EnergySolutions'* standard assumptions for these rates
31. DAEC staff severance and retention costs were supplied by DAEC.
32. 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.
33. 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.
34. 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. 11), 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.
35. 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.

36. 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.

37. 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
- Reg. Guide 1.159 Assuring the Availability of Funds for Decommissioning Nuclear Reactors

38. 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 four 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 2024. 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 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.

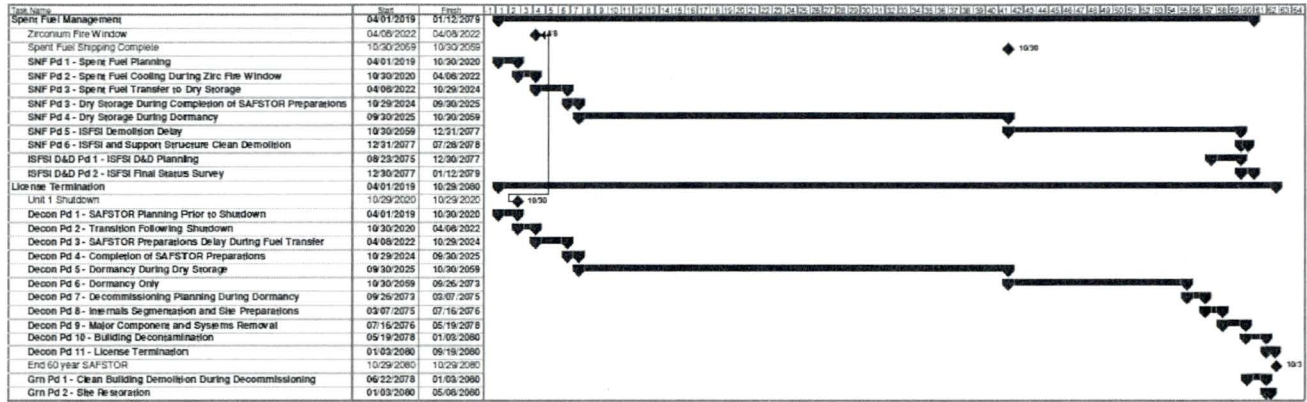
#### Waste Disposal Volumes

The estimated cubic feet of waste are summarized as follows:

Class A	501,978
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



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

Period No.	Period Description	Start	End	Years	Total Cost
<b>License Termination (50.75(c))</b>					
Decon Pd 1	SAFSTOR Planning Prior to Shutdown	4/1/2019	10/30/2020	1.58	\$11,666
Decon Pd 2	Transition Following Shutdown	10/30/2020	4/8/2022	1.43	\$92,226
Decon Pd 3	SAFSTOR Preparation Delay During Spent Fuel Pool Operations	4/8/2022	10/29/2024	2.55	\$23,724
Decon Pd 4	Completion of SAFSTOR Preparations	10/29/2024	9/30/2025	0.91	\$21,886
Decon Pd 5	Dormancy With Dry Storage	9/30/2025	10/30/2059	34.08	\$62,734
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	\$50,682
Decon Pd 8	Internals Segmentation and Site Preparations	3/7/2075	7/16/2076	1.36	\$117,713
Decon Pd 9	Major Component and Systems Removal	7/16/2076	5/19/2078	1.83	\$214,466
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
<b>Account Total</b>				61.41	<b>\$740,099</b>
<b>ISFSI D&amp;D (72.30)</b>					
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
<b>Account Total</b>				3.38	<b>\$1,640</b>
<b>Scenario Total</b>					<b>\$741,739</b>

Note: Numbers may not add due to rounding.

Table 6-2  
 Utility Staff Levels<sup>1</sup>

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	1.25	37	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	187	19	19	5	5	23.75	73.75	82.25	68.5	9

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

<sup>1</sup> Security staff levels are safeguards information and therefore not included.

**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	9.0	9.00	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	5.00	1
Quality Assurance	0	0	0	0	0	0	0.5	1	2	2.00	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
<b>Period Totals</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>19</b>	<b>57</b>	<b>99.5</b>	<b>84</b>	<b>8</b>

**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
<b>Period Totals</b>	<b>0</b>	<b>0</b>

**Table 6-4  
 Waste Disposal Volumes**

<b>Facility and Waste Class</b>	<b>Waste Weight (LBs)</b>	<b>Waste Volume (CF)</b>	<b>Burial Volume (CF)</b>
<b>Commercial Disposal Facility for B &amp; C Wastes</b>			
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
	<b>193,045</b>	<b>1,429</b>	<b>3,365</b>
GTCC	62,590	128	1,018
<b>EnergySolutions</b>			
Class A - Debris	18,389,635	329,151	455,146
Class A - Oversized Debris	7,824,790	112,378	166,355
Class A - Cask Shipment	186,306	380	2,754
Class A - Containerized Waste	163,206	1,333	3,808
Class A - Large Component	4,125,200	58,652	78,230
Mixed Waste (Lead)	30,000	85	288
	<b>30,719,137</b>	<b>501,978</b>	<b>706,582</b>
<b>Other</b>			
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
	<b>310,067,750</b>	<b>4,311,000</b>	<b>4,586,106</b>
<b>Grand Total</b>	<b>340,197,547</b>	<b>4,800,749</b>	<b>5,288,522</b>

Note: Numbers may not add due to rounding.

## 7.0 REFERENCES

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

**List of Systems and Structures**



## Duane Arnold Energy Center System and Structure List

### Unit 1

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

## Duane Arnold Energy Center System and Structure List

Unit 1

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

## Duane Arnold Energy Center System and Structure List

Unit 1

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

## Duane Arnold Energy Center System and Structure List

### Unit 1

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

**Appendix B**

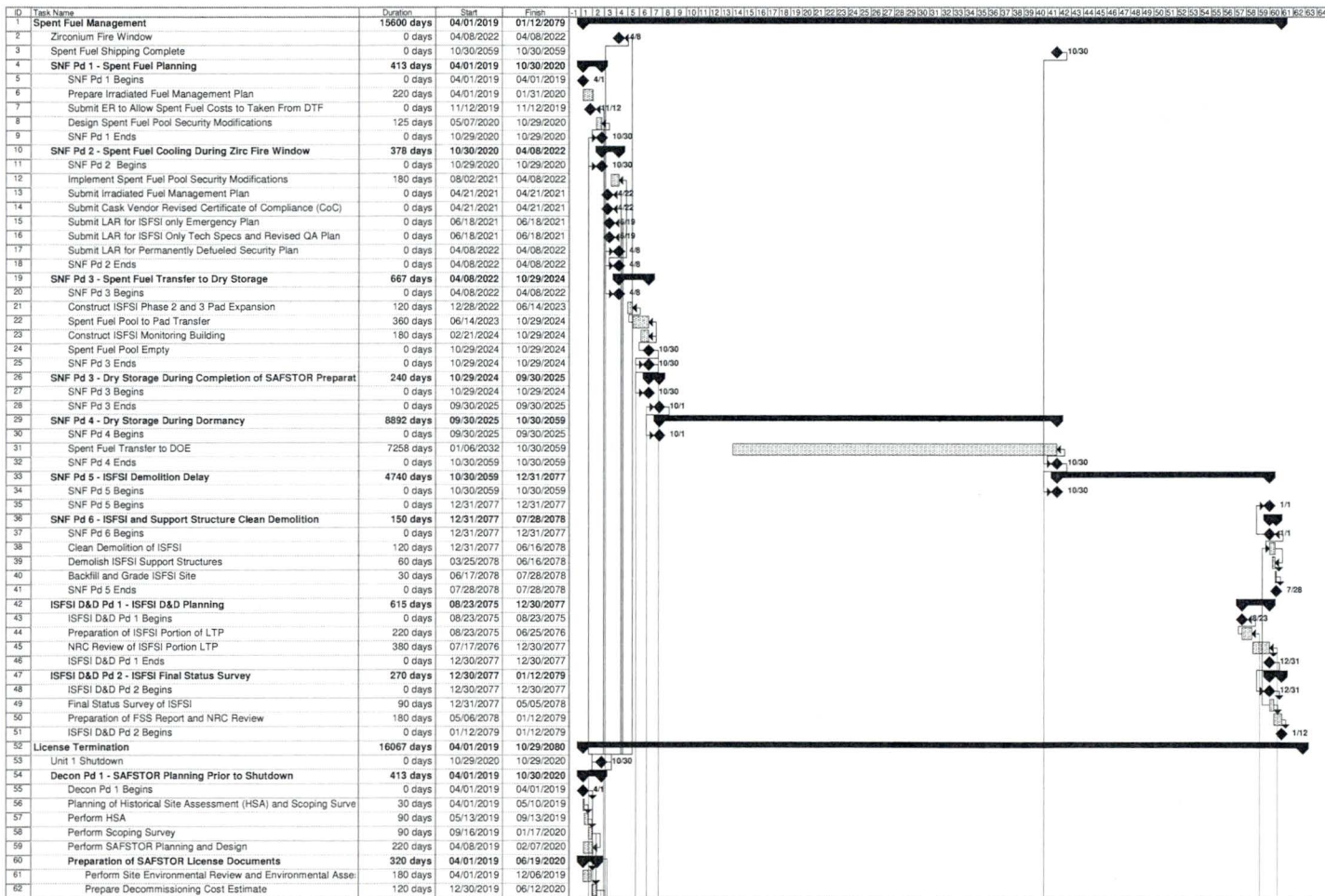
**Spent Fuel Shipping Schedule**

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

Year	Fuel Discharged	No Dry Modules	Assemblies Transferred from Pool to Dry Storage	Assemblies in Fuel Pool Storage	Assemblies in Dry Storage	Total Assemblies in On Site Storage	Assemblies Shipped to DOE From Pool	Assemblies Shipped to DOE from Dry Storage	Cumulative Assemblies Shipped to DOE
2008	0	10	0	1758	610	2368	0	0	0
2009	152	0	0	1910	610	2520	0	0	0
2010	152	0	0	2062	610	2672	0	0	0
2011	0	10	610	1452	1220	2672	0	0	0
2012	152	0	0	1604	1220	2824	0	0	0
2013	0	0	0	1604	1220	2824	0	0	0
2014	152	0	0	1756	1220	2976	0	0	0
2015	0	0	0	1756	1220	2976	0	0	0
2016	152	0	0	1908	1220	3128	0	0	0
2017	0	0	0	1908	1220	3128	0	0	0
2018	152	0	0	2060	1220	3280	0	0	0
2019	0	0	0	2060	1220	3280	0	0	0
2020	368	5	305	2123	1525	3648	0	0	0
2021	0	0	0	2123	1525	3648	0	0	0
2022	0	0	0	2123	1525	3648	0	0	0
2023	0	0	0	2123	1525	3648	0	0	0
2024	0	35	2123	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	3648	3526	0	122	122
2033	0	0	0	0	3648	3282	0	244	366
2034	0	0	0	0	3648	3099	0	183	549
2035	0	0	0	0	3648	2916	0	183	732
2036	0	0	0	0	3648	2794	0	122	854
2037	0	0	0	0	3648	2611	0	183	1037
2038	0	0	0	0	3648	2489	0	122	1159
2039	0	0	0	0	3648	2367	0	122	1281
2040	0	0	0	0	3648	2245	0	122	1403
2041	0	0	0	0	3648	2062	0	183	1586
2042	0	0	0	0	3648	1879	0	183	1769
2043	0	0	0	0	3648	1757	0	122	1891
2044	0	0	0	0	3648	1635	0	122	2013
2045	0	0	0	0	3648	1635	0	0	2013
2046	0	0	0	0	3648	1513	0	122	2135
2047	0	0	0	0	3648	1330	0	183	2318
2048	0	0	0	0	3648	1269	0	61	2379
2049	0	0	0	0	3648	1147	0	122	2501
2050	0	0	0	0	3648	1025	0	122	2623
2051	0	0	0	0	3648	903	0	122	2745
2052	0	0	0	0	3648	781	0	122	2867
2053	0	0	0	0	3648	659	0	122	2989
2054	0	0	0	0	3648	598	0	61	3050
2055	0	0	0	0	3648	476	0	122	3172
2056	0	0	0	0	3648	354	0	122	3294
2057	0	0	0	0	3648	232	0	122	3416
2058	0	0	0	0	3648	110	0	122	3538
2059	0	0	0	0	3648	0	0	110	3648

**Appendix C**  
**Detailed Project Schedule**

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











**Appendix D  
Detailed Cost Table**

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

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

**2018 Dollars in Thousands**

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
<b>A. License Termination</b>							
<b>Decon Pd 1 SAFSTOR Planning Prior to Shutdown</b>							
<b>Distributed</b>							
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
1.11	Planning for Asbestos Abatement	\$137	\$2	\$0	\$0	\$18	\$157
<b>Distributed</b>	<b>Subtotal</b>	<b>\$5,380</b>	<b>\$187</b>	<b>\$0</b>	<b>\$1,044</b>	<b>\$859</b>	<b>\$7,471</b>
<b>Undistributed</b>							
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
<b>Undistributed</b>	<b>Subtotal</b>	<b>\$3,705</b>	<b>\$5</b>	<b>\$0</b>	<b>\$0</b>	<b>\$485</b>	<b>\$4,195</b>
<b>Decon Pd 1</b>	<b>Subtotal</b>	<b>\$9,085</b>	<b>\$192</b>	<b>\$0</b>	<b>\$1,044</b>	<b>\$1,345</b>	<b>\$11,666</b>

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

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

**2018 Dollars in Thousands**

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
<b>Decon Pd 2 Transition Following Shutdown</b>							
<b>Distributed</b>							
2.01	Submit Notification of Cessation of Operations	\$0	\$0	\$0	\$0	\$0	\$0
2.02	Submit Notification of Fuel Removal from Vessel	\$0	\$0	\$0	\$0	\$0	\$0
2.03	NRC Review of Post-Shutdown LARs and ERs	\$0	\$0	\$0	\$564	\$73	\$637
2.04	Perform Activation Analyses of Reactor and Internals	\$49	\$4	\$0	\$308	\$47	\$408
2.05	Volume Reduce Control Rods, Fuel Channels and LPRMS	\$1,744	\$672	\$16,716	\$0	\$4,400	\$23,533
2.06	Flush and Drain Non-Essential Systems	\$44	\$8	\$1,016	\$0	\$246	\$1,313
2.07	Perform Asbestos Abatement on Plant Systems	\$750	\$319	\$1,096	\$0	\$498	\$2,663
2.08	Removal and Disposal of Off Gas System Adsorber	\$28	\$28	\$3,175	\$0	\$743	\$3,974
2.09	Remove and Dispose of Hazardous Waste	\$0	\$0	\$0	\$185	\$28	\$213
2.10	Drain and Process Suppression Pool Water and Hydrolase Torus Walls	\$0	\$0	\$0	\$0	\$0	\$0
<b>Distributed</b>	<b>Subtotal</b>	<b>\$2,614</b>	<b>\$1,032</b>	<b>\$22,004</b>	<b>\$1,057</b>	<b>\$6,035</b>	<b>\$32,742</b>
<b>Undistributed</b>							
1.01	Utility Staff	\$33,759	\$0	\$0	\$0	\$4,389	\$38,148
1.02	Utility Staff HP Supplies	\$0	\$835	\$0	\$0	\$125	\$960
1.04	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$389	\$58	\$448
1.05	Non-Nuclear Insurance	\$0	\$0	\$0	\$65	\$10	\$75
1.06	Property Taxes	\$0	\$0	\$0	\$144	\$22	\$165
1.07	NRC Annual Fees - LT	\$0	\$0	\$0	\$664	\$100	\$764
1.08	Materials and Services	\$0	\$4,657	\$0	\$0	\$699	\$5,356
1.09	Energy	\$0	\$0	\$0	\$3,464	\$520	\$3,983
1.10	Environmental Permits and Fees	\$0	\$0	\$0	\$11	\$2	\$13
1.13	DAW Disposal	\$0	\$0	\$45	\$0	\$7	\$52
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	\$50	\$0	\$0	\$7	\$57
<b>Undistributed</b>	<b>Subtotal</b>	<b>\$41,988</b>	<b>\$5,542</b>	<b>\$45</b>	<b>\$4,738</b>	<b>\$7,172</b>	<b>\$59,485</b>

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

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

**2018 Dollars in Thousands**

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
<b>Decon Pd 2</b>	<b>Subtotal</b>	<b>\$44,602</b>	<b>\$6,574</b>	<b>\$22,049</b>	<b>\$5,794</b>	<b>\$13,207</b>	<b>\$92,226</b>
<b>Decon Pd 3</b>	<b>SAFSTOR Preparation Delay During Spent Fuel Pool Operations</b>						
	<b>Undistributed</b>						
1.01	Utility Staff	\$6,087	\$0	\$0	\$0	\$791	\$6,878
1.02	Utility Staff HP Supplies	\$0	\$278	\$0	\$0	\$42	\$320
1.04	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$237	\$35	\$272
1.05	Non-Nuclear Insurance	\$0	\$0	\$0	\$116	\$17	\$134
1.06	Property Taxes	\$0	\$0	\$0	\$256	\$38	\$294
1.07	NRC Annual Fees - LT	\$0	\$0	\$0	\$710	\$106	\$816
1.08	Materials and Services	\$0	\$843	\$0	\$0	\$126	\$969
1.09	Energy	\$0	\$0	\$0	\$2,623	\$393	\$3,016
1.10	Environmental Permits and Fees	\$0	\$0	\$0	\$20	\$3	\$23
1.13	DAW Disposal	\$0	\$0	\$7	\$0	\$1	\$8
1.14	Severance	\$9,550	\$0	\$0	\$0	\$1,433	\$10,983
1.16	Workers Comprehensive Insurance	\$0	\$9	\$0	\$0	\$1	\$10
<b>Undistributed</b>	<b>Subtotal</b>	<b>\$15,637</b>	<b>\$1,130</b>	<b>\$7</b>	<b>\$3,962</b>	<b>\$2,989</b>	<b>\$23,724</b>
<b>Decon Pd 3</b>	<b>Subtotal</b>	<b>\$15,637</b>	<b>\$1,130</b>	<b>\$7</b>	<b>\$3,962</b>	<b>\$2,989</b>	<b>\$23,724</b>

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

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

**2018 Dollars in Thousands**

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
<b>Decon Pd 4</b>	<b>Completion of SAFSTOR Preparations</b>						
<b>Distributed</b>							
4.01	Remove and Dispose of Spent Fuel Storage Racks	\$124	\$281	\$1,683	\$0	\$480	\$2,569
4.02	Drain Spent Fuel Pool and Process Liquid Waste	\$0	\$0	\$0	\$0	\$0	\$0
4.03	Flush and Drain Essential Systems Following Fuel Pool Closure	\$27	\$14	\$1,016	\$0	\$243	\$1,300
4.04	Removal and Disposal of Spent Resins, Filter Media and Tank Sludge	\$28	\$28	\$2,540	\$0	\$597	\$3,194
4.05	Segment, Package and Dispose of Spent Fuel Pool Island Equipment	\$7	\$2	\$190	\$0	\$46	\$245
4.06	General Area Cleanup	\$1,511	\$694	\$195	\$0	\$552	\$2,952
4.07	Secure Site for Dormancy Period	\$0	\$0	\$0	\$1,845	\$277	\$2,122
<b>Distributed</b>	<b>Subtotal</b>	<b>\$1,698</b>	<b>\$1,019</b>	<b>\$5,624</b>	<b>\$1,845</b>	<b>\$2,195</b>	<b>\$12,381</b>
<b>Undistributed</b>							
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	\$23	\$0	\$3	\$26
1.14	Severance	\$4,550	\$0	\$0	\$0	\$683	\$5,233
1.16	Workers Comprehensive Insurance	\$0	\$3	\$0	\$0	\$0	\$4
<b>Undistributed</b>	<b>Subtotal</b>	<b>\$6,737</b>	<b>\$406</b>	<b>\$23</b>	<b>\$1,137</b>	<b>\$1,202</b>	<b>\$9,505</b>
<b>Decon Pd 4</b>	<b>Subtotal</b>	<b>\$8,435</b>	<b>\$1,425</b>	<b>\$5,647</b>	<b>\$2,981</b>	<b>\$3,397</b>	<b>\$21,886</b>



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

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

**2018 Dollars in Thousands**

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
<b>Decon Pd 5</b>	<b>Dormancy With Dry Storage</b>						
<b>Distributed</b>							
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
<b>Distributed</b>	<b>Subtotal</b>	<b>\$842</b>	<b>\$212</b>	<b>\$61</b>	<b>\$0</b>	<b>\$167</b>	<b>\$1,283</b>
<b>Undistributed</b>							
1.01	Utility Staff	\$24,870	\$0	\$0	\$0	\$3,233	\$28,104
1.02	Utility Staff HP Supplies	\$0	\$1,554	\$0	\$0	\$233	\$1,787
1.04	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$2,705	\$406	\$3,111
1.05	Non-Nuclear Insurance	\$0	\$0	\$0	\$775	\$116	\$891
1.06	Property Taxes	\$0	\$0	\$0	\$1,491	\$224	\$1,715
1.06	Property Taxes	\$0	\$0	\$0	\$525	\$79	\$604
1.07	NRC Annual Fees - LT	\$0	\$0	\$0	\$9,447	\$1,417	\$10,865
1.08	Materials and Services	\$0	\$2,952	\$0	\$0	\$443	\$3,395
1.09	Energy	\$0	\$0	\$0	\$8,549	\$1,282	\$9,831
1.10	Environmental Permits and Fees	\$0	\$0	\$0	\$269	\$40	\$310
1.13	DAW Disposal	\$0	\$0	\$30	\$0	\$5	\$35
1.14	Severance	\$668	\$0	\$0	\$0	\$100	\$768
1.16	Workers Comprehensive Insurance	\$0	\$32	\$0	\$0	\$5	\$36
<b>Undistributed</b>	<b>Subtotal</b>	<b>\$25,538</b>	<b>\$4,538</b>	<b>\$30</b>	<b>\$23,762</b>	<b>\$7,583</b>	<b>\$61,451</b>
<b>Decon Pd 5</b>	<b>Subtotal</b>	<b>\$26,380</b>	<b>\$4,750</b>	<b>\$92</b>	<b>\$23,762</b>	<b>\$7,750</b>	<b>\$62,734</b>

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

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

**2018 Dollars in Thousands**

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
<b>Decon Pd 6</b>	<b>Dormancy Only</b>						
	<b>Undistributed</b>						
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
<b>Undistributed</b>	<b>Subtotal</b>	<b>\$15,951</b>	<b>\$3,313</b>	<b>\$12</b>	<b>\$13,345</b>	<b>\$4,690</b>	<b>\$37,311</b>
<b>Decon Pd 6</b>	<b>Subtotal</b>	<b>\$15,951</b>	<b>\$3,313</b>	<b>\$12</b>	<b>\$13,345</b>	<b>\$4,690</b>	<b>\$37,311</b>

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

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

**2018 Dollars in Thousands**

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
<b>Decon Pd 7 Decommissioning Planning During Dormancy</b>							
<b>Distributed</b>							
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	Prepare Integrated Work Sequence and Schedule for Decommissioning	\$179	\$0	\$0	\$0	\$23	\$202
7.06	Prepare Decommissioning Activity Specifications	\$2,201	\$19	\$0	\$0	\$289	\$2,508
7.07	Prepare Detailed Work Procedures for Decommissioning	\$2,154	\$0	\$0	\$0	\$280	\$2,434
7.08	Update Decommissioning Cost Estimate (DCE)	\$281	\$1	\$0	\$0	\$37	\$318
7.09	Update Post-Shutdown Decommissioning Activities Report (PSDAR)	\$229	\$1	\$0	\$0	\$30	\$259
7.10	Planning and Design of Site Revitalization	\$1,038	\$18	\$0	\$0	\$137	\$1,193
7.11	Planning and Design Rail Spur Upgrade	\$252	\$10	\$0	\$0	\$34	\$296
7.12	Planning and Design Cold & Dark Site Repowering	\$593	\$7	\$0	\$0	\$78	\$677
7.13	Develop Effluent Management Plan	\$93	\$0	\$0	\$0	\$12	\$105
7.14	Design Liquid Radwaste Treatment and Demin Makeup Water Systems	\$175	\$0	\$0	\$0	\$23	\$198
7.15	Prepare and Submit Environmental Permits	\$112	\$0	\$0	\$0	\$15	\$126
7.16	Design Containment Access Modifications	\$227	\$3	\$0	\$0	\$30	\$260
7.17	Design and Procure RPV/RVI Segmentation Tooling and Equipment	\$2,068	\$19,000	\$0	\$0	\$2,739	\$23,807
7.18	Select Shipping Casks and Obtain Shipping Permits	\$38	\$0	\$0	\$0	\$5	\$43
7.19	Purchase Canisters for GTCC Waste	\$0	\$1,588	\$0	\$0	\$238	\$1,826
<b>Distributed</b>	<b>Subtotal</b>	<b>\$10,345</b>	<b>\$20,654</b>	<b>\$0</b>	<b>\$3,543</b>	<b>\$4,593</b>	<b>\$39,136</b>
<b>Undistributed</b>							
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
1.05	Non-Nuclear Insurance	\$0	\$0	\$0	\$33	\$5	\$38

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

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

**2018 Dollars in Thousands**

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
1.06	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
<b>Undistributed</b>	<b>Subtotal</b>	<b>\$7,609</b>	<b>\$951</b>	<b>\$4</b>	<b>\$1,600</b>	<b>\$1,383</b>	<b>\$11,547</b>
<b>Decon Pd 7</b>	<b>Subtotal</b>	<b>\$17,954</b>	<b>\$21,605</b>	<b>\$4</b>	<b>\$5,143</b>	<b>\$5,976</b>	<b>\$50,682</b>

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

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

**2018 Dollars in Thousands**

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
<b>Decon Pd 8 Internals Segmentation and Site Preparations</b>							
<b>Distributed</b>							
8.01	Revitalize Infrastructure	\$0	\$0	\$0	\$17,683	\$2,652	\$20,336
8.02	Implement Cold & Dark	\$3,095	\$5,023	\$0	\$0	\$1,218	\$9,336
8.03	Install Liquid Radwaste Treatment System	\$0	\$0	\$0	\$1,750	\$263	\$2,013
8.04	Install Demin Makeup Water System for RVI Segmentation	\$0	\$0	\$0	\$313	\$47	\$360
8.05	Perform Post-SAFSTOR Site Characterization	\$367	\$250	\$0	\$0	\$80	\$698
8.06	Prepare License Termination Plan (LTP)	\$331	\$10	\$0	\$0	\$44	\$385
8.07	Segment and Dispose of Drywell Head	\$142	\$31	\$49	\$0	\$51	\$274
8.08	Reflood RPV and Steam Separator Pool for RVI Segmentation	\$129	\$80	\$0	\$0	\$48	\$257
8.09	Remove and Dispose of Rx Head	\$151	\$26	\$757	\$0	\$271	\$1,205
8.10	Test Special Cutting and Handling Equipment and Train Operators	\$1,335	\$217	\$0	\$0	\$202	\$1,753
8.11	Finalize Internals and Vessel Segmenting Details	\$23	\$0	\$0	\$0	\$3	\$26
8.12	Segment, Package and Ship Reactor Internals	\$4,247	\$1,449	\$12,486	\$0	\$5,578	\$23,760
8.13	RVI GTCC Waste Transportation and Disposal	\$0	\$0	\$5,674	\$2,288	\$1,648	\$9,610
8.14	Construct New Change Rooms, Hot Laundry, Waste Staging Area	\$0	\$1,192	\$0	\$0	\$179	\$1,371
8.15	Modify Containment Access	\$454	\$837	\$0	\$0	\$194	\$1,484
8.16	Upgrade Rail Spur	\$0	\$0	\$0	\$2,410	\$362	\$2,772
8.17	Install Truck Radiological Monitoring System	\$0	\$0	\$0	\$500	\$75	\$575
<b>Distributed</b>	<b>Subtotal</b>	<b>\$10,273</b>	<b>\$9,115</b>	<b>\$18,966</b>	<b>\$24,944</b>	<b>\$12,914</b>	<b>\$76,212</b>
<b>Undistributed</b>							
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
1.07	NRC Annual Fees - LT	\$0	\$0	\$0	\$629	\$94	\$723

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

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

**2018 Dollars in Thousands**

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
1.08	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	\$126	\$0	\$19	\$145
1.16	Workers Comprehensive Insurance	\$0	\$20	\$0	\$0	\$3	\$23
<b>Undistributed</b>	<b>Subtotal</b>	<b>\$31,576</b>	<b>\$3,031</b>	<b>\$126</b>	<b>\$1,894</b>	<b>\$4,873</b>	<b>\$41,500</b>
<b>Decon Pd 8</b>	<b>Subtotal</b>	<b>\$41,849</b>	<b>\$12,147</b>	<b>\$19,092</b>	<b>\$26,838</b>	<b>\$17,787</b>	<b>\$117,713</b>

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

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

**2018 Dollars in Thousands**

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
<b>Decon Pd 9 Major Component and Systems Removal</b>							
<b>Distributed</b>							
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	Segment, Package and Dispose of Nuclear Steam Supply System	\$4,432	\$1,445	\$39,047	\$0	\$10,333	\$55,257
9.05	Remove, Package and Dispose of Remaining Active Plant Systems	\$4,379	\$1,359	\$4,451	\$0	\$2,344	\$12,533
9.06	Remove and Dispose of Control Rod Drives	\$330	\$79	\$1,585	\$0	\$458	\$2,452
9.07	Remove and Dispose of Shield Plugs, Pool Plugs and Stud Tensioners	\$82	\$58	\$1,774	\$0	\$440	\$2,354
9.08	Reactor Vessel Insulation Removal and Disposal	\$123	\$21	\$384	\$0	\$122	\$650
9.09	Segment, Package and Ship Reactor Pressure Vessel	\$3,328	\$1,394	\$5,761	\$0	\$3,425	\$13,908
9.10	Drain Dryer Separator Pool and Process Liquid Waste	\$0	\$0	\$0	\$0	\$0	\$0
9.11	Transportation and Disposal of Liquid Radwaste Filters and Resins	\$13	\$103	\$272	\$0	\$89	\$477
9.12	Removal and Disposal of Sacrificial Shield Wall and Reactor Pedestal	\$399	\$606	\$974	\$0	\$455	\$2,433
9.13	Segment, Package and Dispose of Refueling Bridge	\$60	\$13	\$313	\$0	\$89	\$475
9.14	Removal and Disposal of Lead Shielding	\$29	\$8	\$181	\$0	\$50	\$267
<b>Distributed</b>	<b>Subtotal</b>	<b>\$26,058</b>	<b>\$16,500</b>	<b>\$67,155</b>	<b>\$1,078</b>	<b>\$25,558</b>	<b>\$136,349</b>
<b>Undistributed</b>							
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
1.09	Energy	\$0	\$0	\$0	\$834	\$125	\$960
1.10	Environmental Permits and Fees	\$0	\$0	\$0	\$15	\$2	\$17

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

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

**2018 Dollars in Thousands**

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
1.11	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	\$236	\$0	\$35	\$271
1.16	Workers Comprehensive Insurance	\$0	\$30	\$0	\$0	\$5	\$35
<b>Undistributed</b>	<b>Subtotal</b>	<b>\$58,995</b>	<b>\$7,298</b>	<b>\$236</b>	<b>\$2,413</b>	<b>\$9,175</b>	<b>\$78,118</b>
<b>Decon Pd 9</b>	<b>Subtotal</b>	<b>\$85,053</b>	<b>\$23,799</b>	<b>\$67,391</b>	<b>\$3,491</b>	<b>\$34,733</b>	<b>\$214,466</b>



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

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

**2018 Dollars in Thousands**

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
<b>Decon Pd 10 Building Decontamination Distributed</b>							
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
<b>Distributed</b>	<b>Subtotal</b>	<b>\$11,318</b>	<b>\$11,426</b>	<b>\$13,823</b>	<b>\$1,087</b>	<b>\$7,402</b>	<b>\$45,056</b>
<b>Undistributed</b>							
1.01	Utility Staff	\$13,175	\$0	\$0	\$0	\$1,713	\$14,888
1.02	Utility Staff HP Supplies	\$0	\$1,457	\$0	\$0	\$219	\$1,675
1.03	Security	\$609	\$0	\$0	\$0	\$91	\$700
1.04	Nuclear Property and Liability Insurance	\$0	\$0	\$0	\$516	\$77	\$594
1.05	Non-Nuclear Insurance	\$0	\$0	\$0	\$74	\$11	\$85
1.06	Property Taxes	\$0	\$0	\$0	\$41	\$6	\$47
1.07	NRC Annual Fees - LT	\$0	\$0	\$0	\$751	\$113	\$864
1.08	Materials and Services	\$0	\$2,099	\$0	\$0	\$315	\$2,414
1.09	Energy	\$0	\$0	\$0	\$690	\$104	\$794

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

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

**2018 Dollars in Thousands**

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
1.10	Environmental Permits and Fees	\$0	\$0	\$0	\$13	\$2	\$15
1.11	Decommissioning General Contractor Staff	\$29,651	\$0	\$0	\$0	\$3,855	\$33,506
1.12	DGC HP Supplies	\$0	\$2,071	\$0	\$0	\$311	\$2,382
1.13	DAW Disposal	\$0	\$0	\$168	\$0	\$25	\$194
1.16	Workers Comprehensive Insurance	\$0	\$23	\$0	\$0	\$3	\$26
<b>Undistributed</b>	<b>Subtotal</b>	<b>\$43,435</b>	<b>\$5,650</b>	<b>\$168</b>	<b>\$2,086</b>	<b>\$6,844</b>	<b>\$58,184</b>
<b>Decon Pd 10</b>	<b>Subtotal</b>	<b>\$54,754</b>	<b>\$17,076</b>	<b>\$13,991</b>	<b>\$3,173</b>	<b>\$14,246</b>	<b>\$103,240</b>
<b>Decon Pd 11</b>	<b>License Termination</b>						
	<b>Distributed</b>						
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
<b>Distributed</b>	<b>Subtotal</b>	<b>\$64</b>	<b>\$2</b>	<b>\$0</b>	<b>\$539</b>	<b>\$79</b>	<b>\$683</b>
<b>Undistributed</b>							
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
<b>Undistributed</b>	<b>Subtotal</b>	<b>\$2,727</b>	<b>\$187</b>	<b>\$0</b>	<b>\$405</b>	<b>\$449</b>	<b>\$3,768</b>
<b>Decon Pd 11</b>	<b>Subtotal</b>	<b>\$2,791</b>	<b>\$189</b>	<b>\$0</b>	<b>\$944</b>	<b>\$527</b>	<b>\$4,451</b>
<b>A. License Termination</b>	<b>Subtotal</b>	<b>\$322,491</b>	<b>\$92,200</b>	<b>\$128,284</b>	<b>\$90,476</b>	<b>\$106,647</b>	<b>\$740,099</b>

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

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

**2018 Dollars in Thousands**

No	Item Description	Labor	Equipment	Disposal	Other	Contingency	Total
<b>D. ISFSI D&amp;D</b>							
<b>ISFSI D&amp;D Pd 1 ISFSI D&amp;D Planning</b>							
<b>Distributed</b>							
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
<b>Distributed</b>	<b>Subtotal</b>	<b>\$185</b>	<b>\$0</b>	<b>\$0</b>	<b>\$44</b>	<b>\$30</b>	<b>\$259</b>
<b>Undistributed</b>							
4.01	Utility Staff	\$556	\$0	\$0	\$0	\$72	\$628
<b>Undistributed</b>	<b>Subtotal</b>	<b>\$556</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$72</b>	<b>\$628</b>
<b>ISFSI D&amp;D Pd</b>	<b>Subtotal</b>	<b>\$741</b>	<b>\$0</b>	<b>\$0</b>	<b>\$44</b>	<b>\$102</b>	<b>\$887</b>
<b>ISFSI D&amp;D Pd 2 ISFSI Final Status Survey</b>							
<b>Distributed</b>							
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
<b>Distributed</b>	<b>Subtotal</b>	<b>\$245</b>	<b>\$50</b>	<b>\$0</b>	<b>\$33</b>	<b>\$43</b>	<b>\$371</b>
<b>Undistributed</b>							
4.01	Utility Staff	\$338	\$0	\$0	\$0	\$44	\$382
<b>Undistributed</b>	<b>Subtotal</b>	<b>\$338</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$44</b>	<b>\$382</b>
<b>ISFSI D&amp;D Pd</b>	<b>Subtotal</b>	<b>\$584</b>	<b>\$50</b>	<b>\$0</b>	<b>\$33</b>	<b>\$87</b>	<b>\$754</b>
<b>D. ISFSI D&amp;D</b>	<b>Subtotal</b>	<b>\$1,324</b>	<b>\$50</b>	<b>\$0</b>	<b>\$77</b>	<b>\$189</b>	<b>\$1,640</b>
<b>Scenario No. 2</b>	<b>Total</b>	<b>\$323,815</b>	<b>\$92,250</b>	<b>\$128,284</b>	<b>\$90,553</b>	<b>\$106,836</b>	<b>\$741,739</b>

**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	ISFSI Demolition	Total
2019	\$4,099	\$0	\$4,099
2020	\$29,127	\$0	\$29,127
2021	\$61,198	\$0	\$61,198
2022	\$24,100	\$0	\$24,100
2023	\$4,969	\$0	\$4,969
2024	\$9,600	\$0	\$9,600
2025	\$17,270	\$0	\$17,270
2026	\$2,201	\$0	\$2,201
2027	\$1,827	\$0	\$1,827
2028	\$1,827	\$0	\$1,827
2029	\$1,827	\$0	\$1,827
2030	\$1,884	\$0	\$1,884
2031	\$1,770	\$0	\$1,770
2032	\$1,770	\$0	\$1,770
2033	\$1,770	\$0	\$1,770
2034	\$1,770	\$0	\$1,770
2035	\$1,770	\$0	\$1,770
2036	\$1,770	\$0	\$1,770
2037	\$1,770	\$0	\$1,770
2038	\$1,770	\$0	\$1,770
2039	\$1,770	\$0	\$1,770
2040	\$2,411	\$0	\$2,411
2041	\$1,770	\$0	\$1,770
2042	\$1,770	\$0	\$1,770
2043	\$1,770	\$0	\$1,770
2044	\$1,770	\$0	\$1,770
2045	\$1,770	\$0	\$1,770
2046	\$1,770	\$0	\$1,770
2047	\$1,770	\$0	\$1,770
2048	\$1,770	\$0	\$1,770
2049	\$1,770	\$0	\$1,770
2050	\$1,770	\$0	\$1,770
2051	\$1,770	\$0	\$1,770
2052	\$1,770	\$0	\$1,770
2053	\$1,770	\$0	\$1,770
2054	\$2,065	\$0	\$2,065

## Duane Arnold Annual Cost By Account

SAFSTOR, 2030 DOE Acceptance, Utility and DGC

Unit No: Unit 1

2018 Dollars in Thousands			
Year	License Termination	ISFSI Demolition	Total
2055	\$2,116	\$0	\$2,116
2056	\$1,770	\$0	\$1,770
2057	\$1,770	\$0	\$1,770
2058	\$1,770	\$0	\$1,770
2059	\$2,159	\$0	\$2,159
2060	\$3,077	\$0	\$3,077
2061	\$2,634	\$0	\$2,634
2062	\$2,634	\$0	\$2,634
2063	\$2,634	\$0	\$2,634
2064	\$2,634	\$0	\$2,634
2065	\$2,634	\$0	\$2,634
2066	\$2,634	\$0	\$2,634
2067	\$2,634	\$0	\$2,634
2068	\$2,634	\$0	\$2,634
2069	\$2,634	\$0	\$2,634
2070	\$2,634	\$0	\$2,634
2071	\$2,634	\$0	\$2,634
2072	\$2,634	\$0	\$2,634
2073	\$15,319	\$0	\$15,319
2074	\$32,572	\$0	\$32,572
2075	\$75,626	\$184	\$75,811
2076	\$88,570	\$403	\$88,973
2077	\$117,141	\$303	\$117,444
2078	\$101,050	\$731	\$101,780
2079	\$57,385	\$19	\$57,404
2080	\$4,828	\$0	\$4,828
Total	\$740,099	\$1,640	\$741,739