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Serial: RA-25-0146
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10 CFR 50.54(bb)
10 CFR 50.75(f)(3)
10 CFR 50.4

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

H. B. Robinson Steam Electric Plant, Unit 2
Renewed Facility Operating License No. DPR-23
Docket No. 50-261

SUBJECT: Robinson Unit 2 - Submittal of Program for Maintenance of Irradiated Fuel and Preliminary Decommissioning Cost Analysis in Accordance with 10 CFR 50.54(bb) and 10 CFR 50.75(f)(3)

REFERENCE:

1. Duke Energy Letter, *Biennial Decommissioning Financial Assurance Reports*, RA-25-0093, dated March 31, 2025, ML25090A242
2. Duke Energy Letter, *Decommissioning Funding Plan for Independent Spent Fuel Storage Installations (ISFSIs)*, RA-25-0094, dated March 31, 2025, ML25090A246
3. Duke Energy Letter, *Duke Energy Progress, LLC (Duke Energy) H.B. Robinson Steam Electric Plant, Unit Number 2 Docket Number 50-261 / Renewed License Number DPR-23 Application for Subsequent Renewed Operating Licenses*, RA-25-0067, dated April 1, 2025, ML25091A291

Ladies and Gentlemen:

Pursuant to 10 CFR 50.54(bb), a licensee of a nuclear power plant that is within five years of the expiration of the reactor operating license shall submit to the NRC the program by which the licensee intends to manage and provide funding for the management of all irradiated fuel at the reactor facility following permanent cessation of reactor operations until title and possession of the irradiated fuel is transferred to the U.S. Department of Energy for ultimate disposal. The Program for Maintenance of Irradiated Fuel at Robinson Unit 2 (RNP) is included as Enclosure 1 to this letter. Pursuant to 10 CFR 50.75(f)(3), a licensee of a nuclear power plant that is at or about five years of the expiration of the reactor operating license shall submit a preliminary decommissioning cost estimate to the NRC. The Preliminary Decommissioning Cost Estimate for RNP is included as Enclosure 2.

In the event that RNP does cease operations in 2030, Duke Energy would intend to fund the expenditures for license termination and spent fuel management from the decommissioning trust fund currently held by Duke Energy. Duke Energy separately allocates assets within the trust fund for license termination and spent fuel management. Trust fund allocations for license termination are $1,122.6 million as of December 31, 2024, for qualified and non-qualified funds, as reported in Reference 1. A separate allocation within the trust fund for spent fuel management totals $50.5 million as of December 31, 2024, for qualified and non-qualified funds. Enclosure 1 to this letter demonstrates how these funds will be used for the management of irradiated fuel at RNP. Duke Energy would make the appropriate submittals for an exemption, in accordance with 10 CFR 50.12, from the requirements of 10 CFR 50.82(a)(8)(i)(A) in order to use the license termination decommissioning trust funds reported in accordance with 10 CFR 50.75(f)(1) for expenses that are not decommissioning related expenses, as defined by 10 CFR 50.2. Table 6 "Decommissioning Funding Plan 2030 Shutdown," of Enclosure 1 demonstrates that the trust fund, and its earnings over the project duration, provides surplus funds to cover both the license termination and spent fuel management costs.

Additionally, it should be noted that Duke Energy submitted an application for Subsequent License Renewal pursuant to 10 CFR Part 54 (Reference 3). The RNP renewed facility operating license is scheduled to expire on July 31, 2030. Therefore, Duke Energy requests that the NRC schedule the review of the enclosed information following a final decision on the Subsequent License Renewal application.

There are no regulatory commitments associated with this letter. If you have additional questions, please contact Ryan Treadway, Director – Fleet Licensing at (980) 373-5873.

Sincerely,

Rounette Nader
Vice President – New Nuclear Generation & License Renewal

Enclosures:

1. 10 CFR 50.54(bb) Program for Maintenance of Irradiated Fuel
2. Preliminary Decommissioning Cost Analysis for the H.B. Robinson Nuclear Plant

xc (with enclosure):

J. Lara (Acting), USNRC, Region II – Regional Administrator
J. Zeiler, USNRC Senior Resident Inspector – RNP
N. Jordan, USNRC Project Manager – RNP
A. Siwy, USNRC Subsequent License Renewal Project Manager – RNP
D. Powers, Public Service Commission of South Carolina – Chairman

ENCLOSURE 1

10 CFR 50.54(bb) Program for Maintenance of Irradiated Fuel

10 CFR 50.54(bb) Program for Maintenance of Irradiated Fuel

1. Background and Introduction

Duke Energy Corporation (Duke Energy) is seeking renewal of the current operating license for the H.B. Robinson Nuclear Plant (Robinson). The current license, initially renewed April 19, 2004, is set to expire at midnight on July 31, 2030. Duke Energy submitted an application for subsequent license renewal of Facility Operating License No. DPR-23 on April 1, 2025.[1]

However, pursuant to 10 CFR 50.54(bb), licensees of nuclear power plants that are within five years of the expiration of the reactor operating license shall 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 caretaking of all irradiated fuel at the reactor following permanent cessation of operation of the reactor until title to and possession of the irradiated fuel is transferred to the U.S. Department of Energy (DOE) for ultimate disposal.

2. Spent Fuel Management Strategy

The NRC requires (in 10 CFR 50.54(bb)) that licensees establish a program to manage and provide funding for the caretaking of all irradiated fuel at the reactor site until title of the fuel is transferred to the DOE. Interim storage of Robinson spent fuel, until the DOE takes receipt, will be in the fuel handling building's storage pool as well as at an on-site ISFSI.

Completion of the decommissioning process is dependent upon the DOE's ability to remove spent fuel from the site in a timely manner. DOE's repository program assumes that spent fuel allocations will be accepted for disposal from the nation's commercial nuclear plants, with limited exceptions, in the order (the "queue") in which it was discharged from the reactor.

For planning purposes only, Duke Energy conducted a probability analysis of the three scenarios discussed in DOE's 2013 Strategy for the Management and Disposal of used Nuclear Fuel and High-Level Radioactive Waste, and selected an industry DOE pickup start date of 2034. The analysis assumes shutdown sites will receive priority.

Duke Energy's current spent fuel management plan for the Robinson spent fuel if the plant ceases operation in 2030 is based in general upon: 1) a 2039 start date for DOE initiating transfer of commercial spent fuel from the currently operating Duke Energy units to a licensed facility at a maximum rate of transfer of 3,000 metric tons of uranium (MTU)/year[2], 2) reassignment of allocations between the Brunswick, Harris, and Robinson units in the Duke

Energy fleet so as to minimize on-site storage costs, such that the DOE begins accepting Robinson-generated spent fuel stored at Brunswick Nuclear Plant and Harris Nuclear Plant starting in 2039, then from the Robinson ISFSI in 2049, 3) expectations for spent fuel receipt by the DOE for the already canistered Robinson fuel, and 4) periodic off-loading of Robinson ISFSI dry shielded canisters (DSCs) into DOE transport casks such that all canisters are removed in 2056.

Robinson is projected to generate 2,295 spent fuel assemblies through the end of its currently licensed operations in 2030. Of the 2,295 spent fuel assemblies, 808 are currently in storage at the Brunswick and Harris plants. Disposition of the Robinson assemblies at Brunswick and Harris are included in those respective decommissioning estimates. To date, the DOE has failed to remove fuel from the site, provide interim storage casks, identify an acceptable/compatible interim storage system, or identify what casks it will be using in the future for the transfer of fuel from the site. Because of this failure of the DOE, two separate dry fuel storage facilities have been constructed for the Robinson site. The first facility was licensed in 1986 and is designated the 7P-ISFSI, as each canister contains 7 fuel assemblies. The second facility began operation in 2005 and is designated the 24P-ISFSI, as each canister contains 24 fuel assemblies. Both facilities employ the NUHOMS storage system. The 7P-ISFSI is operated under site-specific Materials License No. SNM-2502 and has its own Safety Analysis Report and Technical Specifications. The 24P-ISFSI is operated under the general license provisions of 10 CFR 72 and must meet the requirements for Certificate of Compliance 1004 for the NUHOMS 24-PTH system. The current plan, in mitigation of DOE's breach, is to put Robinson spent fuel into on-site dry storage pending delivery of the fuel to DOE.

The 7P-ISFSI contains 56 fuel assemblies in 8 canisters that are not currently licensed for transport nor assumed to be licensed for transport at any point in the future. These canisters will be off-loaded and the assemblies transferred back into the fuel handling building's spent fuel pool. For the purpose of this plan, Duke Energy will assume that all assemblies, including the 56 assemblies from the 7Ps stored in the fuel handling building's spent fuel storage pool at the time of shutdown will be moved into dry storage modules on the 24P-ISFSI pad through 2033. From there, they will be loaded into a DOE-supplied transport cask for transport to DOE's site.

Duke Energy believes this plan would be workable for transfer of fuel to DOE. The use of the assumptions in this plan should not be construed by the DOE or any other party as a statement that Duke Energy believes this approach would or should be used when DOE ultimately performs its obligations under the contract to bring a cask suitable to Robinson. Duke Energy advances this plan only because the DOE has not identified its cask system, and the system's attributes, including but not limited to its weight, fuel capacity, and loading and handling requirements.

In the event that Robinson does cease operations in 2030, Duke Energy will continue to comply with existing NRC licensing requirements, including the operation and maintenance of the systems and structures needed to support continued operation of the spent fuel pool and ISFSI, as necessary. In addition, Duke Energy will also comply with applicable license termination requirements in accordance with 10 CFR 50.82 with respect to plant shutdown and post-shutdown activities including seeking such NRC approvals and on such schedules as necessary to satisfy these requirements consistent with the continued storage of irradiated fuel.

3. Cost Considerations

Decommissioning costs are allocated into the three major categories of license termination, spent fuel management and site restoration.[1] The allocations are provided in Table 1 (Summary of Major Cost Contributors). All costs are reported in 2024 nominal dollars.

The timing of the spent fuel management expenditures ($201.852 million) is shown in Table 2 (Schedule of Annual Expenditures, Spent Fuel Management Allocation). The expenditures include direct costs (e.g., for dry storage modules, spent fuel handling, packaging and transferring the spent fuel) and indirect costs such as program management and oversight, security, pool and ISFSI operating costs, fees, insurance, etc., that are projected to be incurred over the post-operations storage period.

The significant contributors to the direct cost of Robinson spent fuel management are identified in Table 3 (Significant Cost Contributors). As shown, costs are included for the procurement of DSCs, as well as the loading and transfer activities associated with transferring the spent fuel from the pool to the 24P-ISFSI pad, and the eventual transfer of the fuel at the ISFSI to the DOE. Costs are also included to transfer the 56 assemblies currently stored on the 7P-ISFSI back into the spent fuel pool for eventual repackaging and transfer to the 24P-ISFSI. The direct cost of $57.494 million is a subset of the $201.852 million shown in Table 2. The timing of the direct spent fuel management expenditures ($57.494 million) is shown in Table 4 (Estimated Expenditures for Spent Fuel Packaging, Storage, and Canister Transfer).

It must also be noted that these figures will vary based on actual DOE performance, including the cask provisions and requirements that DOE settles upon. At this time, DOE has not identified any transport casks or

[1] The total cost to decommission Robinson is delineated in the "Preliminary Decommissioning Cost Analysis"[3] (Enclosure 2 of this submittal).

requirements. Therefore, there is considerable uncertainty as to the actual costs that may have to be incurred; and uncertainty as to whether the DOE will agree to bear portions of those costs. Major scheduling milestones are identified in Table 5 (Projected Schedule and Milestones).

In the absence of identifiable DOE cask requirements, for the purposes of this plan only, the design and capacity of the DSCs is based upon Transnuclear, Inc.'s standardized NUHOMS® commercial dry cask storage system currently used at Robinson. It should be noted that Duke Energy's contract with the DOE requires the DOE to provide transport casks to Duke Energy, but for present purposes, this estimate conservatively includes those costs.

At shutdown, the Robinson spent fuel pool is expected to contain freshly discharged assemblies from the most recent refueling cycles. It is assumed for purposes of this cost estimate that Robinson will transfer spent fuel directly from its pool into 17 DSCs and placed into the 24P-ISFSI. The transfer would occur over a three-and-one-half-year period following the permanent cessation of Robinson operations. It is assumed that this time period (three-and-one-half years) is sufficient to meet the decay heat requirements for dry storage.

The decommissioning estimate includes costs to expand the ISFSI to accommodate the required number of casks (62).

There are material and labor costs associated with the transfer of these 17 casks from the spent fuel pool to the ISFSI (including transfer of the 56 assemblies from the 7P-ISFSI to the 24P-ISFSI casks). The NUHOMS dry storage canister has a capacity of 24 fuel assemblies at a unit cost of approximately $1.25 million. An additional cost of $500,000 is allocated for the concrete horizontal storage module (HSM). An average unit cost of approximately $312,500 was estimated for the labor and equipment to load, seal and transfer each DSC from the storage pool to the ISFSI.

A unit cost of approximately $156,250 was estimated for the final transfer of each of the 62 DSCs at the ISFSI into DOE transport casks. It is not known what the loading, sealing and transport costs will be for actual DOE-supplied equipment, because DOE has not identified that equipment. For purposes of this plan only, it is assumed that the DOE will accept the NUHOMS' DSCs and will not require offloading of the fuel to the DOE-supplied equipment.

All fuel is transferred to dry storage by 2033, at which time the spent fuel pool is drained and decontaminated. ISFSI operations continue until such time that the DOE is able to complete the transfer of the fuel from the site (currently anticipated to be in 2056).

4. Plan for Funding Spent Fuel Management

As an electric utility, financial assurance for the decommissioning of Robinson is provided by an external sinking fund in accordance with 10 CFR 50.75(e)(1)(ii). Duke Energy separately allocates assets within the trust fund for license termination and spent fuel management. Trust fund allocations for license termination are $1,122.6 million as of December 31, 2024, for qualified and non-qualified funds, as reported in Reference 4. A separate allocation within the trust fund for spent fuel management totals $50.5 million as of December 31, 2024, for qualified and non-qualified funds.

To the extent that the license termination trust fund balance exceeds costs required for radiological decommissioning, these funds would be available to address costs incurred including spent fuel management costs. Duke Energy acknowledges the need for an exemption pursuant to 10 CFR 50.12 to use license termination trust funds for anything beyond decommissioning activities as defined in 10 CFR 50.2.

As demonstrated in Enclosure 2, the total cost to decommission Robinson is estimated at approximately $1,045.9 million (in 2024 dollars). Approximately 73.1% of the total or $764.2 million is estimated to be required to terminate the license and 19.3% of the total or $201.9 million to manage the spent fuel until such time that it can be transferred to the DOE (the remaining 7.6% is associated with site restoration activities).

The estimate is based upon a scenario under which the unit would be promptly decommissioned following the cessation of operations in 2030. Decommissioning would be complete no later than 60 years after cessation of permanent operations and anticipated to be in 2057. Contingency has been included in the decommissioning cost estimate commensurate with the level of uncertainty associated with each cost category. Contingency funds are expected to be fully expended throughout the program. Spent Fuel Management and ISFSI costs include a 15% and 25% contingency factor, respectively.

The decommissioning funding plan is shown in Table 6 (Decommissioning Funding Plan, 2030 Shutdown). To demonstrate the adequacy of the existing funds to cover both license termination and spent fuel management, the qualified and non-qualified fund balances going forward are escalated at 4.53% and 2.50% per year, respectively[2]. The results of this analysis demonstrate that

[2] The qualified and non-qualified rates of return, escalation (inflation) rates, and the Robinson trust fund amount as of December 31, 2024, for license termination costs only are also included in Reference 4. These rates were approved by the NCUC of North Carolina and were filed with the PSC of South Carolina, which are the rate-setting authorities that permit the use of rates of return exceeding 2% in accordance with 10 CFR 50.75(e)(1)(ii).

the balance in the decommissioning trust is adequate to fund both the license termination and spent fuel management costs.

It should be noted that the projected expenditures for spent fuel management identified in the decommissioning cost analysis do not consider the outcome of the litigation (including compensation for damages) with the DOE. Duke Energy views the extended spent fuel management costs incurred by Duke Energy, caused by delays with respect to the timely removal of the spent fuel from the site, to be damages that should be paid by the government because of the DOE's breach of the spent fuel disposal contract.

5. References

1. Duke Energy Letter, *Duke Energy Progress, LLC (Duke Energy) H.B. Robinson Steam Electric Plant, Unit Number 2 Docket Number 50-261 / Renewed License Number DPR-23 Application for Subsequent Renewed Operating Licenses*, RA-25-0067, dated April 1, 2025

2. "Acceptance Priority Ranking & Annual Capacity Report," DOE/RW-0567, July 2004

3. "Preliminary Decommissioning Cost Analysis for the H.B. Robinson Nuclear Plant," Document D03-1834-007, Rev. 4, TLG Services, LLC, July 2025.

4. Duke Energy Letter, *Biennial Decommissioning Financial Assurance Reports*, RA-25-0093, dated March 31, 2025

Table 1
Summary of Major Cost Contributors
(thousands, 2024 dollars)

	License Termination	Spent Fuel Management	Site Restoration	Total
Decontamination	22,015	-	-	22,015
Removal	121,057	-	45,807	166,864
Packaging	33,664	-	-	33,664
Transportation	26,200	-	-	26,200
Waste Disposal	87,357	-	-	87,357
Off-site Waste Processing	26,643	-	-	26,643
Program Management [1]	228,805	25,932	21,533	276,270
Site Security	69,269	79,592	3,059	151,920
Spent Fuel Pool Isolation	17,313	-	-	17,313
Spent Fuel (Direct Expenditures) [2]	2,596	79,335	80	82,011
Insurance and Regulatory Fees	13,482	11,490	1,261	26,233
Energy	5,092	-	191	5,283
Characterization and Licensing Surveys	25,683	-	-	25,683
Property Taxes	27,924	829	7	28,760
Corporate A&G	14,875	1,691	1,357	17,923
Non-Labor Overhead	3,504	2,984	81	6,569
Severance Program	27,554	-	6,299	33,853
Miscellaneous Equipment	8,845	-	24	8,869
Miscellaneous Site Services	2,314	-	141	2,455
Total [3]	764,192	201,852	79,841	1,045,885

[1] Includes engineering costs

[2] Excludes program management costs (staffing) and security but includes costs for spent fuel loading/transfer/spent fuel pool O&M and EP fees

[3] Columns may not add due to rounding

Table 2
Schedule of Annual Expenditures
Spent Fuel Management Allocation
(thousands, 2024 dollars)

Year	Labor	Equipment & Materials	Energy	LLRW Disposal	Other	Total
2030	-	-	-	-	1,198	1,198
2031	2,175	6,526	-	-	2,840	11,541
2032	0	0	-	-	2,056	2,056
2033	9,413	28,240	-	-	1,550	39,203
2034	-	-	-	-	443	443
2035	-	-	-	-	443	443
2036	5,050	-	-	-	403	5,453
2037	5,030	-	-	-	819	5,849
2038	5,030	-	-	-	1,004	6,034
2039	5,030	-	-	-	1,561	6,591
2040	5,044	-	-	-	1,565	6,609
2041	5,030	-	-	-	1,561	6,591
2042	5,030	-	-	-	1,561	6,591
2043	5,030	-	-	-	1,561	6,591
2044	5,044	-	-	-	1,565	6,609
2045	5,030	-	-	-	1,561	6,591
2046	5,030	-	-	-	1,561	6,591
2047	5,030	-	-	-	1,561	6,591
2048	5,044	-	-	-	1,565	6,609
2049	5,255	674	-	-	1,561	7,489
2050	5,210	539	-	-	1,561	7,309
2051	5,434	1,213	-	-	1,561	8,208
2052	5,223	539	-	-	1,565	7,328
2053	5,479	1,348	-	-	1,561	8,388
2054	5,479	1,348	-	-	1,561	8,388
2055	5,479	1,348	-	-	1,561	8,388
2056	5,300	1,348	-	-	1,526	8,174
Total	119,897	43,121	-	-	38,834	201,852

Note: Columns may not add due to rounding

Table 3
Significant Cost Contributors
(2024 dollars)

Spent Fuel Management - Direct Expenditures	Cost
Capital Costs for ISFSI DSCs and HSMs (17 HSMs)	34,212,500
Loading and Transfer Costs from Pool to ISFSI	6,109,375
7P Recasking Effort	4,446,744
DSC Transfer Costs from ISFSI to DOE (62 DSCs)	11,140,625
ISFSI Expansion	1,585,045
Total	57,494,289

Table 4
Estimated Expenditures for Spent Fuel Packaging, Storage and Canister Transfer *
(2024 dollars)

Year	Capital Costs for DSCs and HSMs	Pool to ISFSI Loading and Transfer	7P Re-casking Effort	ISFSI to DOE DSC Transfer	ISFSI Expansion	Total
2030		-	-	-	-	-
2031	6,037,500	1,078,125	-	-	1,585,045	8,700,670
2032	-	-	4,446,744	-	-	4,446,744
2033	28,175,000	5,031,250	-	-	-	33,206,250
2034	-	-	-	-	-	-
2035	-	-	-	-	-	-
2036	-	-	-	-	-	-
2037	-	-	-	-	-	-
2038	-	-	-	-	-	-
2039	-	-	-	-	-	-
2040	-	-	-	-	-	-
2041	-	-	-	-	-	-
2042	-	-	-	-	-	-
2043	-	-	-	-	-	-
2044	-	-	-	-	-	-
2045	-	-	-	-	-	-
2046	-	-	-	-	-	-
2047	-	-	-	-	-	-
2048	-	-	-	-	-	-
2049	-	-	-	898,438	-	898,438
2050	-	-	-	718,750	-	718,750
2051	-	-	-	1,617,188	-	1,617,188
2052	-	-	-	718,750	-	718,750
2053	-	-	-	1,796,875	-	1,796,875
2054	-	-	-	1,796,875	-	1,796,875
2055	-	-	-	1,796,875	-	1,796,875
2056	-	-	-	1,796,875	-	1,796,875
Total	34,212,500	6,109,375	4,446,744	11,140,625	1,585,045	57,494,289

* A 15% contingency factor has been applied to all spent fuel related costs

Table 5
Projected Schedule and Milestones

Major Milestones and Fuel-Related Events	
Cessation of plant operations	July 2030
First DSC transferred post-shutdown from pool to ISFSI	2031
Last DSC transferred post-shutdown from pool to ISFSI	2033
End of wet storage pool operations	2034
DOE begins to receive commercial spent fuel	2034
First Robinson fuel assembly removed from site	2049
Last Robinson fuel assembly leaves site	2056
Last year of ISFSI operations	2056
ISFSI decommissioned	2057

Table 6
Decommissioning Funding Plan
2030 Shutdown

Basis Year			2024		
License Termination Fund (Qualified)			$1,107.966	(millions as of 12/31/2024)	
License Termination Fund (Non-Qualified)			$14.627	(millions as of 12/31/2024)	
Spent Fuel Management Fund (Qualified)			$43.672	(millions as of 12/31/2024)	
Spent Fuel Management Fund (Non-Qualified)			$6.807	(millions as of 12/31/2024)	
Annual Escalation (X)			2.82%		
Annual Earnings (Qualified) (Y)			4.53%		
Annual Earnings (Non-Qualified) (Z)			2.50%		
	A	B	C	D	E
Year	50.75 License Termination Cost[1] (millions)	50.54(bb) Spent Fuel Management Cost (millions)	Total License Termination and Spent Fuel Management Cost (millions)	Total Cost Escalated at 2.82% (millions)	Decommissioning Trust Fund Escalated Per Fund[2] (minus expenses) (millions)
2024	-	-	-	-	$1,173.072
2025	-	-	-	-	$1,225.777
2026	-	-	-	-	$1,280.859
2027	-	-	-	-	$1,338.425
2028	-	-	-	-	$1,398.587
2029	-	-	-	-	$1,461.462
2030	42.461	1.198	43.660	51.588	$1,474.361[3]
2031	161.406	11.541	172.947	210.115	$1,326.275
2032	162.888	2.056	164.943	206.041	$1,175.648
2033	140.599	39.203	179.802	230.937	$992.737
2034	102.362	0.443	102.805	135.766	$898.867
2035	102.362	0.443	102.805	139.594	$796.830
2036	29.717	5.453	35.170	49.102	$782.712
2037	0.074	5.849	5.922	8.501	$809.475
2038	0.055	6.034	6.089	8.987	$836.954
2039	-	6.591	6.591	10.003	$864.638
2040	-	6.609	6.609	10.313	$893.260
2041	-	6.591	6.591	10.575	$922.910
2042	-	6.591	6.591	10.873	$953.598
2043	-	6.591	6.591	11.180	$985.363
2044	-	6.609	6.609	11.526	$1,018.213
2045	-	6.591	6.591	11.819	$1,052.251
2046	-	6.591	6.591	12.152	$1,087.491

Table 6 (continued)
Decommissioning Funding Plan
2030 Shutdown

Basis Year			2024		
License Termination Fund (Qualified)			$1,107.966	(millions as of 12/31/2024)	
License Termination Fund (Non-Qualified)			$14.627	(millions as of 12/31/2024)	
Spent Fuel Management Fund (Qualified)			$43.672	(millions as of 12/31/2024)	
Spent Fuel Management Fund (Non-Qualified)			$6.807	(millions as of 12/31/2024)	
Annual Escalation (X)			2.82%		
Annual Earnings (Qualified) (Y)			4.53%		
Annual Earnings (Non-Qualified) (Z)			2.50%		
	A	B	C	D	E
Year	50.75 License Termination Cost[1] (millions)	50.54(bb) Spent Fuel Management Cost (millions)	Total License Termination and Spent Fuel Management Cost (millions)	Total Cost Escalated at 2.82% (millions)	Decommissioning Trust Fund Escalated Per Fund[2] (minus expenses) (millions)
2047	-	6.591	6.591	12.495	$1,123.976
2048	-	6.609	6.609	12.882	$1,161.719
2049	-	7.489	7.489	15.009	$1,198.996
2050	-	7.309	7.309	15.062	$1,237.907
2051	-	8.208	8.208	17.391	$1,276.199
2052	-	7.328	7.328	15.965	$1,317.684
2053	-	8.388	8.388	18.789	$1,358.161
2054	-	8.388	8.388	19.319	$1,399.929
2055	-	8.388	8.388	19.864	$1,443.032
2056	12.102	8.174	20.276	49.370	$1,457.913
2057	10.167	-	10.167	25.454	$1,497.926
Total	$764.193	$201.856	$966.048	$1,350.672	

[1] Costs to decommission the ISFSI are included as license termination costs as required by 10 CFR 72.30.

[2] Qualified and non-qualified funds are escalated at different rates (4.53% and 2.50%, respectively). This column includes both qualified and non-qualified fund balances.

[3] The non-qualified fund will be prioritized for paying decommissioning costs. The fund will be emptied in year 2030, and all further costs will be covered by the qualified fund.

Calculations:

Column C = A + B
Column D = (C)*(1+X)^(current year – 2024)
Column E (until non-qualified fund is emptied in 2030) = (Previous year's qualified funds balance) * (1 + Y) + (Previous year's non-qualified funds balance) * (1 + Z)
Column E (after non-qualified fund is emptied) = (Previous year's qualified fund balance) – (current year's decommissioning expenditures) + (Previous year's qualified fund balance – half of the current year's decommissioning expenditures) * (Y)

ENCLOSURE 2

Preliminary Decommissioning Cost Analysis for the H.B. Robinson Nuclear Plant

Document D03-1834-007, Rev. 4

PRELIMINARY DECOMMISSIONING COST ANALYSIS

for the

H.B. ROBINSON NUCLEAR PLANT

prepared for

Duke Energy Corporation

prepared by

TLG Services, LLC
Bridgewater, Connecticut

July 2025

APPROVALS

Project Manager	Adam M. Kaczmarek	07/23/2025 Date
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Technical Manager	Lori A. Glander	07/23/2025 Date

TABLE OF CONTENTS

SECTION **PAGE**

TABLE OF CONTENTS
(continued)

SECTION **PAGE**

TABLES

FIGURES

TABLE OF CONTENTS
(continued)

SECTION PAGE

APPENDICES

REVISION LOG

No.	Date	Item Revised	Reason for Revision
0	12/19/2024		Original Issue
1	05/30/2025	Text in Executive Summary; Table 3	Updated trust fund balances (qualified and non-qualified funds)
2	06/19/2025	Table 3	Revised fund calculations to prioritize non-qualified fund
3	07/15/2025	Table 3	Revised table to include LT and SFM expenditures
4	07/23/2025	Table 3	Revised calculation formula for Column E

ACRONYMS / DEFINITIONS

- AIF Atomic Industrial Forum
- ALARA As-Low-As-Reasonably Achievable
- CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
- CISF Consolidated Interim Storage Facility
- DOC Decommissioning Operations Contractor
- DOE Department of Energy
- EPA Environmental Protection Agency
- GTCC Greater Than Class C
- IPs Industrial Packages
- ISFSI Independent Spent Fuel Storage Installation
- kW Kilowatt
- LTP License Termination Plan
- LSA Low Specific Activity
- MARSSIM Multi-Agency Radiation Survey & Site Investigation Manual
- MOU Memorandum of Understanding
- MRS Monitored Retrieval Storage
- MW Megawatt
- NESP National Environmental Studies Project
- NRC Nuclear Regulatory Commission
- NSSS Nuclear Steam Supply Systems
- NWPA Nuclear Waste Policy Act
- PERT Program Evaluation and Review Technique
- PSDAR Post-Shutdown Decommissioning Activities Report
- SCO Surface Contaminated Object
- TAD Transport, Aging, Disposal
- TEDE Total Effective Dose Equivalent
- TLG TLG Services, LLC
- TSC Transportable Storage Canister
- WCS Waste Control Specialists
- UFSAR Updated Final Safety Analysis Report

EXECUTIVE SUMMARY

Duke Energy Corporation (Duke Energy) is seeking renewal of the current operating license for the H.B. Robinson Nuclear Plant (Robinson). The current license, initially renewed April 19, 2004, is set to expire at midnight on July 31, 2030. Duke Energy submitted an application for subsequent license renewal of Facility Operating License No. DPR-23 on April 1, 2025.[1]

However, pursuant to 10 CFR 50.75(f)(3), each power reactor licensee shall at or about 5 years prior to the projected end of operations submit a preliminary decommissioning cost estimate which includes an up-to-date assessment of the major factors that could affect the cost to decommission. This report presents an estimate of the cost to decommission Robinson assuming a cessation of operations after a nominal 60-year operating life in 2030. The cost estimate includes an assessment of the major factors that could affect the cost to decommission the Robinson nuclear unit.

Duke Energy is submitting this estimate to comply with the requirements of 10 CFR 50.75(f)(3). Duke Energy has not determined or committed to a specific decommissioning approach for Robinson at this time. However, for purposes of demonstrating the adequacy of funding to meet regulatory requirements, it is Duke Energy's current plan to use the DECON decommissioning option based on the current license expiration date. Successful license renewal will require a need to revise this preliminary plan.

Site-specific Decommissioning Cost Analyses are performed for Robinson every 5 years in accordance with state regulatory orders to support Decommissioning Trust Fund funding analysis. This Preliminary Decommissioning Cost Analysis was performed coincident with the most recent site-specific Decommissioning Cost Analysis.[2] As such, the methodology used to develop this estimate is consistent with the methodology used to develop the site-specific Decommissioning Cost Analysis. The analysis relies upon site-specific, technical information from an evaluation prepared in 2019,[3] updated to reflect current assumptions pertaining to the disposition of the nuclear plant and relevant industry experience in undertaking such projects. The currently projected

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1 Duke Energy Letter, Duke Energy Progress, LLC (Duke Energy) H.B. Robinson Steam Electric Plant, Unit Number 2 Docket Number 50-261 / Renewed License Number DPR-23 Application for Subsequent Renewed Licenses, dated April 1, 2025

2 "Decommissioning Cost Analysis for the H.B. Robinson Nuclear Plant," Document D03-1834-003, Rev. 4, TLG Services, LLC, November 2024

3 "Decommissioning Cost Analysis for the H.B. Robinson Nuclear Plant," Document D03-1766-007, Rev. 4, TLG Services, Inc., December 2019

total cost to decommission the nuclear unit, assuming the DECON alternative, is estimated at $1,045.9 million, as reported in 2024 dollars. The cost includes the monies anticipated to be spent for operating license termination, spent fuel storage and site remediation activities. The cost is based on several key assumptions in areas of regulation, component characterization, high-level radioactive waste management, low-level radioactive waste disposal, performance uncertainties (contingency) and site remediation and restoration requirements. The assumptions are discussed in more detail in this document.

While the analysis is not a detailed engineering evaluation, it represents the estimate prepared in advance of the detailed engineering required to carry out the decommissioning of the nuclear plant. It may also not reflect the actual plan to decommission Robinson; the plan may differ from the assumptions made in this analysis based on facts that exist at the time of decommissioning.

The 2019 plant inventory, the basis for the decontamination and dismantling requirements and cost, and the decommissioning waste streams, was reviewed for this analysis. The plant confirmed there were no substantive changes over the five-year period to the configuration of the plant or site facilities (that would significantly impact decommissioning).

The costs to decommission Robinson are tabulated at the end of this section. Costs are reported in 2024 dollars and include monies anticipated to be spent for radiological remediation and operating license termination, spent fuel management, and site restoration activities.

A complete discussion of the assumptions relied upon in this analysis is provided in Section 3, along with a schedule of annual expenditures. A sequence of significant project activities is provided in Section 4 with a timeline. Detailed cost reports used to generate the summary tables contained within this document are provided in Appendix C.

Consistent with the 2019 analysis, the current cost estimate assumes that the shutdown of the nuclear plant is a scheduled and pre-planned event (e.g., there is no delay in transitioning the plant and workforce from operations or in obtaining regulatory relief from operating requirements, etc.). The estimate includes the continued operation of the fuel handling building as an interim wet fuel storage facility for approximately three and one-half years after operations cease. During this time period, it is assumed that the spent fuel residing in the pool will be transferred to an onsite independent spent fuel storage installation (ISFSI). The 7P-ISFSI contains 56 fuel assemblies in 8 canisters that are not currently licensed for transport nor assumed to be licensed for transport at any point in the future. Therefore, the canisters will be off-loaded and the assemblies transferred back into the fuel handling building's spent fuel pool. These 56 assemblies will be loaded to the 24P ISFSI for eventual transfer to the DOE. The 24P-ISFSI horizontal storage modules will remain operational until the DOE is able to complete the transfer of the fuel to a federal facility (e.g., a monitored retrievable storage facility).[4] DOE officials have stated that DOE does not have an obligation to accept already-canistered fuel without an amendment to DOE's contracts with plant licensees to remove the fuel (the "Standard Contract"), but DOE has not explained what any such amendment would involve. For purposes of this analysis, it is assumed that DOE will accept already-canistered fuel. If this assumption is incorrect, it is assumed the DOE will have liability for costs incurred to transfer the fuel to DOE-supplied containers.

Alternatives and Regulations

The Nuclear Regulatory Commission (NRC) provided general decommissioning requirements in a rule adopted on June 27, 1988.[5] In this rule, the NRC set forth technical and financial criteria for decommissioning licensed nuclear facilities. The regulations addressed planning needs, timing, funding methods, and environmental review requirements for decommissioning. The rule also defined three decommissioning alternatives as being acceptable to the NRC: DECON, SAFSTOR, and ENTOMB.

> DECON is defined as "the alternative in which the equipment, structures, and portions of a facility and site containing radioactive contaminants are removed or decontaminated to a level that permits the property to be released for unrestricted use shortly after cessation of operations."[6]
>
> SAFSTOR is defined as "the alternative in which the nuclear facility is placed and maintained in a condition that allows the nuclear facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use."[7] Decommissioning is required to be completed within 60 years, although longer time periods will be considered when necessary to protect public health and safety.
>
> ENTOMB is defined as "the alternative in which radioactive contaminants are encased in a structurally long-lived material, such as

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4 Projected expenditures for spent fuel management identified in the cost analyses do not consider the outcome of the litigation with the DOE with regard to the delays incurred by the owner in the timely removal of spent fuel from the site.

5 U.S. Code of Federal Regulations, Title 10, Parts 30, 40, 50, 51, 70 and 72 "General Requirements for Decommissioning Nuclear Facilities," Nuclear Regulatory Commission, Federal Register Volume 53, Number 123 (p 24018 et seq.), June 27, 1988

6 Ibid. Page FR24022, Column 3

7 Ibid.

concrete; the entombed structure is appropriately maintained and continued surveillance is carried out until the radioactive material decays to a level permitting unrestricted release of the property."[8] As with the SAFSTOR alternative, decommissioning is currently required to be completed within 60 years, although longer time periods will also be considered when necessary to protect public health and safety.

The 60-year restriction has limited the practicality for the ENTOMB alternative at commercial reactors that generate significant amounts of long-lived radioactive material. In 1997, the Commission directed its staff to re-evaluate this alternative and identify the technical requirements and regulatory actions that would be necessary for entombment to become a viable option. The resulting evaluation provided several recommendations, however, rulemaking has been deferred pending the completion of additional research studies (e.g., on engineered barriers).

In a draft regulatory basis document published in March 2017 in support of rulemaking that would amend NRC regulations concerning nuclear plant decommissioning, the NRC staff proposed removing any discussion of the ENTOMB option from existing guidance documents since the method is not deemed practically feasible.

In 1996, the NRC published revisions to its general requirements for decommissioning nuclear power plants to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process.[9] The amendments allow for greater public participation and better define the transition process from operations to decommissioning. Regulatory Guide 1.184, issued in July 2000, further described the methods and procedures that are acceptable to the NRC staff for implementing the requirements of the 1996 revised rule that relate to the initial activities and the major phases of the decommissioning process. The costs and schedules presented in this analysis follow the general guidance and sequence in the amended regulations. The format and content of the estimate is also consistent with the recommendations of Regulatory Guide 1.202, issued February 2005.[10]

In 2011, the NRC issued regulations to improve decommissioning planning and thereby reduce the likelihood that any current operating facility will become a legacy

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8 Ibid. Page FR24023, Column 2

9 U.S. Code of Federal Regulations, Title 10, Parts 2, 50, and 51, "Decommissioning of Nuclear Power Reactors," Nuclear Regulatory Commission, Federal Register Volume 61, (p 39278 et seq.), July 29, 1996

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

site.[11] The regulations require licensees to report additional details in their decommissioning cost estimate, including a decommissioning estimate for the ISFSI. This estimate is provided in Appendix D.

Decommissioning Scenario

This analysis assumes that the plant would be promptly decommissioned (DECON alternative) upon the expiration of the current operating license, i.e., in 2030. The spent fuel storage pool is assumed to be operational for three and one-half years following the cessation of operations. The equipment, structures, and portions of the plant containing radioactive contaminants are removed or decontaminated to a level that permits the facility to be released for unrestricted use. Site structures are then demolished. Spent fuel storage operations continue at the site until the transfer of the fuel from the ISFSI to the DOE is complete, assumed to be in the year 2056.

Methodology

The methodology used to develop the estimate follows the basic approach originally presented in the cost estimating guidelines[12] developed by the Atomic Industrial Forum (now Nuclear Energy Institute). This reference describes a unit cost factor method for estimating decommissioning activity costs. The unit cost factors used in this analysis incorporate site-specific costs and the latest available information about worker productivity in decommissioning.

An activity duration critical path is used to determine the total decommissioning program schedule. This is required for calculating the carrying costs, which include program management, administration, field engineering, equipment rental, quality assurance, and security. This systematic approach for assembling decommissioning estimates ensures a high degree of confidence in the reliability of the resulting costs.

The estimate also reflects lessons learned from TLG's involvement in the Shippingport Station Decommissioning Project, completed in 1989, as well as the decommissioning of the Cintichem reactor, hot cells and associated facilities, completed in 1997. In addition, the planning and engineering for the Rancho Seco, Trojan, Yankee Rowe, Big Rock Point, Maine Yankee, Humboldt Bay-3, Oyster Creek, Connecticut Yankee, Crystal River, Vermont Yankee, Fort Calhoun, Pilgrim, and Indian Point nuclear units have provided additional insight into the process, the regulatory aspects, and the technical challenges of decommissioning commercial nuclear units.

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11 U.S. Code of Federal Regulations, Title 10, Parts 20, 30, 40, 50, 70, and 72, "Decommissioning Planning," Nuclear Regulatory Commission, Federal Register Volume 76, (p 35512 et seq.), June 17, 2011

12 T.S. LaGuardia et al., "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," AIF/NESP-036, May 1986

Contingency

Consistent with cost estimating practice, contingencies are applied to the decontamination and dismantling costs developed as "specific provision for unforeseeable elements of cost within the defined project scope, particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur."[13] The cost elements in the estimate are based on ideal conditions; therefore, the types of unforeseeable events that are almost certain to occur in decommissioning, based on industry experience, are addressed through a percentage contingency applied on a line-item basis. This contingency factor is a nearly universal element in all large-scale construction and demolition projects. It should be noted that contingency, as used in this analysis, does not account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the plant.

Contingency funds are expected to be fully expended throughout the program. As such, inclusion of contingency is necessary to provide assurance that sufficient funding will be available to accomplish the intended tasks.

Low-Level Radioactive Waste Disposal

The contaminated and activated material generated in the decontamination and dismantling of a commercial nuclear reactor is generally classified as low-level radioactive waste, although not all of the material is suitable for shallow-land disposal. With the passage of the "Low-Level Radioactive Waste Disposal Act" in 1980 and its Amendments of 1985, [14] the states became ultimately responsible for the disposition of low-level radioactive waste generated within their own borders.

South Carolina is a member of the three-state Atlantic Interstate Low-Level Radioactive Waste Management Compact, formed after South Carolina joined the Atlantic Compact Regional Waste formally known as the Northeast Regional Compact. As such, the owner will continue to have access to the currently operating disposal facility in Barnwell, South Carolina.

Disposition of the various waste streams produced by the decommissioning process considered all options and services currently available to Duke Energy. For this analysis, the majority of the low-level radioactive waste is designated for direct disposal at the Barnwell facility. This includes packaged waste (plant equipment and

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13 Project and Cost Engineers' Handbook, Second Edition, American Association of Cost Engineers, Marcel Dekker, Inc., New York, New York, p. 239.

14 "Low-Level Radioactive Waste Policy Amendments Act of 1985," Public Law 99-240, January 15, 1986

commodities and large components designated as Class A[15]), and higher activity waste forms waste (Class B and C resins and activated metal from the reactor vessel[16]). It is also assumed that Duke Energy can access other disposal sites, should it prove cost-effective. As such, low-activity waste forms (concrete debris, dry-active waste) are assumed to be sent to Energy*Solutions'* facility in Clive, Utah for disposal, and metallic waste suspected of being contaminated is sent to a Tennessee-based radioactive waste processor for decontamination, volume reduction and/or disposal.

The dismantling of the components residing closest to the reactor core generates radioactive waste that may be considered unsuitable for shallow-land disposal (i.e., low-level radioactive waste with concentrations of radionuclides that exceed the limits established by the NRC for Class C radioactive waste (GTCC)). The Low-Level Radioactive Waste Policy Amendments Act of 1985 assigned the federal government the responsibility for the disposal of this material. The Act also stated that the beneficiaries of the activities resulting in the generation of such radioactive waste bear all reasonable costs of disposing of such waste.

The DOE issued its final Environmental Impact Statement for the disposal of GTCC on January 2016.[17] The study evaluated the potential environmental impacts associated with constructing and operating a new facility or using an existing facility, disposal methods, and locations. DOE is awaiting Congressional action on the report and its recommendations. At this time, the federal government has not identified a specific cost for disposing of GTCC or a schedule for acceptance.

For purposes of this analysis, the GTCC radioactive waste is assumed to be packaged and disposed of in a similar manner as high-level waste and at a cost equivalent to that envisioned for the spent fuel. The GTCC is packaged in canisters compatible with the spent fuel dry storage system and either stored on site or shipped directly to a federal facility as it is generated (depending upon the timing of the decommissioning and whether the spent fuel has been removed from the site prior to the start of decommissioning).

A significant portion of the waste material generated during decommissioning may only be potentially contaminated by radioactive materials. This waste can be analyzed on site or shipped off site to licensed facilities for further analysis, for processing and/or for conditioning/recovery. Reduction in the volume of low-level radioactive waste requiring disposal in a licensed low-level radioactive waste disposal

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15 Waste is classified in accordance with U.S. Code of Federal Regulations, Title 10, Part 61.55

16 U.S. Code of Federal Regulations, Title 10, Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste"

17 "Final Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste (DOE/EIS-0375)," January 2016

facility can be accomplished through a variety of methods, including analyses and surveys or decontamination to eliminate the portion of waste that does not require disposal as radioactive waste, compaction, incineration or metal melt. The estimate reflects the savings from waste recovery/volume reduction.

High-Level Radioactive Waste Management

Congress passed the "Nuclear Waste Policy Act" (NWPA) in 1982, assigning the federal government's long-standing responsibility for disposal of the spent nuclear fuel created by the commercial nuclear generating plants to the DOE. The DOE was to begin accepting spent fuel by January 31, 1998; however, to date no progress in the removal of spent fuel from commercial generating sites has been made.

Today, the country is at an impasse on high-level waste disposal, despite DOE's submittal of its License Application for a geologic repository to the NRC in 2008. The Obama administration eliminated the budget for the repository program while promising to "conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle … and make recommendations for a new plan." Towards this goal, the Obama administration appointed a Blue Ribbon Commission on America's Nuclear Future (Blue Ribbon Commission) to make recommendations for a new plan for nuclear waste disposal. The Blue Ribbon Commission's charter included a requirement that it consider "[o]ptions for safe storage of used nuclear fuel while final disposition pathways are selected and deployed."[18]

On January 26, 2012, the Blue Ribbon Commission issued its "Report to the Secretary of Energy" containing a number of recommendations on nuclear waste disposal. Two of the recommendations that may impact decommissioning planning are:

- "[T]he United States [should] establish a program that leads to the timely development of one or more consolidated storage facilities"[19]
- "[T]he United States should undertake an integrated nuclear waste management program that leads to the timely development of one or more permanent deep geological facilities for the safe disposal of spent fuel and high-level nuclear waste."[20]

In January 2013, the DOE issued the "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," in response to the

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18 Ibid.

19 "Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy," https://cybercemetery.unt.edu/brc/20120620220235/http:/brc.gov/sites/default/files/documents/brc_finalreport_jan2012.pdf p. 32, January 2012

20 Ibid., p.27

recommendations made by the Blue Ribbon Commission and as "a framework for moving toward a sustainable program to deploy an integrated system capable of transporting, storing, and disposing of used nuclear fuel..."[21]

"With the appropriate authorizations from Congress, the Administration currently plans to implement a program over the next 10 years that:

- Sites, designs and licenses, constructs and begins operations of a pilot interim storage facility by 2021 with an initial focus on accepting used nuclear fuel from shut-down reactor sites;
- Advances toward the siting and licensing of a larger interim storage facility to be available by 2025 that will have sufficient capacity to provide flexibility in the waste management system and allows for acceptance of enough used nuclear fuel to reduce expected government liabilities; and
- Makes demonstrable progress on the siting and characterization of repository sites to facilitate the availability of a geologic repository by 2048."[22]

The NRC's review of DOE's license application to construct a geologic repository at Yucca Mountain was suspended in 2011, when the Obama administration significantly reduced the budget for completing that work. However, the US Court of Appeals for the District of Columbia Circuit issued a writ of mandamus (in August 2013)[23] ordering NRC to comply with federal law and resume its review of DOE's Yucca Mountain repository license application to the extent allowed by previously appropriated funding for the review. That review was completed with the publication of a five-volume safety evaluation report. A supplement to DOE's environmental impact statement and adjudicatory hearing on the contentions filed by interested parties must be completed before a licensing decision can be made. Although the DOE proposed it would start fuel acceptance in 2025, no progress has been made in the repository program since DOE's 2013 strategy was issued except for the completion of the Yucca Mountain safety evaluation report.

While little progress has been made, some alternatives to a geological repository including interim storage are in various early stages of planning and implementation. Holtec International submitted a license application to the NRC on March 30, 2017 for a consolidated interim spent fuel storage facility in southeast New Mexico called

21 "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," U.S. DOE, January 11, 2013

22 Ibid., p.2

23 U.S. Court of Appeals for the District Of Columbia Circuit, In Re: Aiken County, et al, Aug. 2013

HI-STORE CIS (Consolidated Interim Storage) under the provisions of 10 CFR Part 72. The application was approved by the NRC on May 9, 2023.

Waste Control Specialists submitted an application to the NRC on April 28, 2016, to construct and operate a Consolidated Interim Storage Facility (CISF) at its West Texas facility. On April 18, 2017, WCS requested that the NRC temporarily suspend all safety and environmental review activities, as well as public participation activities associated with WCS's license application. In March 2018, WCS and Orano USA, announced their intent to form a joint venture to license the facility. On September 17, 2021, the NRC approved the joint venture's original CISF license application. At this time, neither storage facility is in service and therefore has not been considered in this estimate.

On May 10, 2018, the U.S. House of Representatives passed H.R. 3053, the "Nuclear Waste Policy Amendments Act of 2018." Proposed to amend the Nuclear Waste Policy Act of 1982, the legislation, if approved by the Senate and signed by the President, would provide the DOE the authority to site, construct, and operate one or more Monitored Retrieval Storage (MRS) facilities while a permanent repository is licensed and constructed and/or to enter into an MRS agreement with a non-Federal entity for temporary storage.

Completion of the decommissioning process is dependent upon the DOE's ability to remove spent fuel from the site in a timely manner. DOE's repository program had originally assumed that spent fuel allocations would be accepted for disposal from the nation's commercial nuclear plants, with limited exceptions, in the order (the "queue") in which it was discharged from the reactor.[24] However, the Blue Ribbon Commission, in its final report, noted that: "[A]ccepting spent fuel according to the OFF [Oldest Fuel First] priority ranking instead of giving priority to shutdown reactor sites could greatly reduce the cost savings that could be achieved through consolidated storage if priority could be given to accepting spent fuel from shutdown reactor sites before accepting fuel from still-operating plants. …. The magnitude of the cost savings that could be achieved by giving priority to shutdown sites appears to be large enough (i.e., in the billions of dollars) to warrant DOE exercising its right under the Standard Contract to move this fuel first."

For planning purposes only, Duke Energy conducted a probability analysis of the three scenarios discussed in DOE's 2013 Strategy for the Management and Disposal

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24 U.S. Code of Federal Regulations, Title 10, Part 961.11, Article IV – Responsibilities of the Parties, B. DOE Responsibilities, 5.(a) … DOE shall issue an annual acceptance priority ranking for receipt of SNF and/or HLW at the DOE repository. This priority ranking shall be based on the age of SNF and/or HLW as calculated from the date of discharge of such materials from the civilian nuclear power reactor. The oldest fuel or waste will have the highest priority for acceptance …"

of used Nuclear Fuel and High-Level Radioactive Waste, and selected an industry DOE pickup start date of 2034. The analysis assumes shutdown sites will receive priority; therefore, DOE will begin accepting spent fuel from currently operating units approximately 5 years after the proposed start date. Duke Energy recognizes that the proposed date for DOE to start accepting spent fuel differs from dates used in past Duke Energy Decommissioning Cost Estimates as well as dates used in the industry. As stated in the Duke Energy DOE Pickup Date and Pickup Rate position paper, "While earlier dates than 2034 are possible, they are not considered probable and would therefore likely underestimate the total decommissioning cost..."[25]

Duke Energy's current spent fuel management plan for the Robinson spent fuel is based in general upon: 1) a 2039 start date for DOE initiating transfer of commercial spent fuel from the currently operating Duke Energy units to a licensed facility, 2) reassignment of allocations between the Brunswick, Harris, and Robinson units in the Duke Energy fleet so as to minimize on-site storage costs, and 3) expectations for spent fuel receipt by the DOE for the already canistered Robinson fuel.

Assuming the DOE starts accepting fuel from the currently operating Duke Energy plants in 2039, and from the Robinson site in 2049, and a maximum rate of transfer of 3,000 metric tons of uranium (MTU)/year, [26] transfer of spent fuel from the ISFSI is anticipated to continue through the year 2056, if the plant ceases operating in 2030.

The NRC requires that licensees establish a program to manage and provide funding for the caretaking of all irradiated fuel at the reactor site until title of the fuel is transferred to the DOE. [27] Interim storage of the fuel, until the DOE has completed the transfer, will be in the fuel handling building's storage pool as well as at an on-site ISFSI.

The 7P-ISFSI contains 56 fuel assemblies in 8 canisters that are not currently licensed for transport nor assumed to be licensed for transport at any point in the future. Therefore, the canisters will be off-loaded and the assemblies transferred back into the fuel handling building's spent fuel pool. These 56 assemblies will be loaded to the 24P ISFSI for eventual transfer to the DOE. The 24P-ISFSI, operated under 10 CFR 72, Subpart K [28], has been constructed to support continued plant operations. Spent fuel stored at the ISFSI will be transferred to the DOE once the spent fuel assemblies in the

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25 "Pickup Date and Pickup Rate for Use in the CR3 Decommissioning Plan and Cost Estimate," Duke Energy, Rev. 4

26 "Acceptance Priority Ranking & Annual Capacity Report," DOE/RW-0567, July 2004

27 U.S. Code of Federal Regulations, Title 10, Part 50 – Domestic Licensing of Production and Utilization Facilities, Subpart 54 (bb), "Conditions of Licenses"

28 U.S. Code of Federal Regulations, Title 10, Part 72, Subpart K, "General License for Storage of Spent Fuel at Power Reactor Sites."

storage pool have been removed. Once the storage pool is emptied, the fuel handling building can be either decontaminated and dismantled or prepared for long-term storage.

Duke Energy's position is that the DOE has a contractual obligation to accept the spent fuel earlier than the projections set out above consistent with its contract commitments. No assumption made in this study should be interpreted to be inconsistent with this claim.

Site Restoration

The efficient removal of the contaminated materials at the site may result in damage to many of the site structures. Blasting, coring, drilling, and the other decontamination activities can substantially damage power block structures, potentially weakening the footings and structural supports. It is unreasonable to anticipate that these structures would be repaired and preserved after the radiological contamination is removed. The cost to dismantle site structures with a work force already mobilized is more efficient and less costly than if the process is deferred.

Consequently, this study assumes that non-essential site structures addressed by this analysis are removed, once remediation is complete, to a nominal depth of three feet below the local grade level wherever possible. The site is then graded and stabilized.

Decommissioning Trust Fund

As of December 31, 2024, the aggregate trust fund balance for Robinson was approximately $1,173.1 million (see Table 3 for a break out of qualified and non-qualified funds).

Financial Assurance

Duke Energy intends to fund the expenditures for license termination (comprising 73% of the total cost) from the decommissioning trust fund currently held by Duke Energy. The management of the spent fuel, until it can be transferred to the DOE, may be funded from excess trust fund assets and from proceeds from spent fuel litigation against the Department of Energy (DOE). Expenditures from the trust fund for the management of the spent fuel will not reduce the value of the decommissioning trust fund to below the amount necessary to terminate the license. The licensee would make the appropriate submittals for an exemption, in accordance with 10 CFR 50.12, from the requirements of 10 CFR 50.82(a)(8)(i)(A) in order to use the decommissioning trust funds for non-decommissioning related expenses, as defined by 10 CFR 50.2.

The total cost projected for license termination (in accordance with 10 CFR 50.75) for the prompt decommissioning alternative (DECON) is shown at the bottom of Table 1 ($764.2 million). The schedule of expenditures for license termination activities is provided in Table 2. Table 3 provides the details of the proposed funding plan for decommissioning Robinson based on a 4.53% real rate of return on qualified funds and a 2.50% real rate of return on non-qualified funds. As shown in Table 3, the current trust funds (as of December 31, 2024) are sufficient to accomplish the intended tasks and terminate the operating license for Robinson. The analysis also shows a surplus in the fund at the completion of decommissioning. This surplus could be made available to fund other activities at the site (e.g., spent fuel management and/or site restoration activities), recognizing that the licensee would need to make the appropriate submittals for an exemption in accordance with 10 CFR 50.12 from the requirements of 10 CFR 50.82(a)(8)(i)(A) in order to use the decommissioning trust funds for non-decommissioning related expenses, as defined by 10 CFR 50.2.

Summary

The estimate to decommission Robinson assumes the removal of all contaminated and activated plant components and structural materials such that the owner may then have unrestricted use of the site with no further requirements for an operating license. Low-level radioactive waste, other than GTCC waste, is sent to a commercial processor for treatment/conditioning or to a controlled disposal facility.

Decommissioning is accomplished within the 60-year period required by current NRC regulations. In the interim, the spent fuel remains in storage at the site until such time that the transfer to a DOE facility is complete. Once emptied, the storage facility can also be decommissioned.

The alternative evaluated in this analysis is described in Section 2. The assumptions are presented in Section 3, along with schedules of annual expenditures. The major cost contributors are identified in Section 6, with detailed activity costs, waste volumes, and associated manpower requirements delineated in Appendix C. The major cost components are also identified in the cost summary provided at the end of this section.

The cost elements in the estimate are assigned to one of three subcategories: NRC License Termination (radiological remediation), Spent Fuel Management, and Site Restoration. The subcategory "NRC License Termination" is used to accumulate costs that are consistent with "decommissioning" as defined by the NRC in its financial assurance regulations (i.e., 10 CFR §50.75). The cost reported for this subcategory is generally sufficient to terminate the unit's operating license, recognizing that there may be some additional cost impact from spent fuel management. The License Termination cost subcategory also includes costs to decommission the ISFSI (as required by 10 CFR §72.30). Section 3.4.1 provides the basis for the ISFSI decommissioning cost.

The "Spent Fuel Management" subcategory contains costs associated with the containerization and transfer of spent fuel from the wet storage pool to the ISFSI, as well as the eventual transfer of the spent fuel in storage at the ISFSI to the DOE. Costs are included for the operation of the storage pool and the management of the ISFSI until such time that the transfer is complete. It does not include any spent fuel management expenses incurred prior to the cessation of plant operations, nor does it include any costs related to the final disposal of the spent fuel.

"Site Restoration" is used to capture costs associated with the dismantling and demolition of buildings and facilities demonstrated to be free from contamination. This includes structures never exposed to radioactive materials, as well as those facilities that have been decontaminated to appropriate levels. Structures are removed to a depth of three feet and backfilled to conform to local grade.

It should be noted that the costs assigned to these subcategories are allocations. Delegation of cost elements is for the purposes of comparison (e.g., with NRC financial guidelines) or to permit specific financial treatment (e.g., Asset Retirement Obligation determinations). In reality, there can be considerable interaction between the activities in the three subcategories. For example, an owner may decide to remove non-contaminated structures early in the project to improve access to highly contaminated facilities or plant components. In these instances, the non-contaminated removal costs could be reassigned from Site Restoration to an NRC License Termination support activity. However, in general, the allocations represent a reasonable accounting of those costs that can be expected to be incurred for the specific subcomponents of the total estimated program cost, if executed as described.

As noted within this document, the estimate was developed and costs are presented in 2024 dollars. As such, the estimate does not reflect the escalation of costs (due to inflationary and market forces) over the remaining operating life of the plant or during the decommissioning period.

TABLE 1
DECOMMISSIONING COST ELEMENTS
(thousands of 2024 dollars)

Cost Element	Total
Decontamination	22,015
Removal	166,864
Packaging	33,664
Transportation	26,200
Waste Disposal	87,357
Off-site Waste Processing	26,643
Program Management [1]	276,270
Site Security	151,920
Spent Fuel Pool Isolation	17,313
Spent Fuel (Direct Expenditures) [2]	82,011
Insurance and Regulatory Fees	26,233
Energy	5,283
Characterization and Licensing Surveys	25,683
Property Taxes	28,760
Corporate A&G	17,923
Non-Labor Overhead	6,569
Severance Program	33,853
Miscellaneous Equipment	8,869
Miscellaneous Site Services	2,455
Total [3]	1,045,885

Cost Element	Total
License Termination	764,192
Spent Fuel Management	201,852
Site Restoration	79,841
Total [3]	1,045,885

[1] Includes engineering costs
[2] Excludes program management costs (staffing) but includes costs for spent fuel loading/transfer/spent fuel pool O&M and EP fees
[3] Columns may not add due to rounding

TABLE 2
SCHEDULE OF LICENSE TERMINATION EXPENDITURES
(thousands of 2024 dollars)

Year	Labor	Equipment & Materials	Energy	LLRW Disposal	Other	Total
2030	28,685	1,302	396	31	12,047	42,461
2031	84,788	19,131	1,334	11,835	44,319	161,406
2032	71,610	40,540	969	30,447	19,322	162,888
2033	64,623	32,251	838	25,998	16,889	140,599
2034	55,017	11,594	704	14,384	20,663	102,362
2035	55,017	11,594	704	14,384	20,663	102,362
2036	22,369	1,902	141	43	5,261	29,717
2037	74	0	0	0	0	74
2038	55	0	0	0	0	55
2039 - 55	0	0	0	0	0	0
2056	193	977	0	0	10,932	12,102
2057	768	418	7	2,854	6,120	10,167
Total	383,199	119,709	5,092	99,977	156,216	764,192

TABLE 3
FUNDING REQUIREMENTS
2030 SHUTDOWN

Basis Year			2024		
License Termination Fund (Qualified)			$1,107.966	(millions as of 12/31/2024)	
License Termination Fund (Non-Qualified)			$14.627	(millions as of 12/31/2024)	
Spent Fuel Management Fund (Qualified)			$43.672	(millions as of 12/31/2024)	
Spent Fuel Management Fund (Non-Qualified)			$6.807	(millions as of 12/31/2024)	
Annual Escalation (X)			2.82%		
Annual Earnings (Qualified) (Y)			4.53%		
Annual Earnings (Non-Qualified) (Z)			2.50%		
	A	B	C	D	E
Year	50.75 License Termination Cost[1] (millions)	50.54(bb) Spent Fuel Management Cost (millions)	Total License Termination and Spent Fuel Management Cost (millions)	Total Cost Escalated at 2.82% (millions)	Decommissioning Trust Fund Escalated Per Fund[2] (minus expenses) (millions)
2024	-	-	-	-	$1,173.072
2025	-	-	-	-	$1,225.777
2026	-	-	-	-	$1,280.859
2027	-	-	-	-	$1,338.425
2028	-	-	-	-	$1,398.587
2029	-	-	-	-	$1,461.462
2030	42.461	1.198	43.660	51.588	$1,474.361[3]
2031	161.406	11.541	172.947	210.115	$1,326.275
2032	162.888	2.056	164.943	206.041	$1,175.648
2033	140.599	39.203	179.802	230.937	$992.737
2034	102.362	0.443	102.805	135.766	$898.867
2035	102.362	0.443	102.805	139.594	$796.830
2036	29.717	5.453	35.170	49.102	$782.712
2037	0.074	5.849	5.922	8.501	$809.475
2038	0.055	6.034	6.089	8.987	$836.954
2039	-	6.591	6.591	10.003	$864.638
2040	-	6.609	6.609	10.313	$893.260
2041	-	6.591	6.591	10.575	$922.910
2042	-	6.591	6.591	10.873	$953.598
2043	-	6.591	6.591	11.180	$985.363
2044	-	6.609	6.609	11.526	$1,018.213
2045	-	6.591	6.591	11.819	$1,052.251
2046	-	6.591	6.591	12.152	$1,087.491
2047	-	6.591	6.591	12.495	$1,123.976

TABLE 3 (continued)
FUNDING REQUIREMENTS
2030 SHUTDOWN

Basis Year			2024		
License Termination Fund (Qualified)			$1,107.966	(millions as of 12/31/2024)	
License Termination Fund (Non-Qualified)			$14.627	(millions as of 12/31/2024)	
Spent Fuel Management Fund (Qualified)			$43.672	(millions as of 12/31/2024)	
Spent Fuel Management Fund (Non-Qualified)			$6.807	(millions as of 12/31/2024)	
Annual Escalation (X)			2.82%		
Annual Earnings (Qualified) (Y)			4.53%		
Annual Earnings (Non-Qualified) (Z)			2.50%		
	A	B	C	D	E
Year	50.75 License Termination Cost[1] (millions)	50.54(bb) Spent Fuel Management Cost (millions)	Total License Termination and Spent Fuel Management Cost (millions)	Total Cost Escalated at 2.82% (millions)	Decommissioning Trust Fund Escalated Per Fund[2] (minus expenses) (millions)
2048	-	6.609	6.609	12.882	$1,161.719
2049	-	7.489	7.489	15.009	$1,198.996
2050	-	7.309	7.309	15.062	$1,237.907
2051	-	8.208	8.208	17.391	$1,276.199
2052	-	7.328	7.328	15.965	$1,317.684
2053	-	8.388	8.388	18.789	$1,358.161
2054	-	8.388	8.388	19.319	$1,399.929
2055	-	8.388	8.388	19.864	$1,443.032
2056	12.102	8.174	20.276	49.370	$1,457.913
2057	10.167	-	10.167	25.454	$1,497.926
Total	$764.193	$201.856	$966.048	$1,350.672	

[1] Costs to decommission the ISFSI are included as license termination costs as required by 10 CFR 72.30.
[2] Qualified and non-qualified funds are escalated at different rates (4.53% and 2.50%, respectively). This column includes both qualified and non-qualified fund balances.
[3] The non-qualified fund will be prioritized for paying decommissioning costs. The fund will be emptied in year 2030, and all further costs will be covered by the qualified fund.

Calculations:

Column C = A + B
Column D = (C)*(1+X)^(current year – 2024)
Column E (until non-qualified fund is emptied in 2030) = (Previous year's qualified funds balance) * (1 + Y) + (Previous year's non-qualified funds balance) * (1 + Z)
Column E (after non-qualified fund is emptied) = (Previous year's qualified fund balance) – (current year's decommissioning expenditures) + (Previous year's qualified fund balance – half of the current year's decommissioning expenditures) * (Y)

1. INTRODUCTION

This report presents an estimate of the cost to decommission the H.B. Robinson Nuclear Plant (Robinson), also known as Unit 2 of the H. B. Robinson Steam Electric Plant, for the selected decommissioning scenario following the scheduled cessation of plant operations. Pursuant to 10 CFR 50.75(f)(3),[1]* each power reactor licensee shall at or about 5 years prior to the projected end of operations submit a preliminary decommissioning cost estimate which includes an up-to-date assessment of the major factors that could affect the cost to decommission. Duke Energy Corporation (Duke Energy) is submitting this estimate to comply with the requirements of 10 CFR 50.75(f)(3).

Site-specific Decommissioning Cost Analyses are performed for Robinson every 5 years in accordance with state regulatory orders to support Decommissioning Trust Fund funding analysis. This Preliminary Decommissioning Cost Analysis was performed coincident with the most recent site-specific Decommissioning Cost Analysis.[2] As such, the methodology used to develop this estimate is consistent with the methodology used to develop the site-specific Decommissioning Cost Analysis. The analysis relies upon site-specific, technical information from an evaluation prepared in 2019,[3] updated to reflect current assumptions pertaining to the disposition of the nuclear plant and relevant industry experience in undertaking such projects.

Duke Energy has not determined or committed to a specific decommissioning approach for Robinson at this time. However, it is Duke Energy's current plan for purposes of demonstrating the adequacy of funding to meet regulatory requirements to use the DECON decommissioning option based on the current license expiration date. Subsequent license renewal is likely to require a need to revise this preliminary plan.

The estimate is designed to provide Duke Energy with sufficient information to assess the plant owner's financial obligations, as they pertain to the eventual decommissioning of the nuclear plant. The analysis is not a detailed engineering evaluation, but rather an estimate prepared in advance of the detailed engineering required to carry out the decommissioning of the nuclear plant.

1.1 OBJECTIVES OF STUDY

The objectives of this study are to prepare a comprehensive estimate of the costs to decommission Robinson, to provide a sequence or schedule for the associated activities, and to develop waste stream projections from the decontamination and dismantling activities.

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* References provided in Section 7 of the document

The operating license for Robinson was originally set to expire on July 31, 2010. Carolina Power and Light Company (CP&L) applied for a renewal of the license, for a period of twenty years, on June 17, 2002. The NRC subsequently approved the request on April 19, 2004. As such, for the purposes of this study, the shutdown date for the plant is assumed to be midnight, July 31, 2030.

1.2 SITE DESCRIPTION

Robinson, also known as Unit 2 of the H. B. Robinson Steam Electric Plant, was constructed adjacent to Unit 1, a former coal-fired steam power plant (which was retired in October 2012 and demolished in 2016). The Robinson site is located in northwest Darlington County, South Carolina, approximately 3 miles west-northwest of Hartsville, South Carolina; 25 miles northwest of Florence, South Carolina; 35 miles north-northeast of Sumter, South Carolina; and 56 miles east-northeast of Columbia, South Carolina. The North Carolina border is 28 miles north of the site and the Atlantic Ocean is about 88 miles southeast. The plant is located on Lake Robinson, a man-made 2250 acre lake and cooling impoundment of Black Creek.

The Robinson plant was designed and built by the Westinghouse Electric Corporation as prime contractor for CP&L. Westinghouse engaged the engineering firm of Ebasco Services to provide the design of the structures and non-nuclear portions of the plant.

The Robinson reactor is a pressurized light water moderated and cooled system. The nuclear power plant incorporates a three-loop, closed-cycle, pressurized water Nuclear Steam Supply System (NSSS) designed by Westinghouse Electric Corporation. The reactor coolant system is arranged as three closed reactor coolant loops connected in parallel to the reactor vessel, each loop containing a reactor coolant pump and a steam generator. An electrically heated pressurizer is connected to one of the loops.

The major structures are a reactor containment, auxiliary building, turbine building, radwaste facility and fuel handling building. The reactor containment is a vertical, reinforced concrete cylinder with prestressed tendons in the vertical wall, a reinforced concrete hemispherical domed roof and a substantial base slab of reinforced concrete supported by piles.

The turbine-generator system utilizes saturated steam produced by the NSSS. The turbine is a tandem-compound, 3-element, 1,800 rpm unit. Four combination moisture separator-reheater units are employed to dry and superheat the steam between the high and low pressure turbine cylinders. The system converts thermal energy of the steam produced in the steam generators into electrical energy by means of the turbine generator unit. Exhaust steam from the low pressure turbines is condensed, reheated in the feedwater heaters, and returned to the steam generators as feedwater.

The main generator is an 1,800 rpm, 3 phase, 60 cycle unit. Three single phase main step-up transformers deliver power to the 230 kV switchyard. Condenser circulating water is conveyed to the plant from Lake Robinson through a conduit approximately 10 feet in diameter. Condenser water discharge is via a conduit and canal from the plant to the lake.

1.3 REGULATORY GUIDANCE

The Nuclear Regulatory Commission (NRC or Commission) provided initial decommissioning requirements in its rule "General Requirements for Decommissioning Nuclear Facilities," issued in June 1988.[4] This rule set forth financial criteria for decommissioning licensed nuclear power facilities. The regulation addressed decommissioning planning needs, timing, funding methods, and environmental review requirements. The intent of the rule was to ensure that decommissioning would be accomplished in a safe and timely manner and that adequate funds would be available for this purpose. Subsequent to the rule, the NRC issued Regulatory Guide 1.159, “Assuring the Availability of Funds for Decommissioning Nuclear Reactors,”[5] which provided additional guidance to the licensees of nuclear facilities on the financial methods acceptable to the NRC staff for complying with the requirements of the rule. The regulatory guide addressed the funding requirements and provided guidance on the content and form of the financial assurance mechanisms indicated in the rule.

The rule defined three decommissioning alternatives as being acceptable to the NRC: DECON, SAFSTOR, and ENTOMB. The DECON alternative assumes that any contaminated or activated portion of the plant’s systems, structures and facilities are removed or decontaminated to levels that permit the site to be released for unrestricted use shortly after the cessation of plant operations, while the SAFSTOR and ENTOMB alternatives defer the process.

The rule also placed limits on the time allowed to complete the decommissioning process. For all alternatives, the process is restricted in overall duration to 60 years, unless it can be shown that a longer duration is necessary to protect public health and safety. At the conclusion of a near 60-year dormancy period (or longer if the NRC approves such a case), the site would still require significant remediation to meet the unrestricted release limits for license termination.

The ENTOMB alternative has not been viewed as a viable option for power reactors due to the significant time required to isolate the long-lived radionuclides for decay to permissible levels. However, with rulemaking permitting the controlled release of a site,[6] the NRC did re-evaluate the alternative. The resulting feasibility study, based upon an assessment by Pacific Northwest National Laboratory, concluded that the method did have conditional merit for some, if not most reactors. The staff also found that additional rulemaking would be needed before this option could be treated as a generic alternative.

The NRC had considered rulemaking to alter the 60-year time for completing decommissioning and to clarify the use of engineered barriers for reactor entombments.[7] However, the NRC's staff has subsequently recommended that rulemaking be deferred, based upon several factors (e.g., no licensee has committed to pursuing the entombment option, the unresolved issues associated with the disposition of greater-than-Class C material (GTCC), and the NRC's current priorities), at least until after the additional research studies are complete. The Commission concurred with the staff's recommendation.

In a draft regulatory basis document published in March 2017 in support of rulemaking that would amend NRC regulations concerning nuclear plant decommissioning, the NRC staff proposes removing any discussion of the ENTOMB option from existing guidance documents since the method is not deemed practically feasible.

In 1996, the NRC published revisions to the general requirements for decommissioning nuclear power plants.[8] When the decommissioning regulations were adopted in 1988, it was assumed that the majority of licensees would decommission at the end of the facility's operating licensed life. Since that time, several licensees permanently and prematurely ceased operations. Exemptions from certain operating requirements were required once the reactor was defueled to facilitate the decommissioning. Each case was handled individually, without clearly defined generic requirements. The NRC amended the decommissioning regulations in 1996 to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process. The amendments allow for greater public participation and better define the transition process from operations to decommissioning.

Under the revised regulations, licensees will submit written certification to the NRC within 30 days after the decision to cease operations. Certification will also be required once the fuel is permanently removed from the reactor vessel. Submittal of these notices, along with related changes to Technical

Specifications, entitle the licensee to a fee reduction and eliminate the obligation to follow certain requirements needed only during operation of the reactor. Prior to or within 2 years following permanent cessation of operations, the licensee is required to submit a Post-Shutdown Decommissioning Activities Report (PSDAR) to the NRC, and a copy to the affected State(s) (10 CFR 50.82(a)(4)(i)). The PSDAR describes the planned decommissioning activities, the associated sequence and schedule, and an estimate of expected costs. Prior to completing decommissioning, the licensee is required to submit an application to the NRC to terminate the license, which includes a license termination plan (LTP).

In 2011, the NRC issued regulations to improve decommissioning planning and thereby reduce the likelihood that any current operating facility will become a legacy site.[9] The regulations require licensees to report additional details in their decommissioning cost estimate including a decommissioning estimate for the ISFSI. This estimate is provided in Appendix D.

1.3.1 Nuclear Waste Policy Act

Congress passed the "Nuclear Waste Policy Act" (NWPA) in 1982,[10] assigning the federal government's long-standing responsibility for disposal of the spent nuclear fuel created by the commercial nuclear generating plants to the DOE. It was to begin accepting spent fuel by January 31, 1998; however, to date no progress in the removal of spent fuel from commercial generating sites has been made.

Today, the country is at an impasse on high-level waste disposal, despite DOE's submittal of its License Application for a geologic repository to the NRC in 2008. The Obama administration eliminated the budget for the repository program while promising to "conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle … and make recommendations for a new plan." Towards this goal, the Obama administration appointed a Blue Ribbon Commission on America's Nuclear Future (Blue Ribbon Commission) to make recommendations for a new plan for nuclear waste disposal. The Blue Ribbon Commission's charter included a requirement that it consider "[o]ptions for safe storage of used nuclear fuel while final disposition pathways are selected and deployed."[11]

On January 26, 2012, the Blue Ribbon Commission issued its "Report to the Secretary of Energy" containing a number of recommendations on nuclear waste disposal. Two of the recommendations that may impact decommissioning planning are:

- "[T]he United States [should] establish a program that leads to the timely development of one or more consolidated storage facilities"
- "[T]he United States should undertake an integrated nuclear waste management program that leads to the timely development of one or more permanent deep geological facilities for the safe disposal of spent fuel and high-level nuclear waste."[12]

In January 2013, the DOE issued the "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," in response to the recommendations made by the Blue Ribbon Commission and as "a framework for moving toward a sustainable program to deploy an integrated system capable of transporting, storing, and disposing of used nuclear fuel..."[13]

"With the appropriate authorizations from Congress, the Administration currently plans to implement a program over the next 10 years that:

- Sites, designs and licenses, constructs and begins operations of a pilot interim storage facility by 2021 with an initial focus on accepting used nuclear fuel from shut-down reactor sites;
- Advances toward the siting and licensing of a larger interim storage facility to be available by 2025 that will have sufficient capacity to provide flexibility in the waste management system and allows for acceptance of enough used nuclear fuel to reduce expected government liabilities; and
- Makes demonstrable progress on the siting and characterization of repository sites to facilitate the availability of a geologic repository by 2048."

The NRC's review of DOE's license application to construct a geologic repository at Yucca Mountain was suspended in 2011, when the Obama administration significantly reduced the budget for completing that work. However, the US Court of Appeals for the District of Columbia Circuit issued a writ of mandamus (in August 2013)[14] ordering NRC to comply with federal law and resume its review of DOE's Yucca Mountain repository license application to the extent allowed by previously appropriated funding for the review. That review was completed with the publication of a five-volume safety evaluation report. A supplement to DOE's environmental impact statement and adjudicatory hearing on the contentions filed by interested parties must be completed before a licensing decision can be made. Although the DOE proposed it would start fuel acceptance in 2025, no progress has been made in the repository program since DOE's 2013 strategy was issued except for the completion of the Yucca Mountain safety evaluation report.

While little progress has been made, some alternatives to a geological repository including interim storage are in various early stages of planning and implementation. Holtec International submitted a license application to the NRC on March 30, 2017 for a consolidated interim spent fuel storage facility in southeast New Mexico called HI-STORE CIS (Consolidated Interim Storage) under the provisions of 10 CFR Part 72. The application was approved by the NRC on May 9, 2023.

Waste Control Specialists submitted an application to the NRC on April 28, 2016, to construct and operate a Consolidated Interim Storage Facility (CISF) at its West Texas facility. On April 18, 2017, WCS requested that the NRC temporarily suspend all safety and environmental review activities, as well as public participation activities associated with WCS's license application. In March 2018, WCS and Orano USA, announced their intent to form a joint venture to license the facility. On September 17, 2021, the NRC approved the joint venture's original CISF license application. At this time, neither storage facility is in service and therefore has not been considered in this estimate.

On May 10, 2018, the U.S. House of Representatives passed H.R. 3053, the "Nuclear Waste Policy Amendments Act of 2018." Proposed to amend the Nuclear Waste Policy Act of 1982, the legislation, if approved by the Senate and signed by the President, would provide the DOE the authority to site, construct, and operate one or more Monitored Retrieval Storage (MRS) facilities while a permanent repository is licensed and constructed and/or to enter into an MRS agreement with a non-Federal entity for temporary storage.

Completion of the decommissioning process is dependent upon the DOE's ability to remove spent fuel from the site in a timely manner. DOE's repository program had originally assumed that spent fuel allocations would be accepted for disposal from the nation's commercial nuclear plants, with limited exceptions, in the order (the "queue") in which it was discharged from the reactor.[15] However, the Blue Ribbon Commission, in its final report, noted that: "[A]ccepting spent fuel according to the OFF [Oldest Fuel First] priority ranking instead of giving priority to shutdown reactor sites could greatly reduce the cost savings that could be achieved through consolidated storage if priority could be given to accepting spent fuel from shutdown reactor sites before accepting fuel from still-operating plants. …. The magnitude of the cost savings that could be achieved by giving priority to shutdown sites appears to be large enough (i.e., in the billions of dollars) to warrant DOE exercising its right under the Standard Contract to move this fuel first."

For planning purposes only, Duke Energy conducted a probability analysis of the three scenarios discussed in DOE's 2013 Strategy for the Management and Disposal of used Nuclear Fuel and High-Level Radioactive Waste, and selected an industry DOE pickup start date of 2034. The analysis assumes shutdown sites will receive priority; therefore, DOE will begin accepting spent fuel from currently operating units approximately 5 years after the proposed start date. Duke Energy recognizes that the proposed date for DOE to start accepting spent fuel differs from dates used in past Duke Energy Decommissioning Cost Estimates as well as dates used in the industry. As stated in the Duke Energy DOE Pickup Date and Pickup Rate position paper, "While earlier dates than 2034 are possible, they are not considered probable and would therefore likely underestimate the total decommissioning cost."[16]

Duke Energy's current spent fuel management plan for the Robinson spent fuel is based in general upon: 1) a 2039 start date for DOE initiating transfer of commercial spent fuel from the currently operating Duke Energy units to a licensed facility, 2) reassignment of allocations between the Brunswick, Harris, and Robinson units in the Duke Energy fleet so as to minimize on-site storage costs, and 3) expectations for spent fuel receipt by the DOE for the already canistered Robinson fuel.

Assuming the DOE starts accepting fuel from the currently operating Duke Energy plants in 2039, and from Robinson in 2049, a maximum rate of transfer of 3,000 metric tons of uranium (MTU)/year,[17] transfer of spent fuel from the ISFSI is anticipated to continue through the year 2056, if the unit ceases operating in 2030.

The NRC requires that licensees establish a program to manage and provide funding for the caretaking of all irradiated fuel at the reactor site until title of the fuel is transferred to the DOE.[18] Interim storage of the fuel, until the DOE has completed the transfer, will be in the fuel handling building's storage pool as well as at an on-site ISFSI.

The 7P-ISFSI contains 56 fuel assemblies in 8 canisters that are not currently licensed for transport nor assumed to be licensed for transport at any point in the future. Therefore, the canisters will be off-loaded and the assemblies transferred back into the fuel handling building's spent fuel pool.

The assemblies will be loaded to the 24P ISFSI for eventual transfer to the DOE. The 24P-ISFSI, operated under 10 CFR 72, Subpart K [19], has been constructed to support continued plant operations. Spent fuel stored at the ISFSI will be transferred to the DOE once the spent fuel assemblies in the storage pool have been removed. Once the storage pool is emptied, the fuel handling building can be either decontaminated and dismantled or prepared for long-term storage.

Duke Energy's position is that the DOE has a contractual obligation to accept the spent fuel earlier than the projections set out above consistent with its contract commitments. No assumption made in this study should be interpreted to be inconsistent with this claim.

1.3.2 Low-Level Radioactive Waste Management

The contaminated and activated material generated in the decontamination and dismantling of a commercial nuclear reactor is classified as low-level (radioactive) waste, although not all of the material is suitable for "shallow-land" disposal. With the passage of the "Low-Level Radioactive Waste Policy Act" in 1980,[20] and its Amendments of 1985,[21] the states became ultimately responsible for the disposition of low-level radioactive waste generated within their own borders.

South Carolina is a member of the three-state Atlantic Interstate Low-Level Radioactive Waste Management Compact, formed after South Carolina joined the Atlantic Compact Regional Waste formally known as the Northeast Regional Compact. As such, the owners will continue to have access to the currently operating disposal facility in Barnwell, South Carolina.

Disposition of the various waste streams produced by the decommissioning process considered all options and services currently available to Duke Energy. For this analysis, the majority of the low-level radioactive waste is designated for direct disposal at the Barnwell facility. This includes packaged waste (plant equipment and commodities and large components designated as Class A[22]), and higher activity waste forms waste (Class B and C resins and activated metal from the reactor vessel). It is also assumed that Duke Energy can access other disposal sites, should it prove cost-effective. As such, low-activity waste forms (concrete debris, dry-active waste) are assumed to be sent to Energy*Solutions*' facility in Clive, Utah for disposal, and metallic waste suspected of being contaminated is sent to a Tennessee-based radioactive waste processor for decontamination, volume reduction and/or disposal.

The dismantling of the components residing closest to the reactor core generates radioactive waste that may be considered unsuitable for shallow-land disposal (i.e., low-level radioactive waste with concentrations of radionuclides that exceed the limits established by the NRC for Class C radioactive waste (GTCC)). The Low-Level Radioactive Waste Policy Amendments Act of 1985 assigned the federal government the responsibility for the disposal of this material. The Act also stated that the beneficiaries of the activities resulting in the generation of such radioactive waste bear all reasonable costs of disposing of such waste.

The DOE issued its final Environmental Impact Statement for the disposal of GTCC on January 2016.[23] The study evaluated the potential environmental impacts associated with constructing and operating a new facility or using an existing facility, disposal methods, and locations. DOE is awaiting Congressional action on the report and its recommendations. At this time, the federal government has not identified a specific cost for disposing of GTCC or a schedule for acceptance.

For purposes of this analysis, the GTCC radioactive waste is assumed to be packaged and disposed of in a similar manner as high-level waste and at a cost equivalent to that envisioned for the spent fuel. The GTCC is packaged in canisters compatible with the spent fuel dry storage system and either stored on site or shipped directly to a federal facility as it is generated (depending upon the timing of the decommissioning and whether the spent fuel has been removed from the site prior to the start of decommissioning).

A significant portion of the waste material generated during decommissioning may only be potentially contaminated by radioactive materials. This waste can be analyzed on site or shipped off site to licensed facilities for further analysis, for processing and/or for conditioning/recovery. Reduction in the volume of low-level radioactive waste requiring disposal in a licensed low-level radioactive waste disposal facility can be accomplished through a variety of methods, including analyses and surveys or decontamination to eliminate the portion of waste that does not require disposal as radioactive waste, compaction, incineration or metal melt. The estimate reflects the savings from waste recovery/volume reduction.

1.3.3 Radiological Criteria for License Termination

In 1997, the NRC published Subpart E, "Radiological Criteria for License Termination,"[24] amending 10 CFR Part 20. This subpart provides radiological criteria for releasing a facility for unrestricted use. The regulation states that the site can be released for unrestricted use if radioactivity levels are such that the average member of a critical group would not receive a Total Effective Dose Equivalent (TEDE) in excess of 25 millirem per year, and provided that residual radioactivity has been reduced to levels that are As Low As Reasonably Achievable (ALARA). The decommissioning estimate assumes that the Robinson site will be remediated to a residual level consistent with the NRC-prescribed level.

It should be noted that the NRC and the Environmental Protection Agency (EPA) differ on the amount of residual radioactivity considered acceptable in site remediation. The EPA has two limits that apply to radioactive materials. An EPA limit of 15 millirem per year is derived from criteria established by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund).[25] An additional and separate limit of 4 millirem per year, as defined in 40 CFR §141.16, is applied to drinking water.[26]

On October 9, 2002, the NRC signed an agreement with the EPA on the radiological decommissioning and decontamination of NRC-licensed sites. The Memorandum of Understanding (MOU)[27] provides that EPA will defer exercise of authority under CERCLA for the majority of facilities decommissioned under NRC authority. The MOU also includes provisions for NRC and EPA consultation for certain sites when, at the time of license termination, (1) groundwater contamination exceeds EPA-permitted levels; (2) NRC contemplates restricted release of the site; and/or (3) residual radioactive soil concentrations exceed levels defined in the MOU.

The MOU does not impose any new requirements on NRC licensees and should reduce the involvement of the EPA with NRC licensees who are decommissioning. Most sites are expected to meet the NRC criteria for unrestricted use, and the NRC believes that only a few sites will have groundwater or soil contamination in excess of the levels specified in the MOU that trigger consultation with the EPA. However, if there are other hazardous materials on the site, the EPA may be involved in the cleanup. As such, the possibility of dual regulation remains for certain licensees. The present study does not include any costs for this occurrence.

2. DECON DECOMMISSIONING ALTERNATIVE

A detailed cost estimate was developed to decommission Robinson based upon the NRC-approved DECON decommissioning alternative. The following sections describe the basic activities associated with the alternative. Although detailed procedures for each activity identified are not provided, and the actual sequence of work may vary, the activity descriptions provide a basis not only for estimating but also for the expected scope of work, i.e., engineering and planning at the time of decommissioning.

The conceptual approach that the NRC has described in its regulations divides decommissioning into three phases. The initial phase commences with the effective date of permanent cessation of operations and involves the transition of both plant and licensee from reactor operations (i.e., power production) to facility de-activation and closure. During the first phase, notification is to be provided to the NRC certifying the permanent cessation of operations and the removal of fuel from the reactor vessel. The licensee is then prohibited from reactor operation.

The second phase encompasses activities during the storage period or during major decommissioning activities, or a combination of the two. The third phase pertains to the activities involved in license termination. The decommissioning estimate developed for Robinson is also divided into phases or periods; however, demarcation of the phases is based upon major milestones within the project or significant changes in the projected expenditures.

2.1 PERIOD 1 - PREPARATIONS

The DECON alternative, as defined by the NRC, is "the alternative in which the equipment, structures, and portions of a facility and site containing radioactive contaminants are removed or decontaminated to a level that permits the property to be released for unrestricted use shortly after cessation of operations." This study does not address the cost to dispose of the spent fuel residing at the site; such costs are funded through a surcharge on electrical generation. However, the study does estimate the costs incurred with the interim on-site storage of the fuel pending shipment by the DOE to an off-site disposal facility.

In anticipation of the cessation of plant operations, detailed preparations are undertaken to provide a smooth transition from plant operations to site decommissioning. Through implementation of a staffing transition plan, the organization required to manage the intended decommissioning activities is assembled from available plant staff and outside resources. Preparations include the planning for permanent defueling of the reactor, revision of technical specifications applicable to the operating conditions and requirements, a characterization of the facility and major components, and the development of the PSDAR.

Engineering and Planning

The PSDAR, required prior to or within two years of permanent cessation of operations, provides a description of the licensee's planned decommissioning activities, a timetable, and the associated financial requirements of the intended decommissioning program. Upon receipt of the PSDAR, the NRC will make the document available to the public for comment in a local hearing to be held in the vicinity of the reactor site. Ninety days following submittal and NRC receipt of the PSDAR, the licensee may begin to perform major decommissioning activities under a modified 10 CFR §50.59 procedure, i.e., without specific NRC approval. Major activities are defined as any activity that results in permanent removal of major radioactive components, permanently modifies the structure of the containment, or results in dismantling components (for shipment) containing GTCC, as defined by 10 CFR §61. Major components are further defined as comprising the reactor vessel and internals, large bore reactor coolant system piping, and other large components that are radioactive. The NRC includes the following additional criteria for use of the §50.59 process in decommissioning. The proposed activity must not:

- foreclose release of the site for possible unrestricted use,
- significantly increase decommissioning costs,
- cause any significant environmental impact, or
- violate the terms of the licensee's existing license

Existing operational technical specifications are reviewed and modified to reflect plant conditions and the safety concerns associated with permanent cessation of operations. The environmental impact associated with the planned decommissioning activities is also considered. Typically, a licensee will not be allowed to proceed if the consequences of a particular decommissioning activity are greater than that bounded by previously evaluated environmental assessments or impact statements. In this instance, the licensee would have to submit a license amendment for the specific activity and update the environmental report.

The decommissioning program outlined in the PSDAR will be designed to accomplish the required tasks within the ALARA guidelines (as defined in 10 CFR §20) for protection of personnel from exposure to radiation hazards. It will also address the continued protection of the health and safety of the public and the environment during the dismantling activity. Consequently, with the development of the PSDAR, activity specifications, cost-benefit and safety analyses, work packages, and procedures, would be assembled to support the proposed decontamination and dismantling activities.

Site Preparations

Following final plant shutdown, and in preparation for actual decommissioning activities, the following activities are initiated:

- Characterization of the site and surrounding environs. This includes radiation surveys of work areas, major components (including the reactor vessel and its internals), internal piping, and biologic shield cores.
- Isolation of the spent fuel storage pool and fuel handling systems, such that decommissioning operations can commence on the balance of the plant.
- Specification of transport and disposal requirements for activated materials and/or hazardous materials, including shielding and waste stabilization.
- Development of procedures for occupational exposure control, control and release of liquid and gaseous effluent, processing of radwaste (including dry-active waste, resins, filter media, metallic and non-metallic components generated in decommissioning), site security and emergency programs, and industrial safety.

2.2 PERIOD 2 – DECOMMISSIONING OPERATIONS

This period includes the physical decommissioning activities associated with the removal and disposal of contaminated and activated components and structures, including the successful release of the site from the 10 CFR §50 operating license, exclusive of the ISFSI. Significant decommissioning activities in this phase include:

- Construction of temporary facilities and/or modification of existing facilities to support dismantling activities. For example, this will include a centralized processing area to facilitate equipment removal and component preparations for off-site disposal.
- Reconfiguration and modification of site structures and facilities as needed to support decommissioning operations. This will include the upgrading of roads (on- and off-site) to facilitate hauling and transport. Modifications will be required to the containment structure to

facilitate access of large/heavy equipment. Modifications will also be required to the refueling area of the reactor building to support the segmentation of the reactor vessel internals and component extraction.

- Transfer of the spent fuel from the spent fuel pool to the ISFSI. The spent fuel pool at Robinson is kept open for approximately three and one-half years after the cessation of plant operations. In the prompt decommissioning scenario, once the majority of the decontamination and dismantling activities have been completed (over the first five years), the site organization is configured and streamlined to support the remaining spent fuel transfer activities. With the pool emptied, management resources are remobilized to support the final site survey (exclusive of the ISFSI) and building demolition.
- Design and fabrication of temporary and permanent shielding to support removal and transportation activities, construction of contamination control envelopes, and the procurement of specialty tooling.
- Procurement (lease or purchase) of shipping casks, cask liners, and industrial packages.
- Decontamination of components and piping systems as required to control (minimize) worker exposure.
- Removal of piping and components no longer essential to support decommissioning operations.
- Removal of control rod drive housings and the head service structure from reactor vessel head. Segmentation of the vessel closure head.
- Removal and segmentation of the upper internals assemblies. Segmentation will maximize the loading of the shielded transport casks, i.e., by weight and activity. The operations are conducted under water using remotely operated tooling and contamination controls.
- Disassembly and segmentation of the remaining reactor internals, including the core former and lower core support assembly. Some material is expected to exceed Class C disposal requirements. As such, the segments will be packaged in modified fuel storage canisters for geologic disposal.
- Segmentation of the reactor vessel. A shielded platform is installed for segmentation as cutting operations are performed in-air using remotely operated equipment within a contamination control envelope. The water level is maintained just below the cut to minimize the working area dose rates. Segments are transferred in-air to

containers that are stored under water, for example, in an isolated area of the refueling canal.

- Removal of the activated portions of the concrete biological shield and accessible contaminated concrete surfaces. If dictated by the steam generator and pressurizer removal scenarios, those portions of the associated cubicles necessary for access and component extraction are removed.
- Removal of the steam generators and pressurizer for material recovery and controlled disposal. These components can serve as their own burial containers provided that all penetrations are properly sealed and the internal contaminants are stabilized, e.g., with grout. Steel shielding will be added, as necessary, to those external areas of the package to meet transportation limits and regulations.

At least two years prior to the anticipated date of license termination, an LTP is required. Submitted as a supplement to the Final Safety Analysis Report (FSAR) or its equivalent, the plan must include: a site characterization, description of the remaining dismantling activities, plans for site remediation, procedures for the final radiation survey, designation of the end use of the site, an updated cost estimate to complete the decommissioning, and any associated environmental concerns. The NRC will notice the receipt of the plan, make the plan available for public comment, and schedule a local hearing. LTP approval will be subject to any conditions and limitations as deemed appropriate by the Commission. The licensee may then commence with the final remediation of site facilities and services, including:

- Removal of remaining plant systems and associated components as they become nonessential to the decommissioning program or worker health and safety (e.g., waste collection and treatment systems, electrical power and ventilation systems).
- Removal of the steel liners from refueling canal, disposing of the activated and contaminated sections as radioactive waste. Removal of any activated/ contaminated concrete.
- Surveys of the decontaminated areas of the containment structure.
- Removal of the contaminated equipment and material from the auxiliary and fuel buildings and any other contaminated facility. Radiation and contamination controls will be utilized until residual levels indicate that the structures and equipment can be released for unrestricted access and conventional demolition. This activity may necessitate the dismantling and disposition of most of the systems and components (both clean and contaminated) located within these

buildings. This activity facilitates surface decontamination and subsequent verification surveys required prior to obtaining release for demolition.

- Routing of material removed in the decontamination and dismantling to a central processing area. Material certified to be free of contamination is released for unrestricted disposition, e.g., as scrap, recycle, or general disposal. Contaminated material is characterized and segregated for additional off-site processing (disassembly, chemical cleaning, volume reduction, and waste treatment), and/or packaged for controlled disposal at a low-level radioactive waste disposal facility.
- The estimate assumes the remediation of contaminated soil. The quantity assumed may be affected by continued plant operations and/or future regulatory actions, such as the development of site-specific release criteria.

Incorporated into the LTP is the Final Survey Plan. This plan identifies the radiological surveys to be performed once the decontamination activities are completed and is developed using the guidance provided in the "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)."[28] This document incorporates the statistical approaches to survey design and data interpretation used by the EPA. It also identifies commercially available instrumentation and procedures for conducting radiological surveys. Use of this guidance ensures that the surveys are conducted in a manner that provides a high degree of confidence that applicable NRC criteria are satisfied. Once the survey is complete, the results are provided to the NRC in a format that can be verified. The NRC then reviews and evaluates the information, performs an independent confirmation of radiological site conditions, and makes a determination on the requested change to the operating license (that would release the property, exclusive of the ISFSI, for unrestricted use).

The NRC will amend the operating license if it determines that site remediation has been performed in accordance with the LTP, and that the terminal radiation survey and associated documentation demonstrate that the property (exclusive of the ISFSI) is suitable for release.

2.3 PERIOD 3 – SITE RESTORATION

Following completion of decommissioning operations, site restoration activities can begin. Efficient removal of the contaminated materials and verification that residual radionuclide concentrations are below the NRC limits will result in substantial damage to many of the structures. Although performed in a controlled, safe manner, blasting, coring, drilling, scarification (surface removal), and the other decontamination activities will substantially degrade power block structures including the containment, reactor auxiliary, fuel handling, and radioactive waste buildings. Under certain circumstances, verifying that subsurface radionuclide concentrations meet NRC site release requirements will require removal of grade slabs and lower floors, potentially weakening footings and structural supports. This removal activity will be necessary for those facilities and plant areas where historical records, when available, indicate the potential for radionuclides having been present in the soil, where system failures have been recorded, or where it is required to confirm that subsurface process and drain lines were not breached over the operating life of the plant.

It is not currently anticipated that these structures would be repaired and preserved after the radiological contamination is removed. The cost to dismantle site structures with a work force already mobilized on site is more efficient than if the process is deferred.

This cost study presumes that site structures and other facilities are dismantled as a continuation of the decommissioning activity. Foundations and exterior walls are removed to a nominal depth of three feet below grade. The three-foot depth allows for the placement of gravel for drainage, as well as topsoil, so that vegetation can be established for erosion control. Site areas affected by the dismantling activities are restored and the plant area graded as required to prevent ponding and inhibit the refloating of subsurface materials.

Non-contaminated concrete rubble produced by demolition activities is processed to remove reinforcing steel and miscellaneous embedments. The processed material is then used on site to backfill foundation voids. Excess non-contaminated materials are trucked to an off-site area for disposal as construction debris.

2.4 ISFSI OPERATIONS AND DECOMMISSIONING

Transfer of spent fuel to a DOE repository or interim facility is assumed to be exclusively from the ISFSI once the fuel pool has been emptied and the fuel handling building released for decommissioning. The ISFSI will continue to operate under 10 CFR 72, Subpart K following the amendment of the operating license to release the adjacent (power block) property.

Assuming the DOE starts accepting fuel from the currently operating Duke Energy plants in 2039, and from Robinson in 2049, at a maximum rate of transfer of 3,000 metric tons of uranium (MTU)/year,[17] transfer of spent fuel from the ISFSI is anticipated to continue through the year 2056, if the plant ceases operating in 2030.

At the conclusion of the spent fuel transfer process, the ISFSI will be decommissioned. The Commission will terminate the Part 72 license if it determines that the remediation of the ISFSI has been performed in accordance with an ISFSI license termination plan and that the final radiation survey and associated documentation demonstrate that the facility is suitable for release. Once the requirements are satisfied, the NRC can terminate the license for the ISFSI.

The design of the ISFSI is based upon a transportable storage canister to house the spent fuel assemblies, and a horizontal storage module for pad storage. It is assumed that, once the canisters containing the spent fuel assemblies have been removed and any required decontamination of the storage modules has been performed (with minor neutron activation assumed), the facility license will be terminated. Afterward, the modules can be dismantled using conventional techniques for demolishing reinforced concrete. The concrete storage pad is then removed and the area regraded.

3. COST ESTIMATE

The cost estimate prepared for decommissioning Robinson considers the unique features of the site, including the nuclear steam supply system, electric power generating systems, structures, and supporting facilities. The basis of the estimate, including the sources of information relied upon, the estimating methodology employed, site-specific considerations, and other pertinent assumptions, is described in this section.

3.1 BASIS OF ESTIMATE

The current estimate was developed using the site-specific, technical information from a previous analysis performed in 2019. This information was reviewed for the current analysis and updated as deemed appropriate. The site-specific considerations and assumptions used in the previous evaluation were also revisited. Modifications were incorporated where new information was available or experience from ongoing decommissioning programs provided viable alternatives or improved processes.

3.2 METHODOLOGY

The methodology used to develop the estimate follows the basic approach originally presented in the AIF/NESP-036 study report, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates,"[29] and the DOE "Decommissioning Handbook."[30] These documents present a unit factor method for estimating decommissioning activity costs, which simplifies the estimating calculations. Unit factors for concrete removal ($/cubic yard), steel removal ($/ton), and cutting costs ($/inch) are developed using local labor rates. The activity-dependent costs are estimated with the item quantities (cubic yards and tons), developed from plant drawings and inventory documents. Removal rates and material costs for the conventional disposition of components and structures rely upon information available in the industry publication, "Building Construction Cost Data," published by RSMeans.[31]

The unit factor method provides a demonstrable basis for establishing reliable cost estimates. The detail provided in the unit factors, including activity duration, labor costs (by craft), and equipment and consumable costs, ensures that essential elements have not been omitted. Appendix A presents the detailed development of a typical unit factor. Appendix B provides the values contained within one set of factors developed for this analysis.

Regulatory Guide 1.184[32] Revision 1, issued in October 2013, describes the methods and procedures that are acceptable to the NRC staff for implementing the requirements that relate to the initial activities and the major phases of the decommissioning process. The costs and schedules presented in this analysis follow the general guidance and sequence in the regulations. The format and content of the estimate is also consistent with the recommendations of Regulatory Guide 1.202,[33] issued February 2005.

This analysis reflects lessons learned from TLG's involvement in the Shippingport Station Decommissioning Project, completed in 1989, as well as the decommissioning of the Cintichem reactor, hot cells, and associated facilities, completed in 1997. In addition, the planning and engineering for the Rancho Seco, Trojan, Yankee Rowe, Big Rock Point, Maine Yankee, Humboldt Bay-3, Oyster Creek, Connecticut Yankee, Crystal River, Vermont Yankee, Fort Calhoun, Pilgrim, and Indian Point nuclear units have provided additional insight into the process, the regulatory aspects, and the technical challenges of decommissioning commercial nuclear units.

Work Difficulty Factors

The estimate follows the principles of ALARA through the use of work duration adjustment factors. These factors address the impact of activities such as radiological protection instruction, mock-up training, and the use of respiratory protection and protective clothing. The factors lengthen a task's duration, increasing costs and lengthening the overall schedule. ALARA planning is considered in the costs for engineering and planning, and in the development of activity specifications and detailed procedures. Changes to worker exposure limits may impact the decommissioning cost and project schedule.

Work difficulty adjustment factors (WDFs) account for the inefficiencies in working in a power plant environment. The factors are assigned to each unique set of unit cost factors, commensurate with the inefficiencies associated with working in confined, hazardous environments. The ranges used for the WDFs are as follows:

- Access Factor 10% to 20%
- Respiratory Protection Factor 10% to 50%
- Radiation/ALARA Factor 10% to 37%
- Protective Clothing Factor 10% to 30%
- Work Break Factor 8.33%

The factors and their associated range of values were developed in conjunction with the AIF/NESP-036 study. The application of the factors is discussed in more detail in that publication.

Scheduling Program Durations

The unit factors, adjusted by the WDFs as described above, are applied against the inventory of materials to be removed in the radiological controlled areas. The resulting labor-hours, or crew-hours, are used in the development of the decommissioning program schedule, using resource loading and event sequencing considerations. The scheduling of conventional removal and dismantling activities is based upon productivity information available from the "Building Construction Cost Data" publication. In the DECON alternative, dismantling of the fuel handing building systems and decontamination of the spent fuel pool is also dependent upon the timetable for the transfer of the spent fuel assemblies from the pool to the ISFSI.

An activity duration critical path is used to determine the total decommissioning program schedule. The schedule is relied upon in calculating the carrying costs, which include program management, administration, field engineering, equipment rental, and support services such as quality control and security. This systematic approach for assembling decommissioning estimates ensures a high degree of confidence in the reliability of the resulting costs.

3.3 FINANCIAL COMPONENTS OF THE COST MODEL

TLG's proprietary decommissioning cost model, DECCER, produces a number of distinct cost elements. These direct expenditures, however, do not comprise the total cost to accomplish the project goal, i.e., license termination, spent fuel management and site restoration.

3.3.1 Contingency

Inherent in any cost estimate that does not rely on historical data is the inability to specify the precise source of costs imposed by factors such as tool breakage, accidents, illnesses, weather delays, and labor stoppages. In the DECCER cost model, contingency fulfills this role. Contingency is added to each line item to account for costs that are difficult or impossible to develop analytically. Such costs are historically inevitable over the duration of a job of this magnitude; therefore, this cost analysis includes funds to cover these types of expenses.

The activity- and period-dependent costs are combined to develop the total decommissioning cost. A contingency is then applied on a line-item basis, using one or more of the contingency types listed in the AIF/NESP-036 study. "Contingencies" are defined in the American Association of Cost Engineers "Project and Cost Engineers' Handbook"[34] as "specific provision for unforeseeable elements of cost within the defined project scope; particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur." The cost elements in this analysis are based upon ideal conditions and maximum efficiency; therefore, consistent with industry practice, contingency is included. In the AIF/NESP-036 study, the types of unforeseeable events that are likely to occur in decommissioning are discussed and guidelines are provided for a contingency percentage in each category. It should be noted that contingency, as used in this analysis, does not account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the plant.

Contingency funds are an integral part of the total cost to complete the decommissioning process. Exclusion of this component puts at risk a successful completion of the intended tasks and, potentially, subsequent related activities. For this study, TLG examined the major activity-related problems (decontamination, segmentation, equipment handling, packaging, transport, and waste disposal) that necessitate a contingency. Individual activity contingencies ranged from 10% to 75%, depending on the degree of difficulty judged to be appropriate from TLG's actual decommissioning experience. The contingency values used in this study are as follows:

- Decontamination 50%
- Contaminated Component Removal 25%
- Contaminated Component Packaging 10%
- Contaminated Component Transport 15%
- Low-Level Radioactive Waste Disposal 25%

- Low-Level Radioactive Waste Processing 15%
- Reactor Segmentation 75%
- NSSS Component Removal 25%
- Reactor Waste Packaging 25%
- Reactor Waste Transport 25%

- Reactor Vessel Component Disposal 50%
- GTCC Disposal 15%

• Staffing	15%
• Spent Fuel Management	15%
• Non-Radioactive Component Removal	15%
• Heavy Equipment and Tooling	15%
• Supplies	25%
• Engineering	15%
• Energy	15%
• Insurance and Fees	10%
• Characterization and Termination Surveys	30%
• Operations and Maintenance Expense	15%
• Construction	15%
• Property Taxes	10%
• ISFSI Decommissioning	25%

The contingency values are applied to the appropriate components of the estimate on a line item basis. A composite value is then reported at the end of the detailed estimate (as provided in Appendix C). A contingency of 25% is applied to the subtotal of the ISFSI decommissioning costs.

3.3.2 Financial Risk

In addition to the routine uncertainties addressed by contingency, another cost element that is sometimes necessary to consider when bounding decommissioning costs relates to uncertainty, or risk. Examples can include changes in work scope, pricing, job performance, and other variations that could conceivably, but not necessarily, occur. Consideration is sometimes necessary to generate a level of confidence in the estimate, within a range of probabilities. TLG considers these types of costs under the broad term "financial risk." Included within the category of financial risk are:

- Transition activities and costs: ancillary expenses associated with eliminating 50% to 80% of the site labor force shortly after the cessation of plant operations, added cost for worker separation packages throughout the decommissioning program, national or company-mandated retraining, and retention incentives for key personnel.
- Delays in approval of the decommissioning plan due to intervention, public participation in local community meetings, legal challenges, and national and local hearings.

- Changes in the project work scope from the baseline estimate, involving the discovery of unexpected levels of contaminants, contamination in places not previously expected, contaminated soil previously undiscovered (either radioactive or hazardous material contamination), variations in plant inventory or configuration not indicated by the as-built drawings.
- Regulatory changes, for example, affecting worker health and safety, site release criteria, waste transportation, and disposal.
- Policy decisions altering national commitments (e.g., in the ability to accommodate certain waste forms for disposition, or in the timetable for such, or the start and rate of acceptance of spent fuel by the DOE.)
- Pricing changes for basic inputs such as labor, energy, materials, and waste disposal.

This cost study does not add any additional costs to the estimate for financial risk, since there is insufficient historical data from which to project future liabilities. Consequently, the areas of uncertainty or risk are revisited periodically and addressed through repeated revisions or updates of the base estimate.

3.4 SITE-SPECIFIC CONSIDERATIONS

There are a number of site-specific considerations that affect the method for dismantling and removal of equipment from the site and the degree of restoration required. The cost impact of the considerations identified below is included in this cost study.

3.4.1 Spent Fuel Management

The cost to dispose the spent fuel generated from plant operations is not reflected within the estimate to decommission Robinson. Ultimate disposition of the spent fuel is within the province of the DOE's Waste Management System, as defined by the Nuclear Waste Policy Act. As such, the disposal cost is financed by a surcharge paid into the DOE's waste fund during operations. On November 19, 2013, the U.S. Court of Appeals for the D.C. Circuit ordered the Secretary of the Department of Energy to suspend collecting annual fees for nuclear waste disposal from nuclear power plant operators until the DOE has conducted a legally adequate fee assessment.

The NRC does, however, require licensees to establish a program to manage and provide funding for the management of all irradiated fuel at the reactor site until title of the fuel is transferred to the Secretary of Energy. This requirement is prepared for through inclusion of certain high-level waste cost elements within the estimate, as described below.

Completion of the decommissioning process is highly dependent upon the DOE's ability to remove spent fuel from the site. For planning purposes only, this estimate assumes that the currently shutdown sites will receive priority. Duke Energy's current spent fuel management plan for the Robinson spent fuel is based in general upon: 1) a 2039 start date for DOE initiating transfer of commercial spent fuel from the currently operating Duke Energy units to a licensed facility, 2) reassignment of allocations between the Brunswick, Harris, and Robinson units in the Duke Energy fleet so as to minimize on-site storage costs, and 3) expectations for spent fuel receipt by the DOE for the already canistered Robinson fuel.

Assuming the DOE starts accepting fuel from the currently operating Duke Energy plants in 2039, and from Robinson in 2049, a maximum rate of transfer of 3,000 metric tons of uranium (MTU)/year,[35] transfer of spent fuel from the ISFSI is anticipated to continue through the year 2056, if the plant ceases operating in 2030.

Spent Fuel Storage and Transfer Logistics

The logistics of transferring the spent fuel to the DOE is provided in Table 3.1. Transfers are shown from year 2030 (shutdown) until all fuel has been removed from the Robinson site. The table includes Robinson spent fuel assemblies currently in storage at the Brunswick and Harris plants. While these assemblies are expected to remain in storage at Brunswick and Harris, they are included in the table for a full accounting for all the fuel expected to be discharged from the Robinson reactor. Disposition of the Robinson assemblies at Brunswick and Harris are included in those respective decommissioning estimates.

The decommissioning estimate is based upon a spent fuel management scenario designed to optimize the cost of spent fuel storage.

ISFSI

There are two separate dry fuel storage facilities for the Robinson site. The first facility was licensed in 1986 and is designated the 7P-ISFSI, as each canister contains 7 fuel assemblies. The second facility began operation in 2005 and is designated the 24P-ISFSI, as each canister contains 24 fuel assemblies. Both facilities employ the NUHOMS storage system.

The 7P-ISFSI is operated under site-specific Materials License No. SNM-2502 and has its own Safety Analysis Report and Technical Specifications. The 24P-ISFSI is operated under the general license provisions of 10 CFR 72 and must meet the requirements for Certificate of Compliance 1004 for the NUHOMS 24-PTH system.

The 7P-ISFSI contains 56 fuel assemblies in 8 canisters that are not currently licensed for transport nor assumed to be licensed for transport at any point in the future. These canisters will be off-loaded and the assemblies transferred back into the fuel handling building's spent fuel pool. The 56 assemblies will be loaded to the 24P ISFSI for eventual transfer to the DOE.

The 24P ISFSI is expected to operate throughout decommissioning, and beyond the conclusion of the remediation phase in the DECON decommissioning scenario, until such time that the transfer of spent fuel to the DOE can be completed.

Operation and maintenance costs for the spent fuel pool and the ISFSI are included within the estimate and address the cost for staffing the facility, as well as other costs (e.g., security, insurance, and licensing fees). The estimate also includes the costs to transfer the transportable storage canisters to the DOE. Costs are also provided for the final disposition of the facilities once the transfer is complete.

Storage Canister Design

The design and capacity of the 24P ISFSI is based upon the NUHOMS® dry cask storage system. The system consists of a transportable storage canister with a nominal capacity of 24 fuel assemblies and a horizontal concrete storage module.

Canister Loading and Transfer

The estimate includes the cost for the materials, equipment and labor to seal and load each spent fuel canister and transfer it from the wet storage pool to the ISFSI. The estimate also includes costs to transfer all fuel canisters from the ISFSI to the DOE

Operations and Maintenance

The estimate also includes the cost of operating and maintaining the spent fuel pool and the ISFSI, respectively. Pool operations are expected to continue for approximately three and one-half years after the cessation of operations. ISFSI operating costs are based upon the previously stated assumptions on fuel transfer expectations.

ISFSI Decommissioning

In accordance with 10 CFR §72.30, licensees must have a proposed decommissioning plan for the ISFSI site and facilities that includes a cost estimate to implement. The plan should contain sufficient information on the proposed practices and procedures for the decontamination of the ISFSI and for the disposal of residual radioactive materials after all spent fuel, high-level radioactive waste, and reactor-related GTCC waste have been removed.

The Robinson ISFSI storage modules are assumed to have some level of neutron-induced activation as a result of the long-term storage of the fuel, i.e., to levels exceeding free-release limits. As an allowance for module remediation, seven horizontal modules are assumed to have some level of neutron-induced activation (i.e., to levels exceeding free-release limits), equivalent to the number of modules required to accommodate the final core off load. The ISFSI pads (both 7P and 24P ISFSI pads are included) are not expected to be contaminated and will be demolished accordingly after a confirmation survey.

The cost estimate for decommissioning the ISFSI reflects: 1) the cost of an independent contractor performing the decommissioning activities; 2) an adequate contingency factor; and 3) the cost of meeting the criteria for unrestricted use. The cost summary for decommissioning the ISFSI is presented in Appendix D.

GTCC

The dismantling of the reactor internals is expected to generate radioactive waste considered unsuitable for shallow land disposal (i.e., low-level radioactive waste with concentrations of radionuclides that exceed the limits established by the NRC for Class C radioactive waste (GTCC)). The Low-Level Radioactive Waste Policy Amendments Act of 1985 assigned the federal government the responsibility for the disposal of this material. The Act also stated that the beneficiaries of the activities resulting in the generation of such radioactive waste bear all reasonable costs of disposing of such waste. Although the DOE is responsible for disposing of GTCC waste, any costs for that service have not been determined. For purposes of this estimate, the GTCC is packaged in canisters compatible with the spent fuel dry storage system and disposed of at a cost equivalent to that envisioned for the spent fuel.

It is assumed that the DOE would not accept this waste prior to completing the transfer of spent fuel. Therefore, until such time the DOE is ready to accept GTCC waste, it is reasonable to assume that this material would remain in storage at the Robinson site.

3.4.2 Reactor Vessel and Internal Components

The reactor pressure vessel and internal components are segmented for disposal in shielded, reusable transportation casks. Segmentation is performed in the refueling canal, where a turntable and remote cutter are installed. The vessel is segmented in place, using a mast-mounted cutter supported off the lower head and directed from a shielded work platform installed overhead in the reactor cavity. Transportation cask specifications and transportation regulations dictate the segmentation and packaging methodology.

Intact disposal of reactor vessel shells has been successfully demonstrated at several of the sites that have been decommissioned. Access to navigable waterways has allowed these large packages to be transported to the Barnwell disposal site with minimal overland travel. Intact disposal of the reactor vessel and internal components can provide savings in cost and worker exposure by eliminating the complex segmentation requirements, isolation of the GTCC material, and transport/storage of the resulting waste packages. Portland General Electric (PGE) was able to dispose of the Trojan reactor as an intact package (including the internals). However, its location on the Columbia River simplified the transportation analysis since:

- the reactor package could be secured to the transport vehicle for the entire journey, i.e., the package was not lifted during transport,
- there were no man-made or natural terrain features between the plant site and the disposal location that could produce a large drop, and
- transport speeds were very low, limited by the overland transport vehicle and the river barge.

As a member of the Northwest Compact, PGE had a site available for disposal of the package - the US Ecology facility in Washington State. The characteristics of this arid site proved favorable in demonstrating compliance with land disposal regulations.

It is not known whether this option will be available when the Robinson plant ceases operation. Future viability of this option will depend upon the ultimate location of the disposal site, as well as the disposal site licensee's ability to accept highly radioactive packages and effectively isolate them from the environment. Consequently, the study assumes that the reactor vessel will require segmentation, as a bounding condition.

3.4.3 Primary System Components

The reactor coolant system components are assumed to be decontaminated using chemical agents prior to the start of dismantling operations. This type of decontamination can be expected to have a significant ALARA impact, since in this scenario the removal work is done within the first few years of shutdown. A decontamination factor (average reduction) of 10 is assumed for the process. Disposal of the decontamination solution effluent is included within the estimate as a "process liquid waste" charge.

The following discussion deals with the removal and disposition of the steam generators, but the techniques involved are also applicable to other large components, such as heat exchangers, component coolers, and the pressurizer. The steam generators' size and weight, as well as their location within the reactor building, will ultimately determine the removal strategy.

A trolley crane is set up for the removal of the generators. It can also be used to move portions of the steam generator cubicle walls and floor slabs from the reactor building to a location where they can be decontaminated and transported to the material handling area. Interferences within the work area, such as grating, piping, and other components are removed to create sufficient laydown space for processing these large components.

The generators are rigged for removal, disconnected from the surrounding piping and supports, and maneuvered into the open area where they are lowered onto a dolly. Each generator is rotated into the horizontal position for extraction from the containment and placed onto a multi-wheeled vehicle for transport to an on-site processing and storage area.

Disposal costs are based upon the displaced volume and weight of the units. Each component is then loaded onto a rail car for transport to the disposal facility.

Reactor coolant piping is cut from the reactor vessel once the water level in the vessel (used for personnel shielding during dismantling and cutting operations in and around the vessel) is dropped below the nozzle zone. The piping is boxed and transported by shielded van. The reactor coolant pumps and motors are lifted out intact, packaged, and transported for processing and/or disposal.

3.4.4 Main Turbine and Condenser

The main turbine is dismantled using conventional maintenance procedures. The turbine rotors and shafts are removed to a laydown area. The lower turbine casings are removed from their anchors by controlled demolition. The main condensers are also disassembled and moved to a laydown area. Material is then prepared for transportation to an off-site recycling facility where it is surveyed and designated for either decontamination or volume reduction, conventional disposal, or controlled disposal. Components are packaged and readied for transport in accordance with the intended disposition.

3.4.5 Retired Components

The estimate includes the costs to packaging, transporting, and disposal of three steam generator primary side tube bundles stored on site from prior change outs and rebuilding of the steam generators.

A retired reactor closure head, with service structure, is also included in the decommissioning waste inventory. The component is currently stored in the reactor head storage building.

3.4.6 Transportation Methods

Contaminated piping, components, and structural material other than the highly activated reactor vessel and internal components will qualify as LSA-I, II or III or Surface Contaminated Object, SCO-I or II, as described in Title 49.[36] The contaminated material will be packaged in Industrial Packages (IP-1, IP-2, or IP-3, as defined in subpart 10 CFR §173.411) for transport unless demonstrated to qualify as their own shipping containers. The reactor vessel and internal components are expected to be transported in accordance with 10 CFR Part 71, in Type B containers. It is conceivable that the reactor, due to its limited specific activity, could qualify as LSA II or III. However, the high radiation levels on the outer surface would require that additional shielding be incorporated within the packaging so as to attenuate the dose to levels acceptable for transport.

Any fuel cladding failure that occurred during the lifetime of the plant is assumed to have released fission products at sufficiently low levels that the buildup of quantities of long-lived isotopes (e.g., ^{137}Cs, ^{90}Sr, or transuranics) has been prevented from reaching levels exceeding those that permit the major reactor components to be shipped under current transportation regulations and disposal requirements.

Transport of the highly activated metal, produced in the segmentation of the reactor vessel and internal components, will be by shielded truck cask. Cask shipments may exceed 95,000 pounds, including vessel segment(s), supplementary shielding, cask tie-downs, and tractor-trailer. The maximum level of activity per shipment assumed permissible was based upon the license limits of the available shielded transport casks. The segmentation scheme for the vessel and internal segments is designed to meet these limits.

The transport of large intact components (e.g., large heat exchangers and other oversized components) will be by a combination of truck, rail, and/or multi-wheeled transporter to the Barnwell disposal facility.

Truck transport costs were developed from published tariffs from Tri-State Motor Transit Co.[37] based upon the mileage to the Barnwell facility and/or the Energy*Solutions* facility in Clive, Utah. Transportation costs for off-site waste processing are based upon the mileage to Oak Ridge, Tennessee. The disposal cost for the GTCC material is assumed to be inclusive of the transportation cost.

3.4.7 Low-Level Radioactive Waste Disposal

To the greatest extent practical, metallic material generated in the decontamination and dismantling processes is processed to reduce the total cost of controlled disposal. Material meeting the regulatory and/or site release criterion, is released as scrap, requiring no further cost consideration. Conditioning (preparing the material to meet the waste acceptance criteria of the disposal site) and recovery of the waste stream is performed off site at a licensed processing center. Any material leaving the site is subject to a survey and release charge, at a minimum.

The mass of radioactive waste generated during the various decommissioning activities at the site is shown on a line-item basis in the detailed Appendix C, and summarized in Section 5. The quantified waste summaries shown in these tables are consistent with 10 CFR Part 61 classifications. Commercially available steel containers are presumed to be used for the disposal of piping, small components, and concrete. Larger components can serve as their own containers, with proper closure of all openings, access ways, and penetrations. The volumes are calculated based on the exterior package dimensions for containerized material or a specific calculation for components serving as their own waste containers.

The more highly activated reactor components will be shipped in reusable, shielded truck casks with disposable liners. In calculating disposal costs, the burial fees are applied against the liner volume, as well as the special handling requirements of the payload.

Disposal fees are based upon estimated charges, with surcharges added for the highly activated components, for example, generated in the segmentation of the reactor vessel. The cost to dispose of the lowest level and majority of the material generated from the decontamination and dismantling activities, including the higher activity waste (Class B and C), is based upon the current cost for disposal at the Barnwell facility in South Carolina.[38] Bulk debris, including dry active waste (DAW), soil and concrete was assumed to be disposed of at Energy*Solutions* facility in Clive, Utah, at the prevailing rate.

Material exceeding Class C limits (limited to material closest to the reactor core and comprising less than 1% of the total waste volume) is generally not suitable for shallow-land disposal. This material is packaged in the same multi-purpose canisters used for spent fuel storage/transport.

3.4.8 Site Conditions Following Decommissioning

The NRC will amend or terminate the site license if it determines that site remediation has been performed in accordance with the license termination plan, and that the terminal radiation survey and associated documentation demonstrate that the facility is suitable for release. The NRC's involvement in the decommissioning process will end at this point. Building codes and environmental regulations will dictate the next step in the decommissioning process, as well as owner's own future plans for the site.

All structures will be removed except for the switchyard. The switchyard is required for the electrical grid operations. Structures to be removed include but are not limited to the containment, reactor auxiliary, fuel handling, and turbine buildings, intake and discharge structures.

The structures that may require decontamination or radiological remediation are the containment, reactor auxiliary, turbine, environmental & rad control, radwaste and fuel handling buildings.
The estimate presented herein includes the dismantling of the major structures to a nominal depth of three feet below grade, backfilling and the collapsing of below grade voids, and general terra-forming such that the site upon which the power block and supplemental structures are located is transformed into a "grassy plain."

Environmental Remediation

For purposes of this estimate, the low volume retention basins which collect storm water and wash-down from the plant are not projected to require remediation.

The ponds will be backfilled to grade level. The firing range will be remediated of lead, closed, and landscaped to grade level. Costs are also included for the remediation of contaminated soil and the closure of groundwater monitoring wells.

Asbestos

At the time of Robinson construction, asbestos was still being used for system component and piping insulation, and as fireproofing material for structures. The allowance for the remediation of this asbestos is captured in the detailed cost analysis (Appendix C).

3.5 ASSUMPTIONS

The following are the major assumptions made in the development of the estimate for decommissioning the site.

3.5.1 Estimating Basis

Decommissioning costs are reported in the year of projected expenditure; however, the values are provided in 2024 dollars. Costs are not inflated, escalated, or discounted over the periods of performance.

The estimate relies upon the physical plant inventory that was the basis for the 2019 analysis (updated to reflect any material changes to the plant over the past five years).

The study follows the principles of ALARA through the use of work duration adjustment factors. These factors address the impact of activities such as radiological protection instruction, mock-up training, and the use of respiratory protection and protective clothing. The factors lengthen a task's duration, increasing costs and lengthening the overall schedule. ALARA planning is considered in the costs for engineering and planning, and in the development of activity specifications and detailed procedures. Changes to worker exposure limits may impact the decommissioning cost and project schedule.

3.5.2 Labor Costs

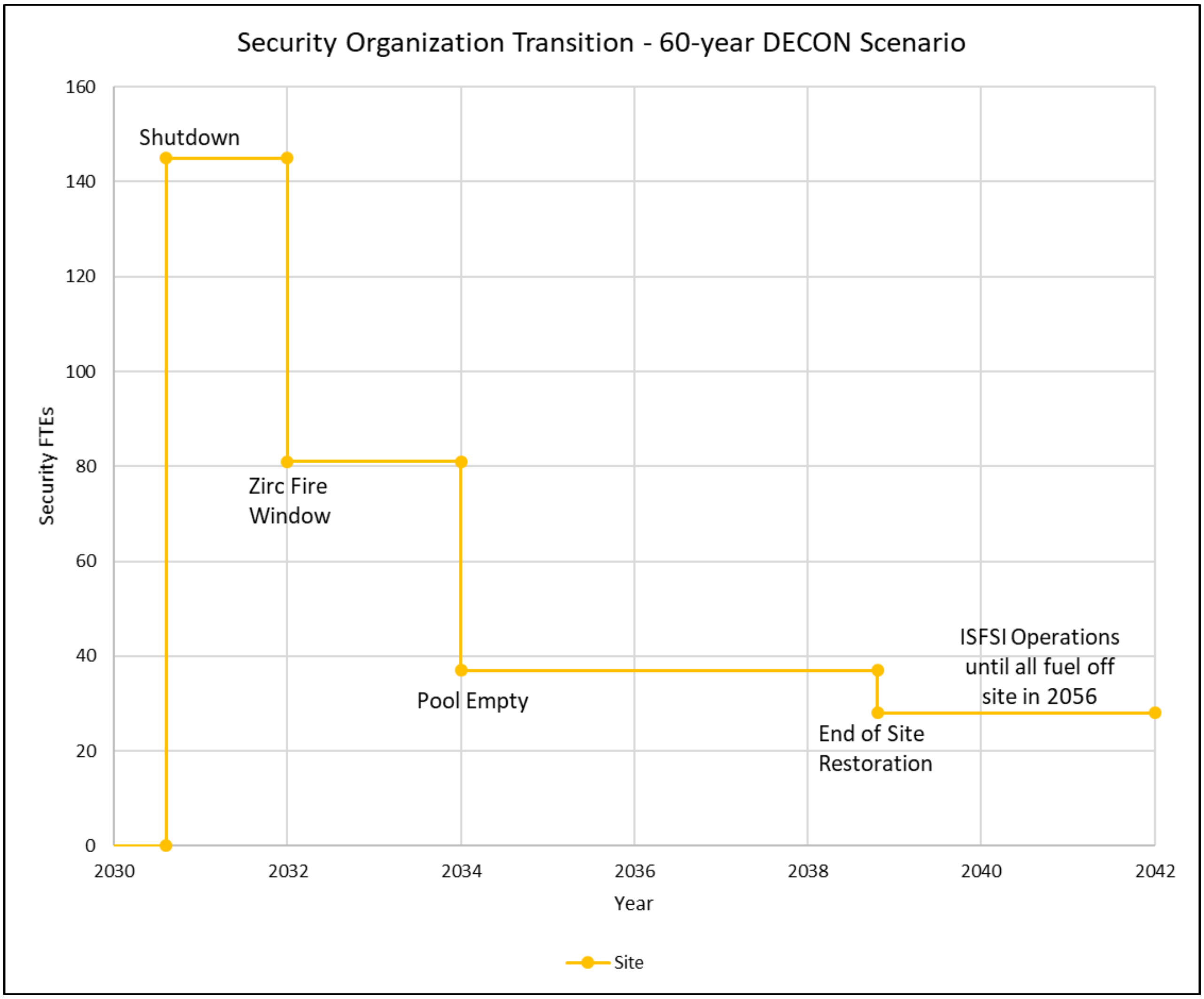
For purposes of this analysis, Duke Energy will continue to provide site operations support, including decommissioning program management, licensing, radiological protection, and site security. Duke Energy will serve as the Decommissioning Operations Contractor (DOC), providing the supervisory staff needed to oversee the labor subcontractors, consultants, and specialty contractors needed to perform the work envisioned in the decontamination and dismantling effort. Duke Energy will also provide the engineering services needed to develop activity specifications, detailed procedures, detailed activation analyses, and support field activities such as structural modifications.

Personnel costs are based upon average salary information provided by Duke Energy. Overhead costs are included for site and corporate support, reduced commensurate with the staffing of the project.

The craft labor required to decontaminate and dismantle the nuclear plant is acquired through standard site contracting practices. The current cost of labor at the site is used as an estimating basis.

Security levels are assumed to be maintained at "operating levels" upon commencement of the decommissioning project and are subsequently reduced in accordance with project milestones, i.e., end of zirc-fire window, end of wet fuel storage, and completion of the decommissioning and site restoration activities. Figure 3.1 provides a graphic representation of the security levels throughout the project.

FIGURE 3.1
POST-OPERATIONS SECURITY ORGANIZATION TRANSITION



3.5.3 Design Conditions

Any fuel cladding failure that occurred during the lifetime of the plant is assumed to have released fission products at sufficiently low levels that the buildup of quantities of long-lived isotopes (e.g., ^{137}Cs, ^{90}Sr, or transuranics) has been prevented from reaching levels exceeding those that permit the major NSSS components to be shipped under current transportation regulations and disposal requirements.

The curie contents of the vessel and internals at final shutdown are derived from those listed in NUREG/CR-3474.[39] Actual estimates are derived from the curie/gram values contained therein and adjusted for the different mass of the Robinson components, projected operating life, and different periods of decay. Additional short-lived isotopes were derived from NUREG/CR-0130[40] and NUREG/CR-0672,[41] and benchmarked to the long-lived values from NUREG/CR-3474.

Neutron activation of the containment building structure is assumed to be confined to the biological shield.

3.5.4 General

Transition Activities

Existing warehouses are cleared of non-essential material and remain for use by Duke Energy and its subcontractors. The plant's operating staff performs the following activities at no additional cost or credit to the project during the transition period:

- Drain and collect fuel oils, lubricating oils, and transformer oils for recycle and/or sale.
- Drain and collect acids, caustics, and other chemical stores for recycle and/or sale.
- Process operating waste inventories. Disposal of operating wastes (e.g., filtration media, resins) during this initial period is not considered a decommissioning expense.

Scrap and Salvage

The existing plant equipment is considered obsolete and suitable for scrap as deadweight quantities only. Duke Energy will make economically reasonable efforts to salvage equipment following final plant shutdown.

However, dismantling techniques assumed by TLG for equipment in this analysis are not consistent with removal techniques required for salvage (resale) of equipment. Experience has indicated that some buyers wanted equipment stripped down to very specific requirements before they would consider purchase. This required expensive rework after the equipment had been removed from its installed location. Since placing a salvage value on this machinery and equipment would be speculative, and the value would be small in comparison to the overall decommissioning expenses, this analysis does not attempt to quantify the value that an owner may realize based upon those efforts.

It is assumed, for purposes of this analysis, that any value received from the sale of scrap generated in the dismantling process would be more than offset by the on-site processing costs. The dismantling techniques assumed in the decommissioning estimate do not include the additional cost for size reduction and preparation to meet "furnace ready" conditions. For example, the recovery of copper from electrical cabling may require the removal and disposition of any contaminated insulation, an added expense. With a volatile market, the potential profit margin in scrap recovery is highly speculative, regardless of the ability to free release this material. This assumption is an implicit recognition of scrap value in the disposal of clean metallic waste at no additional cost to the project.

Furniture, tools, mobile equipment such as forklifts, trucks, bulldozers, and other property is removed at no cost or credit to the decommissioning project. Disposition may include relocation to other facilities. Spare parts are also made available for alternative use.

<u>Energy</u>

For estimating purposes, the plant is assumed to be de-energized, except for those facilities associated with spent fuel storage. Replacement power costs are used to calculate the cost of energy consumed during decommissioning for tooling, lighting, ventilation, and essential services.

<u>Insurance</u>

Costs for continuing coverage (nuclear liability and property insurance) following cessation of plant operations and during decommissioning are included and based upon current operating premiums. Reductions in premiums, throughout the decommissioning process, are based upon the guidance provided in SECY-00-0145, "Integrated Rulemaking Plan for Nuclear Power Plant Decommissioning."[42] The NRC's financial protection requirements are based on various reactor (and spent fuel) configurations.

Emergency Planning

FEMA emergency planning fees are included for approximately 18 months after the cessation of plant operations. At that time, the fees are discontinued. The timing is based upon the anticipated condition of the spent fuel (i.e., the hottest spent fuel assemblies are assumed to be cool enough that no substantial Zircaloy oxidation and off-site event would occur with the loss of spent fuel pool water). State emergency planning fees are included until the spent fuel storage pool has been emptied.

Severance Program

Severance is included for the personnel in the decommissioning organization only (exclusive of personnel in the operating organization that are not retained once the plant ceases operation). Severance is paid out as the positions are no longer needed. All severance will be paid out by the end of site restoration period.

Severance is based on two weeks' pay for each year of service. It is assumed that all employees on average have twelve years of service plus two additional weeks to model COBRA and outplacement services. Therefore, approximately 26 weeks of annual salary was estimated for each position that is part of the decommissioning organization present at the time of shutdown. Once a position is reduced in number, severance will not be paid for any subsequent increase in staff.

Taxes

Property tax payments continue throughout the decommissioning process, although at a substantially reduced level.

The value of plant structures and equipment decreases from 100% to 0% over a six-year period. The property taxes are determined based on a 100% value of the plant structures and equipment for the first two years, 66.7% of the value for the next two years, 33.3% of the value for the next three years, and 0% for the remainder of the decommissioning period. Taxes on land are paid at 100% throughout the decommissioning project.

Site Modifications

The perimeter fence and in-plant security barriers will be moved, as appropriate, to conform to the Site Security Plan in force during the various stages of the project.

Earthworks created during the initial formation of the Robinson Lake area and integral with it will be left intact.

3.6 COST ESTIMATE SUMMARY

Schedules of expenditures are provided in Table 3.2. The table delineates the cost contributors by year of expenditures as well as cost contributor (e.g., labor, materials, and waste disposal).

The table in Appendix C provides additional detail. The cost elements in these tables are assigned to one of three subcategories: "License Termination," "Spent Fuel Management," and "Site Restoration." The subcategory "License Termination" is used to accumulate costs that are consistent with "decommissioning" as defined by the NRC in its financial assurance regulations (i.e., 10 CFR §50.75). The cost reported for this subcategory is generally sufficient to terminate the plant's operating license, recognizing that there may be some additional cost impact from spent fuel management.

The "Spent Fuel Management" subcategory contains costs associated with the containerization and transfer of spent fuel from the wet storage pool to the ISFSI, as well as the eventual transfer of the spent fuel in storage at the ISFSI to the DOE. Costs are also included for the operations of the pool and management of the ISFSI until such time that the transfer of all fuel from this facility to an off-site location (e.g., interim storage facility) is complete.

"Site Restoration" is used to capture costs associated with the dismantling and demolition of buildings and facilities demonstrated to be free from contamination. This includes structures never exposed to radioactive materials, as well as those facilities that have been decontaminated to appropriate levels. Structures are removed to a depth of three feet and backfilled to conform to local grade.

As discussed in Section 3.4.1, it is assumed that the DOE will not accept the GTCC waste prior to completing the transfer of spent fuel. Therefore, the cost of GTCC disposal is shown in the final year of ISFSI operation. While designated for disposal at a federal facility along with the spent fuel, GTCC waste is still classified as low-level radioactive waste and, as such, included as a "License Termination" expense.

Decommissioning costs are reported in 2024 dollars. Costs are not inflated, escalated, or discounted over the period of expenditure (or projected lifetime of the plant). The schedules are based upon the detailed activity costs reported in Appendix C, along with the timeline presented in Section 4.

TABLE 3.1
SPENT FUEL MANAGEMENT SCHEDULE
(Fuel Assembly Totals by Location)

Year	Robinson Pool	Robinson Spent Fuel in ISFSI	Robinson Spent Fuel in Brunswick Pool	Robinson Spent Fuel in Harris Pool	Robinson DOE Acceptance
2030	351	1136	304	504	-
2031	279	1208	304	504	-
2032	279	1208	304	504	-
2033	-	1487[1]	304	504	-
2034	-	1487	304	504	-
2035	-	1487	304	504	-
2036	-	1487	304	504	-
2037	-	1487	304	504	-
2038	-	1487	304	504	-
2039	-	1487	220	399	189
2040	-	1487	-	357	262
2041	-	1487	-	315	42
2042	-	1487	-	273	42
2043	-	1487	-	252	21
2044	-	1487	-	210	42
2045	-	1487	-	168	42
2046	-	1487	-	126	42
2047	-	1487	-	84	42
2048	-	1487	-	42	42
2049	-	1367	-	21	141
2050	-	1271	-	-	117
2051	-	1055	-	-	216
2052	-	959	-	-	96
2053	-	719	-	-	240
2054	-	479	-	-	240
2055	-	239	-	-	240
2056	-	-	-	-	239
Total					2295

[1] Includes the 56 assemblies from the 7P-ISFSI transferred into the 24P-ISFSI

TABLE 3.2
DECON ALTERNATIVE
60 YEAR LIFETIME
TOTAL ANNUAL EXPENDITURES
(Thousands of 2024 Dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2030	28,865	1,302	396	31	13,246	43,840
2031	87,709	25,656	1,334	11,835	47,159	173,693
2032	72,767	40,618	969	30,447	21,378	166,179
2033	75,235	60,569	838	25,998	18,438	181,079
2034	56,336	11,656	704	14,384	21,106	104,186
2035	56,336	11,656	704	14,384	21,106	104,186
2036	31,679	4,885	165	43	7,241	44,013
2037	22,192	11,965	94	0	7,143	41,393
2038	17,913	8,982	70	0	5,751	32,716
2039	5,030	0	0	0	1,561	6,591
2040	5,044	0	0	0	1,565	6,609
2041	5,030	0	0	0	1,561	6,591
2042	5,030	0	0	0	1,561	6,591
2043	5,030	0	0	0	1,561	6,591
2044	5,044	0	0	0	1,565	6,609
2045	5,030	0	0	0	1,561	6,591
2046	5,030	0	0	0	1,561	6,591
2047	5,030	0	0	0	1,561	6,591
2048	5,044	0	0	0	1,565	6,609
2049	5,255	674	0	0	1,561	7,489
2050	5,210	539	0	0	1,561	7,309
2051	5,434	1,213	0	0	1,561	8,208
2052	5,223	539	0	0	1,565	7,328
2053	5,479	1,348	0	0	1,561	8,388
2054	5,479	1,348	0	0	1,561	8,388
2055	5,479	1,348	0	0	1,561	8,388
2056	5,493	2,324	0	0	12,459	20,276
2057	1,685	2,088	10	2,854	6,228	12,865
Total	544,109	188,709	5,283	99,977	207,807	1,045,885

TABLE 3.2a
DECON ALTERNATIVE
60 YEAR LIFETIME
LICENSE TERMINATION EXPENDITURES
(Thousands of 2024 Dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2030	28,685	1,302	396	31	12,047	42,461
2031	84,788	19,131	1,334	11,835	44,319	161,406
2032	71,610	40,540	969	30,447	19,322	162,888
2033	64,623	32,251	838	25,998	16,889	140,599
2034	55,017	11,594	704	14,384	20,663	102,362
2035	55,017	11,594	704	14,384	20,663	102,362
2036	22,369	1,902	141	43	5,261	29,717
2037	74	0	0	0	0	74
2038	55	0	0	0	0	55
2039 - 55	0	0	0	0	0	0
2056	193	977	0	0	10,932	12,102
2057	768	418	7	2,854	6,120	10,167
Total	383,199	119,709	5,092	99,977	156,216	764,192

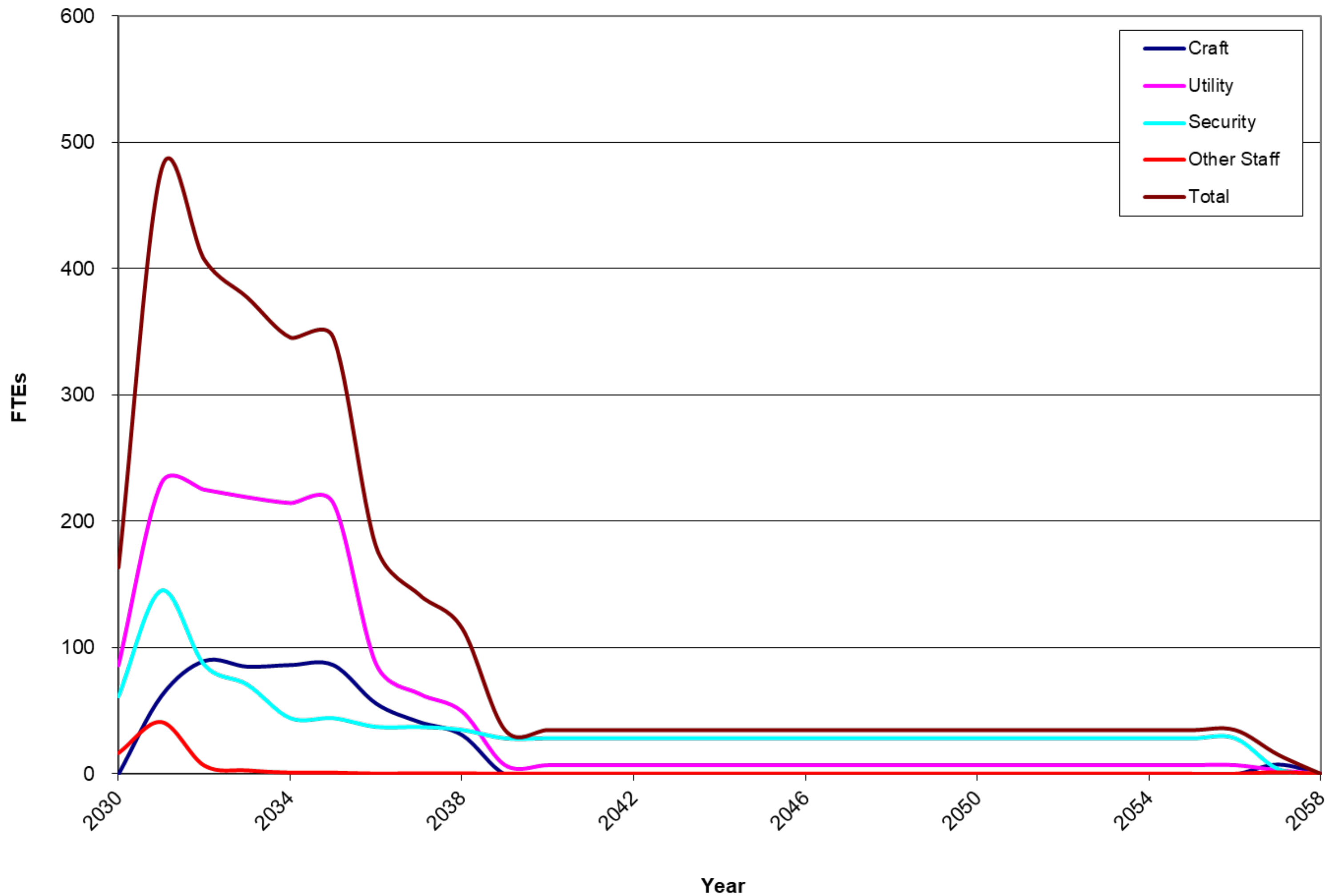
TABLE 3.2b
DECON ALTERNATIVE
60 YEAR LIFETIME
SPENT FUEL MANAGEMENT EXPENDITURES
(Thousands of 2024 Dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2030	0	0	0	0	1,198	1,198
2031	2,175	6,526	0	0	2,840	11,541
2032	0	0	0	0	2,056	2,056
2033	9,413	28,240	0	0	1,550	39,203
2034	0	0	0	0	443	443
2035	0	0	0	0	443	443
2036	5,050	0	0	0	403	5,453
2037	5,030	0	0	0	819	5,849
2038	5,030	0	0	0	1,004	6,034
2039	5,030	0	0	0	1,561	6,591
2040	5,044	0	0	0	1,565	6,609
2041	5,030	0	0	0	1,561	6,591
2042	5,030	0	0	0	1,561	6,591
2043	5,030	0	0	0	1,561	6,591
2044	5,044	0	0	0	1,565	6,609
2045	5,030	0	0	0	1,561	6,591
2046	5,030	0	0	0	1,561	6,591
2047	5,030	0	0	0	1,561	6,591
2048	5,044	0	0	0	1,565	6,609
2049	5,255	674	0	0	1,561	7,489
2050	5,210	539	0	0	1,561	7,309
2051	5,434	1,213	0	0	1,561	8,208
2052	5,223	539	0	0	1,565	7,328
2053	5,479	1,348	0	0	1,561	8,388
2054	5,479	1,348	0	0	1,561	8,388
2055	5,479	1,348	0	0	1,561	8,388
2056	5,300	1,348	0	0	1,526	8,174
2057	0	0	0	0	0	0
Total	119,897	43,121	0	0	38,834	201,852

TABLE 3.2c
DECON ALTERNATIVE
60 YEAR LIFETIME
SITE RESTORATION EXPENDITURES
(Thousands of 2024 Dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2030	180	0	0	0	0	180
2031	746	0	0	0	0	746
2032	1,157	78	0	0	0	1,236
2033	1,199	78	0	0	0	1,277
2034	1,319	62	0	0	0	1,381
2035	1,319	62	0	0	0	1,381
2036	4,260	2,983	23	0	1,577	8,843
2037	17,088	11,965	94	0	6,324	35,471
2038	12,828	8,982	70	0	4,747	26,627
2039 - 56	0	0	0	0	0	0
2057	917	1,669	3	0	109	2,698
Total	41,014	25,880	191	0	12,757	79,841

FIGURE 3.2
DECOMMISSIONING PERSONNEL LEVELS
DECON



4. SCHEDULE ESTIMATE

The schedule for the decommissioning scenario considered in this analysis follow the sequences presented in the AIF/NESP-036 study, with minor changes to reflect recent experience and site-specific constraints. In addition, the scheduling has been revised to reflect the spent fuel management described in Section 3.4.1.

A schedule or sequence of activities for the DECON alternative is presented in Figure 4.1. The scheduling sequence is based on the fuel being removed from the spent fuel pool within approximately three and one-half years. The key activities listed in the schedule do not reflect a one-to-one correspondence with those activities in the cost tables, but reflect dividing some activities for clarity and combining others for convenience. The schedule was prepared using the "Microsoft Project Professional" computer software.[43]

4.1 SCHEDULE ESTIMATE ASSUMPTIONS

The schedule reflects the results of a precedence network developed for the site decommissioning activities, i.e., a PERT (Program Evaluation and Review Technique) Software Package. The work activity durations used in the precedence network reflect the actual man-hour estimates from the cost table, adjusted by stretching certain activities over their slack range and shifting the start and end dates of others. The following assumptions were made in the development of the decommissioning schedule:

- The fuel handling building is isolated until such time that all spent fuel has been discharged from the spent fuel pool to the ISFSI. Decontamination and dismantling of the storage pool is initiated once the transfer of spent fuel is complete.
- All work (except vessel and internals removal) is performed during an 8-hour workday, 5 days per week, with no overtime.
- Reactor and internals removal activities are performed by using separate crews for different activities working on different shifts, with a corresponding backshift charge for the second shift.
- Multiple crews work parallel activities to the maximum extent possible, consistent with optimum efficiency, adequate access for cutting, removal and laydown space, and with the stringent safety measures necessary during demolition of heavy components and structures.

- For plant systems removal, the systems with the longest removal durations in areas on the critical path are considered to determine the duration of the activity.

4.2 PROJECT SCHEDULE

The period-dependent costs presented in the detailed cost tables are based upon the durations developed in the schedule for decommissioning. Durations are established between several milestones in each project period; these durations are used to establish a critical path for the entire project. In turn, the critical path duration for each period is used as the basis for determining the period-dependent costs. A second critical path is shown for the spent fuel storage period, which determines the release of the fuel handling building for final decontamination.

The project timeline is provided in Figure 4.2 with milestone dates based on the 2030 shutdown date. The fuel pool is emptied approximately three and one-half years after shutdown, while ISFSI operations continue until the DOE can complete the transfer of assemblies.

FIGURE 4.1
ACTIVITY SCHEDULE
DECON

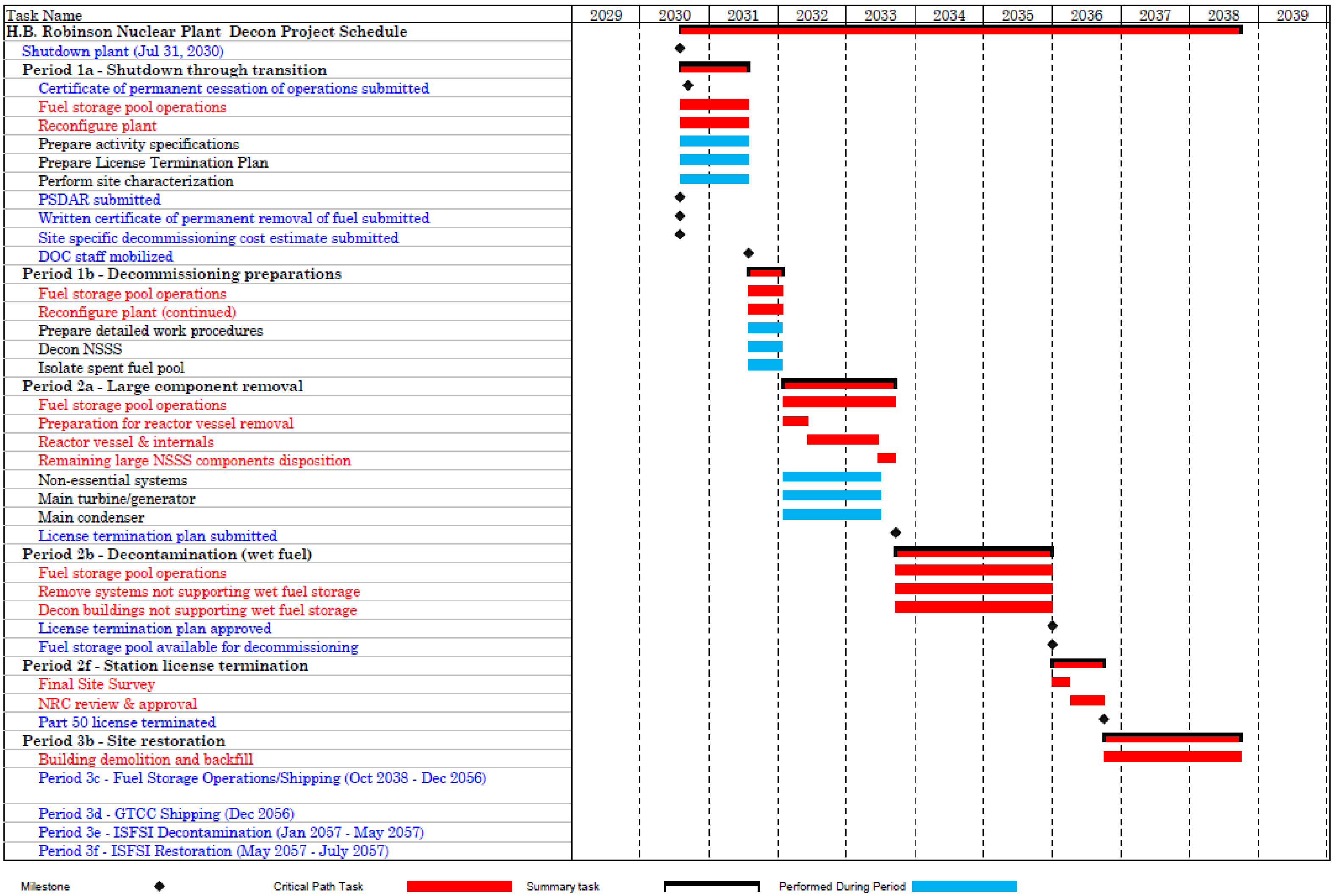


FIGURE 4.2
DECOMMISSIONING TIMELINE
DECON
(not to scale)

	Shutdown and Decommissioning Preparation		Prompt Decommissioning DECON			Site Restoration	Post - Decommissioning ISFSI Operations		ISFSI Decon and Demolition		
Unit 2											
Periods	1a	1b	2a	2b	2f	3b	3c	3d	3e	3f	End
Start Dates	31-Jul-2030	31-Jul-2031	29-Jan-2032	20-Sep-2033	1-Jan-2036	2-Oct-2036	2-Oct-2038	18-Dec-2056	1-Jan-2057	4-May-2057	4-Jul-2057
Durations (Years)	1.0	0.5	1.6	2.3	0.8	2.0	18.2	0.04	0.3	0.2	
Elapsed Time (Years)		1.5	3.1	5.4	6.2	8.2	26.4	26.4	26.8	26.9	

RNP Spent Fuel Schedule

RNP ISFSI (Cask to DOE)							62			62	Total

Note: Cask distribution is provided as a general representation of inventory per period, totals per period are not actuals as used to calculate costs.

5. RADIOACTIVE WASTES

The objectives of the decommissioning process are the removal of all radioactive material from the site that would restrict its future use and the termination of the NRC license. This currently requires the remediation of all radioactive material at the site in excess of applicable legal limits. Under the Atomic Energy Act,[44] the NRC is responsible for protecting the public from sources of ionizing radiation. Title 10 of the Code of Federal Regulations delineates the production, utilization, and disposal of radioactive materials and processes. In particular, Part 71 defines radioactive material as it pertains to transportation and Part 61 specifies its disposition.

Most of the materials being transported for controlled burial are categorized as Low Specific Activity (LSA) or Surface Contaminated Object (SCO) materials containing Type A quantities, as defined in 49 CFR Parts 173-178. Shipping containers are required to be Industrial Packages (IP-1, IP-2 or IP-3, as defined in 10 CFR §173.411). For this study, commercially available steel containers are presumed to be used for the disposal of piping, small components, and concrete. Larger components can serve as their own containers, with proper closure of all openings, access ways, and penetrations.

The destinations for the various waste streams from decommissioning are identified in Figures 5.1 and 5.2. The volumes are shown on a line-item basis in Appendix C and summarized in Table 5.1. The volumes are calculated based on the exterior dimensions for containerized material and on the displaced volume of components serving as their own waste containers.

The reactor vessel and internals are categorized as large quantity shipments and, accordingly, will be shipped in reusable, shielded truck casks with disposable liners. In calculating disposal costs, the burial fees are applied against the liner volume, as well as the special handling requirements of the payload. Packaging efficiencies are lower for the highly activated materials (greater than Type A quantity waste), where high concentrations of gamma-emitting radionuclides limit the capacity of the shipping casks.

No process system containing/handling radioactive substances at shutdown is presumed to meet material release criteria by decay alone (i.e., systems radioactive at shutdown will still be radioactive over the time period during which the decommissioning is accomplished, due to the presence of long-lived radionuclides). While the dose rates decrease with time, radionuclides such as ^{137}Cs will still control the disposition requirements.

The waste material produced in the decontamination and dismantling of the nuclear plant is primarily generated during Period 2. Material that is considered potentially contaminated when removed from the radiological controlled area (e.g., concrete and dry active waste) and metal with low levels of contamination are sent to processing facilities in Tennessee for conditioning and disposal. The disposal volumes reported in the tables reflect the savings resulting from reprocessing and recycling. Heavily contaminated components and activated materials are routed for direct, controlled disposal.

For purposes of constructing the estimate, the Barnwell and Energy*Solutions*' facilities disposal rates were used. Separate rates were used for containerized waste and large components, including the steam generators and reactor coolant pump motors. Demolition debris including miscellaneous steel, scaffolding, and concrete was disposed of at a bulk rate. The decommissioning waste stream also included resins and dry active waste.

The majority of the material generated from the decontamination and dismantling activities, including the higher activity waste (Class B and C), was designated for disposal at the Barnwell facility. Bulk debris, including dry active waste (DAW), soil and concrete was assumed to be disposed of at Energy*Solutions* facility in Clive, Utah, at the prevailing rate.

A small quantity of material that will be generated during the decommissioning will not be considered suitable for near-surface disposal, and is assumed to be disposed of in a geologic repository, in a manner similar to that envisioned for spent fuel disposal. This material, known as GTCC material, is estimated to require five spent fuel storage canisters (or the equivalent) to dispose of the most radioactive portions of the reactor vessel internals. The volume and weight reported in Table 5.1 represent the packaged weight and volume of the spent fuel storage canisters.

FIGURE 5.1
RADIOACTIVE WASTE DISPOSITION

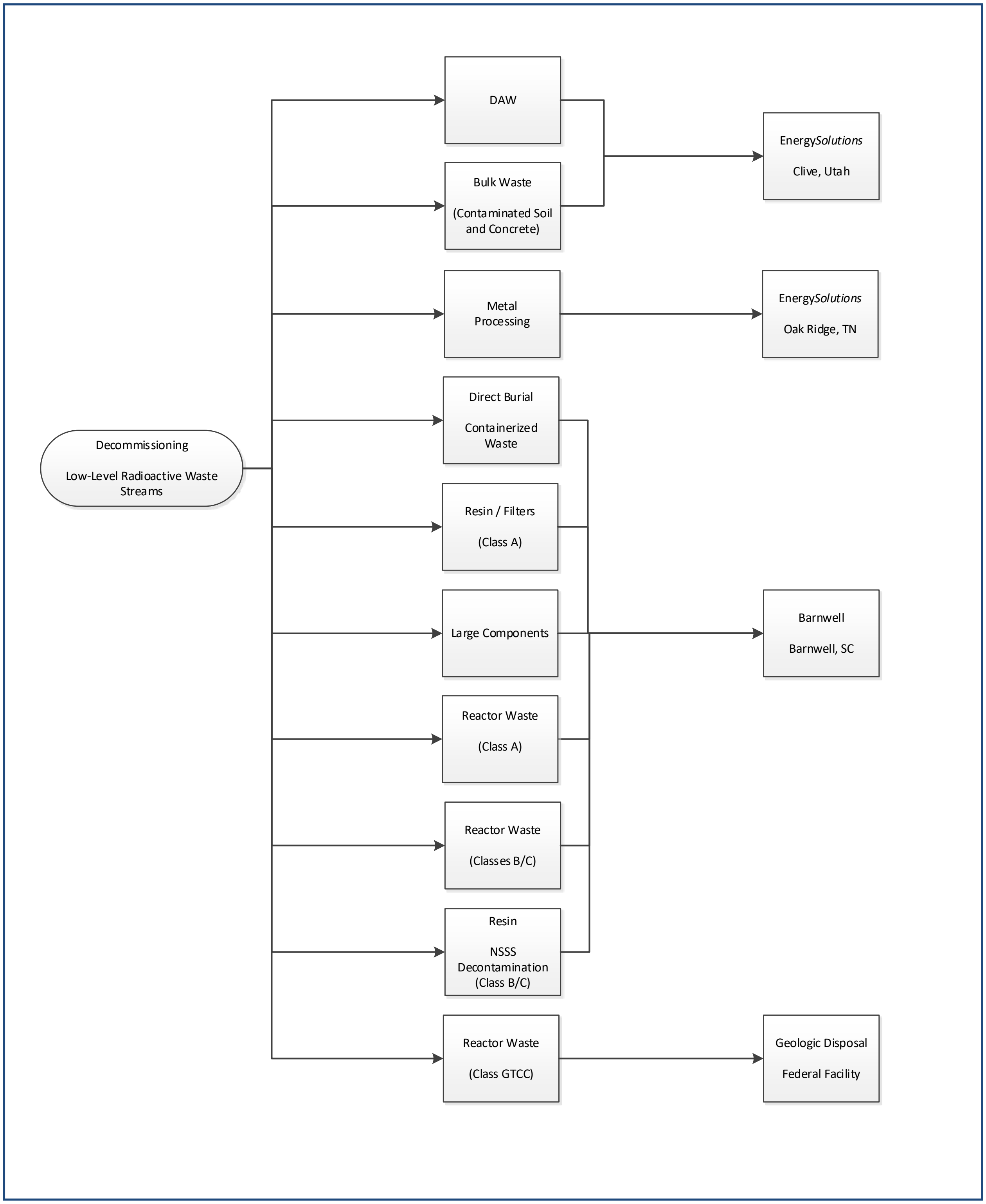
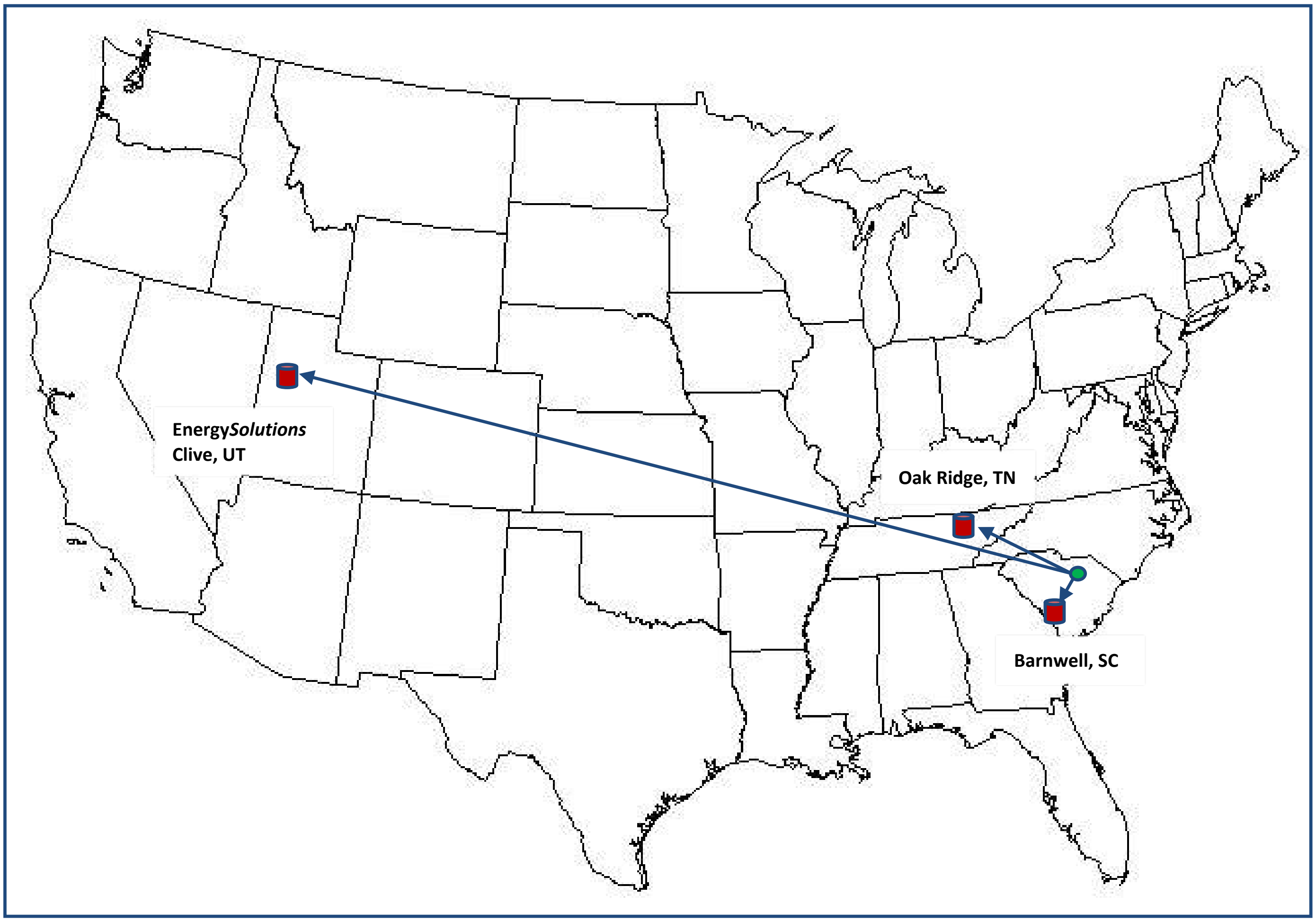


FIGURE 5.2
DECOMMISSIONING WASTE DESTINATIONS
RADIOLOGICAL



The figure indicates the destinations for the low-level radioactive waste designated for direct disposal (Barnwell, South Carolina and Clive, Utah) and processing/recovery (Oak Ridge, Tennessee).

Disposition of the majority of Class A low-level radioactive waste, and Class B and C waste will be at the Atlantic Compact's disposal facility in Barnwell, South Carolina.

Disposal options (and destinations) for GTCC are still being evaluated.

TABLE 5.1
DECON ALTERNATIVE
DECOMMISSIONING WASTE SUMMARY

Waste	Cost Basis	Class [1]	Waste Form	Waste Volume (cubic feet)	Weight (pounds)
Low-Level Radioactive Waste (near-surface disposal)	Barnwell	A	Containerized	67,204	4,160,913
	Energy*Solutions*	A	Bulk	167,232	12,532,810
	Barnwell	A	Large Components [2]	24,168	3,624,910
	Barnwell	B	Shielded Cask	2,330	259,938
	Barnwell	C	Shielded Cask	898	118,789
Greater than Class C (geologic repository)	Spent Fuel Equivalent	GTCC	Dry Storage Container	1,785	356,397
Processed/Conditioned (off-site recycling center)	Recycling Vendors	A	Bulk	186,990	7,239,923
Total [3]				450,607	28,293,680

[1] Waste is classified according to the requirements as delineated in Title 10 CFR, Part 61.55
[2] Steam generators, pressurizer and reactor coolant pumps
[3] Columns may not add due to rounding

6. RESULTS

The analysis to estimate the costs to decommission Robinson relied upon the site-specific, technical information developed for a previous analysis. While not an engineering study, the estimate provides the owner with sufficient information to assess their financial obligations, as they pertain to the eventual decommissioning of the nuclear plant.

The estimate described in this report is based on numerous fundamental assumptions, including regulatory requirements, project contingencies, low-level radioactive waste disposal practices, high-level radioactive waste management options, and site restoration requirements. The decommissioning scenario assumes continued operation of the plant's spent fuel pool for a minimum of approximately three and one-half years following the cessation of operations for continued cooling of the assemblies.

The cost projected to promptly decommission (DECON) Robinson is estimated to be $1,045.9 million. The majority of this cost (approximately 73.1%) is associated with the physical decontamination and dismantling of the nuclear plant so that the operating license can be terminated. Another 19.3% is associated with the management, interim storage, and eventual transfer of the spent fuel. The remaining 7.6% is for the demolition of the designated structures and limited restoration of the site.

The primary cost contributors, identified in Table 6.1, are either labor-related or associated with the management and disposition of the radioactive waste. Program management is the largest single contributor to the overall cost. The magnitude of the expense is a function of both the size of the organization required to manage the decommissioning, as well as the duration of the program. It is assumed, for purposes of this analysis, that Duke Energy will oversee the decommissioning program, acting as the DOC to manage the decommissioning labor force and the associated subcontractors. The size and composition of the management organization varies with the decommissioning phase and associated site activities. However, once the operating license is terminated, the staff is substantially reduced for the conventional demolition and restoration of the site, and the long-term care of the spent fuel.

As described in this report, the spent fuel pool will remain operational for a minimum of three and one-half years following the cessation of operations. Over this time period, the spent fuel will be packaged into transportable canisters for loading into a DOE-provided transport cask. Spent fuel will also be in storage at the ISFSI (from operations). This inventory will be transferred to the DOE after the pool is emptied.

The cost for waste disposal includes only those costs associated with the controlled disposition of the low-level radioactive waste generated from decontamination and dismantling activities, including plant equipment and components, structural material, filters, resins and dry-active waste. As described in Section 5, disposition of the low-level radioactive material requiring controlled disposal is at the Energy*Solutions*' and Barnwell facilities. Highly activated components, requiring additional isolation from the environment (GTCC), are packaged for geologic disposal. The cost of geologic disposal is based upon a cost equivalent for spent fuel.

A significant portion of the metallic waste is designated for additional processing and treatment at an off-site facility. Processing reduces the volume of material requiring controlled disposal through such techniques and processes as survey and sorting, decontamination, and volume reduction. The material that cannot be unconditionally released is packaged for controlled disposal at one of the currently operating facilities. The cost identified in the summary tables for processing is all-inclusive, incorporating the ultimate disposition of the material.

Removal costs reflect the labor-intensive nature of the decommissioning process, as well as the management controls required to ensure a safe and successful program. Decontamination and packaging costs also have a large labor component that is based upon prevailing union wages. Non-radiological demolition is a natural extension of the decommissioning process. The methods employed in decontamination and dismantling are generally destructive and indiscriminate in inflicting collateral damage. With a work force mobilized to support decommissioning operations, non-radiological demolition can be an integrated activity and a logical expansion of the work being performed in the process of terminating the operating license. Prompt demolition reduces future liabilities and can be more cost effective than deferral, due to the deterioration of the facilities (and therefore the working conditions) with time.

The reported cost for transport includes the tariffs and surcharges associated with moving large components and/or overweight shielded casks overland, as well as the general expense, e.g., labor and fuel, of transporting material to the destinations identified in this report. For purposes of this analysis, material is primarily moved overland by truck.

Decontamination is used to reduce the plant's radiation fields and minimize worker exposure. Slightly contaminated material or material located within a contaminated area is sent to an off-site processing center, i.e., this analysis does not assume that contaminated plant components and equipment can be decontaminated for uncontrolled release in-situ. Centralized processing centers have proven to be a more economical means of handling the large volumes of material produced in the dismantling of a nuclear plant.

License termination survey costs are associated with the labor intensive and complex activity of verifying that contamination has been removed from the site to the levels specified by the regulating agency. This process involves a systematic survey of all remaining plant surface areas and surrounding environs, sampling, isotopic analysis, and documentation of the findings. The status of any plant components and materials not removed in the decommissioning process will also require confirmation and will add to the expense of surveying the facilities alone.

The remaining costs include allocations for heavy equipment and temporary services, as well as for other expenses such as regulatory fees and the premiums for nuclear insurance. While site operating costs are greatly reduced following the final cessation of plant operations, certain administrative functions do need to be maintained either at a basic functional or regulatory level.

TABLE 6.1
DECOMMISSIONING COST ELEMENTS
(thousands of 2024 dollars)

Cost Element	Total	%
Decontamination	22,015	2.1%
Removal	166,864	16.0%
Packaging	33,664	3.2%
Transportation	26,200	2.5%
Waste Disposal	87,357	8.4%
Off-site Waste Processing	26,643	2.5%
Program Management [1]	276,270	26.4%
Site Security	151,920	14.5%
Spent Fuel Pool Isolation	17,313	1.7%
Spent Fuel (Direct Expenditures) [2]	82,011	7.8%
Insurance and Regulatory Fees	26,233	2.5%
Energy	5,283	0.5%
Characterization and Licensing Surveys	25,683	2.5%
Property Taxes	28,760	2.7%
Corporate A&G	17,923	1.7%
Non-Labor Overhead	6,569	0.6%
Severance Program	33,853	3.2%
Miscellaneous Equipment	8,869	0.8%
Miscellaneous Site Services	2,455	0.2%
Total [3]	1,045,885	100.0%

Cost Element	Total	%
License Termination	764,192	73.1%
Spent Fuel Management	201,852	19.3%
Site Restoration	79,841	7.6%
Total [3]	1,045,885	100.0%

[1] Includes engineering costs
[2] Excludes program management costs (staffing) but includes costs for spent fuel loading/transfer/spent fuel pool O&M and EP fees
[3] Columns may not add due to rounding

7. REFERENCES

1. U.S. Code of Federal Regulations, Title 10, Part 50, "Domestic Licensing of Production and Utilization Facilities," Subpart 75, "Reporting and Recordkeeping for Decommissioning Planning " [Open]

2. "Decommissioning Cost Analysis for the H.B. Robinson Nuclear Plant," Document D03-1834-003, Rev. 4, TLG Services, LLC, November 2024

3. "Decommissioning Cost Analysis for the H.B. Robinson Nuclear Plant," Document D03-1766-007, Rev. 4, TLG Services, Inc., December 2019

4. U.S. Code of Federal Regulations, Title 10, Parts 30, 40, 50, 51, 70 and 72, "General Requirements for Decommissioning Nuclear Facilities," Nuclear Regulatory Commission, 53 Fed. Reg. 24018, June 27, 1988 [Open]

5. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.159, "Assuring the Availability of Funds for Decommissioning Nuclear Reactors," Rev. 4, October 2011 [Open]

6. U.S. Code of Federal Regulations, Title 10, Part 20, Subpart E, "Radiological Criteria for License Termination" [Open]

7. U.S. Code of Federal Regulations, Title 10, Parts 20 and 50, "Entombment Options for Power Reactors," Advance Notice of Proposed Rulemaking, 66 Fed. Reg. 52551, October 16, 2001 [Open]

8. U.S. Code of Federal Regulations, Title 10, Parts 2, 50 and 51, "Decommissioning of Nuclear Power Reactors," Nuclear Regulatory Commission, 61 Fed. Reg. 39278, July 29, 1996 [Open]

9. U.S. Code of Federal Regulations, Title 10, Parts 20, 30, 40, 50, 70, and 72, "Decommissioning Planning," Nuclear Regulatory Commission, Federal Register Volume 76, (p 35512 et seq.), June 17, 2011 [Open]

10. "Nuclear Waste Policy Act of 1982, As Amended," 42 U.S. Code 10101, et seq. [Open]

11. Charter of the Blue Ribbon Commission on America's Nuclear Future, "Objectives and Scope of Activities" [Open]

12. "Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy," p. 27, 32, January 2012 [Open]

7. REFERENCES
(continued)

13. "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," U.S. DOE, January 11, 2013 [Open]

14. United States Court of Appeals for the District of Columbia Circuit, In Re: Aiken County, Et Al., August 2013 [Open]

15. U.S. Code of Federal Regulations, Title 10, Part 961.11, Article IV – Responsibilities of the Parties, B. DOE Responsibilities, 5.(a) "… DOE shall issue an annual acceptance priority ranking for receipt of SNF and/or HLW at the DOE repository. This priority ranking shall be based on the age of SNF and/or HLW as calculated from the date of discharge of such materials from the civilian nuclear power reactor. The oldest fuel or waste will have the highest priority for acceptance …" [Open]

16. "Pickup Date and Pickup Rate for Use in the CR3 Decommissioning Plan and Cost Estimate," Duke Energy, Rev. 4

17. "Acceptance Priority Ranking & Annual Capacity Report," DOE/RW-0567, July 2004 [Open]

18. U.S. Code of Federal Regulations, Title 10, Part 50, "Domestic Licensing of Production and Utilization Facilities," Subpart 54 (bb), "Conditions of Licenses" [Open]

19. U.S. Code of Federal Regulations, Title 10, Part 72, Subpart K, "General License for Storage of Spent Fuel at Power Reactor Sites" [Open]

20. "Low-Level Radioactive Waste Policy Act," Public Law 96-573, 1980 [Open]

21. "Low-Level Radioactive Waste Policy Amendments Act of 1985," Public Law 99-240, January 15, 1986 [Open]

22. U.S. Code of Federal Regulations, Title 10, Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste" [Open]

23. "Final Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste," (DOE/EIS-0375), January 2016 [Open]

7. REFERENCES
(continued)

24. U.S. Code of Federal Regulations, Title 10, Part 20, Subpart E, "Final Rule, Radiological Criteria for License Termination," 62 Fed. Reg. 39058, July 21, 1997 [Open]

25. "Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination," EPA Memorandum OSWER No. 9200.4-18, August 22, 1997 [Open]

26. U.S. Code of Federal Regulations, Title 40, Part 141.66, "Maximum contaminant levels for radionuclides" [Open]

27. "Memorandum of Understanding Between the Environmental Protection Agency and the Nuclear Regulatory Commission: Consultation and Finality on Decommissioning and Decontamination of Contaminated Sites," OSWER 9295.8-06a, October 9, 2002 [Open]

28. "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," NUREG-1575, Rev. 4, EPA 402-R-97-016, Rev. 4, August 2000 [Open]

29. T.S. LaGuardia et al., "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," AIF/NESP-036, May 1986 [Open]

30. W.J. Manion and T.S. LaGuardia, "Decommissioning Handbook," U.S. Department of Energy, DOE/EV/10128-1, November 1980 [Open]

31. "Building Construction Cost Data 2024," RSMeans (From the Gordian Group), Rockland, Massachusetts [Open]

32. "Decommissioning of Nuclear Power Reactors," Regulatory Guide 1.184, Nuclear Regulatory Commission, October 2013 [Open]

33. "Standard Format and Content of Decommissioning Cost Estimates for Nuclear Power Reactors," Regulatory Guide 1.202, Nuclear Regulatory Commission, February 2005 [Open]

34. Project and Cost Engineers' Handbook, Second Edition, p. 239, American Association of Cost Engineers, Marcel Dekker, Inc., New York, New York, 1984 [Open]

7. REFERENCES
(continued)

35. DOE/RW-0351, "Civilian Radioactive Waste Management System Waste Acceptance System Requirements Document", Revision 5, May 31, 2007

36. U.S. Department of Transportation, Title 49 of the Code of Federal Regulations, "Transportation," Parts 173 through 178 [Open]

37. Tri-State Motor Transit Company, Radioactive Materials Tariffs, TSMT 7000, January 2024. [Open}

38. Atlantic Compact Regional Waste, Alternative Rate Schedule, Effective July 1, 2023

39. J.C. Evans et al., "Long-Lived Activation Products in Reactor Materials" NUREG/CR-3474, Pacific Northwest Laboratory for the Nuclear Regulatory Commission, August 1984 [Open]

40. R.I. Smith, G.J. Konzek, W.E. Kennedy, Jr., "Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station," NUREG/CR-0130 and addenda, Pacific Northwest Laboratory for the Nuclear Regulatory Commission, June 1978 [Open Main Report] [Open Appendices]

41. H.D. Oak, et al., "Technology, Safety and Costs of Decommissioning a Reference Boiling Water Reactor Power Station," NUREG/CR-0672 and addenda, Pacific Northwest Laboratory for the Nuclear Regulatory Commission, June 1980 [Open Main Report] [Open Appendices]

42. SECY-00-0145, "Integrated Rulemaking Plan for Nuclear Power Plant Decommissioning," June 2000 [Open]

43. "Microsoft Project Professional," Microsoft Corporation, Redmond, WA

44. "Atomic Energy Act of 1954," (68 Stat. 919) [Open]

APPENDIX A

UNIT COST FACTOR DEVELOPMENT

APPENDIX A
UNIT COST FACTOR DEVELOPMENT

Example: Unit Factor for Removal of Contaminated Heat Exchanger < 3,000 lbs.

1. SCOPE

Heat exchangers weighing < 3,000 lbs. will be removed in one piece using a crane or small hoist. They will be disconnected from the inlet and outlet piping. The heat exchanger will be sent to the waste processing area.

2. CALCULATIONS

Act ID	Activity Description	Activity Duration (minutes)	Critical Duration (minutes)*
a	Remove insulation	60	(b)
b	Mount pipe cutters	60	60
c	Install contamination controls	20	(b)
d	Disconnect inlet and outlet lines	60	60
e	Cap openings	20	(d)
f	Rig for removal	30	30
g	Unbolt from mounts	30	30
h	Remove contamination controls	15	15
i	Remove, wrap, send to waste processing area	60	60
	Totals (Activity/Critical)	355	255
Duration adjustment(s):			
	+ Respiratory protection adjustment (50% of critical duration)		128
	+ Radiation/ALARA adjustment (37.1% of critical duration)		95
Adjusted work duration			478
	+ Protective clothing adjustment (30% of adjusted duration)		143
Productive work duration			621
	+ Work break adjustment (8.33 % of productive duration)		52
Total work duration (minutes)			673

*** Total duration = 11.217 hours ***

* alpha designators indicate activities that can be performed in parallel

APPENDIX A
(continued)

3. LABOR REQUIRED

Crew	Number	Duration (hours)	Rate ($/hr)	Cost
Laborers	3.00	11.217	$##.##	$##.##
Craftsmen	2.00	11.217	$##.##	$##.##
Foreman	1.00	11.217	$##.##	$##.##
General Foreman	0.25	11.217	$##.##	$##.##
Fire Watch	0.05	11.217	$##.##	$##.##
Health Physics Technician	1.00	11.217	$##.##	$##.##

Total Labor Cost $4,688.26

$##.## denotes business sensitive information

4. EQUIPMENT & CONSUMABLES COSTS

Equipment Costs	none
Consumables/Materials Costs	
-Universal Sorbent 50 @ $1.07 sq. ft. {1}	$53.50
-Tarpaulins (oil resistant/fire retardant) 50 @ $0.62/sq. ft. {2}	$31.00
-Gas torch consumables 1 @ $32.95/hr. x 1 hr. {3}	$32.95
Subtotal cost of equipment and materials	$117.45
Overhead & profit on equipment and materials @ 18.00 %	$21.14
Total costs, equipment & material	$138.59

TOTAL COST:

Removal of contaminated heat exchanger <3000 pounds:	$4,826.85
Total labor cost:	$4,688.26
Total equipment/material costs:	$138.59
Total craft labor man-hours required per unit:	81.88

5. NOTES AND REFERENCES

- Work difficulty factors were developed in conjunction with the Atomic Industrial Forum's (now NEI) program to standardize nuclear decommissioning cost estimates and are delineated in Volume 1, Chapter 5 of the "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," AIF/NESP-036, May 1986.

- References for equipment & consumables costs:

    1. www.mcmaster.com online catalog, McMaster Carr Spill Control (7193T88)
    2. RSMeans (2024) Division 01 56, Section 13.60-0600, page 23
    3. RSMeans (2024) Division 01 54 33, Section 40-6360, page 744

- Material and consumable costs were adjusted using the regional indices for Florence, South Carolina.

APPENDIX B

UNIT COST FACTOR LISTING
(DECON: Power Block Structures Only)

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of clean instrument and sampling tubing, $/linear foot	0.51
Removal of clean pipe 0.25 to 2 inches diameter, $/linear foot	5.49
Removal of clean pipe >2 to 4 inches diameter, $/linear foot	7.88
Removal of clean pipe >4 to 8 inches diameter, $/linear foot	15.48
Removal of clean pipe >8 to 14 inches diameter, $/linear foot	29.64
Removal of clean pipe >14 to 20 inches diameter, $/linear foot	38.84
Removal of clean pipe >20 to 36 inches diameter, $/linear foot	57.06
Removal of clean pipe >36 inches diameter, $/linear foot	67.66
Removal of clean valve >2 to 4 inches	102.46
Removal of clean valve >4 to 8 inches	154.84
Removal of clean valve >8 to 14 inches	296.36
Removal of clean valve >14 to 20 inches	388.35
Removal of clean valve >20 to 36 inches	570.62
Removal of clean valve >36 inches	676.63
Removal of clean pipe hanger for small bore piping	39.58
Removal of clean pipe hanger for large bore piping	132.24
Removal of clean pump, <300 pound	267.66
Removal of clean pump, 300-1000 pound	736.01
Removal of clean pump, 1000-10,000 pound	2,867.72
Removal of clean pump, >10,000 pound	5,568.91
Removal of clean pump motor, 300-1000 pound	302.31
Removal of clean pump motor, 1000-10,000 pound	1,183.59
Removal of clean pump motor, >10,000 pound	2,663.09
Removal of clean heat exchanger <3000 pound	1,550.35
Removal of clean heat exchanger >3000 pound	3,934.40
Removal of clean feedwater heater/deaerator	11,017.04
Removal of clean moisture separator/reheater	22,548.78
Removal of clean tank, <300 gallons	343.55
Removal of clean tank, 300-3000 gallon	1,070.90
Removal of clean tank, >3000 gallons, $/square foot surface area	9.12

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of clean electrical equipment, <300 pound	140.65
Removal of clean electrical equipment, 300-1000 pound	492.20
Removal of clean electrical equipment, 1000-10,000 pound	984.42
Removal of clean electrical equipment, >10,000 pound	2,345.70
Removal of clean electrical transformer < 30 tons	1,629.06
Removal of clean electrical transformer > 30 tons	4,691.39
Removal of clean standby diesel generator, <100 kW	1,663.94
Removal of clean standby diesel generator, 100 kW to 1 MW	3,714.03
Removal of clean standby diesel generator, >1 MW	7,688.77
Removal of clean electrical cable tray, $/linear foot	13.55
Removal of clean electrical conduit, $/linear foot	5.94
Removal of clean mechanical equipment, <300 pound	140.65
Removal of clean mechanical equipment, 300-1000 pound	492.20
Removal of clean mechanical equipment, 1000-10,000 pound	984.42
Removal of clean mechanical equipment, >10,000 pound	2,345.70
Removal of clean HVAC equipment, <300 pound	170.08
Removal of clean HVAC equipment, 300-1000 pound	591.42
Removal of clean HVAC equipment, 1000-10,000 pound	1,178.71
Removal of clean HVAC equipment, >10,000 pound	2,345.70
Removal of clean HVAC ductwork, $/pound	0.54
Removal of contaminated instrument and sampling tubing, $/linear foot	1.74
Removal of contaminated pipe 0.25 to 2 inches diameter, $/linear foot	28.02
Removal of contaminated pipe >2 to 4 inches diameter, $/linear foot	44.76
Removal of contaminated pipe >4 to 8 inches diameter, $/linear foot	70.48
Removal of contaminated pipe >8 to 14 inches diameter, $/linear foot	135.19
Removal of contaminated pipe >14 to 20 inches diameter, $/linear foot	160.91
Removal of contaminated pipe >20 to 36 inches diameter, $/linear foot	219.21
Removal of contaminated pipe >36 inches diameter, $/linear foot	257.32
Removal of contaminated valve >2 to 4 inches	519.95
Removal of contaminated valve >4 to 8 inches	618.96

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated valve >8 to 14 inches	1,252.19
Removal of contaminated valve >14 to 20 inches	1,582.45
Removal of contaminated valve >20 to 36 inches	2,092.43
Removal of contaminated valve >36 inches	2,473.53
Removal of contaminated pipe hanger for small bore piping	173.27
Removal of contaminated pipe hanger for large bore piping	562.95
Removal of contaminated pump, <300 pound	1,114.86
Removal of contaminated pump, 300-1000 pound	2,544.31
Removal of contaminated pump, 1000-10,000 pound	7,910.03
Removal of contaminated pump, >10,000 pound	19,261.42
Removal of contaminated pump motor, 300-1000 pound	1,129.18
Removal of contaminated pump motor, 1000-10,000 pound	3,266.92
Removal of contaminated pump motor, >10,000 pound	7,335.11
Removal of contaminated heat exchanger <3000 pound	4,826.85
Removal of contaminated heat exchanger >3000 pound	14,156.52
Removal of contaminated tank, <300 gallons	1,864.58
Removal of contaminated tank, >300 gallons, $/square foot	34.83
Removal of contaminated electrical equipment, <300 pound	831.98
Removal of contaminated electrical equipment, 300-1000 pound	2,020.28
Removal of contaminated electrical equipment, 1000-10,000 pound	3,893.22
Removal of contaminated electrical equipment, >10,000 pound	7,639.84
Removal of contaminated electrical cable tray, $/linear foot	40.45
Removal of contaminated electrical conduit, $/linear foot	20.92
Removal of contaminated mechanical equipment, <300 pound	924.85
Removal of contaminated mechanical equipment, 300-1000 pound	2,228.36
Removal of contaminated mechanical equipment, 1000-10,000 pound	4,287.03
Removal of contaminated mechanical equipment, >10,000 pound	7,639.84
Removal of contaminated HVAC equipment, <300 pound	924.85
Removal of contaminated HVAC equipment, 300-1000 pound	2,228.36
Removal of contaminated HVAC equipment, 1000-10,000 pound	4,287.03

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated HVAC equipment, >10,000 pound	7,639.84
Removal of contaminated HVAC ductwork, $/pound	2.76
Removal/plasma arc cut of contaminated thin metal components, $/linear in.	4.36
Additional decontamination of surface by washing, $/square foot	9.26
Additional decontamination of surfaces by hydrolasing, $/square foot	39.37
Decontamination rig hook up and flush, $/ 250 foot length	7,742.40
Chemical flush of components/systems, $/gallon	44.78
Removal of clean standard reinforced concrete, $/cubic yard	92.34
Removal of grade slab concrete, $/cubic yard	104.86
Removal of clean concrete floors, $/cubic yard	479.19
Removal of sections of clean concrete floors, $/cubic yard	1,354.46
Removal of clean heavily rein concrete w/#9 rebar, $/cubic yard	132.74
Removal of contaminated heavily rein concrete w/#9 rebar, $/cubic yard	2,654.81
Removal of clean heavily rein concrete w/#18 rebar, $/cubic yard	179.53
Removal of contaminated heavily rein concrete w/#18 rebar, $/cubic yard	3,509.44
Removal heavily rein concrete w/#18 rebar & steel embedments, $/cubic yard	666.19
Removal of below-grade suspended floors, $/cubic yard	251.24
Removal of clean monolithic concrete structures, $/cubic yard	1,125.81
Removal of contaminated monolithic concrete structures, $/cubic yard	2,632.61
Removal of clean foundation concrete, $/cubic yard	890.52
Removal of contaminated foundation concrete, $/cubic yard	2,453.78
Explosive demolition of bulk concrete, $/cubic yard	62.38
Removal of clean hollow masonry block wall, $/cubic yard	37.18
Removal of contaminated hollow masonry block wall, $/cubic yard	96.45
Removal of clean solid masonry block wall, $/cubic yard	37.18
Removal of contaminated solid masonry block wall, $/cubic yard	96.45
Backfill of below-grade voids, $/cubic yard	38.01
Removal of subterranean tunnels/voids, $/linear foot	133.67
Placement of concrete for below-grade voids, $/cubic yard	294.52
Excavation of clean material, $/cubic yard	4.05

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Excavation of contaminated material, $/cubic yard	54.67
Removal of clean concrete rubble (tipping fee included), $/cubic yard	39.25
Removal of contaminated concrete rubble, $/cubic yard	36.01
Removal of building by volume, $/cubic foot	0.48
Removal of clean building metal siding, $/square foot	1.74
Removal of contaminated building metal siding, $/square foot	5.91
Removal of standard asphalt roofing, $/square foot	2.40
Removal of transite panels, $/square foot	2.75
Scarifying contaminated concrete surfaces (drill & spall), $/square foot	17.03
Scabbling contaminated concrete floors, $/square foot	9.95
Scabbling contaminated concrete walls, $/square foot	25.54
Scabbling contaminated ceilings, $/square foot	86.93
Scabbling structural steel, $/square foot	8.08
Removal of clean overhead crane/monorail < 10 ton capacity	693.04
Removal of contaminated overhead crane/monorail < 10 ton capacity	2,061.33
Removal of clean overhead crane/monorail >10-50 ton capacity	1,663.32
Removal of contaminated overhead crane/monorail >10-50 ton capacity	4,946.36
Removal of polar crane > 50 ton capacity	6,959.32
Removal of gantry crane > 50 ton capacity	26,193.58
Removal of structural steel, $/pound	0.35
Removal of clean steel floor grating, $/square foot	5.41
Removal of contaminated steel floor grating, $/square foot	16.07
Removal of clean free standing steel liner, $/square foot	13.68
Removal of contaminated free standing steel liner, $/square foot	40.43
Removal of clean concrete-anchored steel liner, $/square foot	6.84
Removal of contaminated concrete-anchored steel liner, $/square foot	47.19
Placement of scaffolding in clean areas, $/square foot	23.52
Placement of scaffolding in contaminated areas, $/square foot	35.27
Landscaping with topsoil, $/acre	29,895.64
Cost of CPC B-88 LSA box & preparation for use	3,161.42

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Cost of CPC B-25 LSA box & preparation for use	2,698.21
Cost of CPC B-12V 12 gauge LSA box & preparation for use	2,438.94
Cost of CPC B-144 LSA box & preparation for use	15,974.44
Cost of LSA drum & preparation for use	460.52
Cost of cask liner for CNSI 8 120A cask (resins)	20,728.81
Cost of cask liner for CNSI 8 120A cask (filters)	14,689.55
Decontamination of surfaces with vacuuming, $/square foot	1.06

APPENDIX C

DETAILED COST ANALYSIS

Table C
H. B. Robinson Nuclear Power Plant U2
DECON Decommissioning Cost Estimate
(Thousands of 2024 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 1a - Shutdown through Transition																					
Period 1a Direct Decommissioning Activities																					
1a.1.1	Prepare preliminary decommissioning cost	-	-	-	-	-	-	107	16	123	123	-	-	-	-	-	-	-	-	-	1,300
1a.1.2	Notification of Cessation of Operations									a											
1a.1.3	Remove fuel & source material									n/a											
1a.1.4	Notification of Permanent Defueling									a											
1a.1.5	Deactivate plant systems & process waste									a											
1a.1.6	Prepare and submit PSDAR	-	-	-	-	-	-	164	25	189	189	-	-	-	-	-	-	-	-	-	2,000
1a.1.7	Review plant dwgs & specs.	-	-	-	-	-	-	378	57	434	434	-	-	-	-	-	-	-	-	-	4,600
1a.1.8	Perform detailed rad survey									a											
1a.1.9	Estimate by-product inventory	-	-	-	-	-	-	82	12	94	94	-	-	-	-	-	-	-	-	-	1,000
1a.1.10	End product description	-	-	-	-	-	-	82	12	94	94	-	-	-	-	-	-	-	-	-	1,000
1a.1.11	Detailed by-product inventory	-	-	-	-	-	-	107	16	123	123	-	-	-	-	-	-	-	-	-	1,300
1a.1.12	Define major work sequence	-	-	-	-	-	-	616	92	708	708	-	-	-	-	-	-	-	-	-	7,500
1a.1.13	Perform SER and EA	-	-	-	-	-	-	255	38	293	293	-	-	-	-	-	-	-	-	-	3,100
1a.1.14	Prepare/submit Defueled Technical Specifications	-	-	-	-	-	-	616	92	708	708	-	-	-	-	-	-	-	-	-	7,500
1a.1.15	Perform Site-Specific Cost Study	-	-	-	-	-	-	411	62	472	472	-	-	-	-	-	-	-	-	-	5,000
1a.1.16	Prepare/submit Irradiated Fuel Management Plan	-	-	-	-	-	-	82	12	94	94	-	-	-	-	-	-	-	-	-	1,000
Activity Specifications																					
1a.1.17.1	Plant & temporary facilities	-	-	-	-	-	-	404	61	465	418	-	46	-	-	-	-	-	-	-	4,920
1a.1.17.2	Plant systems	-	-	-	-	-	-	342	51	393	354	-	39	-	-	-	-	-	-	-	4,167
1a.1.17.3	NSSS Decontamination Flush	-	-	-	-	-	-	41	6	47	47	-	-	-	-	-	-	-	-	-	500
1a.1.17.4	Reactor internals	-	-	-	-	-	-	583	87	671	671	-	-	-	-	-	-	-	-	-	7,100
1a.1.17.5	Reactor vessel	-	-	-	-	-	-	534	80	614	614	-	-	-	-	-	-	-	-	-	6,500
1a.1.17.6	Biological shield	-	-	-	-	-	-	41	6	47	47	-	-	-	-	-	-	-	-	-	500
1a.1.17.7	Steam generators	-	-	-	-	-	-	256	38	295	295	-	-	-	-	-	-	-	-	-	3,120
1a.1.17.8	Reinforced concrete	-	-	-	-	-	-	131	20	151	76	-	76	-	-	-	-	-	-	-	1,600
1a.1.17.9	Main Turbine	-	-	-	-	-	-	33	5	38	-	-	38	-	-	-	-	-	-	-	400
1a.1.17.10	Main Condensers	-	-	-	-	-	-	33	5	38	-	-	38	-	-	-	-	-	-	-	400
1a.1.17.11	Plant structures & buildings	-	-	-	-	-	-	256	38	295	147	-	147	-	-	-	-	-	-	-	3,120
1a.1.17.12	Waste management	-	-	-	-	-	-	378	57	434	434	-	-	-	-	-	-	-	-	-	4,600
1a.1.17.13	Facility & site closeout	-	-	-	-	-	-	74	11	85	42	-	42	-	-	-	-	-	-	-	900
1a.1.17	Total	-	-	-	-	-	-	3,106	466	3,572	3,146	-	427	-	-	-	-	-	-	-	37,827
Planning & Site Preparations																					
1a.1.18	Prepare dismantling sequence	-	-	-	-	-	-	197	30	227	227	-	-	-	-	-	-	-	-	-	2,400
1a.1.19	Plant prep. & temp. svces	-	-	-	-	-	-	4,200	630	4,830	4,830	-	-	-	-	-	-	-	-	-	-
1a.1.20	Design water clean-up system	-	-	-	-	-	-	115	17	132	132	-	-	-	-	-	-	-	-	-	1,400
1a.1.21	Rigging/Cont. Cntrl Envlps/tooling/etc.	-	-	-	-	-	-	2,900	435	3,335	3,335	-	-	-	-	-	-	-	-	-	-
1a.1.22	Procure casks/liners & containers	-	-	-	-	-	-	101	15	116	116	-	-	-	-	-	-	-	-	-	1,230
1a.1	Subtotal Period 1a Activity Costs	-	-	-	-	-	-	13,518	2,028	15,546	15,119	-	427	-	-	-	-	-	-	-	78,157
Period 1a Collateral Costs																					
1a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	4,374	656	5,030	-	5,030	-	-	-	-	-	-	-	-	-
1a.3.2	Groundwater	-	-	-	-	-	-	250	37	287	287	-	-	-	-	-	-	-	-	-	-
1a.3.3	Severance Program	-	-	-	-	-	-	5,432	815	6,247	6,247	-	-	-	-	-	-	-	-	-	-
1a.3.4	Barnwell Annual Access Fee	-	-	-	-	-	-	500	75	575	575	-	-	-	-	-	-	-	-	-	-
1a.3	Subtotal Period 1a Collateral Costs	-	-	-	-	-	-	10,555	1,583	12,138	7,109	5,030	-	-	-	-	-	-	-	-	-
Period 1a Period-Dependent Costs																					
1a.4.1	Insurance	-	-	-	-	-	-	2,453	245	2,699	2,699	-	-	-	-	-	-	-	-	-	-
1a.4.2	Property taxes	-	-	-	-	-	-	7,382	738	8,121	8,121	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	962	-	-	-	-	-	240	1,202	1,202	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	912	-	-	-	-	-	137	1,049	1,049	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	18	6	-	59	-	18	101	101	-	-	-	610	-	-	-	12,190	20	-
1a.4.6	Plant energy budget	-	-	-	-	-	-	816	122	938	938	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	1,464	146	1,611	1,611	-	-	-	-	-	-	-	-	-	-
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	1,367	137	1,504	-	1,504	-	-	-	-	-	-	-	-	-
1a.4.9	Site O&M Cost	-	-	-	-	-	-	726	109	835	835	-	-	-	-	-	-	-	-	-	-
1a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	1,029	154	1,183	-	1,183	-	-	-	-	-	-	-	-	-
1a.4.11	ISFSI Operating Costs	-	-	-	-	-	-	133	20	153	-	153	-	-	-	-	-	-	-	-	-
1a.4.12	Corporate A&G Cost	-	-	-	-	-	-	2,107	316	2,423	2,423	-	-	-	-	-	-	-	-	-	-
1a.4.13	Security Modifications	-	-	-	-	-	-	5,000	750	5,750	5,750	-	-	-	-	-	-	-	-	-	-
1a.4.14	Security Staff Cost	-	-	-	-	-	-	16,860	2,529	19,389	19,389	-	-	-	-	-	-	-	-	-	301,592
1a.4.15	Utility Staff Cost	-	-	-	-	-	-	29,820	4,473	34,293	34,293	-	-	-	-	-	-	-	-	-	422,240

Table C
H. B. Robinson Nuclear Power Plant U2
DECON Decommissioning Cost Estimate
(Thousands of 2024 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
1a.4	Subtotal Period 1a Period-Dependent Costs	-	1,874	18	6	-	59	69,158	10,135	81,251	78,411	2,840	-	-	610	-	-	-	12,190	20	723,832
1a.0	TOTAL PERIOD 1a COST	-	1,874	18	6	-	59	93,232	13,746	108,935	100,639	7,870	427	-	610	-	-	-	12,190	20	801,988
PERIOD 1b - Decommissioning Preparations																					
Period 1b Direct Decommissioning Activities																					
Detailed Work Procedures																					
1b.1.1.1	Plant systems	-	-	-	-	-	-	389	58	447	402	-	45	-	-	-	-	-	-	-	4,733
1b.1.1.2	NSSS Decontamination Flush	-	-	-	-	-	-	82	12	94	94	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.3	Reactor internals	-	-	-	-	-	-	205	31	236	236	-	-	-	-	-	-	-	-	-	2,500
1b.1.1.4	Remaining buildings	-	-	-	-	-	-	111	17	127	32	-	96	-	-	-	-	-	-	-	1,350
1b.1.1.5	CRD cooling assembly	-	-	-	-	-	-	82	12	94	94	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.6	CRD housings & ICI tubes	-	-	-	-	-	-	82	12	94	94	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.7	Incore instrumentation	-	-	-	-	-	-	82	12	94	94	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.8	Reactor vessel	-	-	-	-	-	-	298	45	343	343	-	-	-	-	-	-	-	-	-	3,630
1b.1.1.9	Facility closeout	-	-	-	-	-	-	99	15	113	57	-	57	-	-	-	-	-	-	-	1,200
1b.1.1.10	Missile shields	-	-	-	-	-	-	37	6	42	42	-	-	-	-	-	-	-	-	-	450
1b.1.1.11	Biological shield	-	-	-	-	-	-	99	15	113	113	-	-	-	-	-	-	-	-	-	1,200
1b.1.1.12	Steam generators	-	-	-	-	-	-	378	57	434	434	-	-	-	-	-	-	-	-	-	4,600
1b.1.1.13	Reinforced concrete	-	-	-	-	-	-	82	12	94	47	-	47	-	-	-	-	-	-	-	1,000
1b.1.1.14	Main Turbine	-	-	-	-	-	-	128	19	147	-	-	147	-	-	-	-	-	-	-	1,560
1b.1.1.15	Main Condensers	-	-	-	-	-	-	128	19	147	-	-	147	-	-	-	-	-	-	-	1,560
1b.1.1.16	Auxiliary building	-	-	-	-	-	-	224	34	258	232	-	26	-	-	-	-	-	-	-	2,730
1b.1.1.17	Reactor building	-	-	-	-	-	-	224	34	258	232	-	26	-	-	-	-	-	-	-	2,730
1b.1.1	Total	-	-	-	-	-	-	2,730	409	3,139	2,549	-	590	-	-	-	-	-	-	-	33,243
1b.1.2	Decon primary loop	3,214	-	-	-	-	-	-	1,607	4,820	4,820	-	-	-	-	-	-	-	-	1,067	-
1b.1	Subtotal Period 1b Activity Costs	3,214	-	-	-	-	-	2,730	2,016	7,960	7,369	-	590	-	-	-	-	-	-	1,067	33,243
Period 1b Additional Costs																					
1b.2.1	Spent Fuel Pool Isolation	-	-	-	-	-	-	15,055	2,258	17,313	17,313	-	-	-	-	-	-	-	-	-	-
1b.2.2	Site Characterization	-	-	-	-	-	-	6,073	1,822	7,895	7,895	-	-	-	-	-	-	-	-	32,260	10,796
1b.2.3	Asbestos Remediation	-	12,469	-	-	-	-	-	3,117	15,586	15,586	-	-	-	-	-	-	-	-	112,315	-
1b.2	Subtotal Period 1b Additional Costs	-	12,469	-	-	-	-	21,128	7,197	40,794	40,794	-	-	-	-	-	-	-	-	144,575	10,796
Period 1b Collateral Costs																					
1b.3.1	Decon equipment	1,253	-	-	-	-	-	-	188	1,441	1,441	-	-	-	-	-	-	-	-	-	-
1b.3.2	Staff relocation expenses	-	-	-	-	-	-	1,389	208	1,598	1,598	-	-	-	-	-	-	-	-	-	-
1b.3.3	Process decommissioning water waste	42	-	42	39	-	179	-	76	377	377	-	-	-	240	-	-	-	14,425	47	-
1b.3.4	Process decommissioning chemical flush waste	6	-	321	574	-	10,936	-	2,855	14,692	14,692	-	-	-	-	1,937	-	-	206,450	363	-
1b.3.5	Small tool allowance	-	169	-	-	-	-	-	25	194	194	-	-	-	-	-	-	-	-	-	-
1b.3.6	Pipe cutting equipment	-	1,500	-	-	-	-	-	225	1,725	1,725	-	-	-	-	-	-	-	-	-	-
1b.3.7	Decon rig	2,596	-	-	-	-	-	-	389	2,985	2,985	-	-	-	-	-	-	-	-	-	-
1b.3.8	Spent Fuel Capital and Transfer	-	-	-	-	-	-	3,192	479	3,671	-	3,671	-	-	-	-	-	-	-	-	-
1b.3.9	Groundwater	-	-	-	-	-	-	125	19	143	143	-	-	-	-	-	-	-	-	-	-
1b.3.10	Severance Program	-	-	-	-	-	-	5,835	875	6,711	6,711	-	-	-	-	-	-	-	-	-	-
1b.3.11	Barnwell Annual Access Fee	-	-	-	-	-	-	249	37	287	287	-	-	-	-	-	-	-	-	-	-
1b.3	Subtotal Period 1b Collateral Costs	3,897	1,669	363	613	-	11,115	10,791	5,377	33,824	30,153	3,671	-	-	240	1,937	-	-	220,874	409	-
Period 1b Period-Dependent Costs																					
1b.4.1	Decon supplies	45	-	-	-	-	-	-	11	56	56	-	-	-	-	-	-	-	-	-	-
1b.4.2	Insurance	-	-	-	-	-	-	1,223	122	1,346	1,346	-	-	-	-	-	-	-	-	-	-
1b.4.3	Property taxes	-	-	-	-	-	-	3,493	349	3,843	3,843	-	-	-	-	-	-	-	-	-	-
1b.4.4	Health physics supplies	-	1,558	-	-	-	-	-	390	1,948	1,948	-	-	-	-	-	-	-	-	-	-
1b.4.5	Heavy equipment rental	-	455	-	-	-	-	-	68	523	523	-	-	-	-	-	-	-	-	-	-
1b.4.6	Disposal of DAW generated	-	-	11	3	-	35	-	10	59	59	-	-	-	357	-	-	-	7,146	12	-
1b.4.7	Plant energy budget	-	-	-	-	-	-	813	122	936	936	-	-	-	-	-	-	-	-	-	-
1b.4.8	NRC Fees	-	-	-	-	-	-	449	45	494	494	-	-	-	-	-	-	-	-	-	-
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	682	68	750	-	750	-	-	-	-	-	-	-	-	-
1b.4.10	Site O&M Cost	-	-	-	-	-	-	379	57	436	436	-	-	-	-	-	-	-	-	-	-
1b.4.11	Spent Fuel Pool O&M	-	-	-	-	-	-	513	77	590	-	590	-	-	-	-	-	-	-	-	-
1b.4.12	ISFSI Operating Costs	-	-	-	-	-	-	66	10	76	-	76	-	-	-	-	-	-	-	-	-
1b.4.13	Corporate A&G Cost	-	-	-	-	-	-	1,382	207	1,589	1,589	-	-	-	-	-	-	-	-	-	-
1b.4.14	Security Staff Cost	-	-	-	-	-	-	8,407	1,261	9,668	9,668	-	-	-	-	-	-	-	-	-	150,383
1b.4.15	Utility Staff Cost	-	-	-	-	-	-	19,812	2,972	22,784	22,784	-	-	-	-	-	-	-	-	-	276,919

Table C
H. B. Robinson Nuclear Power Plant U2
DECON Decommissioning Cost Estimate
(Thousands of 2024 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
1b.4	Subtotal Period 1b Period-Dependent Costs	45	2,013	11	3	-	35	37,220	5,770	45,097	43,681	1,416	-	-	357	-	-	-	7,146	12	427,302
1b.0	TOTAL PERIOD 1b COST	7,156	16,151	374	616	-	11,149	71,869	20,361	127,675	121,997	5,087	590	-	598	1,937	-	-	228,020	146,063	471,341
PERIOD 1 TOTALS		7,156	18,025	392	622	-	11,208	165,101	34,107	236,610	222,636	12,957	1,017	-	1,207	1,937	-	-	240,210	146,083	1,273,330
PERIOD 2a - Large Component Removal																					
Period 2a Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
2a.1.1.1	Reactor Coolant Piping	322	289	98	91	-	431	-	364	1,596	1,596	-	-	-	3,473	-	-	-	242,289	9,553	-
2a.1.1.2	Pressurizer Relief Tank	28	25	13	12	-	58	-	38	175	175	-	-	-	467	-	-	-	32,612	871	-
2a.1.1.3	Reactor Coolant Pumps & Motors	103	85	566	206	-	1,720	-	590	3,270	3,270	-	-	-	4,548	-	-	-	576,900	3,504	100
2a.1.1.4	Pressurizer	-	63	465	130	-	615	-	235	1,508	1,508	-	-	-	1,625	-	-	-	207,852	1,346	1,875
2a.1.1.5	Steam Generators	-	8,093	4,568	1,447	2,503	3,403	-	3,924	23,938	23,938	-	-	25,862	8,997	-	-	-	2,278,096	17,515	3,500
2a.1.1.6	Retired Steam Generator Units	-	-	115	1,403	-	3,403	-	1,073	5,994	5,994	-	-	-	8,997	-	-	-	1,344,307	78	2,250
2a.1.1.7	CRDMs/ICIs/Service Structure Removal	160	322	357	55	-	320	-	285	1,499	1,499	-	-	-	4,888	-	-	-	179,569	7,289	-
2a.1.1.8	Reactor Vessel Internals	81	7,961	13,761	717	-	10,839	366	15,105	48,830	48,830	-	-	-	2,097	393	842	-	268,904	30,790	1,390
2a.1.1.9	Reactor Vessel	126	9,761	3,122	616	-	3,082	366	9,914	26,987	26,987	-	-	-	11,743	-	-	-	856,001	30,790	1,390
2a.1.1	Totals	820	26,599	23,066	4,676	2,503	23,872	732	31,528	113,798	113,798	-	-	25,862	46,836	393	842	-	5,986,530	101,736	10,505
Removal of Major Equipment																					
2a.1.2	Main Turbine/Generator	-	343	319	21	504	156	-	235	1,578	1,578	-	-	2,623	1,460	-	-	-	250,136	5,743	-
2a.1.3	Main Condensers	-	1,344	193	67	644	211	-	515	2,975	2,975	-	-	4,472	1,868	-	-	-	319,872	22,564	-
Cascading Costs from Clean Building Demolition																					
2a.1.4.1	Containment Building	-	512	-	-	-	-	-	77	589	589	-	-	-	-	-	-	-	-	4,246	-
2a.1.4.2	Radwaste	-	69	-	-	-	-	-	10	80	80	-	-	-	-	-	-	-	-	606	-
2a.1.4.3	Reactor Auxiliary	-	107	-	-	-	-	-	16	124	124	-	-	-	-	-	-	-	-	870	-
2a.1.4.4	Turbine	-	267	-	-	-	-	-	40	307	307	-	-	-	-	-	-	-	-	2,866	-
2a.1.4.5	Fuel Handling Bldg	-	116	-	-	-	-	-	17	133	133	-	-	-	-	-	-	-	-	1,037	-
2a.1.4	Totals	-	1,072	-	-	-	-	-	161	1,233	1,233	-	-	-	-	-	-	-	-	9,625	-
Disposal of Plant Systems																					
2a.1.5.1	Auxiliary Steam	-	142	-	-	-	-	-	21	164	16	-	147	-	-	-	-	-	-	2,588	-
2a.1.5.2	Chemical Feed	-	19	-	-	-	-	-	3	21	2	-	19	-	-	-	-	-	-	342	-
2a.1.5.3	Condensate Polishing	-	876	12	37	562	-	-	310	1,798	1,798	-	-	4,326	-	-	-	-	175,666	12,811	-
2a.1.5.4	Condenser Cleaning/Circ Water	-	78	-	-	-	-	-	12	90	9	-	81	-	-	-	-	-	-	1,447	-
2a.1.5.5	Fdwtr Condensate & Air Evac	-	471	-	-	-	-	-	71	541	135	-	406	-	-	-	-	-	-	8,650	-
2a.1.5.6	Gland Steam	-	36	-	-	-	-	-	5	41	4	-	37	-	-	-	-	-	-	653	-
2a.1.5.7	H2 & N2 Supply	-	7	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	141	-
2a.1.5.8	Heater Drains & Vents	-	331	-	-	-	-	-	50	380	-	-	380	-	-	-	-	-	-	5,982	-
2a.1.5.9	Hydrogen Seal Oil	-	60	-	-	-	-	-	9	69	7	-	62	-	-	-	-	-	-	1,100	-
2a.1.5.10	Instrument & Station Air	-	286	-	-	-	-	-	43	329	66	-	264	-	-	-	-	-	-	5,433	-
2a.1.5.11	Lube Oil	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	644	-
2a.1.5.12	Main & Extraction Steam	-	2,074	136	420	6,297	-	-	1,540	10,468	10,468	-	-	48,459	-	-	-	-	1,967,953	33,582	-
2a.1.5.13	Non-Contam Waste Oil Storage	-	27	-	-	-	-	-	4	31	-	-	31	-	-	-	-	-	-	484	-
2a.1.5.14	Penetration Pressurization	-	4	-	-	-	-	-	1	5	4	-	1	-	-	-	-	-	-	80	-
2a.1.5.15	Primary & Make-Up Water	-	223	-	-	-	-	-	33	256	77	-	179	-	-	-	-	-	-	4,018	-
2a.1.5.16	Reactor Aux Bldg Refridgerant	-	30	-	-	-	-	-	4	34	-	-	34	-	-	-	-	-	-	543	-
2a.1.5.17	Residual Heat Removal	670	357	163	72	222	493	-	608	2,584	2,584	-	-	1,712	4,308	-	-	-	346,587	7,758	-
2a.1.5.18	Service & Cooling Water	-	538	-	-	-	-	-	81	619	310	-	310	-	-	-	-	-	-	9,850	-
2a.1.5	Totals	670	5,595	311	529	7,082	493	-	2,801	17,480	15,480	-	2,001	54,497	4,308	-	-	-	2,490,205	96,104	-
2a.1.6	Scaffolding in support of decommissioning	-	214	-	-	-	-	-	32	246	246	-	-	-	-	-	-	-	-	4,337	-
2a.1	Subtotal Period 2a Activity Costs	1,490	35,167	23,890	5,294	10,733	24,732	732	35,272	137,309	135,308	-	2,001	87,452	54,472	393	842	-	9,046,742	240,109	10,505
Period 2a Additional Costs																					
2a.2.1	Remedial Action Surveys	-	-	-	-	-	-	2,362	709	3,071	3,071	-	-	-	-	-	-	-	-	34,168	-
2a.2.2	Retired Reactor Closure Head	-	-	589	129	-	700	-	253	1,672	1,672	-	-	-	2,180	-	-	-	260,330	1,970	500
2a.2.3	B&C SFP Legacy Waste	-	54	108	30	-	501	7	155	856	856	-	-	-	-	-	56	-	4,788	667	27
2a.2.4	Misc Hazardous Waste	-	-	6	8	-	4	-	3	21	21	-	-	-	53	-	-	-	2,000	67	-
2a.2	Subtotal Period 2a Additional Costs	-	54	703	167	-	1,206	2,369	1,120	5,620	5,620	-	-	-	2,232	-	56	-	267,117	36,871	527

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Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 2a Collateral Costs																					
2a.3.1	Process decommissioning water waste	67	-	68	63	-	292	-	123	613	613	-	-	-	392	-	-	-	23,523	76	-
2a.3.2	Process decommissioning chemical flush waste	2	-	112	200	-	893	-	266	1,473	1,473	-	-	-	676	-	-	-	72,014	126	-
2a.3.3	Small tool allowance	-	274	-	-	-	-	-	41	315	284	-	32	-	-	-	-	-	-	-	-
2a.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	23,502	3,525	27,028	-	27,028	-	-	-	-	-	-	-	-	-
2a.3.5	Groundwater	-	-	-	-	-	-	411	62	472	472	-	-	-	-	-	-	-	-	-	-
2a.3.6	Severance Program	-	-	-	-	-	-	490	74	564	564	-	-	-	-	-	-	-	-	-	-
2a.3.7	Barnwell Annual Access Fee	-	-	-	-	-	-	821	123	945	945	-	-	-	-	-	-	-	-	-	-
2a.3	Subtotal Period 2a Collateral Costs	69	274	180	263	-	1,185	25,225	4,213	31,409	4,350	27,028	32	-	1,068	-	-	-	95,537	203	-
Period 2a Period-Dependent Costs																					
2a.4.1	Decon supplies	149	-	-	-	-	-	-	37	186	186	-	-	-	-	-	-	-	-	-	-
2a.4.2	Insurance	-	-	-	-	-	-	942	94	1,036	1,036	-	-	-	-	-	-	-	-	-	-
2a.4.3	Property taxes	-	-	-	-	-	-	8,105	810	8,915	8,915	-	-	-	-	-	-	-	-	-	-
2a.4.4	Health physics supplies	-	4,096	-	-	-	-	-	1,024	5,120	5,120	-	-	-	-	-	-	-	-	-	-
2a.4.5	Heavy equipment rental	-	4,683	-	-	-	-	-	703	5,386	5,386	-	-	-	-	-	-	-	-	-	-
2a.4.6	Disposal of DAW generated	-	-	127	40	-	412	-	122	701	701	-	-	-	4,242	-	-	-	84,837	138	-
2a.4.7	Plant energy budget	-	-	-	-	-	-	1,274	191	1,465	1,465	-	-	-	-	-	-	-	-	-	-
2a.4.8	NRC Fees	-	-	-	-	-	-	1,353	135	1,488	1,488	-	-	-	-	-	-	-	-	-	-
2a.4.9	Emergency Planning Fees	-	-	-	-	-	-	970	97	1,067	-	1,067	-	-	-	-	-	-	-	-	-
2a.4.10	Site O&M Cost	-	-	-	-	-	-	701	105	806	806	-	-	-	-	-	-	-	-	-	-
2a.4.11	Spent Fuel Pool O&M	-	-	-	-	-	-	1,691	254	1,945	-	1,945	-	-	-	-	-	-	-	-	-
2a.4.12	ISFSI Operating Costs	-	-	-	-	-	-	219	33	251	-	251	-	-	-	-	-	-	-	-	-
2a.4.13	Corporate A&G Cost	-	-	-	-	-	-	3,762	564	4,326	4,326	-	-	-	-	-	-	-	-	-	-
2a.4.14	Security Staff Cost	-	-	-	-	-	-	16,247	2,437	18,684	18,684	-	-	-	-	-	-	-	-	-	276,946
2a.4.15	Utility Staff Cost	-	-	-	-	-	-	54,296	8,144	62,441	62,441	-	-	-	-	-	-	-	-	-	753,929
2a.4	Subtotal Period 2a Period-Dependent Costs	149	8,779	127	40	-	412	89,559	14,751	113,817	110,554	3,263	-	-	4,242	-	-	-	84,837	138	1,030,875
2a.0	TOTAL PERIOD 2a COST	1,708	44,274	24,900	5,764	10,733	27,535	117,885	55,356	288,155	255,832	30,290	2,032	87,452	62,014	393	898	-	9,494,233	277,321	1,041,906
PERIOD 2b - Site Decontamination																					
Period 2b Direct Decommissioning Activities																					
2b.1.1	Remove spent fuel racks	212	20	89	19	-	163	-	163	665	665	-	-	-	1,439	-	-	-	91,414	396	-
Disposal of Plant Systems																					
2b.1.2.1	Chemical & Volume Control	264	1,137	147	76	387	432	-	608	3,051	3,051	-	-	2,977	3,775	-	-	-	363,374	21,398	-
2b.1.2.2	Component Cooling Water	-	1,333	55	170	2,550	-	-	747	4,855	4,855	-	-	19,622	-	-	-	-	796,846	20,462	-
2b.1.2.3	Containment Smplng & P/A Vntng	-	125	12	5	14	36	-	44	236	236	-	-	106	312	-	-	-	24,390	1,790	-
2b.1.2.4	Contaminated Waste Oil Storage	-	133	12	7	52	33	-	52	289	289	-	-	401	287	-	-	-	34,797	1,969	-
2b.1.2.5	Dedicated Shutdown Diesel Gen	-	23	-	-	-	-	-	3	27	-	-	27	-	-	-	-	-	-	417	-
2b.1.2.6	Electrical (Clean)	-	2,004	-	-	-	-	-	301	2,304	-	-	2,304	-	-	-	-	-	-	35,162	-
2b.1.2.7	Electrical (Contaminated)	-	2,916	90	213	3,019	99	-	1,247	7,584	7,584	-	-	23,228	875	-	-	-	998,906	43,512	-
2b.1.2.8	Electrical (Decon)	23	455	8	19	271	9	-	172	956	956	-	-	2,086	79	-	-	-	89,697	6,928	-
2b.1.2.9	Electro-Hydraulic Hp Oil	-	20	-	-	-	-	-	3	23	-	-	23	-	-	-	-	-	-	362	-
2b.1.2.10	Emergency Diesel Generator	-	64	-	-	-	-	-	10	74	-	-	74	-	-	-	-	-	-	1,155	-
2b.1.2.11	Fire Protection	-	253	-	-	-	-	-	38	291	-	-	291	-	-	-	-	-	-	4,640	-
2b.1.2.12	Fuel Oil	-	144	-	-	-	-	-	22	165	-	-	165	-	-	-	-	-	-	2,529	-
2b.1.2.13	Gaseous Waste Disposal	-	110	13	10	93	35	-	53	314	314	-	-	716	306	-	-	-	48,713	1,712	-
2b.1.2.14	Generator Hydrogen	-	14	-	-	-	-	-	2	16	4	-	12	-	-	-	-	-	-	257	-
2b.1.2.15	Hvac Other	-	222	-	-	-	-	-	33	256	-	-	256	-	-	-	-	-	-	4,315	-
2b.1.2.16	Hvac React Turb Aux Fuel Rw	-	1,596	66	157	2,222	73	-	781	4,895	4,895	-	-	17,102	645	-	-	-	735,462	21,635	-
2b.1.2.17	Liquid Waste Disposal	741	959	119	56	244	349	-	754	3,223	3,223	-	-	1,878	3,046	-	-	-	272,109	23,521	-
2b.1.2.18	Post Accident Sampling	-	169	2	7	98	-	-	58	333	333	-	-	756	-	-	-	-	30,687	2,512	-
2b.1.2.19	Primary Sampling	-	153	16	5	10	38	-	52	274	274	-	-	78	328	-	-	-	24,665	2,288	-
2b.1.2.20	Reactor Coolant	-	83	6	4	34	17	-	31	176	176	-	-	264	153	-	-	-	20,482	1,343	-
2b.1.2.21	Safety Injection System	-	907	105	78	630	310	-	421	2,451	2,451	-	-	4,849	2,727	-	-	-	371,324	14,139	-
2b.1.2.22	Seconday Sampling	-	238	3	8	127	-	-	80	456	456	-	-	977	-	-	-	-	39,689	3,721	-
2b.1.2.23	Spent Fuel Pit Cooling	220	194	26	16	97	83	-	199	834	834	-	-	750	727	-	-	-	76,935	4,492	-
2b.1.2.24	Steam Generator Blowdown	-	855	78	32	114	213	-	297	1,589	1,589	-	-	878	1,852	-	-	-	155,456	12,304	-
2b.1.2	Totals	1,248	14,106	759	864	9,963	1,727	-	6,008	34,674	31,522	-	3,152	76,667	15,110	-	-	-	4,083,531	232,562	-
2b.1.3	Scaffolding in support of decommissioning	-	321	-	-	-	-	-	48	369	369	-	-	-	-	-	-	-	-	6,505	-
Decontamination of Site Buildings																					
2b.1.4.1	Containment Building	1,933	1,778	120	924	432	1,533	-	2,010	8,730	8,730	-	-	3,326	27,448	-	-	-	1,318,188	55,199	-
2b.1.4.2	Environmental & Rad Control	110	49	4	55	-	41	-	86	346	346	-	-	-	962	-	-	-	45,432	2,325	-

Table C
H. B. Robinson Nuclear Power Plant U2
DECON Decommissioning Cost Estimate
(Thousands of 2024 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Decontamination of Site Buildings (continued)																					
2b.1.4.3	Miscellaneous Structures - Contaminated	402	166	11	129	10	96	-	288	1,102	1,102	-	-	76	2,242	-	-	-	109,019	8,512	-
2b.1.4.4	Radwaste	116	90	7	55	86	40	-	112	506	506	-	-	660	900	-	-	-	69,742	3,002	-
2b.1.4.5	Reactor Auxiliary	291	129	12	146	-	108	-	228	913	913	-	-	-	2,541	-	-	-	120,015	6,142	-
2b.1.4.6	Reactor Head Storage Building	11	-	-	-	-	-	-	5	16	16	-	-	-	-	-	-	-	-	173	-
2b.1.4.7	Steam Generator Storage Building	16	-	-	-	-	-	-	8	24	24	-	-	-	-	-	-	-	-	258	-
2b.1.4.8	Turbine	147	-	-	-	-	-	-	74	221	221	-	-	-	-	-	-	-	-	2,385	-
2b.1.4.9	Fuel Handling Bldg	397	452	7	36	144	25	-	345	1,407	1,407	-	-	1,108	520	-	-	-	70,341	13,589	-
2b.1.4	Totals	3,422	2,664	161	1,346	672	1,843	-	3,156	13,263	13,263	-	-	5,170	34,612	-	-	-	1,732,736	91,583	-
2b.1.5	Prepare/submit License Termination Plan	-	-	-	-	-	-	336	50	387	387	-	-	-	-	-	-	-	-	-	4,096
2b.1.6	Receive NRC approval of termination plan									a											
2b.1	Subtotal Period 2b Activity Costs	4,882	17,110	1,009	2,228	10,635	3,732	336	9,426	49,358	46,206	-	3,152	81,837	51,162	-	-	-	5,907,680	331,047	4,096
Period 2b Additional Costs																					
2b.2.1	Remedial Action Surveys	-	-	-	-	-	-	3,279	984	4,263	4,263	-	-	-	-	-	-	-	-	47,437	-
2b.2.2	License Termination Survey Planning	-	-	-	-	-	-	1,399	420	1,819	1,819	-	-	-	-	-	-	-	-	-	12,480
2b.2.3	Operational Tools and Equipment	-	-	32	85	936	-	-	156	1,210	1,210	-	-	11,700	-	-	-	-	292,500	32	-
2b.2.4	Excavation of Underground Services	-	1,863	-	-	-	-	469	536	2,868	2,868	-	-	-	-	-	-	-	-	11,039	-
2b.2.5	Soil Removal and Disposal	-	437	217	11,161	-	9,315	-	3,586	24,716	24,716	-	-	-	117,720	-	-	-	9,182,160	2,872	-
2b.2	Subtotal Period 2b Additional Costs	-	2,300	249	11,246	936	9,315	5,147	5,682	34,875	34,875	-	-	11,700	117,720	-	-	-	9,474,660	61,381	12,480
Period 2b Collateral Costs																					
2b.3.1	Process decommissioning water waste	151	-	155	145	-	669	-	280	1,399	1,399	-	-	-	899	-	-	-	53,957	175	-
2b.3.2	Process decommissioning chemical flush waste	1	-	68	122	-	544	-	162	897	897	-	-	-	412	-	-	-	43,874	77	-
2b.3.3	Small tool allowance	-	344	-	-	-	-	-	52	395	395	-	-	-	-	-	-	-	-	-	-
2b.3.4	Decommissioning Equipment Disposition	-	-	196	74	864	60	-	175	1,369	1,369	-	-	6,000	529	-	-	-	303,608	147	-
2b.3.5	Spent Fuel Capital and Transfer	-	-	-	-	-	-	9,239	1,386	10,625	-	10,625	-	-	-	-	-	-	-	-	-
2b.3.6	Groundwater	-	-	-	-	-	-	570	86	656	656	-	-	-	-	-	-	-	-	-	-
2b.3.7	Severance Program	-	-	-	-	-	-	9,753	1,463	11,216	11,216	-	-	-	-	-	-	-	-	-	-
2b.3.8	Barnwell Annual Access Fee	-	-	-	-	-	-	1,140	171	1,311	1,311	-	-	-	-	-	-	-	-	-	-
2b.3	Subtotal Period 2b Collateral Costs	152	344	420	340	864	1,273	20,703	3,774	27,870	17,244	10,625	-	6,000	1,840	-	-	-	401,438	399	-
Period 2b Period-Dependent Costs																					
2b.4.1	Decon supplies	2,052	-	-	-	-	-	-	513	2,565	2,565	-	-	-	-	-	-	-	-	-	-
2b.4.2	Insurance	-	-	-	-	-	-	1,308	131	1,439	1,439	-	-	-	-	-	-	-	-	-	-
2b.4.3	Property taxes	-	-	-	-	-	-	6,361	636	6,997	6,997	-	-	-	-	-	-	-	-	-	-
2b.4.4	Health physics supplies	-	5,680	-	-	-	-	-	1,420	7,100	7,100	-	-	-	-	-	-	-	-	-	-
2b.4.5	Heavy equipment rental	-	6,665	-	-	-	-	-	1,000	7,665	7,665	-	-	-	-	-	-	-	-	-	-
2b.4.6	Disposal of DAW generated	-	-	154	49	-	501	-	148	853	853	-	-	-	5,157	-	-	-	103,134	168	-
2b.4.7	Plant energy budget	-	-	-	-	-	-	1,396	209	1,606	1,606	-	-	-	-	-	-	-	-	-	-
2b.4.8	NRC Fees	-	-	-	-	-	-	1,878	188	2,066	2,066	-	-	-	-	-	-	-	-	-	-
2b.4.9	Emergency Planning Fees	-	-	-	-	-	-	213	21	235	-	235	-	-	-	-	-	-	-	-	-
2b.4.10	Site O&M Cost	-	-	-	-	-	-	963	144	1,107	1,107	-	-	-	-	-	-	-	-	-	-
2b.4.11	Spent Fuel Pool O&M	-	-	-	-	-	-	372	56	428	-	428	-	-	-	-	-	-	-	-	-
2b.4.12	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	592	89	680	680	-	-	-	-	-	-	-	-	-	-
2b.4.13	ISFSI Operating Costs	-	-	-	-	-	-	303	46	349	-	349	-	-	-	-	-	-	-	-	-
2b.4.14	Corporate A&G Cost	-	-	-	-	-	-	5,010	751	5,761	5,761	-	-	-	-	-	-	-	-	-	-
2b.4.15	Security Staff Cost	-	-	-	-	-	-	12,331	1,850	14,180	14,180	-	-	-	-	-	-	-	-	-	208,729
2b.4.16	Utility Staff Cost	-	-	-	-	-	-	72,405	10,861	83,266	83,266	-	-	-	-	-	-	-	-	-	1,003,982
2b.4	Subtotal Period 2b Period-Dependent Costs	2,052	12,345	154	49	-	501	103,132	18,062	136,295	135,284	1,011	-	-	5,157	-	-	-	103,134	168	1,212,711
2b.0	TOTAL PERIOD 2b COST	7,085	32,099	1,832	13,864	12,435	14,821	129,318	36,944	248,398	233,610	11,637	3,152	99,537	175,878	-	-	-	15,886,910	392,995	1,229,287
PERIOD 2f - License Termination																					
Period 2f Direct Decommissioning Activities																					
2f.1.1	ORISE confirmatory survey	-	-	-	-	-	-	189	57	246	246	-	-	-	-	-	-	-	-	-	-
2f.1.2	Terminate license									a											
2f.1	Subtotal Period 2f Activity Costs	-	-	-	-	-	-	189	57	246	246	-	-	-	-	-	-	-	-	-	-
Period 2f Additional Costs																					
2f.2.1	License Termination Survey	-	-	-	-	-	-	6,454	1,936	8,390	8,390	-	-	-	-	-	-	-	-	90,927	6,240
2f.2	Subtotal Period 2f Additional Costs	-	-	-	-	-	-	6,454	1,936	8,390	8,390	-	-	-	-	-	-	-	-	90,927	6,240

Table C
H. B. Robinson Nuclear Power Plant U2
DECON Decommissioning Cost Estimate
(Thousands of 2024 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
	Period 2f Collateral Costs																				
2f.3.1	Staff relocation expenses	-	-	-	-	-	-	1,389	208	1,598	1,598	-	-	-	-	-	-	-	-	-	-
2f.3.2	Groundwater	-	-	-	-	-	-	188	28	216	216	-	-	-	-	-	-	-	-	-	-
2f.3.3	Severance Program	-	-	-	-	-	-	2,450	368	2,818	2,818	-	-	-	-	-	-	-	-	-	-
2f.3	Subtotal Period 2f Collateral Costs	-	-	-	-	-	-	4,028	604	4,632	4,632	-	-	-	-	-	-	-	-	-	-
	Period 2f Period-Dependent Costs																				
2f.4.1	Insurance	-	-	-	-	-	-	432	43	475	475	-	-	-	-	-	-	-	-	-	-
2f.4.2	Property taxes	-	-	-	-	-	-	28	3	31	31	-	-	-	-	-	-	-	-	-	-
2f.4.3	Health physics supplies	-	1,104	-	-	-	-	-	276	1,380	1,380	-	-	-	-	-	-	-	-	-	-
2f.4.4	Disposal of DAW generated	-	-	11	3	-	35	-	10	59	59	-	-	-	357	-	-	-	7,134	12	-
2f.4.5	Plant energy budget	-	-	-	-	-	-	123	18	141	141	-	-	-	-	-	-	-	-	-	-
2f.4.6	NRC Fees	-	-	-	-	-	-	621	62	683	683	-	-	-	-	-	-	-	-	-	-
2f.4.7	Site O&M Cost	-	-	-	-	-	-	269	40	309	286	23	-	-	-	-	-	-	-	-	-
2f.4.8	ISFSI Operating Costs	-	-	-	-	-	-	100	15	115	-	115	-	-	-	-	-	-	-	-	-
2f.4.9	Corporate A&G Cost	-	-	-	-	-	-	704	106	809	749	61	-	-	-	-	-	-	-	-	-
2f.4.10	Security Staff Cost	-	-	-	-	-	-	3,435	515	3,950	1,090	2,860	-	-	-	-	-	-	-	-	57,982
2f.4.11	Utility Staff Cost	-	-	-	-	-	-	10,846	1,627	12,473	11,538	936	-	-	-	-	-	-	-	-	141,041
2f.4	Subtotal Period 2f Period-Dependent Costs	-	1,104	11	3	-	35	16,558	2,716	20,426	16,431	3,995	-	-	357	-	-	-	7,134	12	199,023
2f.0	TOTAL PERIOD 2f COST	-	1,104	11	3	-	35	27,228	5,313	33,694	29,699	3,995	-	-	357	-	-	-	7,134	90,938	205,263
	PERIOD 2 TOTALS	8,793	77,477	26,742	19,631	23,168	42,391	274,431	97,613	570,247	519,140	45,922	5,184	186,990	238,249	393	898	-	25,388,280	761,254	2,476,457
	PERIOD 3b - Site Restoration																				
	Period 3b Direct Decommissioning Activities																				
	Demolition of Remaining Site Buildings																				
3b.1.1.1	Condensate Polishing	-	108	-	-	-	-	-	16	124	-	-	124	-	-	-	-	-	-	802	-
3b.1.1.2	Containment Building	-	2,913	-	-	-	-	-	437	3,350	-	-	3,350	-	-	-	-	-	-	24,210	-
3b.1.1.3	Diesel Generator	-	93	-	-	-	-	-	14	107	-	-	107	-	-	-	-	-	-	785	-
3b.1.1.4	Environmental & Rad Control	-	103	-	-	-	-	-	15	119	-	-	119	-	-	-	-	-	-	783	-
3b.1.1.5	Flex Building	-	472	-	-	-	-	-	71	542	-	-	542	-	-	-	-	-	-	2,591	-
3b.1.1.6	Intake & Discharge Structures	-	1,090	-	-	-	-	-	164	1,254	-	-	1,254	-	-	-	-	-	-	11,987	-
3b.1.1.7	Miscellaneous Structures - Clean	-	2,479	-	-	-	-	-	372	2,851	-	-	2,851	-	-	-	-	-	-	14,833	-
3b.1.1.8	Miscellaneous Structures - Contaminated	-	1,128	-	-	-	-	-	169	1,297	-	-	1,297	-	-	-	-	-	-	8,357	-
3b.1.1.9	Radwaste	-	1,315	-	-	-	-	-	197	1,513	-	-	1,513	-	-	-	-	-	-	11,547	-
3b.1.1.10	Reactor Auxiliary	-	992	-	-	-	-	-	149	1,141	-	-	1,141	-	-	-	-	-	-	8,272	-
3b.1.1.11	Reactor Head Storage Building	-	78	-	-	-	-	-	12	89	-	-	89	-	-	-	-	-	-	376	-
3b.1.1.12	Security Enclosures	-	41	-	-	-	-	-	6	47	-	-	47	-	-	-	-	-	-	350	-
3b.1.1.13	Site Paving,Fencing and Rail	-	1,187	-	-	-	-	-	178	1,365	-	-	1,365	-	-	-	-	-	-	11,970	-
3b.1.1.14	Steam Generator Storage Building	-	338	-	-	-	-	-	51	389	-	-	389	-	-	-	-	-	-	3,226	-
3b.1.1.15	Training, EOF & TCS	-	491	-	-	-	-	-	74	564	-	-	564	-	-	-	-	-	-	3,970	-
3b.1.1.16	Transformer & Misc Yard Foundations	-	639	-	-	-	-	-	96	735	-	-	735	-	-	-	-	-	-	6,871	-
3b.1.1.17	Turbine	-	2,579	-	-	-	-	-	387	2,966	-	-	2,966	-	-	-	-	-	-	26,552	-
3b.1.1.18	Fuel Handling Bldg	-	1,070	-	-	-	-	-	160	1,230	-	-	1,230	-	-	-	-	-	-	9,807	-
3b.1.1	Totals	-	17,117	-	-	-	-	-	2,567	19,684	-	-	19,684	-	-	-	-	-	-	147,290	-
	Site Closeout Activities																				
3b.1.2	Remove Rubble	-	2,200	-	-	-	-	-	330	2,530	-	-	2,530	-	-	-	-	-	-	7,679	-
3b.1.3	Grade & landscape site	-	332	-	-	-	-	-	50	382	-	-	382	-	-	-	-	-	-	703	-
3b.1.4	Final report to NRC	-	-	-	-	-	-	128	19	147	147	-	-	-	-	-	-	-	-	-	1,560
3b.1	Subtotal Period 3b Activity Costs	-	19,649	-	-	-	-	128	2,967	22,744	147	-	22,596	-	-	-	-	-	-	155,673	1,560
	Period 3b Additional Costs																				
3b.2.1	Concrete Crushing	-	645	-	-	-	-	21	100	765	-	-	765	-	-	-	-	-	-	2,001	-
3b.2.2	Construction Debris	-	-	-	-	-	-	3,062	459	3,521	-	-	3,521	-	-	-	-	-	-	-	-
3b.2.3	Intake Cofferdam	-	534	-	-	-	-	-	80	614	-	-	614	-	-	-	-	-	-	3,449	-
3b.2.4	Discharge Cofferdam	-	344	-	-	-	-	-	52	395	-	-	395	-	-	-	-	-	-	2,040	-
3b.2.5	Low Volume Retention Basins	-	816	-	-	-	-	15	125	956	-	-	956	-	-	-	-	-	-	1,275	-
3b.2.6	Firing Range Closure	-	109	-	-	-	-	94	31	234	-	-	234	-	-	-	-	-	-	419	-
3b.2.7	Well Closures	-	-	-	-	-	-	28	4	32	-	-	32	-	-	-	-	-	-	242	-
3b.2	Subtotal Period 3b Additional Costs	-	2,448	-	-	-	-	3,220	850	6,518	-	-	6,518	-	-	-	-	-	-	9,426	-

Table C
H. B. Robinson Nuclear Power Plant U2
DECON Decommissioning Cost Estimate
(Thousands of 2024 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
	Period 3b Collateral Costs																				
3b.3.1	Small tool allowance	-	167	-	-	-	-	-	25	192	-	-	192	-	-	-	-	-	-	-	-
3b.3.2	Severance Program	-	-	-	-	-	-	5,477	822	6,299	-	-	6,299	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	-	167	-	-	-	-	5,477	847	6,491	-	-	6,491	-	-	-	-	-	-	-	-
	Period 3b Period-Dependent Costs																				
3b.4.1	Insurance	-	-	-	-	-	-	1,146	115	1,261	-	-	1,261	-	-	-	-	-	-	-	-
3b.4.2	Property taxes	-	-	-	-	-	-	75	7	82	-	82	-	-	-	-	-	-	-	-	-
3b.4.3	Heavy equipment rental	-	7,996	-	-	-	-	-	1,199	9,196	-	-	9,196	-	-	-	-	-	-	-	-
3b.4.4	Plant energy budget	-	-	-	-	-	-	163	24	188	-	-	188	-	-	-	-	-	-	-	-
3b.4.5	NRC ISFSI Fees	-	-	-	-	-	-	723	72	795	-	795	-	-	-	-	-	-	-	-	-
3b.4.6	Site O&M Cost	-	-	-	-	-	-	315	47	362	-	293	69	-	-	-	-	-	-	-	-
3b.4.7	ISFSI Operating Costs	-	-	-	-	-	-	266	40	306	-	306	-	-	-	-	-	-	-	-	-
3b.4.8	Corporate A&G Cost	-	-	-	-	-	-	1,313	197	1,510	-	162	1,348	-	-	-	-	-	-	-	-
3b.4.9	Security Staff Cost	-	-	-	-	-	-	9,119	1,368	10,486	-	7,592	2,894	-	-	-	-	-	-	-	153,916
3b.4.10	Utility Staff Cost	-	-	-	-	-	-	19,867	2,980	22,847	-	2,468	20,380	-	-	-	-	-	-	-	263,120
3b.4	Subtotal Period 3b Period-Dependent Costs	-	7,996	-	-	-	-	32,986	6,050	47,033	-	11,697	35,336	-	-	-	-	-	-	-	417,036
3b.0	TOTAL PERIOD 3b COST	-	30,261	-	-	-	-	41,812	10,714	82,786	147	11,697	70,942	-	-	-	-	-	-	165,098	418,596
	PERIOD 3c - Fuel Storage Operations/Shipping																				
	Period 3c Direct Decommissioning Activities																				
	Period 3c Collateral Costs																				
3c.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	9,688	1,453	11,141	-	11,141	-	-	-	-	-	-	-	-	-
3c.3	Subtotal Period 3c Collateral Costs	-	-	-	-	-	-	9,688	1,453	11,141	-	11,141	-	-	-	-	-	-	-	-	-
	Period 3c Period-Dependent Costs																				
3c.4.1	Insurance	-	-	-	-	-	-	10,445	1,045	11,490	-	11,490	-	-	-	-	-	-	-	-	-
3c.4.2	Property taxes	-	-	-	-	-	-	679	68	747	-	747	-	-	-	-	-	-	-	-	-
3c.4.3	Plant energy budget	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3c.4.4	NRC ISFSI Fees	-	-	-	-	-	-	8,443	844	9,287	-	9,287	-	-	-	-	-	-	-	-	-
3c.4.5	Site O&M Cost	-	-	-	-	-	-	2,320	348	2,668	-	2,668	-	-	-	-	-	-	-	-	-
3c.4.6	ISFSI Operating Costs	-	-	-	-	-	-	2,423	363	2,786	-	2,786	-	-	-	-	-	-	-	-	-
3c.4.7	Corporate A&G Cost	-	-	-	-	-	-	1,277	192	1,468	-	1,468	-	-	-	-	-	-	-	-	-
3c.4.8	Security Staff Cost	-	-	-	-	-	-	60,121	9,018	69,140	-	69,140	-	-	-	-	-	-	-	-	1,061,375
3c.4.9	Utility Staff Cost	-	-	-	-	-	-	19,590	2,939	22,529	-	22,529	-	-	-	-	-	-	-	-	255,874
3c.4	Subtotal Period 3c Period-Dependent Costs	-	-	-	-	-	-	105,298	14,816	120,114	-	120,114	-	-	-	-	-	-	-	-	1,317,249
3c.0	TOTAL PERIOD 3c COST	-	-	-	-	-	-	114,985	16,269	131,255	-	131,255	-	-	-	-	-	-	-	-	1,317,249
	PERIOD 3d - GTCC shipping																				
	Period 3d Direct Decommissioning Activities																				
	Nuclear Steam Supply System Removal																				
3d.1.1.1	Vessel & Internals GTCC Disposal	-	-	781	-	-	9,476	-	1,617	11,874	11,874	-	-	-	-	-	-	1,785	356,397	-	-
3d.1.1	Totals	-	-	781	-	-	9,476	-	1,617	11,874	11,874	-	-	-	-	-	-	1,785	356,397	-	-
3d.1	Subtotal Period 3d Activity Costs	-	-	781	-	-	9,476	-	1,617	11,874	11,874	-	-	-	-	-	-	1,785	356,397	-	-
	Period 3d Period-Dependent Costs																				
3d.4.1	Insurance	-	-	-	-	-	-	22	2	24	24	-	-	-	-	-	-	-	-	-	-
3d.4.2	Property taxes	-	-	-	-	-	-	1	0	2	2	-	-	-	-	-	-	-	-	-	-
3d.4.3	Plant energy budget	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3d.4.4	NRC ISFSI Fees	-	-	-	-	-	-	14	1	15	-	15	-	-	-	-	-	-	-	-	-
3d.4.5	Site O&M Cost	-	-	-	-	-	-	5	1	6	6	-	-	-	-	-	-	-	-	-	-
3d.4.6	ISFSI Operating Costs	-	-	-	-	-	-	5	1	6	-	6	-	-	-	-	-	-	-	-	-
3d.4.7	Corporate A&G Cost	-	-	-	-	-	-	3	0	3	3	-	-	-	-	-	-	-	-	-	-
3d.4.8	Security Staff Cost	-	-	-	-	-	-	127	19	146	146	-	-	-	-	-	-	-	-	-	2,234
3d.4.9	Utility Staff Cost	-	-	-	-	-	-	41	6	47	47	-	-	-	-	-	-	-	-	-	539
3d.4	Subtotal Period 3d Period-Dependent Costs	-	-	-	-	-	-	218	31	249	227	21	-	-	-	-	-	-	-	-	2,772
3d.0	TOTAL PERIOD 3d COST	-	-	781	-	-	9,476	218	1,648	12,123	12,102	21	-	-	-	-	-	1,785	356,397	-	2,772

Table C
H. B. Robinson Nuclear Power Plant U2
DECON Decommissioning Cost Estimate
(Thousands of 2024 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 3e - ISFSI Decontamination																					
Period 3e Direct Decommissioning Activities																					
Period 3e Additional Costs																					
3e.2.1	License Termination ISFSI	-	134	237	2,667	-	2,283	2,077	1,850	9,248	9,248	-	-	-	19,148	-	-	-	2,308,790	8,054	2,225
3e.2	Subtotal Period 3e Additional Costs	-	134	237	2,667	-	2,283	2,077	1,850	9,248	9,248	-	-	-	19,148	-	-	-	2,308,790	8,054	2,225
Period 3e Period-Dependent Costs																					
3e.4.1	Insurance	-	-	-	-	-	-	98	25	123	123	-	-	-	-	-	-	-	-	-	-
3e.4.2	Property taxes	-	-	-	-	-	-	13	3	16	16	-	-	-	-	-	-	-	-	-	-
3e.4.3	Plant energy budget	-	-	-	-	-	-	5	1	7	7	-	-	-	-	-	-	-	-	-	-
3e.4.4	Site O&M Cost	-	-	-	-	-	-	22	5	27	27	-	-	-	-	-	-	-	-	-	-
3e.4.5	Corporate A&G Cost	-	-	-	-	-	-	19	5	24	24	-	-	-	-	-	-	-	-	-	-
3e.4.6	Security Staff Cost	-	-	-	-	-	-	289	72	362	362	-	-	-	-	-	-	-	-	-	5,082
3e.4.7	Utility Staff Cost	-	-	-	-	-	-	289	72	361	361	-	-	-	-	-	-	-	-	-	3,855
3e.4	Subtotal Period 3e Period-Dependent Costs	-	-	-	-	-	-	736	184	919	919	-	-	-	-	-	-	-	-	-	8,937
3e.0	TOTAL PERIOD 3e COST	-	134	237	2,667	-	2,283	2,812	2,033	10,167	10,167	-	-	-	19,148	-	-	-	2,308,790	8,054	11,162
PERIOD 3f - ISFSI Site Restoration																					
Period 3f Direct Decommissioning Activities																					
Period 3f Additional Costs																					
3f.2.1	Demolition and Site Restoration ISFSI	-	1,977	-	-	-	-	70	307	2,354	-	-	2,354	-	-	-	-	-	-	7,555	160
3f.2	Subtotal Period 3f Additional Costs	-	1,977	-	-	-	-	70	307	2,354	-	-	2,354	-	-	-	-	-	-	7,555	160
Period 3f Collateral Costs																					
3f.3.1	Small tool allowance	-	9	-	-	-	-	-	1	11	-	-	11	-	-	-	-	-	-	-	-
3f.3	Subtotal Period 3f Collateral Costs	-	9	-	-	-	-	-	1	11	-	-	11	-	-	-	-	-	-	-	-
Period 3f Period-Dependent Costs																					
3f.4.1	Insurance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3f.4.2	Property taxes	-	-	-	-	-	-	6	1	7	-	-	7	-	-	-	-	-	-	-	-
3f.4.3	Plant energy budget	-	-	-	-	-	-	3	0	3	-	-	3	-	-	-	-	-	-	-	-
3f.4.4	Site O&M Cost	-	-	-	-	-	-	11	2	12	-	-	12	-	-	-	-	-	-	-	-
3f.4.5	Corporate A&G Cost	-	-	-	-	-	-	8	1	9	-	-	9	-	-	-	-	-	-	-	-
3f.4.6	Security Staff Cost	-	-	-	-	-	-	143	22	165	-	-	165	-	-	-	-	-	-	-	2,520
3f.4.7	Utility Staff Cost	-	-	-	-	-	-	119	18	136	-	-	136	-	-	-	-	-	-	-	1,564
3f.4	Subtotal Period 3f Period-Dependent Costs	-	-	-	-	-	-	289	43	333	-	-	333	-	-	-	-	-	-	-	4,084
3f.0	TOTAL PERIOD 3f COST	-	1,987	-	-	-	-	359	352	2,698	-	-	2,698	-	-	-	-	-	-	7,555	4,244
PERIOD 3 TOTALS		-	32,381	1,019	2,667	-	11,759	160,186	31,016	239,028	22,416	142,973	73,640	-	19,148	-	-	1,785	2,665,187	180,707	1,754,024
TOTAL COST TO DECOMMISSION		15,949	127,883	28,153	22,920	23,168	65,359	599,718	162,736	1,045,885	764,193	201,852	79,841	186,990	258,604	2,330	898	1,785	28,293,680	1,088,044	5,503,810

Table C
H. B. Robinson Nuclear Power Plant U2
DECON Decommissioning Cost Estimate
(Thousands of 2024 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours

TOTAL COST TO DECOMMISSION WITH 18.43% CONTINGENCY:	$1,045,885	thousands of 2024 dollars
TOTAL NRC LICENSE TERMINATION COST IS 73.07% OR:	$764,193	thousands of 2024 dollars
SPENT FUEL MANAGEMENT COST IS 19.3% OR:	$201,852	thousands of 2024 dollars
NON-NUCLEAR DEMOLITION COST IS 7.63% OR:	$79,841	thousands of 2024 dollars
TOTAL LOW-LEVEL RADIOACTIVE WASTE VOLUME BURIED (EXCLUDING GTCC):	261,832	Cubic Feet
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	1,785	Cubic Feet
TOTAL SCRAP METAL REMOVED:	40,184	Tons
TOTAL CRAFT LABOR REQUIREMENTS:	1,088,044	Man-hours

End Notes:
n/a - indicates that this activity not charged as decommissioning expense
a - indicates that this activity performed by decommissioning staff
0 - indicates that this value is less than 0.5 but is non-zero
A cell containing " - " indicates a zero value

APPENDIX D

ISFSI DECOMMISSIONING COST SUMMARY

Table D
H.B. Robinson Nuclear Plant
ISFSI Decommissioning Cost Estimate
(thousands of 2024 dollars)

Activity Description	Removal Costs	Packaging Costs	Transport Costs	LLRW Disposal Costs	Other Costs	Total Costs	Burial Volume Class A (cubic feet)	Craft Manhours	Oversight and Contractor Manhours
Decommissioning Contractor									
Planning (characterization, specs and procedures)	-	-	-	-	252	252	-	-	1,072
Decontamination (activated disposition)	134	238	2,667	2,283	-	5,322	19,148	522	-
License Termination (radiological surveys)	-	-	-	-	1,169	1,169	-	7,532	-
Subtotal	**134**	**238**	**2,667**	**2,283**	**1,421**	**6,742**	**19,148**	**8,054**	**1,072**
Supporting Costs									
NRC and NRC Contractor Fees and Costs	-	-	-	-	656	656	-	-	1,153
Insurance	-	-	-	-	98	98	-	-	-
Property taxes	-	-	-	-	13	13	-	-	-
Plant energy budget	-	-	-	-	5	5	-	-	-
Site O&M Cost	-	-	-	-	22	22	-	-	-
Corporate A&G Cost	-	-	-	-	19	19	-	-	-
Security Staff Cost	-	-	-	-	289	289	-	-	5,082
Utility Staff Cost	-	-	-	-	289	289	-	-	3,855
Subtotal	-	-	-	-	**1,391**	**1,391**	**-**	**-**	**10,090**
Total (w/o contingency)	**134**	**238**	**2,667**	**2,283**	**2,812**	**8,134**	**19,148**	**8,054**	**11,162**
Total (w/25% contingency)	**167**	**297**	**3,334**	**2,854**	**3,515**	**10,167**	**-**	**-**	**-**

The application of contingency (25%) is consistent with the evaluation criteria referenced by the NRC in NUREG-1757 ("Consolidated Decommissioning Guidance, Financial Assurance, Recordkeeping, and Timeliness," U.S. NRC's Office of Nuclear Material Safety and Safeguards, NUREG-1757, Vol. 3, Rev. 1, February 2012)