

IM EXHIBIT: _____

INDIANA MICHIGAN POWER COMPANY

PRE-FILED VERIFIED DIRECT TESTIMONY

OF

RODERICK W. KNIGHT

Cause No. 45933

August 9, 2023

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**DIRECT TESTIMONY OF RODERICK W. KNIGHT
ON BEHALF OF
INDIANA MICHIGAN POWER COMPANY**

I. Introduction

1 **Q1. Please state your name and business address.**

2 My name is Roderick W. Knight. My business address is TLG Services, LLC, 148
3 New Milford Road East, Bridgewater, Connecticut 06752.

4 **Q2. How are you employed?**

5 I am employed by TLG Services, LLC (TLG), as Decommissioning Manager.
6 TLG is a wholly owned subsidiary of Entergy Nuclear, Inc. (ENI).

7 **Q3. What are your responsibilities within that organization?**

8 As decommissioning manager, I am responsible for all aspects of cost
9 engineering including estimating, planning, scheduling, material takeoff, cash
10 flow analysis and litigation support. I also manage the engineering staff
11 developing decommissioning cost estimates.

12 **Q4. On whose behalf are you testifying?**

13 I am testifying on behalf of Indiana Michigan Power Company (IMPC).

14 **Q5. Please summarize your educational and professional background.**

15 I earned a Bachelor of Science degree in Civil Engineering from the University of
16 New Haven in 1992, graduating Magna Cum Laude. I also earned a Bachelor of
17 Science degree in Natural Resource Management from the University of Maine in
18 1981. I am a member of Chi Epsilon, an honorary Civil Engineering Society.

1 I have over 37 years of experience performing cost estimates for the nuclear
2 industry for commercial, government and research facilities. My expertise
3 includes the analysis of post-shutdown cost reduction methods including the
4 analysis of spent fuel storage options, volume reduction techniques, staff levels
5 and schedule optimization. I have also performed numerous prudency reviews of
6 cost estimates developed by others, for confidential clients. I have taught
7 classes on how to develop decommissioning cost estimates for the International
8 Atomic Energy Agency (IAEA) to members from various countries. The IAEA
9 work also includes the development of lesson plans for future workshops. I have
10 also taught a similar class in South Korea.

11 I am currently employed by TLG Services, onboarding in 2016. I was formerly
12 employed by Knight Cost Engineering Services, LLC (KCES) from 2004 until
13 2016, SCIENTECH, Inc. and by its predecessor NES, Inc. from 1992 until 2004,
14 and TLG from 1985 to 1992. As the sole proprietor of KCES I was responsible for
15 all aspects of cost engineering including estimating, planning, scheduling,
16 material takeoff, cash flow analysis and litigation support. I also contracted
17 support staff on an as-needed basis and oversaw their work. As an employee of
18 SCIENTECH/NES I served as Project Manager in the preparation of well over
19 100 decommissioning cost estimates. I also served as one of eleven members
20 on the EM-6 Expert Review Team for the Department of Energy at Brookhaven
21 National Laboratory. I presented a paper entitled "How Utilities Can Achieve
22 More Accurate Decommissioning Cost Estimates," at the 1999 ANS Winter
23 Meeting in Long Beach California. I also developed lesson plans and was an
24 instructor at the SCIENTECH-sponsored Decommissioning Workshop. Prior to
25 this, I was employed by TLG Engineering for seven years, where I was
26 responsible for the management of decommissioning cost estimates from
27 preliminary client contact to preparation of the final report.

28 I also have extensive international experience including numerous missions with
29 the IAEA. These missions include providing decommissioning cost estimating

1 support in Kazakhstan for the BN-350 Nuclear Power Plant and in Croatia and
2 Slovenia in support of the Krsko Nuclear Power Plant decommissioning plan. I
3 have also worked as part of a SCIENTECH team contracted by PA Government
4 Services (PA) to assist in developing and promoting a series of reforms for the
5 Armenian energy sector.

6 In addition to developing decommissioning cost estimates for commercial nuclear
7 power plants, I have developed estimates for a variety of facilities. These
8 estimates were developed for a number of reasons, including proposal support,
9 owner estimates and project funding. This work includes the development of
10 estimates at several national laboratories, including Los Alamos, Argonne and
11 Brookhaven. In addition, I have developed estimates for manufacturing facilities
12 and research facilities. Most of these estimates included the remediation of both
13 radiological and hazardous wastes.

II. Purpose of Testimony

14 **Q6. What is the purpose of your testimony in this proceeding?**

15 The purpose of my testimony is to present the results of the Decommissioning
16 Cost Study for the D.C. Cook Nuclear Power Plant, December 2021, Revision 0
17 (2021 Study), as prepared for Indiana Michigan Power Company (IMPC) by TLG,
18 and to support the Company's reliance on the 2021 study in this base case.

19 **Q7. Are you sponsoring any attachments in this proceeding?**

20 Yes. I sponsor the following attachments, which were prepared or assembled by
21 me or under my supervision:

22 Att. RWK-1: Resume of Roderick W. Knight

1 decommissioning scenario was developed for the two-unit Cook Plant. This
2 scenario includes the cost for the immediate decommissioning of the site
3 (DECON), on-site spent fuel storage of spent fuel through site restoration and the
4 removal of clean structures.

5 A spent fuel storage period length has not been determined; as such, an annual
6 cost is included for on-going spent fuel storage. A cost for the eventual
7 Independent Spent Fuel Storage Installation ISFSI decontamination and site
8 restoration has also been included. The cost estimate is contained in the 2021
9 Study, which has been marked as Attachment RWK-2.

10 **Q10. Is it reasonable to use the 2021 study to assess nuclear decommissioning**
11 **costs in this case?**

12 Yes. The December 2021 Study, Revision 0 incorporates the most current
13 information available to date. There have not been any significant changes in
14 Site-specific parameters since the 2021 Study.

15 **Q11. What is included in the 2021 study?**

16 The report contains a description of the decommissioning cost estimate
17 considered to be feasible for the Cook Plant, the cost estimate itself, and the
18 estimate of the schedule of performance. All costs are in 2021 dollars, which
19 means that although a task may not actually occur until after final shutdown, its
20 cost is estimated as if it occurred in 2021.

1 The decommissioning cost summary is shown in *Figure RWK-1*.

Figure RWK-1. Cost Summary (\$000, in 2021 dollars)

	License Termination	Spent Fuel Management	Site Restoration	Total Cost ¹
Unit 1	\$735,680	\$259,580	\$58,068	\$1,053,328
Unit 2	\$750,031	\$255,809	\$97,094	\$1,102,934
ISFSI Operations, annual		\$7,446		\$7,446
ISFSI License Termination		\$23,313		\$23,313
ISFSI Site Restoration			\$9,945	\$9,945

2 **Q12. What is the decommissioning scenario?**

3 The decommissioning alternative considered in the study is DECON. The NRC
 4 defines DECON as "the alternative in which the equipment, structures, and
 5 portions of a facility and site containing radioactive contaminants are removed or
 6 decontaminated to a level that permits the property to be released for
 7 unrestricted use shortly after cessation of operations."²

8 This option is based on sequential shutdown of Cook Plant Units 1 and 2, with
 9 Unit 1 shutdown on October 25, 2034, and Unit 2 on December 23, 2037.

¹ Totals may be slightly off due to rounding

² 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 24022, Column 3), June 27, 1988.

1 **Q13. What are the line item entries “license termination” and “site restoration”**
2 **in Figure RWK-1?**

3 The *Figure RWK-1* term License Termination refers to 10 Code of Federal
4 Regulations (CFR) 50.75(c) costs pertaining to the achievement of
5 decommissioning objectives and work, but which specifically excludes the costs
6 of removal and disposal of spent fuel and the removal of clean structures and
7 structures. The *Figure RWK-1* term Site Restoration refers to the costs of
8 removal of clean systems and structures.

9 **Q14. What is the line item entry “spent fuel management” in *Figure RWK-1*?**

10 While the site is licensed under 10 CFR 50, 10 CFR 50.54(bb) requires funding
11 by the licensee “for the management of all irradiated fuel at the reactor following
12 permanent cessation of operation of the reactor until title to the irradiated fuel
13 and possession of the fuel is transferred to the Secretary of Energy for its
14 ultimate disposal in a repository.”

15 The costs labeled Fuel Storage represent the costs that will be incurred after final
16 shutdown of both Cook Plant units during the period of on-site spent fuel storage
17 in the existing fuel storage pool and/or on-site dry storage in an ISFSI. On-site
18 spent fuel storage costs are included through site restoration.

19 Since a spent fuel storage period length has not been determined, an annual
20 cost is included for on-going spent fuel storage. These are the costs that the
21 utility will incur due to the post-shutdown management of spent fuel prior to
22 acceptance by the Department of Energy for disposal at a repository.

23 As prescribed in 10 CFR 50.75(c) a licensee must provide reasonable assurance
24 that funds will be available for the decommissioning process. The NRC definition
25 of decommissioning does not include the operation of the spent fuel pool or the

1 construction and/or operation of an ISFSI. These costs may be included in a site-
2 specific estimate but should be clearly defined.

3 **Q15. Are these spent fuel-related costs included in the 2021 study?**

4 Yes, they are included and specifically identified as such. The 2021 Study
5 updated not only the cost factors associated with spent fuel storage but also the
6 assumptions used to determine the costs and schedules.

7 **Q16. Why was only one scenario considered?**

8 As discussed, the 2021 Study consists of one decommissioning scenario. The
9 decommissioning alternative analyzed in this study is DECON. This alternative is
10 further defined and described later in my testimony. The DECON scenario
11 considers that spent fuel will be transferred to an on-site ISFSI within 3.25 years
12 of Unit 2 shutdown. For this scenario it is assumed that the spent fuel will remain
13 in an on-site ISFSI indefinitely.

14 The selection of one scenario is based on several factors. There has been little
15 movement toward the development of an off-site spent fuel storage repository
16 since 2015. The Annual Capacity Report, identifying spent fuel shipping rates
17 and allocation, has not been updated.

18 There is no viable alternative to the on-site storage of spent fuel. For planning
19 purposes, it is prudent to assume a long-term post-shutdown storage of spent
20 fuel will be required. As IMPC has historically updated this study every 3 years,
21 new developments in spent fuel storage can be addressed as they occur.

22 The DECON scenario is typically the preferred scenario when the funds are
23 available to proceed with decommissioning immediately after cessation of
24 operations. It is anticipated that IMPC will have a fully funded decommissioning
25 fund at the time of Unit 2 shutdown allowing for immediate decommissioning.

1 Having all spent fuel transferred to dry storage will simplify decommissioning as
2 well as reduce annual spent fuel storage costs.

3 **Q17. How was the 2021 study developed?**

4 The 2021 Study, consistent with prior studies, is site specific. Unit cost factors for
5 the various elements of work comprising the decommissioning programs were
6 applied to each element of plant equipment and structures. These cost factors
7 reflect 2021 labor rates experienced at the Cook Plant.

8 The cost estimate was derived by the "building block" approach, whereby the
9 process of decommissioning was broken down into small elements of work and
10 each element of work activity was individually estimated. These activities were
11 laid out in an optimum chronological sequence and schedule, and the additional
12 costs of management and support services, such as health physics, were
13 estimated for the defined work period.

14 The total estimated costs calculated in the study are the sum of these many
15 basic work elements. The costs directly associated with decommissioning and
16 the costs associated with spent fuel storage are presented in separate tables in
17 the study.

18 **Q18. Please further describe the scenario that you considered in the 2021 study.**

19 The DECON option is defined as the removal from the plant site of fuel
20 assemblies, source material, radioactive fission and neutron activated corrosion
21 products, and all other radioactive and contaminated materials having activities
22 above license limits.

23 The reactor pressure vessel and internals will be removed using remote tooling
24 and handling methods. Conventional removal and demolition techniques will be
25 applied to the remaining systems and structures with contamination controls

1 employed as required. After removal of all fixed and removable contamination the
2 site may be released for unrestricted use with no further licensing requirements.
3 The remaining buildings, non-radioactive structures and systems may also be
4 removed and disposed of.

5 With the exception of the area occupied by the ISFSI, this program would result
6 in a site that could be used for any purpose, since the entire nuclear power plant
7 facility would be dismantled and removed from the site.

8 **Q19. What is the benefit of DECON with respect to social and economic**
9 **impacts?**

10 The DECON alternative allows for a quick termination of the license and a return
11 to unrestricted use of the site, eliminating long-term maintenance and
12 surveillance costs. There is also a knowledgeable workforce available to assist in
13 the decommissioning.

14 The DECON alternative also eliminates the uncertainty of the availability of low-
15 level waste facilities in the future. The DECON alternative does come at a cost of
16 higher worker and public doses due to lack of decay time. This increased
17 exposure can be controlled through the use of engineered safety barriers and
18 procedural controls as evidenced by the recent successful decommissioning
19 projects.

20 **Q20. Are there any federal regulations specifically applicable to**
21 **decommissioning?**

22 Yes. The NRC published the Final Rule entitled "General Requirements for
23 Decommissioning Nuclear Facilities" in the Federal Register of June 27, 1988,
24 (53 Fed. Reg. 24018) to establish technical and financial criteria for
25 decommissioning licensed facilities.

1 The regulations addressed decommissioning planning needs, timing, funding
2 methods, and environmental review requirements with the intent of assuring that
3 decommissioning of all licensed facilities would be accomplished in a safe and
4 timely manner, and that adequate licensee funds would be available for this
5 purpose. In 1996, the NRC published revisions to the Final Rule.

6 The amended regulations clarified ambiguities and codified procedures and
7 terminology as a means of enhancing efficiency and uniformity in the
8 decommissioning process. The amendments allow for greater public participation
9 and better define the transition process from operations to decommissioning. The
10 decommissioning cost analysis prepared for the Cook Plant fully satisfies the
11 requirements set forth in the NRC regulations.

12 In 2011, the NRC published amended regulations to improve decommissioning
13 planning and thereby reduce the likelihood that any current operating facility will
14 become a legacy site. The amended regulations require licensees to conduct
15 their operations to minimize the introduction of residual radioactivity into the site,
16 which includes the site's subsurface soil and groundwater.

17 Licensees also may be required to perform site surveys to determine whether
18 residual radioactivity is present in subsurface areas and to keep records of these
19 surveys with records important for decommissioning.

20 The amended regulations require licensees to report additional details in their
21 decommissioning cost estimate as well as requiring additional financial reporting
22 and assurances. These additional details, including the decommissioning
23 estimate for Independent Spent Fuel Storage Installation (ISFSI), are included in
24 this analysis.

1 **Q21. Are there any regulatory or other developments that warrant consideration**
2 **with respect to the ongoing analysis of decommissioning costs?**

3 As stated above, it is reasonable to rely on the 2021 Study because there have
4 not been any significant Site changes since the 2021 Study. That said, there are
5 some issues to consider when assessing nuclear decommissioning costs on a
6 going-forward basis.

7 Economic indicators have increased since the estimate was issued in 2021, the
8 cost of energy increased by approximately 36% (ref. IHS Markit an S&P Global
9 Company) in 2022 and is currently decreasing in the first quarter of 2023. The
10 overall Consumer Price Index (CPI) increased by 8% (ref. IHS Markit an S&P
11 Global Company) in 2022. While these indicators may have an impact on the
12 values reflected in the estimate, the estimate represents the cost to
13 decommission the DC Cook Site in the reference year (2021). Cost Escalations
14 and future estimates are available to better inform the costs in future years. Since
15 Indiana Michigan Power updates its estimate every three years, this economy-
16 related issue can be monitored and considered in the next study as necessary.

17 The 2021 Study assumes all spent fuel must remain in the spent fuel pool for a
18 minimum of 3 years before being transferred to dry storage. This is a reasonable
19 assumption in TLG's opinion.

20 Another issue to consider is the potential for a change of state law that would
21 allow a municipality to charge a property tax on the ISFSI. The New York
22 governor recently signed a law doing just that. The law will allow the village of
23 Buchanan and the town of Cortland to determine the economic value of the ISFSI
24 and then charge a property tax based on that value.

25 While an economic value has not been determined, the law provides a
26 mechanism for municipalities to charge a tax. Since this is a first of a kind law, it
27 may lead other states to enact a similar law. However, as the economic value or
28 implications of this law have not been fully realized as of the time of this filing,

1 and, at this time, no other states have adopted a similar provision, there is no
2 associated impact on the 2021 Study.

3 Overall, I believe that the costs developed for the 2021 Study provide a realistic
4 estimate of the actual future costs and is reliable for IMPC's financial planning
5 purposes. As such, it is reasonable for the Company to rely on the results of the
6 2021 Study to support its decommissioning costs sought to be recovered as part
7 of this proceeding.

8 **Q22. Please summarize the decommissioning costs identified in your study.**

9 As recognized in the Commission's Order in the Company's previous base case,
10 dismantling and demolition of the two power units and all support facilities at the
11 Cook Plant is estimated to cost \$2,156.3 million in 2021 dollars.

12 The estimate includes an overall contingency component of 18.47% for Unit 1
13 and 18.55% for Unit 2, based upon a line-item analysis as described in the
14 AIF/NESP-036 Guidelines report.

15

IV. Summary of Estimated Costs

1 *Figure RWK-2* presents a summary of these costs.

Figure RWK-2. Cost Table (\$000, in 2021 dollars)

Work Activity	Unit 1	Unit 2	Station
Decontamination	10,765	13,884	24,650
Removal	106,728	158,192	264,919
Packaging	29,807	29,876	59,683
Transportation	15,464	16,053	31,517
Waste Disposal	123,285	124,631	247,916
Off-site Waste Processing	14,746	14,262	29,008
Program Management ³	325,389	333,765	659,155
Site Security	75,620	50,340	125,960
Spent Fuel Pool Isolation	-	14,827	14,827
Spent Fuel Management ⁴	253,020	249,694	502,714
Insurance and Regulatory Fees	15,301	9,917	25,218
Energy	14,876	13,050	27,926
Characterization & Licensing Surveys	29,302	34,245	63,547
Property Taxes	1,853	1,853	3,705
Miscellaneous	8,066	7,990	16,056
Corporate A&G	22,760	23,821	46,581
Non-Labor Overhead	5,998	6,278	12,276
Tritium Monitoring	347	256	603
Total ⁵	1,053,328	1,102,934	2,156,262
NRC License Termination	735,680	750,031	1,485,711
Spent Fuel Management	259,580	255,809	515,389
Site Restoration	58,068	97,094	155,162
Total	1,053,328	1,102,934	2,156,262
ISFSI Operations, annual cost			7,446
ISFSI License Termination			23,313
ISFSI Site Restoration			9,945

³ Program Management costs include Utility and subcontractor staffing

⁴ Includes capital expenditures for dry storage system, loading and transfer, spent fuel pool O&M and Emergency Planning fees but excludes program management costs (staffing)

⁵ Columns may not add due to rounding

1 **Q23. What is the basis of the cost estimate in the decommissioning study?**

2 The 2021 estimate was developed primarily using the technical database
3 (inventory of the physical plant) from TLG's prior estimate in 2019 for the D. C.
4 Cook site. This database was reviewed and it was determined that there were no
5 significant changes to the site between 2018 and 2021.

6 Decommissioning is a labor-intensive program. Accordingly, representative 2021
7 craft labor costs were provided by the site. Utility salaries, overhead and benefits,
8 site operating costs, as well as corporate contributions were also provided by site
9 and/or IMPC personnel for inclusion in the cost model.

10 The majority of the low-level radioactive waste designated for direct disposal
11 (Class A) can be sent to EnergySolutions' facility in Clive, Utah. Therefore,
12 disposal costs for Class A waste were based upon IMPC's agreement with
13 Utilities Service Alliance (USA) for the EnergySolutions facility. This facility is not
14 licensed to receive the higher activity portion (Classes B and C) of the
15 decommissioning waste stream.

16 The Waste Control Specialists (WCS) facility, located in Andrews Texas, is able to
17 receive the Class B and C waste. As such, for this analysis, Class B and C waste
18 was assumed to be shipped to the WCS facility. Disposal costs for this waste
19 were also based upon IMPC's agreement with USA for the WCS facility.

20 The spent fuel management requirements identified by IMPC were also
21 incorporated into the decommissioning program and reflected IMPC experience
22 in the handling and storage of spent fuel and the available information on the
23 development of a United States federal waste management system for fuel from
24 commercial nuclear generators.

25

1 **Q24. What is the ISFSI decommissioning cost?**

2 The 2021 Study identified an ISFSI of decommissioning cost of \$33,258,299. The
3 ISFSI decommissioning cost includes the cost to dispose of some of the concrete
4 overpacks, the concrete pad and ancillary structures.

V. Methodology for Decommissioning and Dismantling Costs

5 **Q25. What methodology was used to prepare the cost estimate?**

6 The methodology used to develop the cost estimate followed the basic approach
7 presented in the AIF/NESP-036 study report, "Guidelines for Producing
8 Commercial Nuclear Power Plant Decommissioning Cost Estimates," and the
9 DOE's "Decommissioning Handbook." The estimating techniques have been
10 augmented, when appropriate, to reflect experience gained in decommissioning
11 at several of the large commercial units over the past 30 years.

12 The two references describe a unit cost factor method for estimating
13 decommissioning activity costs to standardize the estimating calculations. Unit
14 cost factors for activities such as concrete removal (\$/cubic yard), steel removal
15 (\$/ton), and cutting costs (\$/inch) were developed from the labor information
16 provided by the site. Material information was taken in large part from RSMeans,
17 "Building Construction Cost Data 2021."

18 The activity-dependent costs for decontamination, removal, packaging, shipping,
19 and burial were estimated using the item quantity (cubic yards, tons, inches, etc.)
20 originally developed from D. C. Cook plant drawings and inventory documents.

21 The activity duration critical path derived from such key activities, e.g., the

1 disposition of the nuclear steam supply system (NSSS), was used to determine
2 the total decommissioning program schedule.⁶

3 The program schedule is used to determine the period-dependent costs such as
4 program management, administration, field engineering, equipment rental, quality
5 assurance, and security. The salary and hourly rates are typical for personnel
6 associated with period-dependent costs.

7 The costs for conventional demolition of non-radioactive structures, materials,
8 backfill, landscaping, and equipment rental were obtained from conventional
9 demolition references, as well as unit cost factors developed by TLG for removal
10 of heavily-reinforced concrete structures. In addition, collateral costs were
11 included for heavy equipment rental or purchase, safety equipment and supplies,
12 energy costs, permits, taxes, and insurance.

13 The activity-dependent, period-dependent, and collateral costs were added to
14 develop the total decommissioning costs. Contingency was added on a line item
15 basis to allow for the effects of unpredictable program problems.

16 One of the primary objectives of every decommissioning program is to protect
17 public health and safety. The cost estimates for the D. C. Cook decommissioning
18 activities include the necessary planning, engineering, and implementation to
19 provide this protection to the public.

20 **Q26. Has the NRC accepted site-specific cost estimates utilizing the TLG cost**
21 **estimating methodology?**

22 Yes. The NRC has reviewed TLG's cost estimating methodology. The NRC
23 approved the decommissioning plan proposed by TLG for the Pathfinder Atomic

⁶ The NSSS is the collection of equipment, including the reactor vessel, which produces the high pressure steam used to drive the turbines. This equipment, together with supporting cleanup systems, is where most of the highly radioactive material resides.

1 Power Station. Funding provisions were based upon a site-specific estimate
2 developed by TLG.

3 TLG was also selected by the following utilities to prepare site-specific cost
4 estimates for inclusion within the decommissioning plans or Post-Shutdown
5 Decommissioning Activity Reports (PSDAR) submitted to the NRC for the
6 following nuclear units:

- 7 Long Island Lighting Company/Long Island Power Authority.....Shoreham
- 8 Sacramento Municipal Utility District.....Rancho Seco
- 9 Portland General Electric.....Trojan
- 10 Yankee Atomic Electric Company.....Rowe
- 11 Maine Yankee Atomic Power Company.....Maine Yankee
- 12 Pacific Gas & Electric.....Humboldt Bay-3
- 13 Southern California Edison.....San Onofre-1
- 14 Consumer Power Company.....Big Rock Point
- 15 Duke Energy Florida.....Crystal River Unit 3
- 16 Exelon Generation.....Oyster Creek
- 17 Entergy Nuclear.....Vermont Yankee
- 18 Entergy Nuclear.....Pilgrim
- 19 Omaha Public Power District.....Fort Calhoun

20 **Q27. What are the financial components of the cost model?**

21 The cost model considers three financial components. The first is the base cost
22 estimate, calculated using the site-specific inventory, and labor, materials costs,
23 equipment rental costs, radioactive waste disposal costs, and other costs
24 consistent with the current site operations at D. C. Cook.

1 The second financial component is the contingency values applied against each
2 of the line items in the estimate; this is discussed later in my testimony.

3 A third component, financial risk, is discussed in the cost estimate report, but is
4 not applied in the cost estimate. As discussed in the report, financial risk is
5 addressed by performing frequent updates to the estimate to account for such
6 changes as regulatory revisions, industry experience, changes in the availability
7 of radioactive waste disposal facilities, and revised DOE performance schedules
8 for pick-up of spent fuel from the site.

9 **Q28. Describe how contingency is calculated.**

10 The purpose of the contingency is to allow for the costs of high probability
11 program problems occurring in the field where the frequency, duration, and
12 severity of such problems cannot be predicted accurately and have not been
13 included in the basic estimate.

14 The Association for the Advancement of Cost Engineering, International (AACEI)
15 (in their Cost Engineers' Notebook) defines contingency as follows:

16 *Contingency – “specific provision for unforeseeable elements of cost*
17 *within the defined project scope; particularly important where previous*
18 *experience relating estimates and actual costs has shown that*
19 *unforeseeable events, which will increase costs, are likely to occur.”⁷*

20 Past decommissioning experience has shown that unforeseeable elements of
21 cost are likely to occur in the field and may have a cumulative effect. In the
22 AIF/NESP-036 Guidelines Study, TLG examined the major activity-related
23 problems (decontamination, segmentation, equipment handling, packaging,
24 shipping and burial) with respect to reasons for contingency. Individual activity

⁷ Project and Cost Engineers' Handbook, Second Edition, p. 239, American Association of Cost Engineers, Marcel Dekker, Inc., New York, New York, 1984.

1 contingencies ranged from 10% to 75% of the related base cost, depending on
2 the degree of difficulty judged to be appropriate from our actual decommissioning
3 experience.

4 The overall contingency, when applied to the appropriate components of all two
5 generating units, and other site support features of the D. C. Cook estimate, on a
6 line item basis, results in an average of approximately 18.5%.

7 **Q29. Is it fair to view contingency as a "safety factor" or cushion against future**
8 **price increases?**

9 No. There is a general misconception on the use and role of contingency within
10 decommissioning estimates, sometimes incorrectly viewed as a "safety factor."
11 Safety factors provide additional security and address situations that may never
12 occur. Contingency dollars are expected to be fully expended throughout the
13 program. They also provide assurance that sufficient funding is available to
14 accomplish the intended tasks.

15 An estimate without contingency, or from which contingency has been removed
16 or reduced, can disrupt the orderly progression of events and jeopardize a
17 successful conclusion to the decommissioning process. Contingency, as used in
18 these estimates, does not account for price escalation and inflation in the cost of
19 decommissioning over the remaining operating life of the unit.

20 Thus, the contingency is expected to be spent; however, since contingency
21 dollars are intended to address complexities in the performance of the field
22 decontamination and dismantling activities, it is difficult to identify today those
23 activities most likely to be affected in the future.

1 **Q30. Does the estimated cost include the disposal of spent nuclear fuel?**

2 No. It is important to note that, although decommissioning of a site cannot be
3 complete without the removal of all spent fuel, the final disposition of spent
4 nuclear fuel is outside the scope of decommissioning.

5 In accordance with the Nuclear Waste Policy Act, the DOE is required to enter
6 into contracts with owners and/or generators of spent fuel, pursuant to which the
7 DOE is contractually responsible for final disposition of spent fuel as high-level
8 nuclear waste.

9 Previously, the disposal cost was financed by a one mill/kWh surcharge, based
10 on net electrical generation, paid into the DOE's waste fund during operations.
11 On November 19, 2013, the U.S. Court of Appeals for the D.C. Circuit ordered
12 the Secretary of the DOE to suspend collecting annual fees for nuclear waste
13 disposal from nuclear power plant operators until the DOE conducted a legally
14 adequate fee assessment.

15 The disposal fee was formally set to 0.0 mill/kWh as of May 15, 2014. The 2021
16 estimate assumed that an equivalent charge would be reinstated sometime in the
17 future, prior to final shutdown of the Cook Plant, but only for determining the
18 Greater than Class Costs (GTCC) disposal charge that is expected to be
19 imposed by the DOE.

20 Regardless of the disposal fee, the cost of disposal of spent fuel is accounted for
21 separately and is specifically excluded from the decommissioning cost estimates.

VI. Decommissioning Processes

1 **Q31. Please describe the process of decommissioning a nuclear power reactor**
2 **using the DECON alternative.**

3 The conceptual approach that the NRC has identified in their amended
4 regulations is to divide decommissioning into three phases. The initial phase
5 commences with the effective date of permanent cessation of operations and
6 involves the transition of both plant and licensee from reactor operations, i.e.,
7 power production to facility de-activation and closure. Phases II and III pertain to
8 the activities involved in reactor decommissioning and license termination.

9 TLG's estimate for the Cook Plant uses the DECON decommissioning method.
10 This estimate addresses Phase I activities in Period 1. Phases II and III activities
11 are included in Period 2. Period 3 and Post-Period 3 are added for site
12 restoration and long-term spent fuel management; these activities are outside the
13 scope of the NRC decommissioning requirements.

Period 1 – Planning and Engineering

14 This period begins upon shutdown of the facility, and involves site preparations to
15 initiate decommissioning. The reactor would be defueled with the fuel placed in
16 the spent fuel pool until it is cooled sufficiently to be transferred to an on-site
17 storage facility. Notification is provided to the NRC certifying the permanent
18 cessation of operations and the removal of fuel from the reactor vessel; the
19 licensee would then be prohibited from reactor operation.

20 As noted earlier, transportation and disposal of spent fuel at a DOE facility is not
21 considered part of decommissioning and no costs associated with these activities
22 are included in the decommissioning estimates. (These expenses have been
23 funded by the owner throughout the plant's operating life, payable to DOE for
24 future rendering of these services.)

1 However, the impact on the decommissioning schedule due to the presence of
2 the spent fuel on site has been addressed in the study through the schedule.
3 Wastes remaining from plant operations would be removed from the site and all
4 systems nonessential to decommissioning would be isolated and drained.

5 Within two years of notification to cease reactor operations, the licensee is
6 required to provide a PSDAR. This report would provide a description of the
7 licensee's planned decommissioning activities, a corresponding schedule and an
8 estimate of expected costs. The PSDAR would also address whether
9 environmental impacts associated with the proposed decommissioning scenario
10 have already been considered in a previously prepared environmental
11 statement(s).

12 Ninety days following the NRC's receipt of the PSDAR, the licensee can initiate
13 certain decommissioning activities without specific NRC approval, under a
14 modified 10 CFR 50.59 review process. The rule permits the licensee to expend
15 up to 3% of the generic decommissioning cost for planning, with an additional
16 20% available following the 90-day waiting period and certification of permanent
17 defueling. Remaining funds would be available to the licensee with submittal of a
18 detailed, site-specific cost estimate.

Period 2 - Decommissioning Operations

19 This period commences once the PSDAR has been submitted to the NRC for
20 review and with the mobilization of the decontamination and dismantling
21 workforce. This phase addresses the removal of radioactivity from the site and
22 concludes with termination of the NRC's operating license.

23 Activities include selective decontamination of contaminated systems, e.g., using
24 aggressive chemical solvents to dissolve corrosion films holding radionuclides,
25 thereby reducing radiation levels.

1 While effective, the on-site decontamination processes are not expected to
2 reduce residual radioactivity to the levels necessary to release the material as
3 clean scrap. Therefore, all contaminated components will have to be removed for
4 controlled burial. However, decontamination will reduce personnel exposure and
5 permit workers to operate in the immediate vicinity of most components, cutting
6 and removing them for controlled disposition at a low-level radioactive waste
7 burial facility.

8 Contaminated piping to and from major components will be cut and removed.
9 Selected major components such as the reactor coolant pumps, steam
10 generators, pressurizers, and other large components will then be removed intact
11 and sealed so that they may be transported off-site. Smaller components, such
12 as sampling system pumps, filters, filter housings, strainers, etc., will be loaded
13 into containers and shipped for controlled disposal.

14 The reactor vessel and its internals will be segmented and remotely loaded into
15 steel liners for transport to the burial facility in heavily shielded shipping casks.
16 The reactor vessel and internals will have sufficiently high radiation levels to
17 require all cutting to be done underwater or behind heavy shields, using cutting
18 tools operated by remote control to reduce radiation exposure to the workers.

19 Concrete immediately surrounding the reactor vessel is expected to be
20 radioactive and will be removed by controlled blasting. This blasting process is
21 well-developed, safe and is the most cost effective way to remove the
22 heavily-reinforced concrete from the structure.

23 Some surfaces of sections of interior floors within areas of the Containment and
24 other buildings in the power block are expected to be contaminated from
25 exposure to contaminated air/water as a result of plant operations. This
26 contamination will be removed by scarification (surface removal) so that the
27 remaining surfaces will be cleaned to release levels and will not require disposal
28 as Class A radioactive waste.

1 Contaminated process equipment, pipe hangers, supports and electrical
2 components will be removed and routed for controlled disposal.

3 Finally, an extensive radiation survey will be performed to ensure all radioactive
4 materials above the levels specified by the NRC have been removed from the
5 site. With NRC confirmation, the NRC license for most of the site (excluding the
6 ISFSI) will be terminated.

Period 3 – Site Restoration

7 This period begins once license termination activities have concluded and involve
8 the demolition of all remaining structures, typically to a depth of three feet below
9 grade. Clean concrete rubble generated from the demolition of the Containment,
10 Auxiliary, and Turbine Buildings, etc., would be used on-site for fill and additional
11 soil would be used to cover each subgrade structure.

12 Excess rubble is trucked off-site for disposal. Any below grade structures will be
13 either removed, or voids below grade will be filled with sand or concrete. The
14 objective is to prevent any future surface subsidence.

15 Once the below grade features of the site have been addressed, the surface of
16 the site will be graded to conform to the surrounding environs. At this point, the
17 site is available for reuse, except for the footprint of the ISFSI.

Post Period 3 – Spent Fuel Storage

18 The ISFSI will continue to operate under a Part 50 license following the transfer
19 of the spent fuel inventory from the Fuel Building. Transfer of spent fuel to a DOE
20 or interim facility will be exclusively from the ISFSI once the fuel pool has been
21 emptied and the structures released for decommissioning.

22 At the conclusion of the spent fuel transfer process, the ISFSI will be
23 decommissioned. TLG's estimate includes the cost to decommission the ISFSI.

1 The NRC will terminate the remaining license if it determines that site
2 remediation has been performed in accordance with a license termination plan
3 and the terminal radiation survey and associated documentation demonstrate
4 that the facility meets the release criteria. Once the requirements are satisfied,
5 the NRC can terminate the remaining license for the ISFSI.

6 The reinforced concrete dry storage modules are then demolished, the concrete
7 storage pad is removed, and the area graded and landscaped to conform to the
8 surrounding environment.

9 **Q32. How does the presence of spent fuel on site after plant shutdown affect the**
10 **decommissioning processes?**

11 Although the study does not address the transport or disposal of spent fuel from
12 the Cook Plant, it does consider the constraint that the presence of spent fuel on
13 the site can impose on other decommissioning activities.

14 In particular, the decommissioning scheduling developed in support of the cost
15 update of the Cook Plant estimate incorporates an IMPC request for a three-year
16 minimum cooling prerequisite for off-loading the fuel from the storage pools.

17 As such, these spent fuel management activities will necessarily delay the final
18 release of the power blocks for alternative/unrestricted use. This delay is
19 reflected in the increased cost of the period-dependent activities.

20 To the extent possible, the decommissioning estimates were structured around
21 the spent fuel areas and its availability for decontamination, such that delays in
22 decommissioning other portions of the facility could be minimized.

23 Decommissioning would proceed on the surrounding facilities and non-essential
24 systems during the approximately 3.25-year pool off-load period. The operating
25 licenses can then be amended with the remaining fuel placed in dry storage.

1 Some small portion of the existing Cook Plant site will continue to be licensed by
2 the NRC under the existing Part 50 license for the ISFSI. The endpoint of this
3 storage period has not been determined at this time. Once all spent fuel has
4 been removed from the site, the ISFSI will be decommissioned, the license
5 terminated, and the concrete storage casks and pads crushed and removed.

6 **Q33. Does the process of decommissioning extend beyond removal of**
7 **contaminated and activated material from the site?**

8 Yes. There are additional activities, beyond the removal of contaminated material
9 that will be undertaken in the process of releasing the site for alternative use.
10 This work includes costs for the remaining dismantling and grading operations
11 and is generally referred to as site restoration.

12 **Q34. Was there any salvage or scrap value considered for any or the**
13 **components?**

14 It was assumed that there would be no salvage for any equipment left at the site
15 at shutdown. Scrap value was not included in the estimate due to large
16 fluctuations in scrap values.

17 The 2021 Study assumes all clean material will be disposed of at a local landfill.
18 This approach will also reduce liability concerns. The appropriateness of utilizing
19 a scrap dealer can be addressed in future updates closer to shutdown.

20 **Q35. Why were the remaining structures on site assumed to be dismantled?**

21 Efficient removal of the contaminated materials and verification that the
22 radionuclide concentrations are below the stringent NRC limits will require
23 substantial damage to many of the structures. Blasting, coring, drilling,
24 scarification (surface removal), and the other decontamination work will damage

1 power block structures including the Containment, Auxiliary, and the Turbine
2 Building.

3 Verifying that subsurface radionuclide concentrations meet NRC site release
4 requirements may require removal of grade slabs and lower floors, potentially
5 weakening footings and structural supports.

6 It is also important to remember that the Cook Plant structures were custom
7 designed and built to support a specific nuclear unit design that went into service
8 in the 1970s. They would most likely be an impediment rather than a benefit to
9 any potential future plant, if one were ever to be constructed at the site.

10 Moreover, the facility's infrastructure degrades without continual maintenance.
11 Unless the site is redeveloped shortly after release of its NRC license, the value
12 in reusing plant facilities quickly diminishes.

13 As demonstrated by U.S. experience, dismantling is clearly the most appropriate
14 and cost-effective option and should serve as the foundation for the
15 decommissioning cost estimates. It is unreasonable to anticipate that these
16 structures would be repaired and preserved after the radiological contamination
17 is removed.

18 **Q36. Is there support to conclude that Cook plant can be completely**
19 **dismantled?**

20 Yes. In the United States about 15 commercial nuclear power plants (NPPs)
21 have been successfully decommissioned. Each of these NPPs has had their
22 license terminated or modified to allow for the on-site storage of spent fuel.

23 In most of the NPP decommissionings, some combination of reactor vessel and
24 reactor vessel internals have been removed, transported and disposed of in one
25 piece. In some cases, the shutdown was of an unplanned nature causing some
26 lack of coordination in the first few years following shutdown. Once the intent to

1 decommission was accepted, decommissioning proceeded in a timely and
2 efficient manner. There are currently 22 NPPs in some phase of the
3 decommissioning process.

4 In addition to the NPPs there have been numerous government-owned electric
5 generation nuclear power plants, test reactors, research reactors, processing
6 facilities, and many reactor facilities in Canada and Europe that have been
7 successfully decommissioned using proven techniques.

8 The lessons learned from the completed decommissioning projects have been
9 well documented in the reports of successful program completions such as the
10 *Maine Yankee Decommissioning Experience Report, Detailed Experiences 1997*
11 *– 2004*, EPRI, Palo Alto, CA: 2004 and the *Connecticut Yankee*
12 *Decommissioning Experience Report, Detailed Experiences 1996 – 2006*, EPRI,
13 Palo Alto, CA: 2006.⁸

14 The basic activities of cutting piping, segmenting vessel internals, demolishing
15 reinforced concrete and decontaminating contaminated systems and structures
16 are independent of the size of the structure or megawatt rating of the plant. A
17 contaminated 12-inch diameter pipe in a 3000 megawatt thermal plant utilizes the
18 same segmentation process as a 12-inch diameter pipe in a 58 megawatt
19 thermal plant, although the number of cuts will likely be greater in the larger
20 plant. The major activities include removal of contaminated piping and
21 components using conventional power saws or torches within contamination
22 control envelopes, followed by disposal at a waste repository. Lessons learned
23 from recently completed or ongoing decommissioning projects include the one-
24 piece removal of at least the reactor vessel, bulk removal of contaminated
25 components versus decontaminate, survey and release and utility management
26 of the project versus a decommissioning operations contractor. These recent

⁸ <https://www.epri.com/search#q=yankee%20decommissioning&t=research&sort=relevancy>

1 decommissioning projects have learned from and built on the lessons learned
2 from previous decommissioning programs. The successful application of these
3 decommissioning techniques in both small and large nuclear power plants
4 demonstrates assurance of decommissioning feasibility.

5 **Q37. What assurance is there that the estimated cost for decommissioning will**
6 **reflect future developments and increases or decreases in costs?**

7 The cost estimate prepared for the Cook Plant is based on present technology,
8 the current information available on decommissioning costs and on existing
9 federal regulations.

10 It is my understanding that IMPC intends to review these estimates periodically
11 and to revise them to account for cost increases or decreases as influenced by
12 future technology, regulations, labor cost trends and waste disposal trends. It
13 should be noted that the contingency, as used in the estimates, only covers
14 uncertainties within the decommissioning schedule timeframe.

15 **Q38. Have you addressed the means by which decommissioning costs are to be**
16 **financed or recovered?**

17 No. I have addressed only the development of the total decommissioning cost
18 estimate in 2021 dollars.

VII. Recommendations

19 **Q39. Is it necessary to select a specific decommissioning method at this time?**

20 No. The actual method or combination of methods selected to decommission the
21 Cook Plant should be based on a detailed economic, engineering, and
22 environmental evaluation of the alternatives considering the site and

1 surroundings at the time of decommissioning and reflecting the latest experience
2 in the decommissioning of similar nuclear power facilities.

3 Considering that Cook Plant Units 1 and 2 are licensed to operate until 2034 and
4 2037, respectively, changes in waste disposal and/or processing costs, locations
5 and methods are likely. NRC regulations governing decommissioning could also
6 change. These changes could influence the decision on whether to proceed with
7 DECON or SAFSTOR. Funding for DECON does not preclude using SAFSTOR
8 in the future, but funding for SAFSTOR may remove DECON as an option due to
9 funding limitations.

10 The status of the spent fuel acceptance by the DOE may change, affecting the
11 decision to store spent fuel in the spent fuel pool, on-site dry storage or off-site
12 dry storage. Periodic estimate updates should be able to track the
13 decommissioning trends without locking into a specific method or jeopardizing
14 the availability of adequate decommissioning funds.

15 **Q40. What are your recommendations?**

16 I recommend that, for planning purposes, the decommissioning cost funding be
17 based upon removal of the Cook Plant using the DECON alternative. This
18 alternative provides the most reasonable means for amending/terminating the
19 license for the site in the shortest possible time.

20 Furthermore, this alternative avoids the long-term costs and commitments
21 associated with the maintenance, surveillance and security requirements of the
22 conventional delayed dismantling alternatives. The Commission has adopted the
23 DECON alternative as a basis for funding nuclear plant decommissioning in
24 every case in which a TLG witness has testified.

25 The DECON alternative also allows use of the plant's knowledgeable operating
26 staff, a valuable asset to a well-managed, efficient decommissioning program.

1 Equipment needed to support decommissioning operations such as cranes,
2 ventilation systems, and radwaste processing equipment would be fully
3 operational. In addition, the site would be available for other use in the near term,
4 with the exception of the area immediately surrounding the plant's fuel storage
5 facility.

6 **Q41. Does this conclude your testimony?**

7 Yes, it does.

VERIFICATION

I, Roderick Knight, Project Manager for TLG Services, LLC, affirm under penalties of perjury that the foregoing representations are true and correct to the best of my knowledge, information and belief.

Date: August 8, 2023

Roderick W. Knight

Roderick W. Knight

RODERICK KNIGHT

Manager, Decommissioning

SUMMARY OF QUALIFICATIONS:

Cost Estimate development
Report writing
Client interaction
Familiarity with Code of Federal Regulations
CPM Scheduling analysis
Ability to work through complex situations leading to defensible and realistic reports
Computer proficiency, including the following: Microsoft Excel; Microsoft Word, Microsoft Project for Windows; several other spreadsheet / cost analysis programs

EDUCATION:

University of New Haven, BS Civil Engineering 1993
Magna Cum Laude, Selected to Chi Epsilon (Civil Engineering Honor Society)
University of Maine, BS Natural Resource Management 1981

EXPERIENCE:

WORK EXPERIENCE:

TLG Services, LLC
Manager, Decommissioning
2016 to present

Manage cost estimating staff in the completion of various portions of the decommissioning cost estimates
Listen to and respond to employee concerns and recommendations
Verify all aspects of the decommissioning costs estimates adhere to TLG Services high quality standards
Work with Clients to ensure they are receiving the best product available for their needs
Maintain project schedules and budgets
Ensure conformance to federal regulations

Knight Cost Engineering Services, LLC
President
2004 – 2016

Worked on a contract basis as a Certified Cost Professional
Cost estimating, planning and scheduling services
Provided litigation and rate hearing support



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Developed decommissioning cost estimates for the nuclear industry, including utilities and research facilities
Maintained extensive vendor contact in support of cost estimates
Managed cost estimating staff in the completion of various portions of the decommissioning cost estimates
Ensured conformance to federal regulations

Scientech, Inc.
1992 – 2004

Project Manager

Developed decommissioning cost estimates for the nuclear industry
Developed and meet project schedules and budgets
Maintained extensive vendor contact in support of cost estimates
Managed four to five engineers in the completion of various portions of the decommissioning cost estimates
Maintained close client contact to ensure that their comments and concerns are incorporated into the project
Ensured conformance to federal regulations
Prepared cost estimates in support of rate hearings and litigation

Project Engineer

Determined the extent of client-supplied technical information and verify that this information is adequate to support the project
Investigated post-shutdown cost reduction methods
Developed computer-generated models to standardize cost estimating methodologies
Developed reports on decommissioning scheduling and cost analysis
Support development of proposals for projects

TLG Engineering, Inc.
Project Engineer
1985 – 1992

Coordinated all cost estimating components in preparation for a detailed cost estimate for nuclear power plant decommissioning
Calculated structural design specifications
Maintained the schedule and budget for the generation of cost estimates
Contributed to the development of current methodology for accurate decommissioning cost estimates
Developed a database for use within computer codes providing detailed cost estimates
Instructed at conferences and hearings on nuclear power plant decommissioning

PROFESSIONAL EXPERIENCE AND QUALIFICATIONS:

Industry Experience

Acted as Project Manager for numerous TLG decommissioning cost studies from 2016 – 2020 for both United States and Canadian clients.

Acted as project manager for several dismantling cost estimates for other power production facilities, including coal, gas, oil and wind.

Assisted in the development of successful proposals to Utilities for developing decommissioning cost studies from 2016 - 2020.

Prepared Asset Retirement Obligation (ARO) and Escalation Analysis reports for several clients from 2016 - 2020.

Worked with TSSD developing and reviewing decommissioning cost estimates, 2016.

Worked with Enercon Federal Services, Inc. in 2016 developing a decommissioning cost estimate for Electrobras Termonuclear S.A. in Brazil. This project was not finished when I joined Entergy.

Worked as part of a team for a confidential client reviewing decommissioning cost estimates for facilities in Canada, 2015 and 2016.

Presented at the 2014 Nuclear Energy Insider conference in Charlotte, North Carolina. Presentation was titled “How Utilities Can Prepare Accurate Decommissioning Cost Estimates.”

In 2014 worked with Radiation Safety & Control Services, LLC developing lesson plans and presenting lessons to personnel from Korean Hydro and Nuclear Power (KHNP) in South Korea.

In 2014 worked as part of a team developing detailed site specific decommissioning cost estimates for the Vermont Yankee Nuclear Power Plant. The estimates included identification of labor costs, man-hours, duration hours, waste volumes, waste packaging and disposal costs.

Participated in the Department of Energy Project Peer Review of the River Corridor Closure Project at the Hanford Site in Richland, WA. The purpose of the review was to assess the projects progress in the capital asset cleanup project.

In 2012 and 2015 Developed decommissioning cost estimates for the Independent Spent Fuel Storage Installations at the Connecticut Yankee, Maine Yankee and Yankee Rowe sites.

Developed Independent Cost Estimates (ICE) in support of reviews for DOE projects. One each in 2011, 2012, 2013, 2014 and 2015. These projects included both construction and decommissioning estimates.

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In 2011 and 2012 worked as part of a team developing decommissioning cost estimates for Atomic Energy of Canada Limited's (AECL) Chalk River Laboratories.

From 2008 through 2014 developed decommissioning cost estimates for multiple facilities at Argonne National Laboratory in Argonne, IL including four buildings associated with the Intense Pulsed Neutron Source Complex; the Alpha Gamma Hot Cell Facility and Building 310.

In 2006, 2009, 2012 and 2015 developed decommissioning cost estimates for Indiana Michigan Power Company's D. C. Cook Nuclear Power Plant. Cost estimates included numerous scenarios with various spent fuel shipping schedules and decommissioning methodologies.

Developed spent fuel shipping schedules for various nuclear power plants based on various versions of the Department of Energy's Acceptance Priority Ranking (APR) and Annual Capacity Report (ACR).

In summer of 2008 worked with Kiewit Federal Group developing a cost estimate for Northwest Energy's Columbia Generating Station main condenser replacement project.

In fall of 2007 developed multiple project schedules for Environmental Power Company for various energy generation projects.

From 2005 to present developed decommissioning cost estimates, project schedules, spent fuel disposition schedules and present value analysis for confidential clients (3 separate suits) in support of their claim against the United States Department of Energy for damages related to failure of the USDOE to take receipt of spent nuclear fuel beginning in 1998.

In my career I have been responsible for the development of over 100 decommissioning cost estimates for the nuclear industry, including the analysis of spent fuel shipping schedules, effects of license extension on decommissioning and spent fuel storage costs, analyzed post-shutdown cost reduction methods and developed computer generated models to standardize cost estimating methodologies.

In addition to developing decommissioning cost estimates for numerous commercial nuclear power plants, I have also been responsible for developing estimates for a variety of facilities. These estimates were developed for a number of reasons, including proposal support, owner estimates and project funding. This work includes the development of estimates at Los Alamos National Laboratory, manufacturing facilities and research facilities. Most of these estimates included the remediation of both radiological and hazardous wastes.

Performed numerous prudence reviews of cost estimates developed by others. In many cases these reviews were used by confidential clients in the determination whether to purchase nuclear power plants.

One of eleven-member EM-6 expert Review Team for Department of Energy project at Brookhaven National Labs, Long Island, NY, April 3-7, 2000; Assessed cost,

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schedule, technical scope, management planning and control, and external factors for six DOE projects. These projects included both radiological and hazardous contamination requiring a variety of remedial action processes.

International Experience

In the Fall of 2015 and Spring of 2016 worked for the IAEA in revising and developing new training material for decommissioning. Work is both home based and at the IAEA.

In October of 2015 developed and presented information on developing decommissioning cost estimates as part of a decommissioning planning program at the IAEA. The program was in support of planning the decommissioning of research reactors in North Africa.

In June of 2009 served as an expert in the review of the revised KRSKO Nuclear Power Plant Decommissioning Plan, jointly owned by Slovenia and Croatia. The Plan included revisions based on recommendations made in December of 2005. A detailed review was performed and included interviews with many of the authors. A detailed report was prepared and submitted to the IAEA.

In December of 2006 served as an expert in the review of the revised BN-350 partial decommissioning cost estimate. The estimate is a detailed estimate of several areas of the facility and is based on the recommendations of the Experts from two earlier missions. This estimate is to be used as a template for estimating the remaining scope of work. A detailed review was performed and included interviews with many of the authors. A detailed report was prepared and submitted to the IAEA.

In October of 2005 served as an expert in the review of the KRSKO Nuclear Power Plant Decommissioning Plan, jointly owned by Slovenia and Croatia. The Plan included revisions to the cost estimate based on recommendations made in December of 2003. This mission focused on the decommissioning cost estimate and included a presentation on the how to develop a decommissioning cost estimate that conforms to IAEA standards. A detailed review was performed and included interviews with many of the authors. A detailed report was prepared and submitted to the IAEA.

In the fall of 2004 worked as part of a Sciencetech team contracted by PA Government Services (PA) to assist in developing and promoting a series of reforms for the Armenian energy sector. Worked directly with PA's project office in Armenia. The main focus of the activities under this Agreement was to provide expertise on the Armenian Nuclear Power Plant (ANPP) decommissioning and nuclear safety issues. This work included reviewing the existing reports and studies on ANPP's decommissioning; developing a draft proposal for ANPP's decommissioning based on international experience; conducting a workshop for all stakeholders to present draft report on decommissioning the ANPP, report revision based on workshop feedback and finalizing report and plan for decommissioning.

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Served as an expert, in March of 2004, on an International Atomic Energy Agency (IAEA) mission to Vienna, Austria. The mission was to review the comments of the Peer Review held in 2003 (of which I served as an expert) and develop a plan which will lead to an internationally acceptable decommissioning plan for the BN-350 Nuclear Power Plant located in Aktau, Kazakhstan. A report was provided to the IAEA.

Served as an expert on an International Atomic Energy Agency (IAEA) mission to Zagreb, Croatia, in December of 2003. The purpose of this mission was to provide technical support for the review of the decommissioning program for Krsko Nuclear Power Plant, jointly owned by Slovenia and Croatia. The mission consisted of the review of the Krsko NPP decommissioning cost estimate, to be used to establish a funding mechanism. A report of our findings was produced and submitted to the IAEA.

Served as a member of a Peer Review Committee for the International Atomic Energy Agency (IAEA) in the summer of 2003. The purpose of this committee was to review the Decommissioning Plan for the BN-350 Nuclear Reactor in Kazakhstan and produce a report of our findings for the Kazakhstan Atomic Energy Committee. The mission included a site visit to the BN-350 reactor in Aktau, Kazakhstan.

Testimony/Deposition

Provided Direct Written Testimony in 2020 in support of the decommissioning cost study prepared by TLG for the Palo Verde Generating Station on behalf of El Paso Electric Company.

Provided Direct Written Testimony in support of the 2012, 2015 and 2018 D. C. Cook Decommissioning Cost Studies on behalf of Indiana Michigan Power Company.

Testified in front of the Indiana Utility Regulatory Commission in May 2008 in support of the D. C. Cook Decommissioning Cost Study on behalf of Indiana Michigan Power Company.

Provided Direct Written Testimony in support of the D. C. Cook Decommissioning Cost Study on behalf of Indiana Michigan Power Company in 2007.

Provided cost estimates to a confidential client for litigation support in 2006. This work included providing deposition in the fall of 2006.

In the winter of 2005 provided cost estimates to a confidential client for litigation support. Also provided deposition in May of 2005 in support of this work.

Provided direct testimony as a material witness in the United States Court of Federal Claims in March of 2004 in support of their claim against the United States Department of Energy for damages due to failure of the USDOE to take receipt of spent nuclear fuel beginning in 1998.

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In December of 2003 provided deposition for a client in support of their claim against the United States Department of Energy for damages due to failure of the USDOE to take receipt of spent nuclear fuel beginning in 1998.

Additional

Taught at decommissioning seminar in Newport, R.I. in Oct 1995
Developed lesson plans and instructed at ANS Winter Meeting, 1999
Passed Engineer in Training (EIT) exam in 1993

Publications

Presented a paper entitled "How Utilities Can Achieve More Accurate Decommissioning Cost Estimates" at American Nuclear Society Winter Meeting, Long Beach, CA, 1999. The paper was published in ANS Transactions, Volume 81, 1999

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DECOMMISSIONING COST STUDY
for the
D. C. COOK NUCLEAR POWER PLANT



prepared for

INDIANA MICHIGAN POWER COMPANY

prepared by

TLG Services, LLC
Bridgewater, Connecticut

December 2021

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REVISION LOG

Rev. No.	Date	Item Revised	Reason for Revision
0	12-07-2021		Original Issue

EXECUTIVE SUMMARY

This report presents estimates of the costs to promptly decommission (decontaminate and dismantle) the D. C. Cook Nuclear Power Plant (D. C. Cook) following a scheduled cessation of plant operations. The estimates are designed to provide American Electric Power Company (AEP) and Indiana Michigan Power Company (IMPC) with sufficient information to assess their financial obligations as they pertain to the eventual decommissioning of the nuclear station.

The analysis relies upon site-specific, technical information compiled by TLG from information provided by IMPC. The analysis reflects current assumptions pertaining to the disposition of nuclear power plants and relevant industry experience in undertaking such projects. The costs are 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 restoration requirements.

The estimates are 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 estimates incorporate a cooling period of three years and three months for the spent fuel that resides in the plant's storage pool when Unit 2 operations cease. Any residual fuel remaining in the pool after this period will be relocated to an on-site, interim storage facility to await the transfer to a Department of Energy (DOE) facility. The estimates also include the dismantling of non-essential structures and limited restoration of the site.

The analysis is not an engineering evaluation, but consists of estimates prepared in advance of the detailed planning required to carry out the decommissioning of the nuclear units. It may also not reflect the actual plan to decommission D. C. Cook; that plan may differ from the assumptions made in this analysis based on facts that exist at the time of decommissioning.

The primary goal of decommissioning is the removal and disposal of the contaminated systems and structures so that the operating licenses can be terminated. This analysis recognizes that spent fuel will be stored at the site in the wet storage pool and/or in an independent spent fuel storage installation (ISFSI) until such time that it can be transferred to an appropriate disposal facility. Consequently, the estimates include those costs necessary to manage and subsequently decommission these interim storage facilities.

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The costs to decommission D. C. Cook are tabulated at the end of this section. Costs are reported in 2021 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 schedules of annual expenditures for each scenario. A sequence of significant project activities is provided in Section 4 with a timeline for each unit. Detailed cost reports used to generate the summary tables contained within this document are provided in Appendices C through F.

The cost estimates assume that the shutdown dates of the nuclear units are scheduled and pre-planned (i.e., there is no delay in transitioning the plant and workforce from operations or in obtaining regulatory relief from operating requirements, etc.). The estimates include the continued operation of the fuel handling area of the auxiliary building as an interim wet fuel storage facility for approximately three and one-quarter years after Unit 2 operations cease. During this time period, it is assumed that the spent fuel residing in the pool will be transferred to an independent spent fuel storage installation (ISFSI) located on the site.

The ISFSI will remain operational until the spent fuel is transferred to an appropriate disposal facility.^[1] Consequently, the estimates also include those costs to manage (as an annual cost) and subsequently decommission these interim storage facilities. The timing of these expenses is indeterminate and therefore these costs are not included in the tables in Section 3.

Alternatives and Regulations

The Nuclear Regulatory Commission (NRC) provided general decommissioning requirements in the rule adopted on June 27, 1988^[2]. In this rule the NRC set forth 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.

¹ Projected expenditures for spent fuel management identified in the cost analyses do not consider credit for DOE's payment of damages to AEP for DOE's failure to perform under the terms of the disposal contract between DOE and AEP. Collection of spent fuel damages from the DOE is expected to provide the majority of funds needed for spent fuel management following shutdown.

² 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.

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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."^[3]

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."^[4] Decommissioning is 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 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."^[5] As with the SAFSTOR alternative, decommissioning is currently required to be completed within 60 years.

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 NRC 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, for example, 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 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 to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process. The

³ Ibid. FR24022, Column 3

⁴ Ibid.

⁵ Ibid. FR24023, Column 2

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amendments allowed 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 acceptable to the NRC staff for implementing the requirements of the 1996 revised rule that relate to initial activities and major phases of the decommissioning process. The costs and schedules presented in this analysis follow the general guidance and process described in the amended regulations. The format and content of the estimate is also consistent with the recommendations of Regulatory Guide 1.202, issued in February 2005.^[6]

In 2011, the NRC published amended regulations to improve decommissioning planning and thereby reduce the likelihood that any current operating facility will become a legacy site.^[7] The amended regulations require licensees to conduct their operations to minimize the introduction of residual radioactivity into the site, which includes the site's subsurface soil and groundwater. Licensees also may be required to perform site surveys to determine whether residual radioactivity is present in subsurface areas and to keep records of these surveys with records important for decommissioning. The amended regulations require licensees to report additional details in their decommissioning cost estimate as well as requiring additional financial reporting and assurances. These additional details are included in this analysis, including the ISFSI decommissioning estimate (Appendix E).

Decommissioning Scenario

The DECON scenario assumes that decommissioning activities at the two units are sequenced and integrated so as to minimize the total duration of the physical dismantling processes. Spent fuel remaining in the spent fuel pool at shutdown will be transferred to the ISFSI so as to facilitate decontamination and dismantling activities within the Auxiliary Building. For purposes of this study, IMPC has directed TLG to assume spent fuel storage operations continue on-site indefinitely.

⁶ "Standard Format and Content of Decommissioning Cost Estimates of Decommissioning Cost Estimates for Nuclear Power Reactors," Regulatory Guide 1.202, U.S. Nuclear Regulatory Commission, February 2005

⁷ 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

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Methodology

The methodology used to develop the estimates described within this document follows the basic approach originally presented in the cost estimating guidelines^[8] developed by the Atomic Industrial Forum (now Nuclear Energy Institute). This reference described a unit factor method for determining decommissioning activity costs. The unit factors used in this analysis incorporate site-specific costs and the latest available information on worker productivity in decommissioning.

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 cost estimate.

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 Pathfinder, Shoreham, Rancho Seco, Trojan, Yankee Rowe, Big Rock Point, Maine Yankee, Humboldt Bay-3, Oyster Creek, Connecticut Yankee, Crystal River, Vermont Yankee, Pilgrim, Indian Point and Fort Calhoun nuclear units have provided additional insight into the process, the regulatory aspects, and the technical challenges of decommissioning commercial nuclear units.

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."^[9] The cost elements in the estimates 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

⁸ T.S. LaGuardia et al., "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," AIF/NESP-036, May 1986

⁹ Project and Cost Engineers' Handbook, Second Edition, American Association of Cost Engineers, Marcel Dekker, Inc., New York, New York, p. 239

these estimates, does not account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the station.

The use and role of contingency within decommissioning estimates is not a safety factor issue. Safety factors provide additional security and address situations that may never occur. Contingency funds, by contrast, are expected to be fully expended throughout the program. 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,^[10] and its Amendments of 1985,^[11] the states became ultimately responsible for the disposition of low-level radioactive waste generated within their own borders.

With the exception of Texas, no new compact facilities have been successfully sited, licensed, and constructed. The Texas Compact disposal facility is now operational and waste is being accepted from generators within the Compact by the operator, Waste Control Specialists (WCS). The facility is also able to accept limited volumes of non-Compact waste.

Disposition of the various waste streams produced by the decommissioning process considered all options and services currently available to IMPC. The majority of the low-level radioactive waste designated for direct disposal (Class A^[12]) can be sent to EnergySolutions’ facility in Clive, Utah. Therefore, disposal costs for Class A waste were based upon IMPC’s agreement with EnergySolutions, LLC for both disposal of LLRW and off-site processing. This facility is not licensed to receive the higher activity portion (Classes B and C) of the decommissioning waste stream.

The WCS facility is able to receive the Class B and C waste. As such, for this analysis, Class B and C waste was assumed to be shipped to the WCS facility and disposal costs for the waste using this facility were based upon IMPC’s agreement with Waste Control Specialists, LLC for the WCS facility.

¹⁰ “Low-Level Radioactive Waste Policy Act of 1980,” Public Law 96-573, 1980

¹¹ “Low-Level Radioactive Waste Policy Amendments Act of 1985,” Public Law 99-240, 1986

¹² Waste is classified in accordance with U.S. Code of Federal Regulations, Title 10, Part 61.55

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. However, to date, the federal government has not identified a cost for disposing of GTCC or a schedule for acceptance.

For purposes of this analysis only, 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 the same canisters used for spent fuel and stored on site with the spent fuel.

A significant portion of the metallic waste generated during decommissioning may potentially be contaminated by radioactive materials. Rather than designating this large volume for controlled disposal, this analysis assumes that the material is sent to a licensed facility for characterization and processing. Processing is routinely used to reduce the volume, for example, by component disassembly, sorting, and compaction. The estimates reflect the savings from waste recovery/volume reduction.

High-Level Radioactive Waste Management

Congress passed the “Nuclear Waste Policy Act”^[13] (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 NWPA provided that DOE would enter into contracts with utilities in which DOE would promise to take the utilities’ spent fuel and high-level radioactive waste and utilities would pay the cost of the disposition services for that material. NWPA, along with the individual contracts with the utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

Since the original legislation, the DOE has announced several delays in the program schedule. By January 1998, the DOE had failed to accept any spent fuel or high level waste, as required by the NWPA and utility contracts. Delays continue and, as a result, generators have initiated legal action against the DOE in an attempt to obtain

¹³ “Nuclear Waste Policy Act of 1982 and Amendments,” DOE’s Office of Civilian Radioactive Management, 1982

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compensation for DOE's partial breach of contract. To date no spent fuel has been accepted from commercial generating sites for disposal.

In 2010 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 includes a requirement that it consider "[o]ptions for safe storage of used nuclear fuel while final disposition pathways are selected and deployed."¹⁴

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"¹⁵
- "[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."¹⁶

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..."¹⁷ This document states:

"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;

¹⁴ Charter of the Blue Ribbon Commission on America's Nuclear Future, "Objectives and Scope of Activities," 2010

¹⁵ "Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy," p. 32, January 2012

¹⁶ *Ibid.*, p.27

¹⁷ "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," U.S. DOE, January 11, 2013

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- 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.”^[18]

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 slashed 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) ^[19] ordering NRC to comply with federal law and restart its review of DOE's Yucca Mountain repository license application to the extent of previously appropriated funding for the review. That review is now complete with the publication of the five-volume safety evaluation report. A supplement to DOE’s environmental impact statement and an 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.

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 is currently under NRC review.

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. The joint venture has stated that they will request that the NRC resume its review of the original CISF license application.

¹⁸ Ibid., p.2

¹⁹ U.S. Court of Appeals for the District Of Columbia Circuit, In Re: Aiken County, et al, Aug. 2013, [http://www.cadc.uscourts.gov/internet/opinions.nsf/BAE0CF34F762EBD985257BC6004DEB18/\\$file/11-1271-1451347.pdf](http://www.cadc.uscourts.gov/internet/opinions.nsf/BAE0CF34F762EBD985257BC6004DEB18/$file/11-1271-1451347.pdf)

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In May 2018, the U.S. House of Representatives passed H.R. 3053, the “Nuclear Waste Policy Amendments Act of 2017.” 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 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.^[20]

This estimate is based on IMPC’s current spent fuel management plan. This plan assumes indefinite on-site storage for the D. C. Cook spent fuel.

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.^[21] Interim storage of the fuel, until the DOE has completed the transfer, will be in the auxiliary building’s storage pool as well as at an on-site ISFSI. For purposes of this analysis, it is assumed that DOE will accept already-canistered fuel.

An ISFSI, operated under a Part 50 General License (in accordance with 10 CFR 72, Subpart K^[22]), has been constructed to support continued plant operations. The facility

²⁰ In 2008, the DOE issued a report to Congress in which it concluded that it did not have authority, under present law, to accept spent nuclear fuel for interim storage from decommissioned commercial nuclear power reactor sites. 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, this estimate does not assume that D. C. Cook, as a permanently shutdown plant, will receive priority; the fuel removal schedule assumed in this estimate is based upon DOE acceptance of fuel according to the “Oldest Fuel First” priority ranking.

²¹ U.S. Code of Federal Regulations, Title 10, Part 50 – Domestic Licensing of Production and Utilization Facilities, Subpart 54 (bb), “Conditions of Licenses”

²² U.S. Code of Federal Regulations, Title 10, Part 72, Subpart K, “General License for Storage of Spent Fuel at Power Reactor Sites”

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is assumed to be available to support future decommissioning operations. In the three years and three months following the cessation of Unit 2 operations the fuel is packaged for interim storage at the ISFSI. The final core off-load is not eligible to be moved to the ISFSI until after cooling three years in the fuel storage pool. Once the fuel storage pool is emptied, the auxiliary building can be prepared for removal.

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.

This estimate assumes that some site features will remain following the decommissioning project. These include the existing electrical switchyard, which is assumed to remain functional in support of the regional electrical distribution system.

Consequently, this study assumes that site structures will be removed to a nominal depth of three feet below the local grade level wherever possible. The site will then be graded and stabilized.

Summary

The estimate to decommission D. C. Cook 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 (exclusive of the ISFSI). 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. The spent fuel remains in storage at the site until such time that the transfer to a DOE facility is complete. Once spent fuel transfer is complete the ISFSI will be decommissioned and demolished.

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

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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 estimates for the decommissioning alternatives are assigned to one of three subcategories: U.S. Nuclear Regulatory Commission (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 “Spent Fuel Management” subcategory contains costs associated with the containerization and transfer of spent fuel from the wet storage pool to the ISFSI for interim storage. Costs are included for the operation of the storage pool (spent fuel pool will operate until three and a quarter year after shutdown of Unit 2). The management of the ISFSI is included through the end of site restoration. 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 below grade 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 purpose of comparison (i.e., 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 expected to be incurred for the specific subcomponents of the total estimated program cost, if executed as described.

As noted within this document, the estimates were developed and costs are presented in 2021 dollars. As such, the estimates do 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.

COST SUMMARY
 (Thousands of 2021 Dollars)

Work Activity	Unit 1	Unit 2	Station
Decontamination	10,765	13,884	24,650
Removal	106,728	158,192	264,919
Packaging	29,807	29,876	59,683
Transportation	15,464	16,053	31,517
Waste Disposal	123,285	124,631	247,916
Off-site Waste Processing	14,746	14,262	29,008
Program Management ^[1]	325,389	333,765	659,155
Site Security	75,620	50,340	125,960
Spent Fuel Pool Isolation	-	14,827	14,827
Spent Fuel Management ^[2]	253,020	249,694	502,714
Insurance and Regulatory Fees	15,301	9,917	25,218
Energy	14,876	13,050	27,926
Characterization and Licensing Surveys	29,302	34,245	63,547
Property Taxes	1,853	1,853	3,705
Miscellaneous	8,066	7,990	16,056
Corporate A&G	22,760	23,821	46,581
Non-Labor Overhead	5,998	6,278	12,276
Tritium Monitoring	347	256	603
Total ^[3]	1,053,328	1,102,934	2,156,262
NRC License Termination	735,680	750,031	1,485,711
Spent Fuel Management	259,580	255,809	515,389
Site Restoration	58,068	97,094	155,162
Total ^[3]	1,053,328	1,102,934	2,156,262
ISFSI Operations, annual cost			7,446
ISFSI License Termination			23,313
ISFSI Site Restoration			9,945

^[1] Program Management costs include Utility and subcontractor staffing

^[2] Includes capital expenditures for dry storage system, loading and transfer, spent fuel pool O&M and EP fees but excludes program management costs (staffing)

^[3] Columns may not add due to rounding

1. INTRODUCTION

This report presents estimates of the costs to promptly decommission (decontaminate and dismantle) the D. C. Cook Nuclear Power Plant (D. C. Cook) following a scheduled cessation of plant operations. The estimates are designed to provide American Electric Power Company (AEP) and Indiana Michigan Power Company (IMPC) with sufficient information to assess their financial obligations as they pertain to the eventual decommissioning of the nuclear station.

The analysis relies upon site-specific, technical information compiled by TLG from information provided by IMPC. The analysis reflects current assumptions pertaining to the disposition of nuclear power plants and relevant industry experience in undertaking such projects. The costs are 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 restoration requirements.

The estimates are 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 estimates incorporate a cooling period of three years and three months for the spent fuel that resides in the plant's storage pool when Unit 2 operations cease. Any residual fuel remaining in the pool after this period will be relocated to an on-site, interim storage facility to await the transfer to a Department of Energy (DOE) facility. The estimates also include the dismantling of non-essential structures and limited restoration of the site.

The analysis is not an engineering evaluation, but consists of estimates prepared in advance of the detailed planning required to carry out the decommissioning of the nuclear units. It may also not reflect the actual plan to decommission D. C. Cook; the plan may differ from the assumptions made in this analysis based on facts that exist at the time of decommissioning.

1.1 OBJECTIVES OF STUDY

The objectives of this study are to prepare a comprehensive estimate of the costs to decommission D. C. Cook for the scenario outlined in Section 2, to define a sequence of events, and to develop waste stream projections from the decontamination and dismantling activities.

The two units at the D. C. Cook site were designed and constructed concurrently. Unit 1 obtained its operating license on October 25, 1974, with Unit 2 following on December 23, 1977. For the purposes of this study, the shutdown dates were taken as 60 years after the operating license issue dates, or October 25, 2034 for Unit 1 and December 23, 2037 for Unit 2. This time frame was used as input for scheduling the decommissioning.

1.2 SITE DESCRIPTION

The D. C. Cook site is located along the eastern shore of Lake Michigan in Lake Township, Berrien County, Michigan about 11 miles south-southwest of Benton Harbor. The population density of the area surrounding the site is relatively low. The area is primarily devoted to agricultural pursuits with some manufacturing in the Benton Harbor-St. Joseph and Niles areas.

The nuclear steam supply system (NSSS) provided by the Westinghouse Electric Corporation consists of a pressurized water reactor and a four-loop reactor coolant system (RCS). The licensed rating is 3,304 MWt and 3,468 MWt for Units 1 and 2, respectively. The maximum dependable capacity (net) is 1,030 MWe and 1,168 MWe for Units 1 and 2, respectively.

The NSSS is housed within a seismic Category I containment structure. The ice condenser reactor containment involves the very rapid absorption of the energy released in the improbable event of a loss-of-coolant accident by condensing the steam in a low temperature heat sink. This heat sink, located inside the containment, consists of a suitable quantity of borated ice in a cold storage compartment. The containment is a reinforced concrete structure with a steel liner. Access to the containment structure is provided by means of personnel air locks and an equipment hatch.

Heat produced in the reactor is converted to electrical energy by the steam and power conversion systems. A turbine-generator system converts the thermal energy of steam produced in the steam generators into mechanical shaft power and then into electrical energy. Each unit's turbine generator consists of a tandem compound (single shaft) arrangement of a double-flow, high-pressure turbine and three functionally identical low-pressure turbines driving a direct-coupled generator at 1,800 rpm. The turbines are operated in a closed feedwater cycle, which condenses the steam, heats the feedwater, and returns it to the steam generators. Heat rejected in the main condensers is removed by the circulating water system (CWS). The CWS provides the heat sink required for removal of waste heat. The water is pumped via intake tunnels to the main

condensers from where it returns to Lake Michigan via the discharge tunnels and submerged discharge pipes approximately 1,150 feet from the shoreline.

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.^[2] 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,"^[3] 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 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,^[4] 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.^[5] 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.^[6] 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. Within two years of submitting notice of permanent cessation of operations, the licensee is required to submit a Post-Shutdown Decommissioning Activities Report (PSDAR) to the NRC. 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 will include a license termination plan (LTP).

In 2011, the NRC published amended regulations to improve decommissioning planning and thereby reduce the likelihood that any current operating facility will become a legacy site.^[7] The amended regulations require licensees to conduct their operations to minimize the introduction of residual radioactivity into the site, which includes the site's subsurface soil and groundwater. Licensees also may be required to perform site surveys to determine whether residual radioactivity is present in subsurface areas and to keep records of these surveys with records important for decommissioning. The amended regulations require licensees to report additional details in their decommissioning cost estimate as well as requiring additional financial reporting and assurances. The additional details, including a decommissioning estimate for the Independent Spent Fuel Storage Installation (ISFSI), are included in this study.

1.3.1 Nuclear Waste Policy Act

Congress passed the "Nuclear Waste Policy Act"^[8] (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 NWPA provided that DOE would enter into contracts with utilities in which DOE would promise to take the utilities' spent fuel and high-level radioactive waste and utilities would pay the cost of the disposition services for that material. NWPA, along with the individual contracts with the utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

Since the original legislation, the DOE has announced several delays in the program schedule. By January 1998, the DOE had failed to accept any spent fuel or high level waste, as required by the NWPA and utility contracts. Delays continue and, as a result, generators have initiated legal action against the DOE in an attempt to obtain compensation for DOE's partial breach of contract [9]. To date no spent fuel has been accepted from commercial generating sites for disposal.

In 2010, 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 includes a requirement that it

consider “[o]ptions for safe storage of used nuclear fuel while final disposition pathways are selected and deployed.”^[10]

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 ^[11] 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.”

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...” ^[12] This document states:

“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 slashed 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) ^[13] ordering NRC to comply with federal law and restart its review of DOE's Yucca Mountain repository license application to the extent of previously appropriated funding for the review. That review is now complete with the publication of the five-volume safety evaluation report. A supplement to DOE's environmental impact statement and an adjudicatory hearing on the contentions filed by interested parties must be completed before a licensing decision can be made.

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.^[13] For purposes of this study, AEP has directed TLG to assume spent fuel storage operations continue at the site indefinitely

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.^[14] Interim storage of the fuel, until the DOE has completed the transfer, will be in the auxiliary building's storage pool as well as at an on-site ISFSI. For purposes of this analysis, it is assumed that DOE will accept already-canistered fuel.

An ISFSI, operated under a Part 50 General License (in accordance with 10 CFR 72, Subpart K ^[15]), has been constructed to support continued plant operations. The ISFSI is assumed to be expanded following cessation of plant operations to accommodate the assemblies in the plant's wet storage pool. By relocating the fuel to the ISFSI, the wet storage pool may be secured and decommissioning of the nuclear units may proceed. The ISFSI pad will be expanded at the time of decommissioning to be able to accommodate all necessary dry fuel storage casks required in support of the decommissioning program.

IMPC's position is that the DOE has a contractual obligation to accept D. C. Cook's 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. However, including the cost of storing spent fuel in this study is appropriate to

ensure the availability of sufficient decommissioning funds at the end of the station's life if the DOE has not met its obligation. The cost for the interim storage of spent fuel has been calculated and is separately presented as "Spent Fuel Management" expenditures in this report.

1.3.2 Low-Level Radioactive Waste Regulations

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,^[16] and its Amendments of 1985,^[17] the states became ultimately responsible for the disposition of low-level radioactive waste generated within their own borders.

With the exception of Texas, no new compact facilities have been successfully sited, licensed, and constructed. The Texas Compact disposal facility is now operational and waste is being accepted from generators within the Compact by the operator, Waste Control Specialists (WCS). The facility is also able to accept limited volumes of non-Compact waste.

Disposition of the various waste streams produced by the decommissioning process considered all options and services currently available to IMPC. The majority of the low-level radioactive waste designated for direct disposal (Class A^[41]) can be sent to EnergySolutions' facility in Clive, Utah. Therefore, disposal costs for Class A waste were based upon IMPC's agreement with EnergySolutions, LLC for both disposal of LLRW and off-site processing. This facility is not licensed to receive the higher activity portion (Classes B and C) of the decommissioning waste stream.

The WCS facility is able to receive the Class B and C waste. As such, for this analysis, Class B and C waste was assumed to be shipped to the WCS facility and disposal costs for the waste using this facility were based upon IMPC's agreement with Waste Control Specialists, LLC for the WCS facility.

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. However, to date, the federal government has not identified a cost for disposing of GTCC or a schedule for acceptance.

For purposes of this analysis only, 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 the same canisters used for spent fuel and stored on site with the spent fuel.

A significant portion of the metallic waste generated during decommissioning may potentially be contaminated by radioactive materials. Rather than designating this large volume for controlled disposal, this analysis assumes that the material is sent to a licensed facility for characterization and processing. Processing is routinely used to reduce the volume, for example, by component disassembly, sorting, and compaction. The estimates reflect 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,”^[19] 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 estimates assume that the D. C. Cook 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).^[20] An additional and separate limit of 4 millirem per year, as defined in 40 CFR §141.16, is applied to drinking water.^[21]

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)^[22] 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. DECOMMISSIONING ALTERNATIVE

Detailed cost estimates were developed to decommission D. C. Cook based upon the approved DECON decommissioning alternative. 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.

The operating licenses for Units 1 and 2 currently expire in October 2034 and December 2037, respectively. The DECON scenario assumes that decommissioning activities at the two units are sequenced and integrated so as to minimize the total duration of the physical dismantling processes. Spent fuel that remains in the storage pool at shutdown is relocated to the ISFSI so as to facilitate decontamination and dismantling activities within the Auxiliary Building. For purposes of this study, AEP has directed TLG to assume spent fuel storage operations continue at the site indefinitely.

The following section describes the basic activities associated with the DECON decommissioning 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 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 estimates developed for D. C. Cook are 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

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.

2.1.1 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, 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 greater than Class C waste (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 is not 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 must 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, and work packages and procedures, would be assembled to support the proposed decontamination and dismantling activities.

2.1.2 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 (1) performing detailed radiation surveys of work areas and major components (including the reactor vessel and its internals), and (2) performing contamination surveys of internal piping components levels and primary shield cores.
- Isolation of the spent fuel storage pool and fuel handling systems. This allows decommissioning operations to be performed in plant areas to the greatest extent, with minimum impact to the project schedule. The fuel will be transferred from the spent fuel pool once it decays to the point that it meets the heat load criteria of the spent fuel casks. It is therefore assumed that the fuel pool will remain operational for a minimum of three years and three months following the cessation of Unit 2 operations.
- 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 physical decommissioning activities associated with the removal and disposal of systems and structures containing contamination and radioactivity including the successful termination of the Part 50 operating licenses, 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. This may 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 may include the upgrading of roads (on and off site) to facilitate hauling and transport. Building modifications may be required to facilitate access of large/heavy equipment. Modifications may also be required to support the segmentation of the reactor vessel internals and component extraction.
- 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 canisters, 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 the 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.

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- Disassembly and segmentation of the remaining reactor internals, including core former and lower core support assembly.
- Segmentation of the reactor vessel. This requires installation of a shielded work platform. Cutting operations are performed in-air using remotely operated equipment within a contamination control envelope, with the water level maintained just below the cut to minimize the working area dose rates. Segments are transferred in-air to containers that are stored under water.
- 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 controlled disposal. Decontaminate exterior surfaces, as required, and seal-weld openings (nozzles, inspection hatches, and other penetrations). These components can serve as their own burial containers provided that all penetrations are properly sealed and the internal contaminants are stabilized. Steel shielding will be added as necessary to meet transportation limits and regulations.
- Transfer of the spent fuel from the storage pool to the ISFSI pad for interim storage. Spent fuel storage operations continue throughout the active decommissioning period. A date for the fuel transfer to the DOE from the D. C. Cook site has not been determined, as such the ISFSI will remain in operation indefinitely.

At least two years prior to the anticipated date of license termination, an LTP will be required. Submitted as a supplement to the Final Safety Analysis Report (FSAR), or 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 NRC. 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.
- Remediation and removal of the contaminated equipment and material from the auxiliary building and any other contaminated facility. Radiation and contamination controls will be utilized until radiation and contamination levels are reduced such 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.
- Removal of the remaining components, equipment, and plant services in support of the area release survey(s).
- 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.

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).^[23] This document incorporates the statistical approaches to survey design and data interpretation used by the EPA. It also identifies state-of-the-art, 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 surveys are 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 licenses 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, ISFSI OPERATIONS, AND DEMOLITION

2.3.1 Site Restoration

Following completion of decommissioning operations, site restoration activities may begin. Efficient removal of the contaminated materials and verification that residual radionuclide concentrations are below the NRC limits may result in substantial damage to many of the structures. Although performed in a controlled and safe manner, blasting, coring, drilling, scarification (surface removal), and the other decontamination activities will substantially degrade power block structures, including the reactor and auxiliary buildings. Verifying that subsurface radionuclide concentrations meet NRC site release requirements may 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 station.

Prompt dismantling of site structures is clearly the most appropriate and cost-effective option. 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 on site is more efficient than if the process were deferred. Site facilities quickly degrade without maintenance, adding additional expense and creating potential hazards to the public and future workers. Abandonment creates a breeding ground for vermin infestation and other biological hazards.

This cost study presumes that non-essential structures and site 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, and 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 rebar and miscellaneous embedments. The processed material is then used on site to backfill voids. Removable concrete vehicle barriers are removed intact and transported off site (cost of handling and transport is included in the estimate). Disposal of the barriers is based on no cost or credit to the decommissioning project.

2.3.2 ISFSI Operations and Demolition

The ISFSI will continue to operate under a general license (10 CFR Part 50) following the amendment of the operating licenses to release the adjacent (power block) property. As there is no projected start date for the DOE to start accepting spent fuel, IMPC has directed TLG to assume an indefinite ISFSI storage period.

At the conclusion of the spent fuel transfer process, the ISFSI is decommissioned. The NRC terminates the 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.

The existing ISFSI design is based upon the use of a multi-purpose canister (MPC), each with a concrete overpack. The spent fuel is placed inside the MPC, which is placed inside the concrete overpack (cylindrical concrete shielding container), and stored vertically on a storage pad. For purposes of this cost analysis, it is assumed that once the MPCs containing the spent fuel assemblies have been removed, and any residual radioactivity removed from the concrete overpack, the license for the ISFSI will be terminated. Following license termination, the concrete overpacks will be dismantled using conventional reinforced concrete demolition techniques. The concrete storage pad will then be removed, and the area graded and landscaped to conform to the surrounding environment.

3. COST ESTIMATE

The cost estimates prepared for decommissioning D. C. Cook consider the unique features of the site, including the nuclear steam supply system, power generation systems, support services, site buildings, and ancillary facilities. The bases of the estimates, including the sources of information relied upon, the estimating methodology employed, site-specific considerations and other pertinent assumptions are described in this section.

3.1 BASIS OF ESTIMATE

The analysis relies upon site-specific, technical information compiled by TLG from information provided by IMPC. The analysis reflects current assumptions pertaining to the disposition of nuclear power plants and relevant industry experience in undertaking such projects. The costs are 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 restoration requirements.

3.2 METHODOLOGY

The methodology used to develop these cost estimates follow the basic approach originally presented in the AIF/NESP-036 study report, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates,"^[24] and the DOE "Decommissioning Handbook."^[25] 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) were developed using local labor rates provided by IMPC. 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.^[26]

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, provides a high level of confidence 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 ^[27] 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 estimates is also consistent with the recommendations of Regulatory Guide 1.202, issued in February 2005. ^[28]

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 Pathfinder, Shoreham, Rancho Seco, Trojan, Yankee Rowe, Big Rock Point, Maine Yankee, Humboldt Bay-3, Oyster Creek, Connecticut Yankee, Crystal River, Vermont Yankee, Pilgrim, Indian Point and Fort Calhoun nuclear units have provided additional insight into the process, the regulatory aspects, and the technical challenges of decommissioning commercial nuclear units.

Work Difficulty Factors

TLG has historically applied work difficulty adjustment factors (WDFs) to account for the inefficiencies in working in radiologically controlled areas and in a power plant environment. WDFs are assigned to each unique set of unit 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 man-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. Dismantling of the fuel pool 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 provides a high degree of confidence in the reliability of the resulting cost estimate.

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.

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 TLG's 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.

3.3.1 Contingency

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"^[29] 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 estimate are based upon ideal conditions and maximum efficiency; therefore, consistent

with industry practice, a contingency factor has been applied. 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 percentage contingency in each category. It should be noted that contingency, as used in this estimate, does not account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the station.

The use and role of contingency within decommissioning estimates is not a “safety factor issue.” Safety factors provide additional security and address situations that may never occur. Contingency funds are expected to be fully expended throughout the program. They also provide assurance that sufficient funding is available to accomplish the intended tasks. An estimate without contingency, or from which contingency has been removed, could disrupt the orderly progression of events and jeopardize a successful conclusion to the decommissioning process.

For example, the most technologically challenging task in decommissioning a commercial nuclear station is the disposition of the reactor vessel and internal components, which have become highly radioactive after a lifetime of exposure to radiation produced in the core. The disposition of these highly radioactive components forms the basis for the critical path (schedule) for decommissioning operations. Cost and schedule are inter-dependent and any deviation in schedule has a significant impact on cost for performing a specific activity.

Disposition of the reactor vessel internals involves the underwater cutting of complex components that are highly radioactive. Costs are based upon optimum segmentation, handling, and packaging scenarios. The schedule is primarily dependent upon the turnaround time for the heavily shielded shipping casks, including preparation, loading, and decontamination of the containers for transport. The number of casks required is a function of the pieces generated in the segmentation activity, a value calculated on optimum performance of the tooling employed in cutting the various subassemblies. The risks and uncertainties associated with this task are that the expected optimization may not be achieved, resulting in delays and additional program costs. For this reason, contingency must be included to mitigate the consequences of the expected inefficiencies inherent in this complex activity, along with related concerns associated with the operation of highly specialized tooling, field conditions, and water clarity.

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 range 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%
• Non-Radioactive Component Removal	15%
• Heavy Equipment and Tooling	15%
• Supplies	25%
• Engineering	15%
• Energy	15%
• Characterization and Termination Surveys	30%
• Construction	15%
• Taxes and Fees	10%
• Insurance	10%
• Staffing	15%
• Spent Fuel Storage (Dry) Systems	15%
• Spent Fuel Transfer Costs	15%
• Operations and Maintenance Expenses	15%
• ISFSI Decommissioning	25%

The contingency values are applied to the appropriate components of the estimates on a line item basis. A composite value is then reported at the end of each detailed estimate (as provided in Appendix C). The overall contingency, when applied on this basis, results in an average value of 18.5% for Unit 1 and 18.6% for Unit 2. Appendix E, the ISFSI decommissioning calculation, uses a flat 25% contingency added at the end of the calculation.

3.3.2 Financial Risk

In addition to the routine technology-related uncertainties addressed by contingency, there is a broader level of project uncertainty that is sometimes necessary to consider when bounding decommissioning costs. 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, e.g., 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.

- Changes in the DOE's spent fuel transfer schedule and acceptance rate. Changes in these parameters affect the ISFSI size and duration of spent fuel storage and transfer.
- 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 estimates.

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

The cost to dispose the spent fuel generated from plant operations is not reflected within the estimates to decommission D. C. Cook. 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 estimates, as described below.

Since the DOE has not provided a firm acceptance start date, AEP has directed TLG to assume spent fuel will remain on-site indefinitely.

ISFSI

An ISFSI, which is operated under the plant's general license, has been constructed to support management of the spent fuel during operations. Costs are not included to re-license the ISFSI, but are included to expand the capacity of the ISFSI following final plant shutdown. The facility is assumed to be available to support spent fuel management once the units cease operation, until the DOE is able to removal all spent fuel from the site.

The ISFSI will continue to operate throughout decommissioning, until such time that the transfer of spent fuel to the DOE can be completed.

Post-shutdown and maintenance costs for the spent fuel pool and the ISFSI are also included and address the cost for staffing the facility, as well as security, insurance, and licensing fees. Costs for the transfer of spent fuel from the ISFSI to the DOE are not included in this estimate. Costs are provided for the final disposition of the facilities once the transfer is complete. These costs are allocated on a 50:50 basis between Units 1 and 2.

Canister and Overpack

A Holtec HI-STORM 100 system is assumed for future ISFSI capacity expansions. For fuel assemblies transferred from the pool to the ISFSI after shut down, 32 assemblies are loaded into a canister. The cost of the concrete overpack and the MPC is included in the decommissioning estimate.

Canister Loading and Transfer

The estimates include the cost for the labor and equipment to transfer and load each spent fuel canister into the ISFSI from the wet storage pool. Since this estimate assumes that spent fuel will remain on-site indefinitely a cost to transfer the fuel from the ISFSI into the DOE transport cask has not been determined.

Operations and Maintenance

The estimates include the cost of operating and maintaining the spent fuel pool and the ISFSI, respectively. Pool operations are expected to continue approximately three years and three months after the

cessation of Unit 2 operations. ISFSI operating costs are identified as an annual expense in Appendix D.

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 for the plan. 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.

A multi-purpose (storage and transport) canister (MPC) with a concrete overpack is used as a basis for the cost analyses. The majority of the overpacks are assumed to be disposed of as “clean” material. As an allowance, the inner steel liners of the remaining overpacks (total of 14) are assumed to have residual radioactivity due to some minor level of neutron-induced activation as a result of the long-term storage of the spent fuel, i.e., contain residual radioactivity. The allowance is based upon the number of modules required for the final core off-load (i.e., 193 offloaded assemblies, 32 assemblies per canister) which results in 7 overpack liners per unit. It is assumed that these are the final modules offloaded; consequently, they have the least time for radioactive decay of the neutron activation products.

No contamination or activation of the ISFSI pad is assumed. It would be expected that this assumption would be confirmed as a result of good radiological practice of surveying potentially impacted areas after each spent fuel transfer campaign. As such, only verification surveys are included for the pads in the decommissioning estimate. The estimate is limited to costs necessary to terminate the ISFSI’s NRC license and meet the §20.1402 criteria for unrestricted use.

In accordance with the specific requirements of 10 CFR §72.30 for the ISFSI work scope, 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 decommissioning cost for the ISFSI is identified in a stand-alone table in Appendix E.

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.^[32]

Although the material is not classified as high-level waste, federal regulations under the Act designate that disposal of this material is a federal responsibility under Section 3(b)(1)(D). However, the DOE has not been forthcoming with an acceptance criteria or disposition schedule for this material, and numerous questions remain as to the ultimate disposal cost and waste form requirements.

As such, for purposes of this study, the GTCC has been packaged and disposed of in the same manner as high-level waste, at a cost equivalent to that envisioned for the spent fuel. The number of canisters required and the packaged volume for GTCC was based upon experience at Maine Yankee (e.g., the constraints on loading as identified in the canister's certificate of compliance), but adjusted for the increased spent fuel capacity of the current MPCs.

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 D. C. Cook. GTCC costs have been segregated and included within the "License Termination" expenditures. The cost to dispose of the GTCC is included in period 2a of this estimate. The reality is that the cost may be deferred to such time that the DOE accepts this waste.

3.4.2 Reactor Vessel and Internal Components

The reactor pressure vessel and internal components are segmented in order to meet transportation and disposal requirements. 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 well. Transportation cask specifications and transportation regulations will dictate segmentation and packaging methodology. Material is loaded into single use cask liners that are loaded into shielded and reusable transportation casks.

Intact disposal of the reactor vessel and internal components could 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. 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 D. C. Cook ceases operation. Future viability of this option will depend upon the ultimate location of the disposal site, and the disposal site licensee's ability to accept highly radioactive packages and effectively isolate them from the environment. Consequently, as a bounding condition, the study assumes the reactor vessel requires segmentation.

3.4.3 Primary System Components

The reactor coolant system is 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 chemical 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, weight, and location within the containment will ultimately determine the removal strategy.

The extraction of the generators will require the cutting of an access to facilitate the removal process. Sections of the steam generator cubicle walls and adjoining floor slabs may require removal to allow for the generators to be maneuvered to the hatch.

Grating within the work area is decontaminated and removed. Next, a trolley crane is set up for removal of the generators. By setting the trolley crane first, it can be used to move portions of the steam generator cubicle walls and floor slabs from the containment to a location where they are decontaminated and transported to the material handling area.

The generators are rigged for removal, disconnected from the surrounding piping and supports, and maneuvered into the open area where they will be lowered onto a dolly. Once each steam generator has been placed in the horizontal position, nozzles and other openings are sealed. When this stage has been completed, each generator is moved out of containment and lowered onto a multi-wheeled transporter. The generators are relocated to an on-site storage area. The generator secondary side dome and internals are removed in order to reduce the component dimensions to permit rail transport to the disposal facility. The secondary side (dome and internals) is reduced in volume, repackaged, and sent to the recycling facility. If required, the lower shell will have carbon steel plate welded to its outside surface for shielding during transport. The interior volume is filled with low-density cellular concrete for stabilization of the internal contamination and to satisfy burial ground packaging requirements. The pressurizer is removed using the same technique. Each component is then loaded onto a heavy-duty flatcar for rail 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) drops 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 by rail for 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 condenser is disassembled and moved to a laydown area. Material is surveyed and if free of radioactive contamination, released as scrap.

3.4.5 Transportation Methods

Contaminated piping, components, and structural material other than the highly activated reactor vessel and internal components qualifies as LSA-I, II or III or Surface Contaminated Object, SCO-I or II, as described in Title 49 of the Code of Federal Regulations.^[33] The contaminated material is packaged in Industrial Packages (IP I, II, or III) 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 Part 71, as Type B. 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 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., ¹³⁷Cs, ⁹⁰Sr, 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, is 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 is based upon the license limits of the available shielded transport casks. The segmentation scheme for the vessel and internal segments are designed to meet these limits.

The transport of large intact components, e.g., large heat exchangers and other oversized components, is by a combination of truck, rail, and/or multi-wheeled transporter.

Transportation costs for Class A radioactive material requiring controlled disposal are based upon the mileage to the EnergySolutions' facility in Clive, Utah. Transportation costs for the higher activity Class B and C radioactive material are based upon the mileage to the WCS facility in Andrews County, Texas. The transportation cost for the GTCC material is assumed to be contained within the disposal cost. Transportation costs for off-site waste processing are based upon the mileage to Oak Ridge, Tennessee. Truck transport costs are developed from published tariffs from Tri-State Motor Transit.^[34]

3.4.6 Low-Level Radioactive Waste Disposal

To the greatest extent practical, metallic material generated in the decontamination and dismantling processes is treated to reduce the total volume requiring controlled disposal. The treated material, meeting the regulatory and/or site release criterion, is released as scrap, requiring no further cost consideration. Conditioning 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. Packaging efficiencies are lower for the highly-activated materials (greater than

Class A waste), where high concentrations of gamma-emitting radionuclides limit the capacity of the shipping canisters.

Disposition of the various waste streams produced by the decommissioning process considered all options and services currently available to IMPC. The majority of the low-level radioactive waste designated for direct disposal (Class A^[41]) can be sent to EnergySolutions' facility in Clive, Utah. Therefore, disposal costs for Class A waste were based upon IMPC's agreement with EnergySolutions, LLC for both disposal of LLRW and off-site processing. This facility is not licensed to receive the higher activity portion (Classes B and C) of the decommissioning waste stream.

The WCS facility is able to receive the Class B and C waste. As such, for this analysis, Class B and C waste was assumed to be shipped to the WCS facility and disposal costs for the waste using this facility were based upon IMPC's agreement with Waste Control Specialists, LLC for the WCS facility.

3.4.7 Site Conditions Following Decommissioning

The NRC terminates the site licenses (Part 50) 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, of the Part 50 facility, ends at this point. Building codes, environmental regulations and future plans for the site dictate the next step in the decommissioning process. As an example, the estimates assume that the electrical switchyard will remain operational in support of the electrical transmission and distribution system.

The large underground cooling water piping is isolated, sealed, and abandoned in place. Site utility and service piping is abandoned in place. Electrical manholes are backfilled with suitable earthen material and abandoned. Asphalt surfaces in the immediate vicinity of site buildings are broken up and the material used for backfill on site, if needed. The site access road remains. The ISFSI remains and is subsequently decommissioned as explained in Section 3.4.1.

The estimate includes an allowance for the removal and disposal of contaminated soil from the absorption pond. In addition, certain areas of the critical dunes (as designated by Michigan regulations)⁴² and the Unit 1 and 2 tank yards contain low levels of ¹³⁷Cs. The contaminated soil, approximately 6,000 cubic yards, associated with these areas will be removed and disposed of. Continued plant operations and/or future regulatory actions, such as the development of site-specific release criteria, may increase this volume.

The current tritium well monitoring program will continue through the decommissioning process. While at some point in the future this program will be discontinued, a cost is included in the annual ISFSI storage cost.

Structures are removed to a nominal depth of three feet below grade. Concrete rubble generated from demolition activities is processed and used as clean fill. Clean structural fill will be imported to the site to fill any remaining below grade voids. The site is graded following the removal of non-essential structures to conform to the adjacent landscape, and vegetation is established to inhibit erosion.

A significant amount of the below grade piping is located around the perimeter of the power block. The estimate includes a cost to excavate this area to an average depth of six feet so as to expose the piping, duct bank, conduit, and any near-surface grounding grid. The overburden is surveyed and stockpiled on site for future use in backfilling the below grade voids.

3.5 ASSUMPTIONS

The following are the major assumptions made in the development of the estimates 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 2021 dollars. Costs are not inflated, escalated, or discounted over the periods of performance.

The plant inventory, the basis for the decontamination and dismantling requirements and cost, and the decommissioning waste streams, were developed for the 2018 analysis and reviewed for this study.

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

AEP will hire a Decommissioning Operations Contractor (DOC) to manage the decommissioning. The licensee will provide site security, radiological health and safety, quality assurance and overall site administration during the decommissioning and demolition phases. Contract personnel will provide engineering services, e.g., for preparing the activity specifications, work procedures, activation, and structural analyses, under the direction of the owner.

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

The costs associated for the transition of the operating organization to decommissioning, e.g., separation packages beyond the current severance policy, retraining, and incentives are not included in the estimates and were considered to be ongoing operating expenses. Severance costs for utility staff personnel separated at Unit 1 and Unit 2 shutdown have been included in the estimate based on the current IMPC policy. The majority of these costs occur immediately after shutdown of each unit when the largest reductions occur. Severance costs continue to be incurred as decommissioning progresses and the staff is further reduced.

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

administration, operations, construction, and maintenance personnel are based upon average salary information provided by IMPC.

Security, while reduced from operating levels, is maintained throughout the decommissioning for access control, material control, and to safeguard the spent fuel (in accordance with the requirements of 10 CFR Part 37, Part 72, and Part 73). Security costs include provisions for recurring expenses.

The estimates incorporate economies of scale. Examples include the reduction in the man-hours and dollars for the preparation of common engineering work packages for the two units. Staff levels are reduced for supervision and management of parallel activities. Cost sharing is also reflected within the estimates for selective and joint decommissioning activities and in the purchase of specialty decommissioning equipment.

3.5.3 Design Conditions

Any fuel cladding failure that occurred during the lifetime of the plant was assumed to have released fission products at sufficiently low levels so that the buildup of quantities of long-lived isotopes (e.g., ¹³⁷Cs, ⁹⁰Sr, or transuranics) have 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 were derived from those listed in NUREG/CR-3474.^[35] Actual estimates were derived from the curie/gram values contained therein and adjusted for the different mass of D. C. Cook components, projected operating life, and different periods of decay. Additional short-lived isotopes are derived from NUREG/CR-0130^[36] and NUREG/CR-0672,^[37] and benchmarked to the long-lived values from NUREG/CR-3474.

The control elements are disposed of along with the spent fuel, i.e., there is no additional cost provided for their disposal.

Activation of the containment structure was confined to the biological shield in the estimates. More extensive activation (at very low levels) of the interior structures within containment have been detected at several reactors and the owners have elected to dispose of the affected material at a controlled facility rather than reuse the material as fill on site or send it to a landfill. The ultimate disposition of the material removed

depends upon the site release criteria selected and the designated end use for the site.

3.5.4 General

Transition Activities

Existing warehouses will be cleared of non-essential material and remain for use by the IMPC and its subcontractors. The warehouses may be dismantled as they become surplus to the decommissioning program. The station's operating staff will perform 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. It is assumed that these chemicals will have some value; therefore, the cost for their removal will be compensated through their subsequent sale.
- Process operating waste inventories. Disposal of operating wastes (e.g., filtration media, resins) during this initial period is not considered a decommissioning expense. The estimates do not address the disposition of any legacy components, with the exception of the contaminated operations / maintenance tools and equipment.

Scrap and Salvage

The existing plant equipment was considered obsolete and only suitable for scrap as deadweight quantities. Economically reasonable efforts will be made to salvage equipment following final plant shutdown. However, dismantling techniques assumed by TLG for equipment in these estimates are not consistent with removal techniques required for salvage (resale) of equipment. Experience indicates that some buyers wanted equipment stripped down to very specific requirements before they would consider purchase. This required expensive rework after the equipment has 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, these estimates did not attempt to quantify the value that may be realized based upon those efforts.

It is assumed, for purposes of this estimate, 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 did not include the additional cost for size reduction and preparation to meet “furnace ready” conditions. For example, the recovery of copper from electrical cabling from a facility currently being decommissioned has required the removal and disposition of the PCB-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 was 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 such items of property owned by the utility will be removed at no cost or credit to the decommissioning project. Disposition may include relocation to other generating facilities. Spare parts will also be made available for alternative use.

The concrete debris resulting from building demolition activities is crushed on site to reduce the size of the debris. The resulting crushed concrete is used to backfill below grade voids. The rebar removed from the concrete crushing process is disposed of as scrap steel in a similar fashion as other scrap metal as discussed previously.

Energy

For estimating purposes, the plant is assumed to be de-energized, with the exception of 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.

Emergency Planning

FEMA fees associated with emergency planning are assumed to continue for approximately 18 months following the cessation of Unit 2 operations. At this time, the fees are discontinued, 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 fees remain at operating levels until all fuel has been

transferred from the pool to the ISFSI. These fees are then eliminated. Local fees remain in effect until all fuel is removed from the site.

Insurance

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."^[38] The NRC's financial protection requirements are based on various reactor (and spent fuel) configurations.

Property Taxes

A nominal property tax (land only) during the decommissioning period is considered in these estimates.

Site Modifications

The perimeter fence and in-plant security barriers are moved, as appropriate, to conform to the site security plan in force during the various stages of the project.

Hazardous and Mixed Waste

No significant quantities of, industrial solvents, chromated water, lead, mercury or mixed waste are expected to be present on site at the time of decommissioning. Therefore, remediation costs were not included in the study.

Overhead Costs

IMPC has provided TLG with their current corporate and site overhead costs. These costs have been adjusted to the appropriate levels consistent with the staffing levels, as necessary, and are included with the period dependent costs.

3.6 IMPACT OF DECOMMISSIONING MULTIPLE REACTOR UNITS

In estimating the near simultaneous decommissioning of two co-located reactor units there can be opportunities to achieve economies of scale, by sharing costs between units, and coordinating the sequence of work activities. There will also be schedule constraints, particularly where there are requirements for specialty equipment and staff, or practical limitations on when final status surveys can take place. For purposes of the estimate, Units 1 and 2 are assumed to be essentially identical. Common facilities have been assigned to Unit 2. A summary of the principal impacts is listed below.

The sequence of work generally follows the principal that the work is done at Unit 1 first, followed by similar work at Unit 2. This permits the experience gained at Unit 1 to be applied by the workforce at the second unit. It should be noted however, that the estimates do not consider productivity improvements at the second unit, since there is little documented experience with decommissioning two units simultaneously. The work associated with developing activity specifications and procedures can be considered essentially identical between the two units, therefore the second unit costs are assumed to be a fraction of the first unit (~ 43%).

Segmenting the reactor vessel and internals will require the use of special equipment. The decommissioning project will be scheduled such that Unit 2's reactor internals and vessel are segmented after the activities at Unit 1 have been completed.

Some program management and support costs, particularly costs associated with the more senior positions, can be avoided with two reactors undergoing decommissioning simultaneously. As a result, the estimate is based on a "lead" unit that includes these senior positions, and a "second" unit that excludes these positions.

- Unit 1, as the first unit to enter decommissioning, incurs the majority of site characterization costs.
- Unit 1, as the first unit to enter decommissioning, incurs a greater fraction of the NRC hourly charges.
- The final radiological survey schedule is affected by a two-unit decommissioning schedule. It would be considered impractical to try to complete the final status survey of Unit 1, while Unit 2 still has ongoing radiological remediation work and waste handling in process. As such, the final status surveys of Units 1 and 2 are conducted concurrently.

- The final demolition of buildings at Units 1 and 2 are considered to take place concurrently.
- Shared systems and common structures are generally assigned to Unit 2.
- Station costs such as emergency response fees, corporate overhead, and insurance are generally allocated on an equal basis between the two units.

3.7 COST ESTIMATE SUMMARY

Summary level costs, license termination, spent fuel and site restoration costs projected for the decommissioning of each of the two units are provided in Tables 3.1 and 3.2 (sub-parts a, b, c, and d). The tables delineate the cost contributors by year of expenditures as well as cost contributor (e.g., labor, materials, and waste disposal).

The tables in Appendix C provide 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 License Termination cost associated with the decommissioning of the ISFSI (as required by 10 CFR §72.30) is presented separately. The basis for the ISFSI decommissioning cost is provided in Appendix E.

The “Spent Fuel Management” subcategory contains costs associated with the containerization and transfer of spent fuel from the wet storage pool to the ISFSI for interim storage. 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 cost 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.

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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 will be deferred to such time that the DOE accepts this waste. However, the cost to dispose of the GTCC is included in period 2a of this estimate. While designated for disposal at the 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 2021 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 timelines presented in Section 4.

The “Burial” column (Tables 3.1 and 3.2) contains costs for the processing of low-level radioactive waste, as well as for the controlled disposal of material that cannot be recovered (released for unrestricted use). Since the following tables are often used in escalation analyses, costs associated with the disposition of GTCC have been reassigned to the “Other” column, commensurate with contractual payments for a one-time disposal service, although the cost is still reported in the “LLRW Disposal Costs” column in Appendix C and as a “Waste Disposal” cost in the summary tables (i.e., on the table on page xix, and Table 6-1). “Off-site Waste Processing,” separately reported in the summary tables, has been included in the “Burial” column as well.

TABLE 3.1a
SUMMARY SCHEDULE OF ANNUAL EXPENDITURES
UNIT 1
 (Thousands, 2021 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2034	12,815	436	405	7	6,594	20,257
2035	106,716	109,068	2,578	1,470	31,050	250,882
2036	88,599	63,304	2,783	23,480	19,241	197,407
2037	82,748	64,374	2,065	30,513	22,402	202,102
2038	56,685	10,315	1,695	18,154	12,833	99,682
2039	40,272	5,450	1,630	10,939	9,977	68,269
2040	9,521	277	1,634	23	7,479	18,933
2041	26,232	5,513	1,107	36,512	11,425	80,788
2042	9,608	884	83	5,096	2,657	18,327
2043	23,807	1,063	207	16	2,187	27,280
2044	21,983	4,722	278	8	1,810	28,801
2045	14,190	5,713	217	0	1,387	21,507
2046	12,596	5,071	193	0	1,231	19,091
Total	505,773	276,189	14,876	126,217	130,273	1,053,328

TABLE 3.1b
SCHEDULE OF ANNUAL EXPENDITURES – LICENSE TERMINATION
UNIT 1
 (Thousands, 2021 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2034	12,684	436	405	7	6,339	19,871
2035	71,340	5,755	2,578	1,470	29,685	110,828
2036	73,908	23,221	2,783	23,480	18,088	141,482
2037	68,342	24,281	2,065	30,513	21,351	146,551
2038	53,986	10,278	1,695	18,154	11,783	95,896
2039	38,224	5,425	1,630	10,939	8,926	65,145
2040	9,521	277	1,634	23	6,425	17,880
2041	25,826	5,513	1,107	36,512	11,003	79,960
2042	9,551	884	83	5,096	2,520	18,134
2043	23,426	1,063	207	16	2,050	26,763
2044	11,528	574	120	8	765	12,995
2045	93	0	0	0	0	93
2046	83	0	0	0	0	83
Total	398,512	77,707	14,308	126,217	118,936	735,680

TABLE 3.1c
SCHEDULE OF ANNUAL EXPENDITURES – SPENT FUEL
UNIT 1
 (Thousands, 2021 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2034	0	0	0	0	254	254
2035	34,438	103,313	0	0	1,365	139,116
2036	13,353	40,058	0	0	1,152	54,563
2037	13,353	40,058	0	0	1,051	54,462
2038	0	0	0	0	1,051	1,051
2039	0	0	0	0	1,051	1,051
2040	0	0	0	0	1,054	1,054
2041	406	0	0	0	422	828
2042	57	0	0	0	136	193
2043	381	0	0	0	136	517
2044	804	0	158	0	1,028	1,990
2045	803	0	217	0	1,364	2,384
2046	712	0	193	0	1,211	2,116
Total	64,306	183,430	568	0	11,276	259,580

TABLE 3.1d
SCHEDULE OF ANNUAL EXPENDITURES – SITE RESTORATION
UNIT 1
 (Thousands, 2021 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2034	131	0	0	0	0	131
2035	938	0	0	0	0	938
2036	1,338	24	0	0	0	1,362
2037	1,053	35	0	0	0	1,088
2038	2,699	36	0	0	0	2,735
2039	2,049	25	0	0	0	2,073
2040	0	0	0	0	0	0
2041	0	0	0	0	0	0
2042	0	0	0	0	0	0
2043	0	0	0	0	0	0
2044	9,652	4,148	0	0	17	13,816
2045	13,294	5,713	0	0	23	19,030
2046	11,801	5,071	0	0	21	16,893
Total	42,954	15,053	0	0	61	58,068

TABLE 3.2a
SUMMARY SCHEDULE OF ANNUAL EXPENDITURES
UNIT 2
 (Thousands, 2021 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2035	22,568	67,705	0	0	0	90,274
2036	0	0	0	0	0	0
2037	1,524	58	55	1	864	2,502
2038	74,080	38,327	2,299	227	35,192	150,125
2039	87,612	61,628	3,248	19,719	31,535	203,742
2040	84,472	65,082	2,137	30,606	22,403	204,701
2041	67,379	14,806	1,823	30,230	15,140	129,378
2042	65,769	10,197	1,683	30,097	11,868	119,614
2043	59,828	6,626	1,094	15,763	13,320	96,632
2044	29,418	8,543	287	8	5,449	43,705
2045	20,202	10,735	224	0	1,822	32,983
2046	17,932	9,529	199	0	1,617	29,278
Total	530,786	293,237	13,050	126,650	139,211	1,102,934

TABLE 3.2b
SCHEDULE OF ANNUAL EXPENDITURES – LICENSE TERMINATION
UNIT 2
 (Thousands, 2021 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2035	0	0	0	0	0	0
2036	0	0	0	0	0	0
2037	1,517	58	55	1	830	2,461
2038	61,896	2,720	2,299	227	33,827	100,969
2039	73,320	21,550	3,248	19,719	30,335	148,171
2040	70,085	24,986	2,137	30,606	21,349	149,164
2041	62,646	14,680	1,823	30,230	14,718	124,096
2042	59,354	10,030	1,683	30,097	11,732	112,896
2043	56,091	6,539	1,094	15,763	13,184	92,671
2044	14,559	749	124	8	4,089	19,529
2045	40	0	0	0	0	40
2046	35	0	0	0	0	35
Total	399,542	81,311	12,464	126,650	130,064	750,031

TABLE 3.2c
SCHEDULE OF ANNUAL EXPENDITURES – SPENT FUEL
UNIT 2
 (Thousands, 2021 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2035	22,568	67,705	0	0	0	90,274
2036	0	0	0	0	0	0
2037	0	0	0	0	34	34
2038	11,869	35,607	0	0	1,365	48,842
2039	13,353	40,058	0	0	1,200	54,611
2040	13,353	40,058	0	0	1,054	54,465
2041	0	0	0	0	422	422
2042	0	0	0	0	136	136
2043	381	0	0	0	136	517
2044	804	0	163	0	1,028	1,995
2045	803	0	224	0	1,364	2,391
2046	712	0	199	0	1,211	2,122
Total	63,843	183,429	586	0	7,950	255,809

TABLE 3.2d
SCHEDULE OF ANNUAL EXPENDITURES – SITE RESTORATION
UNIT 2
 (Thousands, 2021 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2035	0	0	0	0	0	0
2036	0	0	0	0	0	0
2037	7	0	0	0	0	7
2038	315	0	0	0	0	315
2039	940	20	0	0	0	959
2040	1,035	38	0	0	0	1,072
2041	4,733	127	0	0	0	4,860
2042	6,415	167	0	0	0	6,582
2043	3,357	87	0	0	0	3,444
2044	14,055	7,794	0	0	332	22,182
2045	19,359	10,735	0	0	458	30,552
2046	17,185	9,529	0	0	406	27,120
Total	67,401	28,497	0	0	1,197	97,094

4. SCHEDULE ESTIMATE

The schedule for the decommissioning scenario considered in this study followed the sequence presented in the AIF/NESP-036 study, with minor changes to reflect recent experience and site-specific constraints. In addition, the scheduling was revised to reflect the required cooling period for the spent fuel.

A schedule or sequence of activities is presented in Figure 4.1. The schedule reflects the prompt decommissioning alternative and the start date consistent with a scheduled shutdown in 2034 for Unit 1 and 2037 for Unit 2. The sequence assumed that fuel would be removed from the spent fuel pool within the first three years and three months. The key activities listed in the schedule do not reflect a one-to-one correspondence with those activities in the Appendix C cost table, but reflect dividing some activities for clarity and combining others for convenience. The schedule was prepared using the “Microsoft Office Project” computer software.^[39]

4.1 SCHEDULE ESTIMATE ASSUMPTIONS

The schedule was generated using a precedence network and associated software. Activity durations were based upon the actual man-hour estimates calculated for each area. The schedule was assembled by sequencing the work areas, considering work crew availability and material access/egress. The following assumptions were made in the development of the decommissioning schedule:

- The spent fuel storage areas of the auxiliary building are isolated until such time that all spent fuel has been discharged from the storage pool to the ISFSI. Decontamination and dismantling of the storage pool is initiated once the transfer of spent fuel is complete. The auxiliary building will continue to serve as the spent fuel storage/transfer facility until such time that all spent fuel has been removed from the spent fuel pool. The auxiliary building is expected to operate for approximately three years and three months after the cessation of Unit 2 operations.
- All work (except vessel and internals removal activities) will be performed during an 8-hour workday, 5 days per week, with no overtime. There are nine paid holidays per year.
- Reactor and internals removal activities will be performed by using separate crews for different activities working on different shifts, with a corresponding backshift charge for the second shift.

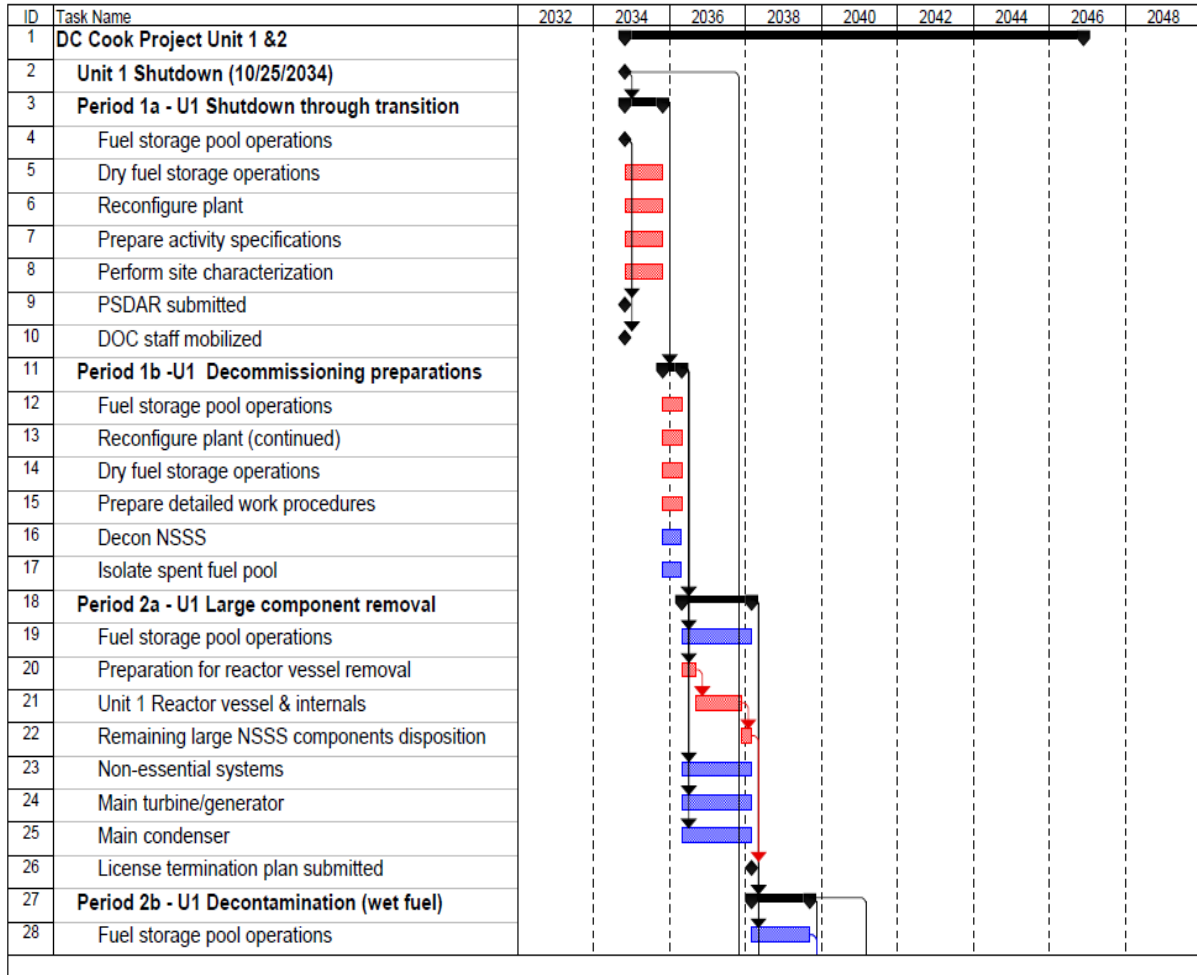
- Multiple crews will work parallel activities to the maximum extent possible, consistent with: optimum efficiency; adequate access for cutting, removal and laydown space; and the stringent safety measures necessary during demolition of heavy components and structures.
- For plant systems removal, the systems with the longest removal durations in areas on the critical path were considered to determine the duration of the activity.

4.2 PROJECT SCHEDULE

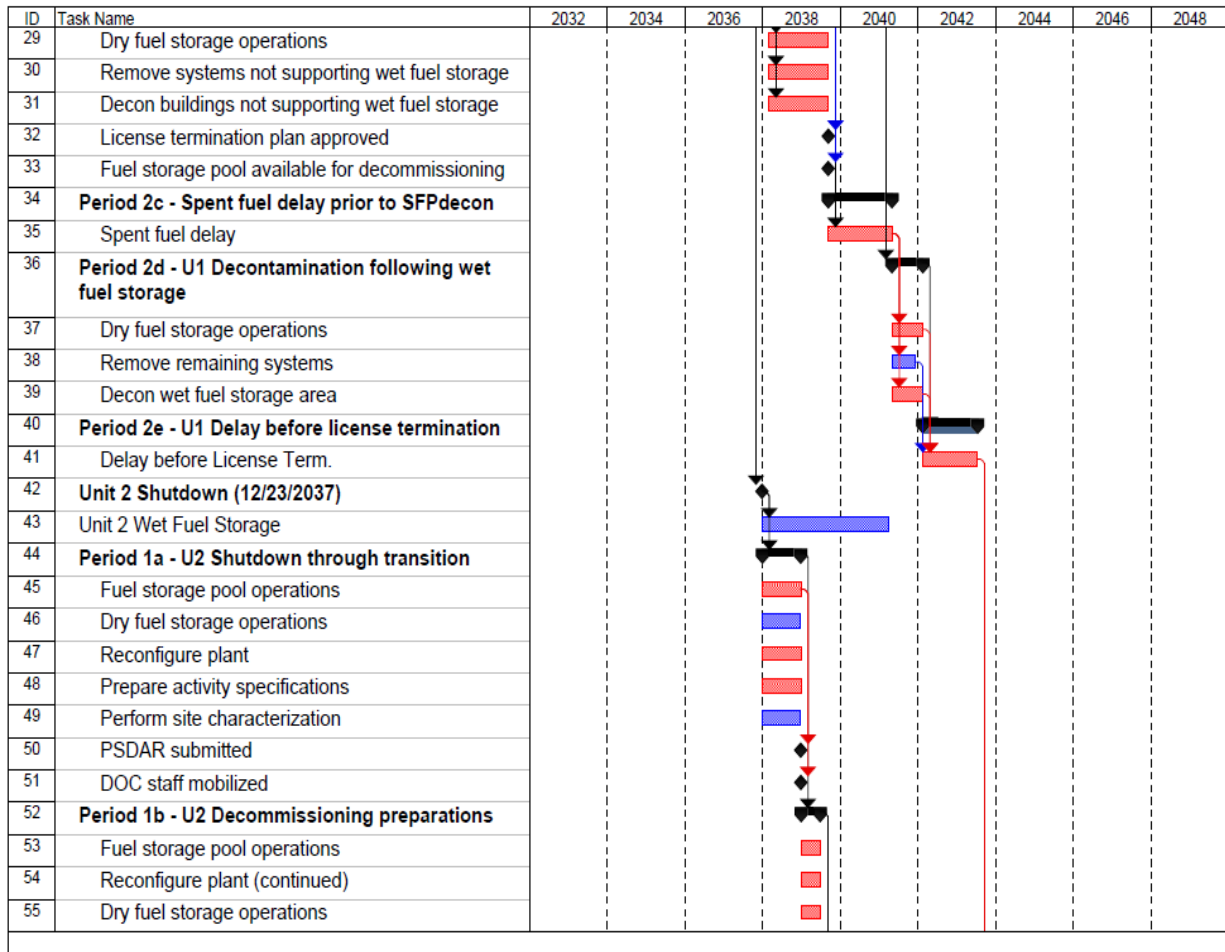
The period-dependent costs presented in Appendix C were based upon the durations developed in the schedule for the decommissioning of D. C. Cook. Durations were established between several milestones in each project period; these durations were used to establish a critical path for the entire project. In turn, the critical path duration for each period was used as the basis for determining the period-dependent costs.

Project timelines are shown in this section as Figure 4.2. Milestone dates were based on a 60-year plant operating life from the operating license issue date, a three-year three-month wet storage period for the last core discharge, and continued operation of the ISFSI. A date for the fuel transfer to the DOE from the D. C. Cook site has not been determined, as such the ISFSI will remain in operation indefinitely.

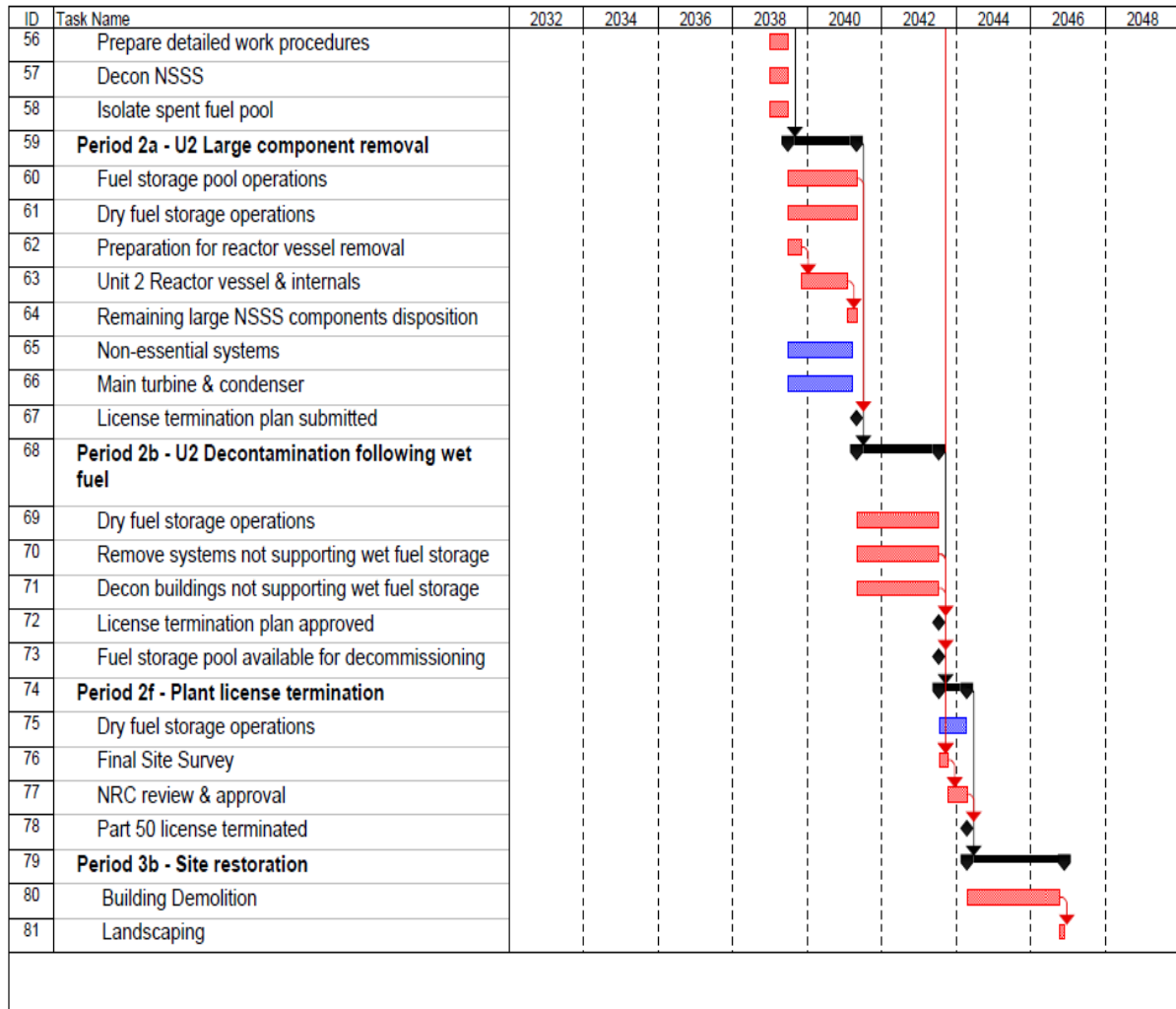
**FIGURE 4.1
 DECOMMISSIONING ACTIVITY SCHEDULE**



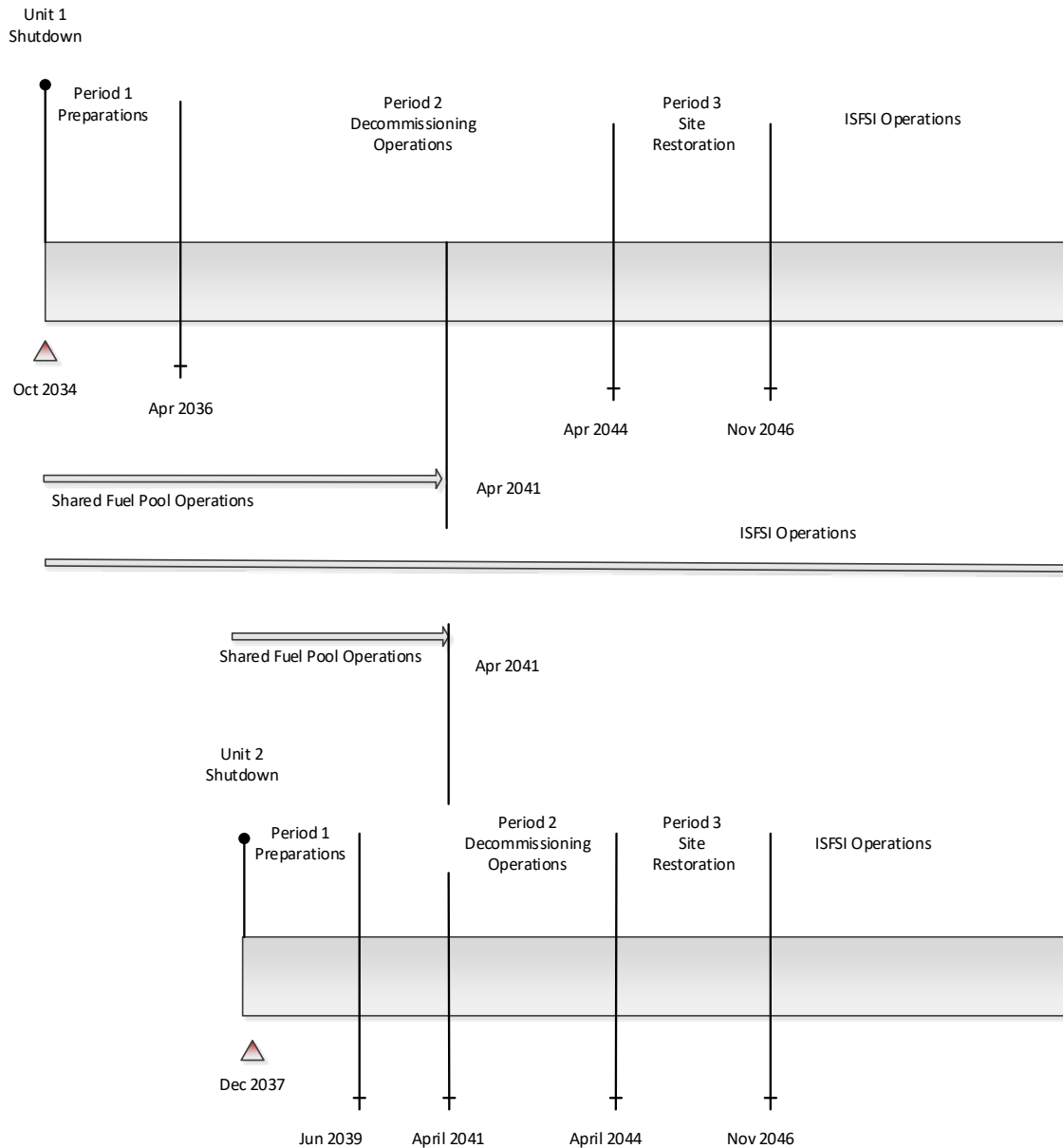
**FIGURE 4.1
 DECOMMISSIONING ACTIVITY SCHEDULE
 (continued)**



**FIGURE 4.1
 DECOMMISSIONING ACTIVITY SCHEDULE
 (continued)**



**FIGURE 4.2
DECOMMISSIONING TIMELINE
(not to scale)**



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(s). This currently requires the remediation of all radioactive material at the site in excess of applicable legal limits. Under the Atomic Energy Act,^[40] the NRC is responsible for protecting the public from sources of ionizing radiation. Title 10 of the Code of Federal Regulations (CFR) delineates the production, utilization, and disposal of radioactive materials and processes. In particular, 10 CFR Part 71 defines the requirements for packaging and transportation of radioactive material and 10 CFR Part 61 defines the criteria and procedures by which the NRC issues licenses for the disposal of radioactive waste. 10 CFR 61.55(a)(2)(iv) states that GTCC waste requires disposal in a geologic repository unless otherwise approved by the NRC.

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 Part 173. Shipping containers are required to be Industrial Packages (IP-1, IP-2 or IP-3). 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 of radioactive waste generated during the various decommissioning activities at the site are shown on a line-item basis in Appendix C and summarized in Tables 5.1 and 5.2. The quantified waste volume summaries shown in these tables are consistent with Part 61 classifications. The volumes were calculated based on the exterior dimensions for containerized material. The volumes were calculated 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 were applied against the liner volume and the special handling requirements of the payload. Packaging efficiencies are lower for the highly activated materials (greater than Class A waste), where high concentrations of gamma-emitting radionuclides limit the capacity of the shipping canisters.

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

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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.

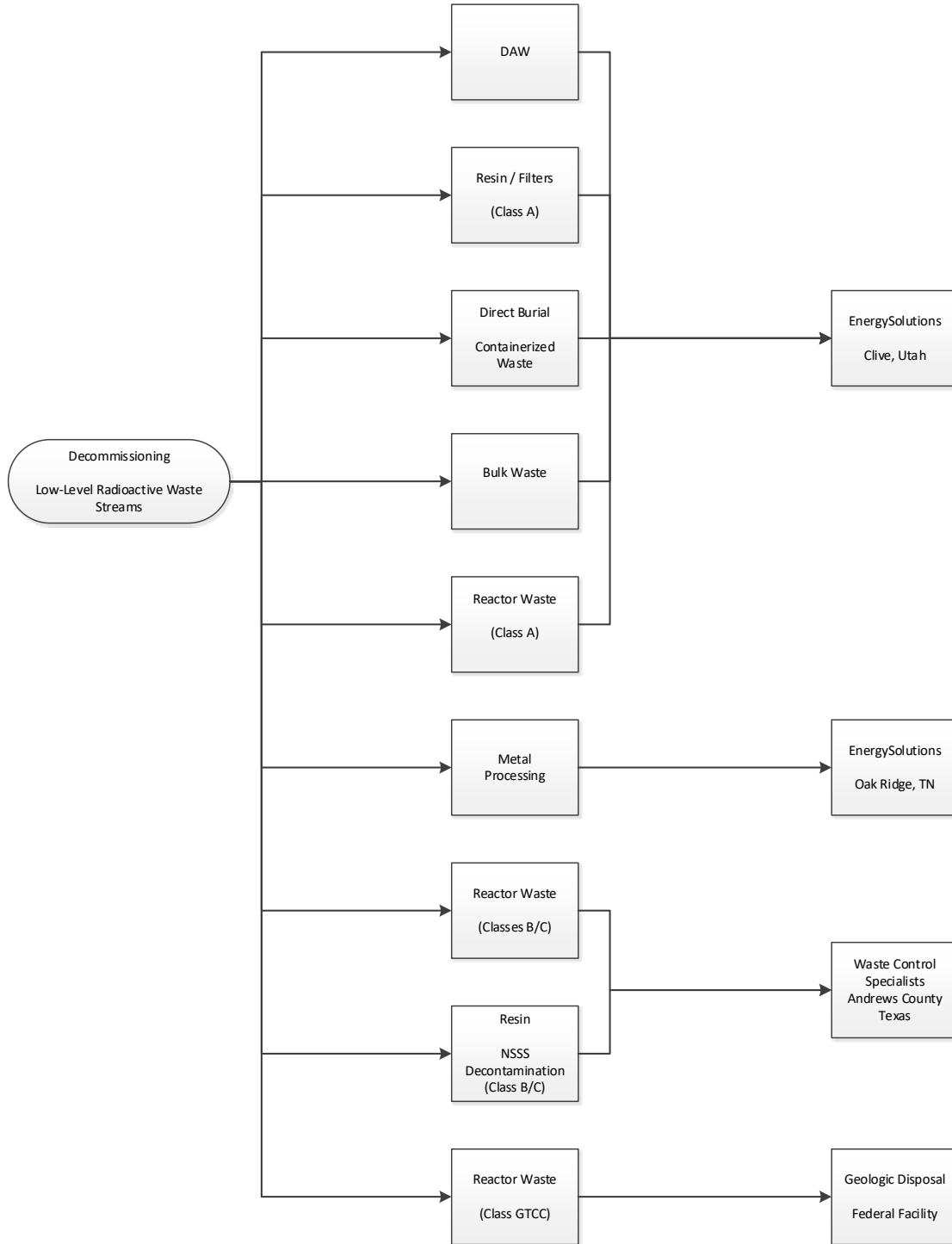
The waste material generated in the decontamination and dismantling of D. C. Cook will primarily be generated during Period 2. A significant portion of the metallic waste will be designated for additional processing and treatment at an off-site facility. Processing reduces the volume of material requiring controlled disposal through such techniques and processes as survey and sorting, decontamination and volume reduction. The material that cannot be unconditionally released will be packaged for controlled disposal at a licensed facility. Material considered potentially contaminated when removed from the radiologically controlled area will be sent to processing facilities for conditioning and disposal at an all-inclusive unit cost. Other contaminated components and activated materials will be routed for controlled disposal. The disposal volumes reported in the tables reflect the reductions resulting from reprocessing.

Disposition of the various waste streams produced by the decommissioning process considered all options and services currently available to IMPC. The majority of the low-level radioactive waste designated for direct disposal (Class A^[23]) can be sent to EnergySolutions' facility in Clive, Utah. Therefore, disposal costs for Class A waste were based upon AEP's agreement with EnergySolutions, LLC for disposal of LLRW and off-site processing. This facility is not licensed to receive the higher activity portion (Classes B and C) of the decommissioning waste stream.

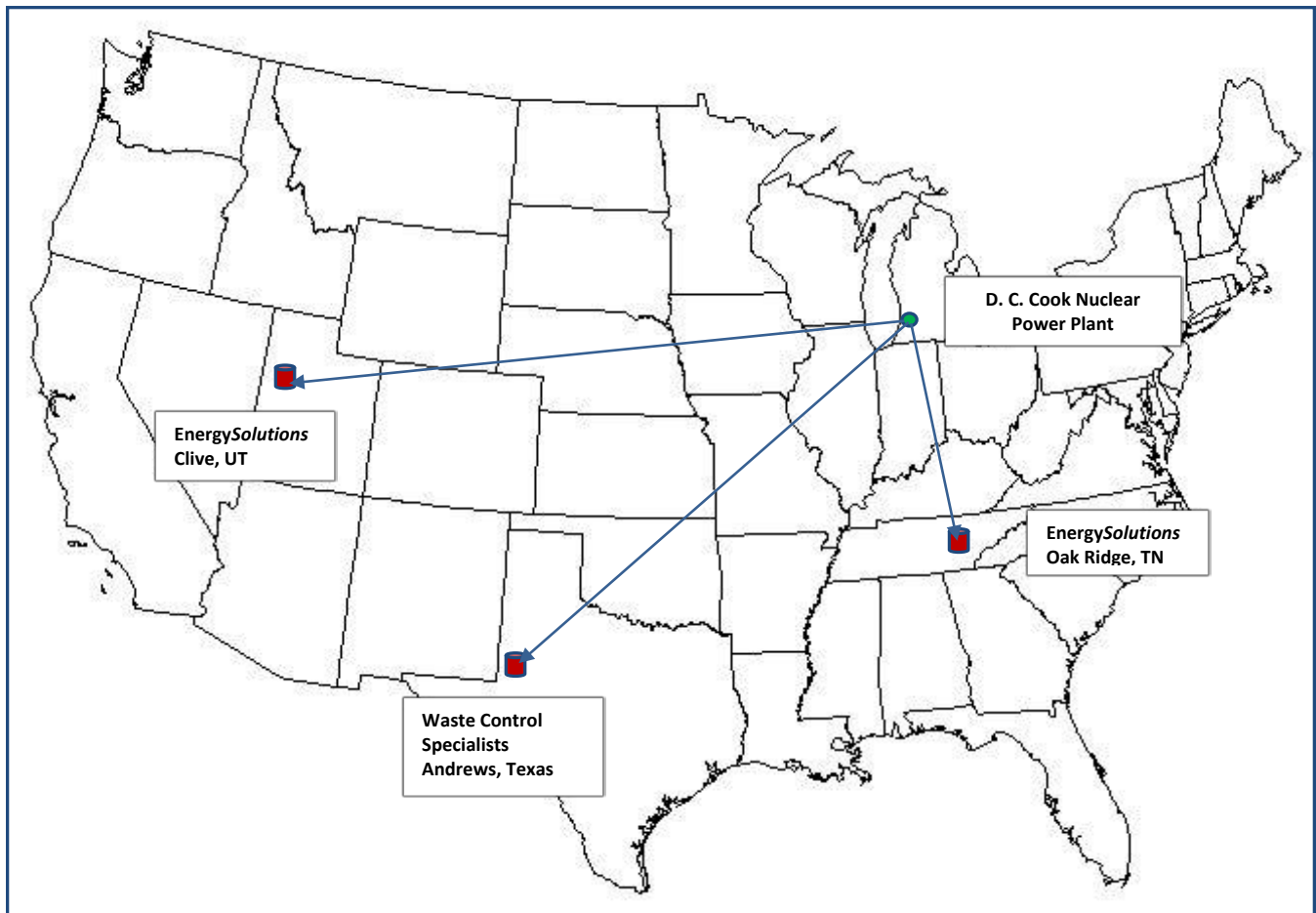
The WCS facility is able to receive the Class B and C waste. As such, for this analysis, Class B and C waste was assumed to be shipped to the WCS facility and disposal costs for the waste using this facility were based upon AEP's agreement with Waste Control Specialists, LLC.

²³ Waste is classified in accordance with U.S. Code of Federal Regulations, Title 10, Part 61.55

**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 (Clive, Utah and Andrews County, Texas) and processing/recovery (Oak Ridge, Tennessee).

Disposal of GTCC is expected to be disposed of in the same location as spent fuel.

**TABLE 5.1
 DECOMMISSIONING WASTE SUMMARY
 UNIT 1**

Waste	Cost Basis	Class [1]	Waste Volume (cubic feet)	Mass (pounds)
Low-Level Radioactive Waste (near-surface disposal)	EnergySolutions Containerized	A	120,928	8,381,431
	EnergySolutions Bulk	A	154,881	10,436,770
	Waste Control Specialists	B	1,841	201,167
	Waste Control Specialists	C	813	113,279
Greater than Class C (geologic repository)	Spent Fuel Equivalent	GTCC	2,061	410,142
Total [2]			280,526	19,542,789
Processed/Conditioned (off-site recycling center)	Recycling Vendors	A	141,731	5,276,687
Scrap Metal				50,898,000

[1] Waste is classified according to the requirements as delineated in 10 CFR Part 61.55

[2] Columns may not add due to rounding

**TABLE 5.2
 DECOMMISSIONING WASTE SUMMARY
 UNIT 2**

Waste	Cost Basis	Class [1]	Waste Volume (cubic feet)	Mass (pounds)
Low-Level Radioactive Waste (near-surface disposal)	EnergySolutions Containerized	A	110,856	7,890,719
	EnergySolutions Bulk	A	187,547	11,930,920
	Waste Control Specialists	B	1,841	201,167
	Waste Control Specialists	C	813	113,279
Greater than Class C (geologic repository)	Spent Fuel Equivalent	GTCC	2,061	410,142
Total [2]			303,118	20,546,227
Processed/Conditioned (off-site recycling center)	Recycling Vendors	A	137,168	5,103,712
Scrap Metal				116,070,000

[1] Waste is classified according to the requirements as delineated in 10 CFR Part 61.55

[2] Columns may not add due to rounding

6. RESULTS

The analysis to estimate the costs to decommission D. C. Cook relied upon the site-specific, technical information provided by AEP. While not an engineering study, the estimates provide the owner with sufficient information to assess their financial obligations as they pertain to the eventual decommissioning of the nuclear station.

The estimates described in this report were 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 assumed continued operation of the plant's spent fuel pool for approximately three years and three months following the cessation of operations for continued cooling of the assemblies. The ISFSI will be expanded to allow transfer of all fuel from the spent fuel pool and the orderly progression of decommissioning activities. The ISFSI will be decontaminated and demolished once the DOE completes the transfer of the assemblies and the GTCC material to its repository.

The costs projected to promptly decommission D. C. Cook are estimated to be \$1,053.3 million for Unit 1 and \$1,102.9 million for Unit 2. The majority of the \$2,156.3 million cost (approximately 68.9%) is associated with the physical decontamination and dismantling of the nuclear units, so that the Part 50 licenses can be terminated. Caretaking and handling of the spent fuel and termination of the ISFSI license constitutes an additional 23.9% of the cost. The remaining 7.2% is for the demolition of the remaining structures and limited restoration of the site.

The primary cost contributors, identified in Table 6.1, are either labor-related, ISFSI 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 and the duration of the program. It was assumed, for purposes of this analysis, that the utility would oversee the decommissioning program, managing the decommissioning labor force and the associated subcontractors. The size and composition of the management organization will vary with the decommissioning phase and associated site activities. However, once the operating license(s) is amended or 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 approximately three years and months following the cessation of plant operations.

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The pool will be isolated and independent spent fuel islands created. This will allow decommissioning operations to proceed in and around the auxiliary building. Over this period, the spent fuel will be packaged into transportable steel canisters for loading into concrete overpacks, on the ISFSI pad. The spent fuel will remain on the ISFSI pad until all spent fuel has been removed from the site by the DOE.

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.

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, disposal of the lower-level radioactive material will be at the EnergySolutions facility. Selective reactor vessel components and processed liquid waste (Class B and C) will be sent to the WCS facility in Andrews County, Texas. Highly radioactive reactor vessel internal components (GTCC waste), requiring additional isolation from the environment, will be packaged for geologic disposal. The cost of geologic disposal was based upon a weight-cost equivalent for spent fuel.

Removal costs reflect the labor-intensive nature of the decommissioning process and 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 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 could be more cost-effective than deferral, due to the ultimate deterioration of facilities (and therefore the working conditions). The reported cost for transport includes the tariffs and surcharges associated with moving large components and/or overweight shielded casks overland, and the general expense, e.g., labor and fuel, of transporting material to the destinations identified in this report. For purposes of this estimate, material will be primarily shipped to the waste disposal facilities by truck.

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Decontamination will be used to reduce the plants radiation fields and minimize worker exposure. Slightly contaminated material or material located within a contaminated area will be sent to an off-site processing center, i.e., this estimate did not assume that contaminated plant components and equipment could be economically decontaminated for uncontrolled release in-situ. Centralized processing centers have proven to be a more efficient means of handling the large volumes of material produced in the dismantling of a nuclear unit.

License termination survey costs were 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, and 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 at a basic functional and regulatory level.

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**TABLE 6.1
 SUMMARY OF DECOMMISSIONING COST ELEMENTS**

Work Activity	Unit 1	Unit 2	Cost 2021 \$s (thousands)	Percent of Total Costs
Decontamination	10,765	13,884	24,650	1.1%
Removal	106,728	158,192	264,919	12.3%
Packaging	29,807	29,876	59,683	2.8%
Transportation	15,464	16,053	31,517	1.5%
Waste Disposal	123,285	124,631	247,916	11.5%
Off-site Waste Processing	14,746	14,262	29,008	1.3%
Program Management ^[1]	325,389	333,765	659,155	30.6%
Site Security	75,620	50,340	125,960	5.8%
Spent Fuel Pool Isolation	0	14,827	14,827	0.7%
Spent Fuel Management ^[2]	253,020	249,694	502,714	23.3%
Insurance and Regulatory Fees	15,301	9,917	25,218	1.2%
Energy	14,876	13,050	27,926	1.3%
Characterization and Licensing Surveys	29,302	34,245	63,547	2.9%
Property Taxes	1,853	1,853	3,705	0.2%
Miscellaneous	8,066	7,990	16,056	0.7%
Corporate A&G	22,760	23,821	46,581	2.2%
Non-Labor Overhead	5,998	6,278	12,276	0.6%
Tritium Monitoring	347	256	603	0.0%
Total ^[3]	1,053,328	1,102,934	2,156,262	100.0%
NRC License Termination	735,680	750,031	1,485,711	68.9%
Spent Fuel Management	259,580	255,809	515,389	23.9%
Site Restoration	58,068	97,094	155,162	7.2%
Total ^[3]	1,053,328	1,102,934	2,156,262	100.0%
ISFSI Operations, annual cost			7,446	
ISFSI License Termination			23,313	
ISFSI Site Restoration			9,945	

^[1] Program Management costs include Utility and subcontractor staffing

^[2] Includes capital expenditures for dry storage system, loading and transfer, spent fuel pool O&M and EP fees but excludes program management costs (staffing)

^[3] Columns may not add due to rounding

7. REFERENCES

1. "Decommissioning Cost Study for the D. C. Cook Nuclear Power Plant," Document No. A02-1745-001, Rev. 0, TLG Services, Inc., January 2019
2. 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 [\[Open\]](#)
3. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.159, "Assuring the Availability of Funds for Decommissioning Nuclear Reactors," Rev. 2, October 2011 [\[Open\]](#)
4. U.S. Code of Federal Regulations, Title 10, Part 20, Subpart E, "Radiological Criteria for License Termination" [\[Open\]](#)
5. 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 [\[Open\]](#)
6. 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 [\[Open\]](#)
7. 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 [\[Open\]](#)
8. "Nuclear Waste Policy Act of 1982," 42 U.S. Code 10101, et seq. [\[Open\]](#)
9. Charter of the Blue Ribbon Commission on America's Nuclear Future, "Objectives and Scope of Activities," 2010 [\[Open\]](#)
10. "Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy," p. 27, 32, January 2012 [\[Open\]](#)
11. "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," U.S. DOE, January 2013 [\[Open\]](#)

7. REFERENCES (Continued)

12. United States Court of Appeals for the District of Columbia Circuit, In Re: Aiken County, Et Al., August 2013 [\[Open\]](#)
13. In 2008, the DOE issued a report to Congress in which it concluded that it did not have authority, under present law, to accept spent nuclear fuel for interim storage from decommissioned commercial nuclear power reactor sites. 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, this estimate does not assume that D. C. Cook, as a permanently shutdown plant, will receive priority; the fuel removal schedule assumed in this estimate is based upon DOE acceptance of fuel according to the “Oldest Fuel First” priority ranking. The plant owner will seek the most expeditious means of removing fuel from the site when DOE commences performance.
14. U.S. Code of Federal Regulations, Title 10, Part 50, “Domestic Licensing of Production and Utilization Facilities,” Subpart 54 (bb), “Conditions of Licenses” [\[Open\]](#)
15. U.S. Code of Federal Regulations, Title 10, Part 72, Subpart K, “General License for Storage of Spent Fuel at Power Reactor Sites” [\[Open\]](#)
16. “Low-Level Radioactive Waste Policy Act,” Public Law 96-573, 1980 [\[Open\]](#)
17. “Low-Level Radioactive Waste Policy Amendments Act of 1985,” Public Law 99-240, January 15, 1986 [\[Open\]](#)
18. U.S. Code of Federal Regulations, Title 10, Part 61, “Licensing Requirements for Land Disposal of Radioactive Waste” [\[Open\]](#)
19. 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 [\[Open\]](#)

7. REFERENCES (Continued)

20. "Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination," EPA Memorandum OSWER No. 9200.4-18, August 22, 1997 [\[Open\]](#)
21. U.S. Code of Federal Regulations, Title 40, Part 141.66, "Maximum contaminant levels for radionuclides" [\[Open\]](#)
22. "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 [\[Open\]](#)
23. "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," NUREG-1575, Rev. 1, EPA 402-R-97-016, Rev. 1, August 2000 [Open](#)
24. T.S. LaGuardia et al., "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," AIF/NESP-036, May 1986
25. W.J. Manion and T.S. LaGuardia, "Decommissioning Handbook," U.S. Department of Energy, DOE/EV/10128-1, November 1980
26. "Building Construction Cost Data 2021," RSMeans (From the Gordian Group), Rockland, Massachusetts
27. "Decommissioning of Nuclear Power Reactors," Regulatory Guide 1.184 Revision 1, Nuclear Regulatory Commission, October 2013 [\[Open\]](#)
28. "Standard Format and Content of Decommissioning Cost Estimates for Nuclear Power Reactors," Regulatory Guide 1.202, Nuclear Regulatory Commission, February 2005 [\[Open\]](#)
29. Project and Cost Engineers' Handbook, Second Edition, p. 239, American Association of Cost Engineers, Marcel Dekker, Inc., New York, New York, 1984
30. DOE/RW-0351, "Civilian Radioactive Waste Management System Waste Acceptance System Requirements Document", Revision 5, INC01, Effective date March 10, 2008

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31. "Civilian Radioactive Waste Management System Requirements Document, DOE/RW-0406, Revision 8, September 2007 [\[Open\]](#)
32. "Strategy for Management and Disposal of Greater-Than-Class C Low-Level Radioactive Waste," Federal Register Volume 60, Number 48 (p 13424 et seq.), March 1995 [\[Open\]](#)
33. U.S. Department of Transportation, Title 49 of the Code of Federal Regulations, "Transportation," Parts 173 through 178 [\[Open\]](#)
34. Tri-State Motor Transit Company, Radioactive Materials Tariffs, TSMT 7000, January 2021. [\[Open\]](#)
35. 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 [\[Open\]](#)
36. 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 [\[Open Main Report\]](#) [\[Open Appendices\]](#)
37. 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 [\[Open Main Report\]](#) [\[Open Appendices\]](#)
38. SECY-00-0145, "Integrated Rulemaking Plan for Nuclear Power Plant Decommissioning," June 2000 [\[Open\]](#)
39. "Microsoft Project Professional," Microsoft Corporation, Redmond, WA
40. "Atomic Energy Act of 1954," (68 Stat. 919) [\[Open\]](#)
41. Waste is classified in accordance with U.S. Code of Federal Regulations, Title 10, Part 61.55
42. Natural Resources and Environmental Protection Act, Act 451 or 1994, Part 353, Sand Dunes Protection and Management.

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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	Critical Duration*
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 in plastic, send to the waste processing area	<u>60</u>	<u>60</u>
Totals (Activity/Critical)		355	255

Duration adjustment(s):

+ Respiratory protection adjustment (50% of critical duration) 128
 + Radiation/ALARA adjustment (37.08% 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 min 673 min

***** Total duration = 11.217 hr *****

* Note: (alpha designation) indicates activities that can be performed in parallel with corresponding Act ID (within critical duration)

**APPENDIX A
 (continued)**

3. LABOR REQUIRED

Crew	Number	Duration (hr)	Rate (\$/hr)	Cost
Laborers	3.00	11.217	39.73	\$1,336.95
Craftsmen	2.00	11.217	71.23	\$1,597.97
Foreman	1.00	11.217	76.26	\$855.41
General Foreman	0.25	11.217	79.84	\$223.89
Fire Watch	0.05	11.217	39.73	\$22.28
Health Physics Technician	1.00	11.217	64.65	<u>\$725.18</u>
Total labor cost				\$4,761.68

4. EQUIPMENT & CONSUMABLES COSTS

Equipment Costs	none
Consumables/Materials Costs	
-Gas torch consumables 1 @ \$20.62/hr x 1 hr {1}	\$20.62
-Blotting paper 50 @ \$0.62 sq ft {2}	\$31.00
-Tarpaulin 12 mils, oil resistant, fire retardant 50 @ \$0.48/sq ft {3}	<u>\$24.00</u>
Subtotal cost of equipment and materials	\$75.62
Overhead & sales tax on equipment and materials @ 16.00 %	<u>\$12.10</u>
Total costs, equipment & material	\$87.72
TOTAL COST:	
Removal of contaminated heat exchanger <3000 pounds:	\$4,849.40
Total labor cost:	\$4,761.68
Total equipment/material costs:	\$87.72
Total craft labor man-hours required per unit:	81.884

5. NOTES AND REFERENCES

- Work difficulty factors were developed in conjunction with the Atomic Industrial Forum (AIF) (now Nuclear Energy Institute) 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. R.S. Means (2021) Division 01 54 33, Section 40-6360, page 734
 2. www.mcmaster.com online catalog, McMaster Carr Spill Control (7193T88)
 3. R.S. Means (2021) Division 01 56, Section 13.60-0600, page 23
- Material and consumable costs were adjusted using the regional indices for Kalamazoo, Michigan.

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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	0.49
Removal of clean pipe 0.25 to 2 inches diameter, \$/linear foot	5.01
Removal of clean pipe >2 to 4 inches diameter, \$/linear foot	7.47
Removal of clean pipe >4 to 8 inches diameter, \$/linear foot	15.56
Removal of clean pipe >8 to 14 inches diameter, \$/linear foot	29.06
Removal of clean pipe >14 to 20 inches diameter, \$/linear foot	37.88
Removal of clean pipe >20 to 36 inches diameter, \$/linear foot	55.71
Removal of clean pipe >36 inches diameter, \$/linear foot	66.15
Removal of clean valve >2 to 4 inches	101.93
Removal of clean valve >4 to 8 inches	155.60
Removal of clean valve >8 to 14 inches	290.61
Removal of clean valve >14 to 20 inches	378.79
Removal of clean valve >20 to 36 inches	557.07
Removal of clean valve >36 inches	661.46
Removal of clean pipe hanger for small bore piping	34.47
Removal of clean pipe hanger for large bore piping	115.67
Removal of clean pump, <300 pound	264.38
Removal of clean pump, 300-1000 pound	755.02
Removal of clean pump, 1000-10,000 pound	2,934.98
Removal of clean pump, >10,000 pound	5,682.47
Removal of clean pump motor, 300-1000 pound	315.13
Removal of clean pump motor, 1000-10,000 pound	1,218.96
Removal of clean pump motor, >10,000 pound	2,742.66
Removal of clean heat exchanger <3000 pound	1,583.18
Removal of clean heat exchanger >3000 pound	3,994.01
Removal of clean feedwater heater/deaerator	11,208.45
Removal of clean moisture separator/reheater	22,976.31
Removal of clean tank, <300 gallons	339.85
Removal of clean tank, 300-3000 gallon	1,068.02
Removal of clean tank, >3000 gallons, \$/square foot surface area	9.29

APPENDIX B

**UNIT COST FACTOR LISTING
 (Power Block Structures Only)**

Unit Cost Factor	Cost/Unit(\$)
Removal of clean electrical equipment, <300 pound	142.54
Removal of clean electrical equipment, 300-1000 pound	513.05
Removal of clean electrical equipment, 1000-10,000 pound	1,026.11
Removal of clean electrical equipment, >10,000 pound	2,481.50
Removal of clean electrical transformer < 30 tons	1,723.36
Removal of clean electrical transformer > 30 tons	4,963.00
Removal of clean standby diesel generator, <100 kW	1,760.27
Removal of clean standby diesel generator, 100 kW to 1 MW	3,929.03
Removal of clean standby diesel generator, >1 MW	8,133.88
Removal of clean electrical cable tray, \$/linear foot	13.45
Removal of clean electrical conduit, \$/linear foot	5.88
Removal of clean mechanical equipment, <300 pound	142.54
Removal of clean mechanical equipment, 300-1000 pound	513.05
Removal of clean mechanical equipment, 1000-10,000 pound	1,026.11
Removal of clean mechanical equipment, >10,000 pound	2,481.50
Removal of clean HVAC equipment, <300 pound	172.36
Removal of clean HVAC equipment, 300-1000 pound	616.48
Removal of clean HVAC equipment, 1000-10,000 pound	1,228.63
Removal of clean HVAC equipment, >10,000 pound	2,481.50
Removal of clean HVAC ductwork, \$/pound	0.52
Removal of contaminated instrument and sampling tubing, \$/linear foot	1.65
Removal of contaminated pipe 0.25 to 2 inches diameter, \$/linear foot	23.00
Removal of contaminated pipe >2 to 4 inches diameter, \$/linear foot	39.41
Removal of contaminated pipe >4 to 8 inches diameter, \$/linear foot	65.88
Removal of contaminated pipe >8 to 14 inches diameter, \$/linear foot	124.86
Removal of contaminated pipe >14 to 20 inches diameter, \$/linear foot	149.68
Removal of contaminated pipe >20 to 36 inches diameter, \$/linear foot	206.33
Removal of contaminated pipe >36 inches diameter, \$/linear foot	243.44
Removal of contaminated valve >2 to 4 inches	493.48
Removal of contaminated valve >4 to 8 inches	595.43

APPENDIX B

**UNIT COST FACTOR LISTING
 (Power Block Structures Only)**

Unit Cost Factor	Cost/Unit(\$)
Removal of contaminated valve >8 to 14 inches	1,184.82
Removal of contaminated valve >14 to 20 inches	1,504.07
Removal of contaminated valve >20 to 36 inches	1,999.50
Removal of contaminated valve >36 inches	2,370.59
Removal of contaminated pipe hanger for small bore piping	158.79
Removal of contaminated pipe hanger for large bore piping	501.79
Removal of contaminated pump, <300 pound	1,064.66
Removal of contaminated pump, 300-1000 pound	2,505.94
Removal of contaminated pump, 1000-10,000 pound	7,951.67
Removal of contaminated pump, >10,000 pound	19,367.93
Removal of contaminated pump motor, 300-1000 pound	1,075.74
Removal of contaminated pump motor, 1000-10,000 pound	3,248.46
Removal of contaminated pump motor, >10,000 pound	7,293.29
Removal of contaminated heat exchanger <3000 pound	4,849.40
Removal of contaminated heat exchanger >3000 pound	14,091.14
Removal of contaminated tank, <300 gallons	1,772.00
Removal of contaminated tank, >300 gallons, \$/square foot	35.00
Removal of contaminated electrical equipment, <300 pound	821.91
Removal of contaminated electrical equipment, 300-1000 pound	2,041.35
Removal of contaminated electrical equipment, 1000-10,000 pound	3,932.40
Removal of contaminated electrical equipment, >10,000 pound	7,806.73
Removal of contaminated electrical cable tray, \$/linear foot	39.71
Removal of contaminated electrical conduit, \$/linear foot	19.78
Removal of contaminated mechanical equipment, <300 pound	914.12
Removal of contaminated mechanical equipment, 300-1000 pound	2,253.52
Removal of contaminated mechanical equipment, 1000-10,000 pound	4,334.03
Removal of contaminated mechanical equipment, >10,000 pound	7,806.73
Removal of contaminated HVAC equipment, <300 pound	914.12
Removal of contaminated HVAC equipment, 300-1000 pound	2,253.52
Removal of contaminated HVAC equipment, 1000-10,000 pound	4,334.03

APPENDIX B

**UNIT COST FACTOR LISTING
 (Power Block Structures Only)**

Unit Cost Factor	Cost/Unit(\$)
Removal of contaminated HVAC equipment, >10,000 pound	7,806.73
Removal of contaminated HVAC ductwork, \$/pound	2.33
Removal/plasma arc cut of contaminated thin metal components, \$/linear in.	4.40
Additional decontamination of surface by washing, \$/square foot	8.47
Additional decontamination of surfaces by hydrolasing, \$/square foot	43.44
Decontamination rig hook up and flush, \$/ 250 foot length	7,688.27
Chemical flush of components/systems, \$/gallon	21.11
Removal of clean standard reinforced concrete, \$/cubic yard	74.69
Removal of grade slab concrete, \$/cubic yard	84.94
Removal of clean concrete floors, \$/cubic yard	413.54
Removal of sections of clean concrete floors, \$/cubic yard	1,230.96
Removal of clean heavily rein concrete w/#9 rebar, \$/cubic yard	107.78
Removal of contaminated heavily rein concrete w/#9 rebar, \$/cubic yard	2,445.98
Removal of clean heavily rein concrete w/#18 rebar, \$/cubic yard	146.10
Removal of contaminated heavily rein concrete w/#18 rebar, \$/cubic yard	3,234.96
Removal heavily rein concrete w/#18 rebar & steel embedments, \$/cubic yard	506.92
Removal of below-grade suspended floors, \$/cubic yard	204.85
Removal of clean monolithic concrete structures, \$/cubic yard	1,028.56
Removal of contaminated monolithic concrete structures, \$/cubic yard	2,430.35
Removal of clean foundation concrete, \$/cubic yard	809.05
Removal of contaminated foundation concrete, \$/cubic yard	2,264.41
Explosive demolition of bulk concrete, \$/cubic yard	57.20
Removal of clean hollow masonry block wall, \$/cubic yard	26.95
Removal of contaminated hollow masonry block wall, \$/cubic yard	71.19
Removal of clean solid masonry block wall, \$/cubic yard	26.95
Removal of contaminated solid masonry block wall, \$/cubic yard	71.19
Backfill of below-grade voids, \$/cubic yard	41.84
Removal of subterranean tunnels/voids, \$/linear foot	116.47
Placement of concrete for below-grade voids, \$/cubic yard	137.90
Excavation of clean material, \$/cubic yard	3.33

APPENDIX B

**UNIT COST FACTOR LISTING
 (Power Block Structures Only)**

Unit Cost Factor	Cost/Unit(\$)
Excavation of contaminated material, \$/cubic yard	48.16
Removal of clean concrete rubble (tipping fee included), \$/cubic yard	26.72
Removal of contaminated concrete rubble, \$/cubic yard	28.33
Removal of building by volume, \$/cubic foot	0.32
Removal of clean building metal siding, \$/square foot	1.31
Removal of contaminated building metal siding, \$/square foot	4.76
Removal of standard asphalt roofing, \$/square foot	2.29
Removal of transite panels, \$/square foot	2.43
Scarifying contaminated concrete surfaces (drill & spall), \$/square foot	13.86
Scabbling contaminated concrete floors, \$/square foot	8.36
Scabbling contaminated concrete walls, \$/square foot	22.14
Scabbling contaminated ceilings, \$/square foot	76.04
Scabbling structural steel, \$/square foot	6.98
Removal of clean overhead crane/monorail < 10 ton capacity	748.47
Removal of contaminated overhead crane/monorail < 10 ton capacity	2,153.14
Removal of clean overhead crane/monorail >10-50 ton capacity	1,796.33
Removal of contaminated overhead crane/monorail >10-50 ton capacity	5,166.63
Removal of polar crane > 50 ton capacity	7,600.60
Removal of gantry crane > 50 ton capacity	27,710.01
Removal of structural steel, \$/pound	0.21
Removal of clean steel floor grating, \$/square foot	5.81
Removal of contaminated steel floor grating, \$/square foot	16.85
Removal of clean free standing steel liner, \$/square foot	13.93
Removal of contaminated free standing steel liner, \$/square foot	40.92
Removal of clean concrete-anchored steel liner, \$/square foot	6.96
Removal of contaminated concrete-anchored steel liner, \$/square foot	47.70
Placement of scaffolding in clean areas, \$/square foot	15.28
Placement of scaffolding in contaminated areas, \$/square foot	26.27
Landscaping with topsoil, \$/acre	24,944.01
Cost of CPC B-88 LSA box & preparation for use	2,009.23

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	1,725.12
Cost of CPC B-12V 12 gauge LSA box & preparation for use	1,560.69
Cost of CPC B-144 LSA box & preparation for use	9,889.83
Cost of LSA drum & preparation for use	230.55
Cost of cask liner for CNSI 8 120A cask (resins)	12,053.56
Cost of cask liner for CNSI 8 120A cask (filters)	8,672.03
Decontamination of surfaces with vacuuming, \$/square foot	0.84

APPENDIX C
DETAILED COST ANALYSES

	Page
Unit 1	C-2
Unit 2	C-11

Table C
DC Cook Unit 1
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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				Burial/Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
PERIOD 1a - Shutdown through Transition																					
Period 1a Direct Decommissioning Activities																					
1a.1.1	Prepare preliminary decommissioning cost	-	-	-	-	-	-	176	26	203	203	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	271	41	312	312	-	-	-	-	-	-	-	-	-	2,000
1a.1.7	Review plant dwgs & specs.	-	-	-	-	-	-	624	94	718	718	-	-	-	-	-	-	-	-	-	4,600
1a.1.8	Perform detailed rad survey	-	-	-	-	-	-	-	-	a	-	-	-	-	-	-	-	-	-	-	-
1a.1.9	Estimate by-product inventory	-	-	-	-	-	-	136	20	156	156	-	-	-	-	-	-	-	-	-	1,000
1a.1.10	End product description	-	-	-	-	-	-	136	20	156	156	-	-	-	-	-	-	-	-	-	1,000
1a.1.11	Detailed by-product inventory	-	-	-	-	-	-	176	26	203	203	-	-	-	-	-	-	-	-	-	1,300
1a.1.12	Define major work sequence	-	-	-	-	-	-	1,018	153	1,170	1,170	-	-	-	-	-	-	-	-	-	7,500
1a.1.13	Perform SER and EA	-	-	-	-	-	-	421	63	484	484	-	-	-	-	-	-	-	-	-	3,100
1a.1.14	Prepare/submit Defueled Technical Specifications	-	-	-	-	-	-	1,018	153	1,170	1,170	-	-	-	-	-	-	-	-	-	7,500
1a.1.15	Perform Site-Specific Cost Study	-	-	-	-	-	-	678	102	780	780	-	-	-	-	-	-	-	-	-	5,000
1a.1.16	Prepare/submit Irradiated Fuel Management Plan	-	-	-	-	-	-	136	20	156	156	-	-	-	-	-	-	-	-	-	1,000
Activity Specifications																					
1a.1.17.1	Plant & temporary facilities	-	-	-	-	-	-	668	100	768	691	-	77	-	-	-	-	-	-	-	4,920
1a.1.17.2	Plant systems	-	-	-	-	-	-	565	85	650	585	-	65	-	-	-	-	-	-	-	4,167
1a.1.17.3	NSSS Decontamination Flush	-	-	-	-	-	-	68	10	78	78	-	-	-	-	-	-	-	-	-	500
1a.1.17.4	Reactor internals	-	-	-	-	-	-	963	145	1,108	1,108	-	-	-	-	-	-	-	-	-	7,100
1a.1.17.5	Reactor vessel	-	-	-	-	-	-	882	132	1,014	1,014	-	-	-	-	-	-	-	-	-	6,500
1a.1.17.6	Biological shield	-	-	-	-	-	-	68	10	78	78	-	-	-	-	-	-	-	-	-	500
1a.1.17.7	Steam generators	-	-	-	-	-	-	423	64	487	487	-	-	-	-	-	-	-	-	-	3,120
1a.1.17.8	Reinforced concrete	-	-	-	-	-	-	217	33	250	125	-	125	-	-	-	-	-	-	-	1,600
1a.1.17.9	Main Turbine	-	-	-	-	-	-	54	8	62	-	-	62	-	-	-	-	-	-	-	400
1a.1.17.10	Main Condensers	-	-	-	-	-	-	54	8	62	-	-	62	-	-	-	-	-	-	-	400
1a.1.17.11	Plant structures & buildings	-	-	-	-	-	-	423	64	487	243	-	243	-	-	-	-	-	-	-	3,120
1a.1.17.12	Waste management	-	-	-	-	-	-	624	94	718	718	-	-	-	-	-	-	-	-	-	4,600
1a.1.17.13	Facility & site closeout	-	-	-	-	-	-	122	18	140	70	-	70	-	-	-	-	-	-	-	900
1a.1.17	Total	-	-	-	-	-	-	5,133	770	5,903	5,198	-	705	-	-	-	-	-	-	-	37,827
Planning & Site Preparations																					
1a.1.18	Prepare dismantling sequence	-	-	-	-	-	-	326	49	375	375	-	-	-	-	-	-	-	-	-	2,400
1a.1.19	Plant prep. & temp. svces	-	-	-	-	-	-	3,600	540	4,140	4,140	-	-	-	-	-	-	-	-	-	-
1a.1.20	Design water clean-up system	-	-	-	-	-	-	190	28	218	218	-	-	-	-	-	-	-	-	-	1,400
1a.1.21	Rigging/Cont. Cntrl Envlp/ooling/etc.	-	-	-	-	-	-	2,400	360	2,760	2,760	-	-	-	-	-	-	-	-	-	-
1a.1.22	Procure casks/liners & containers	-	-	-	-	-	-	167	25	192	192	-	-	-	-	-	-	-	-	-	1,230
1a.1	Subtotal Period 1a Activity Costs	-	-	-	-	-	-	16,605	2,491	19,096	18,391	-	705	-	-	-	-	-	-	-	78,157
Period 1a Collateral Costs																					
1a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	97,467	14,620	112,087	-	112,087	-	-	-	-	-	-	-	-	-
1a.3.2	Severance	-	-	-	-	-	-	20,611	3,092	23,702	23,702	-	-	-	-	-	-	-	-	-	-
1a.3.3	Tritium Monitoring	-	-	-	-	-	-	25	4	29	29	-	-	-	-	-	-	-	-	-	-
1a.3	Subtotal Period 1a Collateral Costs	-	-	-	-	-	-	118,103	17,715	135,818	23,731	112,087	-	-	-	-	-	-	-	-	-
Period 1a Period-Dependent Costs																					
1a.4.1	Insurance	-	-	-	-	-	-	1,967	197	2,163	2,163	-	-	-	-	-	-	-	-	-	-
1a.4.2	Property taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	614	-	-	-	-	-	153	767	767	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	756	-	-	-	-	-	113	869	869	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	12	4	-	30	-	9	55	55	-	-	610	-	-	-	-	12,190	20	-
1a.4.6	Plant energy budget	-	-	-	-	-	-	1,890	283	2,173	2,173	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	1,226	123	1,349	1,349	-	-	-	-	-	-	-	-	-	-
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	736	74	810	-	810	-	-	-	-	-	-	-	-	-
1a.4.9	Site O&M Cost	-	-	-	-	-	-	1,230	184	1,414	1,414	-	-	-	-	-	-	-	-	-	-
1a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	426	64	490	-	490	-	-	-	-	-	-	-	-	-
1a.4.11	ISFSI Operating Costs	-	-	-	-	-	-	57	9	65	-	65	-	-	-	-	-	-	-	-	-

Table C
DC Cook Unit 1
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Period 1a Period-Dependent Costs (Continued)																					
1a.4.12	Corporate A&G Cost	-	-	-	-	-	-	4,666	700	5,365	5,365	-	-	-	-	-	-	-	-	-	-
1a.4.13	Security Staff Cost	-	-	-	-	-	-	7,655	1,148	8,804	8,804	-	-	-	-	-	-	-	-	-	131,040
1a.4.14	Utility Staff Cost	-	-	-	-	-	-	36,155	5,423	41,578	41,578	-	-	-	-	-	-	-	-	-	422,240
1a.4	Subtotal Period 1a Period-Dependent Costs	-	1,370	12	4	-	30	56,007	8,481	65,904	64,538	1,365	-	-	610	-	-	-	12,190	20	553,280
1a.0	TOTAL PERIOD 1a COST	-	1,370	12	4	-	30	190,715	28,687	220,818	106,660	113,453	705	-	610	-	-	-	12,190	20	631,437
PERIOD 1b - Decommissioning Preparations																					
Period 1b Direct Decommissioning Activities																					
Detailed Work Procedures																					
1b.1.1.1	Plant systems	-	-	-	-	-	-	642	96	739	665	-	74	-	-	-	-	-	-	-	4,733
1b.1.1.2	NSSS Decontamination Flush	-	-	-	-	-	-	136	20	156	156	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.3	Reactor internals	-	-	-	-	-	-	339	51	390	390	-	-	-	-	-	-	-	-	-	2,500
1b.1.1.4	Remaining buildings	-	-	-	-	-	-	183	27	211	53	-	158	-	-	-	-	-	-	-	1,350
1b.1.1.5	CRD cooling assembly	-	-	-	-	-	-	136	20	156	156	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.6	CRD housings & ICI tubes	-	-	-	-	-	-	136	20	156	156	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.7	Incore instrumentation	-	-	-	-	-	-	136	20	156	156	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.8	Reactor vessel	-	-	-	-	-	-	493	74	566	566	-	-	-	-	-	-	-	-	-	3,630
1b.1.1.9	Facility closeout	-	-	-	-	-	-	163	24	187	94	-	94	-	-	-	-	-	-	-	1,200
1b.1.1.10	Missile shields	-	-	-	-	-	-	61	9	70	70	-	-	-	-	-	-	-	-	-	450
1b.1.1.11	Biological shield	-	-	-	-	-	-	163	24	187	187	-	-	-	-	-	-	-	-	-	1,200
1b.1.1.12	Steam generators	-	-	-	-	-	-	624	94	718	718	-	-	-	-	-	-	-	-	-	4,600
1b.1.1.13	Reinforced concrete	-	-	-	-	-	-	136	20	156	78	-	78	-	-	-	-	-	-	-	1,000
1b.1.1.14	Main Turbine	-	-	-	-	-	-	212	32	243	-	-	243	-	-	-	-	-	-	-	1,560
1b.1.1.15	Main Condensers	-	-	-	-	-	-	212	32	243	-	-	243	-	-	-	-	-	-	-	1,560
1b.1.1.16	Auxiliary building	-	-	-	-	-	-	370	56	426	383	-	43	-	-	-	-	-	-	-	2,730
1b.1.1.17	Reactor building	-	-	-	-	-	-	370	56	426	383	-	43	-	-	-	-	-	-	-	2,730
1b.1.1	Total	-	-	-	-	-	-	4,511	677	5,187	4,212	-	976	-	-	-	-	-	-	-	33,243
1b.1.2	Decon primary loop	795	-	-	-	-	-	-	397	1,192	1,192	-	-	-	-	-	-	-	-	1,067	-
1b.1	Subtotal Period 1b Activity Costs	795	-	-	-	-	-	4,511	1,074	6,380	5,404	-	976	-	-	-	-	-	-	1,067	33,243
Period 1b Additional Costs																					
1b.2.1	Site Characterization	-	-	-	-	-	-	4,339	1,302	5,641	5,641	-	-	-	-	-	-	-	-	22,960	8,872
1b.2.2	Asbestos Abatement	-	1,382	1	38	-	281	-	422	2,124	2,124	-	-	-	5,861	-	-	-	76,193	12,067	-
1b.2	Subtotal Period 1b Additional Costs	-	1,382	1	38	-	281	4,339	1,723	7,765	7,765	-	-	-	5,861	-	-	-	76,193	35,027	8,872
Period 1b Collateral Costs																					
1b.3.1	Decon equipment	1,073	-	-	-	-	-	-	161	1,234	1,234	-	-	-	-	-	-	-	-	-	-
1b.3.2	DOC staff relocation expenses	-	-	-	-	-	-	1,339	201	1,540	1,540	-	-	-	-	-	-	-	-	-	-
1b.3.3	Process decommissioning water waste	26	-	16	36	-	54	-	33	165	165	-	-	-	159	-	-	-	9,514	31	-
1b.3.4	Process decommissioning chemical flush waste	2	-	85	324	-	2,731	-	741	3,882	3,882	-	-	-	-	879	-	-	93,615	164	-
1b.3.5	Small tool allowance	-	17	-	-	-	-	-	3	20	20	-	-	-	-	-	-	-	-	-	-
1b.3.6	Pipe cutting equipment	-	1,200	-	-	-	-	-	180	1,380	1,380	-	-	-	-	-	-	-	-	-	-
1b.3.7	Decon rig	2,088	-	-	-	-	-	-	313	2,401	2,401	-	-	-	-	-	-	-	-	-	-
1b.3.8	Spent Fuel Capital and Transfer	-	-	-	-	-	-	36,782	5,517	42,299	-	42,299	-	-	-	-	-	-	-	-	-
1b.3.9	Tritium Monitoring	-	-	-	-	-	-	12	2	14	14	-	-	-	-	-	-	-	-	-	-
1b.3	Subtotal Period 1b Collateral Costs	3,189	1,218	101	359	-	2,785	38,134	7,151	52,936	10,637	42,299	-	159	879	-	-	-	103,129	195	-
Period 1b Period-Dependent Costs																					
1b.4.1	Decon supplies	38	-	-	-	-	-	-	9	47	47	-	-	-	-	-	-	-	-	-	-
1b.4.2	Insurance	-	-	-	-	-	-	981	98	1,079	1,079	-	-	-	-	-	-	-	-	-	-
1b.4.3	Property taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1b.4.4	Health physics supplies	-	412	-	-	-	-	-	103	515	515	-	-	-	-	-	-	-	-	-	-
1b.4.5	Heavy equipment rental	-	377	-	-	-	-	-	57	434	434	-	-	-	-	-	-	-	-	-	-
1b.4.6	Disposal of DAW generated	-	-	7	3	-	17	-	5	32	32	-	-	-	356	-	-	-	7,122	12	-
1b.4.7	Plant energy budget	-	-	-	-	-	-	1,885	283	2,167	2,167	-	-	-	-	-	-	-	-	-	-
1b.4.8	NRC Fees	-	-	-	-	-	-	359	36	395	395	-	-	-	-	-	-	-	-	-	-
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	367	37	404	-	404	-	-	-	-	-	-	-	-	-
1b.4.10	Site O&M Cost	-	-	-	-	-	-	616	92	709	709	-	-	-	-	-	-	-	-	-	-
1b.4.11	Spent Fuel Pool O&M	-	-	-	-	-	-	213	32	244	-	244	-	-	-	-	-	-	-	-	-

Table C
DC Cook Unit 1
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Period 1b Period-Dependent Costs (Continued)																					
1b.4.12	ISFSI Operating Costs	-	-	-	-	-	-	28	4	33	-	33	-	-	-	-	-	-	-	-	-
1b.4.13	Corporate A&G Cost	-	-	-	-	-	-	2,338	351	2,689	2,689	-	-	-	-	-	-	-	-	-	-
1b.4.14	Security Staff Cost	-	-	-	-	-	-	3,817	573	4,390	4,390	-	-	-	-	-	-	-	-	-	65,341
1b.4.15	DOC Staff Cost	-	-	-	-	-	-	6,286	943	7,229	7,229	-	-	-	-	-	-	-	-	-	63,266
1b.4.16	Utility Staff Cost	-	-	-	-	-	-	18,130	2,720	20,850	20,850	-	-	-	-	-	-	-	-	-	211,579
1b.4	Subtotal Period 1b Period-Dependent Costs	38	789	7	3	-	17	35,020	5,342	41,215	40,534	681	-	-	356	-	-	-	7,122	12	340,185
1b.0	TOTAL PERIOD 1b COST	4,022	3,389	109	400	-	3,083	82,003	15,291	108,296	64,341	42,980	976	-	6,376	879	-	-	186,444	36,300	382,300
PERIOD 1 TOTALS		4,022	4,759	120	404	-	3,113	272,719	43,977	329,114	171,000	156,433	1,681	-	6,985	879	-	-	198,634	36,320	1,013,737
PERIOD 2a - Large Component Removal																					
Period 2a Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
2a.1.1.1	Reactor Coolant Piping	250	200	49	113	-	1,008	-	449	2,069	2,069	-	-	-	2,700	-	-	-	188,405	6,970	-
2a.1.1.2	Pressurizer Relief Tank	39	31	11	24	-	217	-	86	408	408	-	-	-	581	-	-	-	40,513	1,082	-
2a.1.1.3	Reactor Coolant Pumps & Motors	140	112	165	208	-	2,233	-	704	3,562	3,562	-	-	-	6,241	-	-	-	678,000	4,514	100
2a.1.1.4	Pressurizer	-	71	584	132	-	1,150	-	384	2,321	2,321	-	-	-	3,215	-	-	-	312,462	1,666	938
2a.1.1.5	Steam Generators	-	4,196	3,949	3,261	3,251	8,168	-	4,463	27,289	27,289	-	-	43,179	22,834	-	-	-	3,867,344	23,227	2,875
2a.1.1.6	CRDMs/ICIs/Service Structure Removal	199	346	222	91	-	786	-	418	2,062	2,062	-	-	-	4,089	-	-	-	146,894	8,329	-
2a.1.1.7	Reactor Vessel Internals	160	5,753	14,453	1,818	-	18,325	415	17,687	58,611	58,611	-	-	-	2,527	963	785	-	408,896	35,440	1,576
2a.1.1.8	Vessel & Internals GTCC Disposal	-	-	-	-	-	10,273	-	1,541	11,814	11,814	-	-	-	-	-	-	2,061	410,142	-	-
2a.1.1.9	Reactor Vessel	145	7,286	3,169	1,240	-	4,803	415	9,103	26,161	26,161	-	-	-	13,680	-	-	-	975,893	35,440	1,576
2a.1.1	Totals	933	17,995	22,602	6,889	3,251	46,962	830	34,835	134,297	134,297	-	-	43,179	55,867	963	785	2,061	7,028,548	116,667	7,065
Removal of Major Equipment																					
2a.1.2	Main Turbine/Generator	-	175	-	-	-	-	-	26	202	-	-	202	-	-	-	-	-	-	2,843	-
2a.1.3	Main Condensers	-	436	-	-	-	-	-	65	501	-	-	501	-	-	-	-	-	-	7,130	-
Cascading Costs from Clean Building Demolition																					
2a.1.4.1	Reactor	-	327	-	-	-	-	-	49	376	376	-	-	-	-	-	-	-	-	3,568	-
2a.1.4	Totals	-	327	-	-	-	-	-	49	376	376	-	-	-	-	-	-	-	-	3,568	-
Disposal of Plant Systems																					
2a.1.5.1	Auxiliary Feedwater	-	112	-	-	-	-	-	17	129	-	-	129	-	-	-	-	-	-	1,887	-
2a.1.5.2	Auxiliary Steam	-	65	-	-	-	-	-	10	74	-	-	74	-	-	-	-	-	-	1,154	-
2a.1.5.3	Bleed Steam	-	32	-	-	-	-	-	5	37	-	-	37	-	-	-	-	-	-	596	-
2a.1.5.4	Blowdown	-	1	-	-	-	-	-	0	1	-	-	1	-	-	-	-	-	-	21	-
2a.1.5.5	Chemical Cleaning	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	143	-
2a.1.5.6	Chemical Feed	-	27	2	4	39	25	-	20	117	117	-	-	393	74	-	-	-	20,630	431	-
2a.1.5.7	Circulating Water	-	123	-	-	-	-	-	18	142	-	-	142	-	-	-	-	-	-	2,176	-
2a.1.5.8	Condensate	-	183	-	-	-	-	-	28	211	-	-	211	-	-	-	-	-	-	3,265	-
2a.1.5.9	Condenser Air Removal	-	8	-	-	-	-	-	1	10	-	-	10	-	-	-	-	-	-	156	-
2a.1.5.10	Containment Equalization / Hyd	-	42	8	8	28	83	-	37	206	206	-	-	285	238	-	-	-	27,098	722	-
2a.1.5.11	Control and Decontamination Air	-	30	-	-	-	-	-	5	35	-	-	35	-	-	-	-	-	-	544	-
2a.1.5.12	Control and Instrumentation	-	10	-	-	-	-	-	1	11	-	-	11	-	-	-	-	-	-	174	-
2a.1.5.13	Demineralized Water	-	89	-	-	-	-	-	13	102	-	-	102	-	-	-	-	-	-	1,567	-
2a.1.5.14	HVAC Turbine	-	39	-	-	-	-	-	6	45	-	-	45	-	-	-	-	-	-	740	-
2a.1.5.15	Heaters Drains and Vents	-	35	-	-	-	-	-	5	40	-	-	40	-	-	-	-	-	-	654	-
2a.1.5.16	Main Feedwater	-	88	-	-	-	-	-	13	101	-	-	101	-	-	-	-	-	-	1,554	-
2a.1.5.17	Main Generator	-	42	-	-	-	-	-	6	49	-	-	49	-	-	-	-	-	-	766	-
2a.1.5.18	Main Turbine	-	88	-	-	-	-	-	13	102	-	-	102	-	-	-	-	-	-	1,562	-
2a.1.5.19	Non-Essential Service Water	-	86	-	-	-	-	-	13	99	-	-	99	-	-	-	-	-	-	1,555	-
2a.1.5.20	Plant Air	-	16	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	289	-
2a.1.5.21	Post Accident Ctmt H2 Monitoring	-	36	4	6	26	57	-	28	156	156	-	-	262	166	-	-	-	21,272	593	-
2a.1.5.22	Post Accident Sampling	-	35	1	1	10	6	-	12	64	64	-	-	97	18	-	-	-	5,057	599	-
2a.1.5.23	Reactor Hydrogen & Nitrogen	-	50	2	5	67	9	-	26	158	158	-	-	674	26	-	-	-	29,052	826	-

Table C
DC Cook Unit 1
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Disposal of Plant Systems (Continued)																					
2a.1.5.24	Screen Wash	-	1	-	-	-	-	-	0	1	-	-	1	-	-	-	-	-	-	17	-
2a.1.5.25	Secondary Sampling	-	13	-	-	-	-	-	2	15	-	-	15	-	-	-	-	-	-	241	-
2a.1.5.26	Sodium Hypochlorite System	-	4	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	70	-
2a.1.5.27	Station Drainage	-	16	-	-	-	-	-	2	18	-	-	18	-	-	-	-	-	-	286	-
2a.1.5.28	Turbine Auxiliary Cooling Water	-	22	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	395	-
2a.1.5	Totals	-	1,301	16	23	169	180	-	290	1,979	701	-	1,278	1,711	522	-	-	-	103,108	22,983	-
2a.1.6	Scaffolding in support of decommissioning	-	823	4	2	19	5	-	210	1,063	1,063	-	-	169	15	-	-	-	8,567	17,544	-
2a.1	Subtotal Period 2a Activity Costs	933	21,058	22,622	6,914	3,439	47,147	830	35,476	138,418	136,437	-	1,981	45,059	56,403	963	785	2,061	7,140,223	170,735	7,065
Period 2a Additional Costs																					
2a.2.1	Remedial Action Surveys	-	-	-	-	-	-	2,474	742	3,216	3,216	-	-	-	-	-	-	-	-	38,270	-
2a.2	Subtotal Period 2a Additional Costs	-	-	-	-	-	-	2,474	742	3,216	3,216	-	-	-	-	-	-	-	-	38,270	-
Period 2a Collateral Costs																					
2a.3.1	Process decommissioning water waste	46	-	29	64	-	98	-	60	296	296	-	-	-	287	-	-	-	17,192	56	-
2a.3.2	Process decommissioning chemical flush waste	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2a.3.3	Small tool allowance	-	201	-	-	-	-	-	30	232	209	-	23	-	-	-	-	-	-	-	-
2a.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	78,423	11,763	90,186	-	90,186	-	-	-	-	-	-	-	-	-
2a.3.5	Severance	-	-	-	-	-	-	4,181	627	4,808	4,808	-	-	-	-	-	-	-	-	-	-
2a.3.6	Tritium Monitoring	-	-	-	-	-	-	46	7	53	53	-	-	-	-	-	-	-	-	-	-
2a.3.7	On-site survey and release of 0.0 tons clean metallic waste	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2a.3	Subtotal Period 2a Collateral Costs	46	201	29	64	-	98	82,650	12,488	95,575	5,366	90,186	23	-	287	-	-	-	17,192	56	-
Period 2a Period-Dependent Costs																					
2a.4.1	Decon supplies	140	-	-	-	-	-	-	35	175	175	-	-	-	-	-	-	-	-	-	-
2a.4.2	Insurance	-	-	-	-	-	-	922	92	1,014	1,014	-	-	-	-	-	-	-	-	-	-
2a.4.3	Property taxes	-	-	-	-	-	-	28	3	31	31	-	-	-	-	-	-	-	-	-	-
2a.4.4	Health physics supplies	-	2,344	-	-	-	-	-	586	2,931	2,931	-	-	-	-	-	-	-	-	-	-
2a.4.5	Heavy equipment rental	-	4,629	-	-	-	-	-	694	5,323	5,323	-	-	-	-	-	-	-	-	-	-
2a.4.6	Disposal of DAW generated	-	-	71	26	-	180	-	56	334	334	-	-	-	3,710	-	-	-	74,200	121	-
2a.4.7	Plant energy budget	-	-	-	-	-	-	3,305	496	3,801	3,801	-	-	-	-	-	-	-	-	-	-
2a.4.8	NRC Fees	-	-	-	-	-	-	1,218	122	1,340	1,340	-	-	-	-	-	-	-	-	-	-
2a.4.9	Emergency Planning Fees	-	-	-	-	-	-	829	83	912	-	912	-	-	-	-	-	-	-	-	-
2a.4.10	Site O&M Cost	-	-	-	-	-	-	1,573	236	1,809	1,809	-	-	-	-	-	-	-	-	-	-
2a.4.11	Spent Fuel Pool O&M	-	-	-	-	-	-	785	118	903	-	903	-	-	-	-	-	-	-	-	-
2a.4.12	ISFSI Operating Costs	-	-	-	-	-	-	105	16	121	-	121	-	-	-	-	-	-	-	-	-
2a.4.13	Corporate A&G Cost	-	-	-	-	-	-	5,967	895	6,862	6,862	-	-	-	-	-	-	-	-	-	-
2a.4.14	Security Staff Cost	-	-	-	-	-	-	12,790	1,919	14,709	14,709	-	-	-	-	-	-	-	-	-	216,366
2a.4.15	DOC Staff Cost	-	-	-	-	-	-	28,219	4,233	32,451	32,451	-	-	-	-	-	-	-	-	-	291,040
2a.4.16	Utility Staff Cost	-	-	-	-	-	-	46,970	7,045	54,015	54,015	-	-	-	-	-	-	-	-	-	540,048
2a.4	Subtotal Period 2a Period-Dependent Costs	140	6,973	71	26	-	180	102,711	16,628	126,730	124,795	1,935	-	-	3,710	-	-	-	74,200	121	1,047,454
2a.0	TOTAL PERIOD 2a COST	1,118	28,233	22,721	7,004	3,439	47,425	188,665	65,334	363,939	269,815	92,121	2,004	45,059	60,400	963	785	2,061	7,231,615	209,181	1,054,519
PERIOD 2b - Site Decontamination																					
Period 2b Direct Decommissioning Activities																					
Disposal of Plant Systems																					
2b.1.1.1	Auxiliary Feedwater RCA	-	13	2	3	21	18	-	12	69	69	-	-	213	52	-	-	-	12,025	224	-
2b.1.1.2	Auxiliary Steam RCA	-	25	2	2	17	15	-	13	74	74	-	-	177	42	-	-	-	9,935	424	-
2b.1.1.3	Blowdown RCA	-	37	3	5	41	29	-	24	139	139	-	-	411	83	-	-	-	22,130	622	-
2b.1.1.4	Bus Protection & Metering	-	118	-	-	-	-	-	18	136	-	-	136	-	-	-	-	-	-	2,020	-
2b.1.1.5	Bus Protection & Metering RCA	-	16	1	2	14	12	-	9	54	54	-	-	146	35	-	-	-	8,118	261	-
2b.1.1.6	Chemical Volume Control System	-	697	82	102	342	1,153	-	537	2,914	2,914	-	-	3,469	3,364	-	-	-	356,411	11,704	-
2b.1.1.7	Component Cooling Water	-	102	12	20	188	106	-	84	512	512	-	-	1,904	305	-	-	-	97,114	1,757	-
2b.1.1.8	Condensate RCA	-	5	0	1	6	1	-	3	16	16	-	-	63	4	-	-	-	2,814	90	-
2b.1.1.9	Containment	-	175	30	33	66	420	-	167	891	891	-	-	668	1,223	-	-	-	105,656	2,920	-
2b.1.1.10	Containment Spray	-	404	19	43	523	132	-	221	1,343	1,343	-	-	5,296	383	-	-	-	239,793	6,766	-
2b.1.1.11	Control and Decontamination Air RCA	-	108	4	9	96	39	-	53	309	309	-	-	977	116	-	-	-	47,021	1,780	-
2b.1.1.12	Control and Instrumentation RCA	-	31	0	1	13	2	-	10	57	57	-	-	129	5	-	-	-	5,536	533	-

Table C
DC Cook Unit 1
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours	
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet				
Disposal of Plant Systems (Continued)																						
2b.1.1.13	Demineralized Water RCA	-	18	1	2	9	14	-	10	53	53	-	-	95	39	-	-	-	-	6,389	292	-
2b.1.1.14	Electric Hydrogen Recombiner	-	8	1	2	16	13	-	8	47	47	-	-	160	37	-	-	-	-	8,856	135	-
2b.1.1.15	Electrical	-	1,063	-	-	-	-	-	159	1,223	-	-	1,223	-	-	-	-	-	-	-	18,866	-
2b.1.1.16	Electrical Distribution	-	177	-	-	-	-	-	27	204	-	-	204	-	-	-	-	-	-	-	3,064	-
2b.1.1.17	Electrical Distribution RCA	-	46	1	2	24	5	-	17	93	93	-	-	241	14	-	-	-	-	10,679	774	-
2b.1.1.18	Electrical RCA	-	6,190	120	339	4,549	608	-	2,445	14,251	14,251	-	-	46,094	1,789	-	-	-	-	1,985,515	93,291	-
2b.1.1.19	Emergency Core Cooling System	-	151	19	19	80	202	-	105	575	575	-	-	806	577	-	-	-	-	70,393	2,639	-
2b.1.1.20	Emergency Diesel Generator	-	76	-	-	-	-	-	11	87	-	-	87	-	-	-	-	-	-	-	1,342	-
2b.1.1.21	Engineered Safety Features Ventilation	-	30	1	1	20	3	-	11	65	65	-	-	201	8	-	-	-	-	8,644	509	-
2b.1.1.22	Essential Service Water	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	-	355	-
2b.1.1.23	Essential Service Water RCA	-	31	4	5	45	33	-	24	141	141	-	-	451	96	-	-	-	-	24,592	528	-
2b.1.1.24	Fire Protection	-	72	-	-	-	-	-	11	83	-	-	83	-	-	-	-	-	-	-	1,341	-
2b.1.1.25	Fire Protection RCA	-	42	3	5	46	25	-	25	146	146	-	-	467	73	-	-	-	-	23,678	719	-
2b.1.1.26	Fukushima	-	10	-	-	-	-	-	1	11	-	-	11	-	-	-	-	-	-	-	171	-
2b.1.1.27	HVAC Auxiliary	-	548	23	41	294	322	-	270	1,498	1,498	-	-	2,975	947	-	-	-	-	180,991	8,961	-
2b.1.1.28	HVAC Containment	-	144	18	28	172	244	-	129	735	735	-	-	1,738	717	-	-	-	-	116,281	2,358	-
2b.1.1.29	HVAC Control Room	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	-	374	-
2b.1.1.30	HVAC Miscellaneous	-	153	-	-	-	-	-	23	176	-	-	176	-	-	-	-	-	-	-	2,747	-
2b.1.1.31	HVAC Miscellaneous RCA	-	11	0	1	11	3	-	5	30	30	-	-	109	7	-	-	-	-	4,893	181	-
2b.1.1.32	HVAC Switchgear	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	-	113	-
2b.1.1.33	HVAC Technical Support Center	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	-	147	-
2b.1.1.34	Ice Condenser	-	540	42	47	181	511	-	301	1,622	1,622	-	-	1,833	1,476	-	-	-	-	169,977	9,199	-
2b.1.1.35	Main Feedwater RCA	-	30	4	9	77	50	-	33	203	203	-	-	781	148	-	-	-	-	41,151	532	-
2b.1.1.36	Main Steam	-	57	-	-	-	-	-	9	66	-	-	66	-	-	-	-	-	-	-	1,075	-
2b.1.1.37	Main Steam RCA	-	63	9	13	107	81	-	55	326	326	-	-	1,081	232	-	-	-	-	59,034	1,073	-
2b.1.1.38	Material/Equipment Handling	-	34	8	14	118	96	-	53	323	323	-	-	1,192	283	-	-	-	-	66,336	556	-
2b.1.1.39	Non-Essential Service Water RCA	-	117	11	13	89	103	-	71	405	405	-	-	904	294	-	-	-	-	55,981	1,930	-
2b.1.1.40	Nuclear Instrumentation	-	17	1	1	2	16	-	9	46	46	-	-	23	46	-	-	-	-	3,861	291	-
2b.1.1.41	Nuclear Sampling	-	93	4	4	8	58	-	40	206	206	-	-	78	169	-	-	-	-	13,984	1,594	-
2b.1.1.42	Offsite Power	-	41	-	-	-	-	-	6	47	-	-	47	-	-	-	-	-	-	-	689	-
2b.1.1.43	Pipe Clean - Insulated	-	1,958	-	-	-	-	-	294	2,252	-	-	2,252	-	-	-	-	-	-	-	36,415	-
2b.1.1.44	Pipe Clean - Non-Insulated	-	240	-	-	-	-	-	36	276	-	-	276	-	-	-	-	-	-	-	4,913	-
2b.1.1.45	Pipe Contaminated - Insulated	-	1,295	136	144	226	1,869	-	860	4,529	4,529	-	-	2,291	5,421	-	-	-	-	442,353	20,064	-
2b.1.1.46	Pipe Contaminated - Non-Insulated	-	177	17	19	27	252	-	116	607	607	-	-	270	733	-	-	-	-	58,006	2,740	-
2b.1.1.47	Plant Air RCA	-	21	2	3	32	18	-	15	91	91	-	-	321	53	-	-	-	-	16,418	347	-
2b.1.1.48	Primary Water	-	238	18	30	241	213	-	155	895	895	-	-	2,444	623	-	-	-	-	139,008	3,978	-
2b.1.1.49	Process Drains - Miscellaneous	-	11	-	-	-	-	-	2	13	-	-	13	-	-	-	-	-	-	-	196	-
2b.1.1.50	Radiation Monitoring System	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	-	56	-
2b.1.1.51	Radiation Monitoring System RCA	-	26	1	1	9	9	-	10	56	56	-	-	95	25	-	-	-	-	5,481	438	-
2b.1.1.52	Radioactive Waste Disposal	-	114	15	19	49	231	-	98	525	525	-	-	492	675	-	-	-	-	63,120	1,930	-
2b.1.1.53	Reactor Coolant System	-	201	144	154	276	1,974	-	623	3,373	3,373	-	-	2,800	5,728	-	-	-	-	482,752	3,705	-
2b.1.1.54	Refueling	-	62	3	5	23	56	-	34	184	184	-	-	237	163	-	-	-	-	20,015	1,068	-
2b.1.1.55	Residual Heat Removal	-	106	23	23	43	295	-	112	602	602	-	-	434	855	-	-	-	-	72,846	1,874	-
2b.1.1.56	Security	-	2	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	-	37	-
2b.1.1.57	Sewage Disposal and Treatment	-	0	-	-	-	-	-	0	0	-	-	0	-	-	-	-	-	-	-	5	-
2b.1.1.58	Station Drainage RCA	-	34	3	3	17	32	-	20	109	109	-	-	170	93	-	-	-	-	12,912	567	-
2b.1.1.59	Supplemental Diesel Generator	-	0	-	-	-	-	-	0	0	-	-	0	-	-	-	-	-	-	-	8	-
2b.1.1	Totals	-	16,036	786	1,170	8,115	9,262	-	7,392	42,761	38,117	-	4,644	82,234	26,933	-	-	-	-	5,070,701	263,284	-
2b.1.2	Scaffolding in support of decommissioning	-	1,029	4	2	23	6	-	263	1,328	1,328	-	-	212	19	-	-	-	-	10,709	21,930	-
Decontamination of Site Buildings																						
2b.1.3.1	Reactor	562	620	38	264	68	2,151	-	1,027	4,730	4,730	-	-	693	14,255	-	-	-	-	647,964	18,621	-
2b.1.3	Totals	562	620	38	264	68	2,151	-	1,027	4,730	4,730	-	-	693	14,255	-	-	-	-	647,964	18,621	-
2b.1.4	Prepare/submit License Termination Plan	-	-	-	-	-	-	556	83	639	639	-	-	-	-	-	-	-	-	-	-	4,096
2b.1.5	Receive NRC approval of termination plan	-	-	-	-	-	-	-	-	a	-	-	-	-	-	-	-	-	-	-	-	-
2b.1	Subtotal Period 2b Activity Costs	562	17,686	829	1,436	8,207	11,419	556	8,766	49,458	44,814	-	4,644	83,139	41,207	-	-	-	-	5,729,373	303,835	4,096

Table C
DC Cook Unit 1
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Period 2b Additional Costs																					
2b.2.1	Non-Fuel Pool Item Disposal	-	31	45	37	-	337	-	102	551	551	-	-	-	-	-	28	-	4,322	347	-
2b.2.2	Remedial Action Surveys	-	-	-	-	-	-	2,062	619	2,680	2,680	-	-	-	-	-	-	-	-	31,891	-
2b.2	Subtotal Period 2b Additional Costs	-	31	45	37	-	337	2,062	720	3,232	3,232	-	-	-	-	-	28	-	4,322	32,238	-
Period 2b Collateral Costs																					
2b.3.1	Process decommissioning water waste	44	-	29	64	-	97	-	59	293	293	-	-	-	284	-	-	-	17,041	55	-
2b.3.2	Process decommissioning chemical flush waste	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2b.3.3	Small tool allowance	-	290	-	-	-	-	-	43	333	333	-	-	-	-	-	-	-	-	-	-
2b.3.4	Severance	-	-	-	-	-	-	2,734	410	3,144	3,144	-	-	-	-	-	-	-	-	-	-
2b.3.5	Tritium Monitoring	-	-	-	-	-	-	38	6	44	44	-	-	-	-	-	-	-	-	-	-
2b.3.6	On-site survey and release of 0.0 tons clean metallic waste	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2b.3	Subtotal Period 2b Collateral Costs	44	290	29	64	-	97	2,772	518	3,814	3,814	-	-	-	284	-	-	-	17,041	55	-
Period 2b Period-Dependent Costs																					
2b.4.1	Decon supplies	465	-	-	-	-	-	-	116	582	582	-	-	-	-	-	-	-	-	-	-
2b.4.2	Insurance	-	-	-	-	-	-	769	77	845	845	-	-	-	-	-	-	-	-	-	-
2b.4.3	Property taxes	-	-	-	-	-	-	287	29	316	316	-	-	-	-	-	-	-	-	-	-
2b.4.4	Health physics supplies	-	2,781	-	-	-	-	-	695	3,476	3,476	-	-	-	-	-	-	-	-	-	-
2b.4.5	Heavy equipment rental	-	3,959	-	-	-	-	-	594	4,553	4,553	-	-	-	-	-	-	-	-	-	-
2b.4.6	Disposal of DAW generated	-	-	74	27	-	188	-	58	348	348	-	-	-	3,865	-	-	-	77,304	126	-
2b.4.7	Plant energy budget	-	-	-	-	-	-	2,175	326	2,501	2,501	-	-	-	-	-	-	-	-	-	-
2b.4.8	NRC Fees	-	-	-	-	-	-	1,015	102	1,117	1,117	-	-	-	-	-	-	-	-	-	-
2b.4.9	Emergency Planning Fees	-	-	-	-	-	-	691	69	760	-	760	-	-	-	-	-	-	-	-	-
2b.4.10	Site O&M Cost	-	-	-	-	-	-	934	140	1,074	1,074	-	-	-	-	-	-	-	-	-	-
2b.4.11	Spent Fuel Pool O&M	-	-	-	-	-	-	654	98	752	-	752	-	-	-	-	-	-	-	-	-
2b.4.12	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	329	49	378	378	-	-	-	-	-	-	-	-	-	-
2b.4.13	ISFSI Operating Costs	-	-	-	-	-	-	87	13	100	-	100	-	-	-	-	-	-	-	-	-
2b.4.14	Corporate A&G Cost	-	-	-	-	-	-	3,544	532	4,075	4,075	-	-	-	-	-	-	-	-	-	-
2b.4.15	Security Staff Cost	-	-	-	-	-	-	10,658	1,599	12,257	12,257	-	-	-	-	-	-	-	-	-	180,305
2b.4.16	DOC Staff Cost	-	-	-	-	-	-	15,973	2,396	18,369	18,369	-	-	-	-	-	-	-	-	-	172,327
2b.4.17	Utility Staff Cost	-	-	-	-	-	-	27,469	4,120	31,590	31,590	-	-	-	-	-	-	-	-	-	320,719
2b.4	Subtotal Period 2b Period-Dependent Costs	465	6,740	74	27	-	188	64,585	11,014	83,093	81,481	1,612	-	-	3,865	-	-	-	77,304	126	673,350
2b.0	TOTAL PERIOD 2b COST	1,071	24,746	976	1,564	8,207	12,040	69,975	21,018	139,597	133,340	1,612	4,644	83,139	45,357	-	28	-	5,828,040	336,255	677,446
PERIOD 2c - Spent fuel delay prior to SFP decon																					
Period 2c Direct Decommissioning Activities																					
Period 2c Collateral Costs																					
2c.3.1	Severance	-	-	-	-	-	-	6,274	941	7,215	7,215	-	-	-	-	-	-	-	-	-	-
2c.3.2	Tritium Monitoring	-	-	-	-	-	-	41	6	47	47	-	-	-	-	-	-	-	-	-	-
2c.3	Subtotal Period 2c Collateral Costs	-	-	-	-	-	-	6,315	947	7,262	7,262	-	-	-	-	-	-	-	-	-	-
Period 2c Period-Dependent Costs																					
2c.4.1	Insurance	-	-	-	-	-	-	817	82	898	898	-	-	-	-	-	-	-	-	-	-
2c.4.2	Property taxes	-	-	-	-	-	-	305	30	335	335	-	-	-	-	-	-	-	-	-	-
2c.4.3	Health physics supplies	-	350	-	-	-	-	-	88	438	438	-	-	-	-	-	-	-	-	-	-
2c.4.4	Disposal of DAW generated	-	-	12	4	-	30	-	9	55	55	-	-	-	610	-	-	-	12,195	20	-
2c.4.5	Plant energy budget	-	-	-	-	-	-	2,310	347	2,657	2,657	-	-	-	-	-	-	-	-	-	-
2c.4.6	NRC Fees	-	-	-	-	-	-	1,031	103	1,134	1,134	-	-	-	-	-	-	-	-	-	-
2c.4.7	Emergency Planning Fees	-	-	-	-	-	-	734	73	807	-	807	-	-	-	-	-	-	-	-	-
2c.4.8	Site O&M Cost	-	-	-	-	-	-	74	11	85	85	-	-	-	-	-	-	-	-	-	-
2c.4.9	Spent Fuel Pool O&M	-	-	-	-	-	-	695	104	799	-	799	-	-	-	-	-	-	-	-	-
2c.4.10	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	349	52	402	402	-	-	-	-	-	-	-	-	-	-
2c.4.11	ISFSI Operating Costs	-	-	-	-	-	-	93	14	107	-	107	-	-	-	-	-	-	-	-	-
2c.4.12	Corporate A&G Cost	-	-	-	-	-	-	281	42	323	323	-	-	-	-	-	-	-	-	-	-
2c.4.13	Security Staff Cost	-	-	-	-	-	-	11,325	1,699	13,023	13,023	-	-	-	-	-	-	-	-	-	191,574
2c.4.14	Utility Staff Cost	-	-	-	-	-	-	2,133	320	2,453	2,453	-	-	-	-	-	-	-	-	-	25,430
2c.4	Subtotal Period 2c Period-Dependent Costs	-	350	12	4	-	30	20,147	2,975	23,518	21,804	1,713	-	-	610	-	-	-	12,195	20	217,004
2c.0	TOTAL PERIOD 2c COST	-	350	12	4	-	30	26,462	3,922	30,780	29,067	1,713	-	-	610	-	-	-	12,195	20	217,004

Table C
DC Cook Unit 1
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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					Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet				
PERIOD 2d - Decontamination Following Wet Fuel Storage																						
Period 2d Direct Decommissioning Activities																						
2d.1.1	Remove spent fuel racks	1,285	137	378	224	-	3,248	-	1,560	6,833	6,833	-	-	-	9,557	-	-	-	-	607,127	2,632	-
Disposal of Plant Systems																						
2d.1.2.1	HVAC Spent Fuel Pool	-	49	4	7	51	47	-	33	190	190	-	-	514	138	-	-	-	-	29,661	771	-
2d.1.2.2	Spent Fuel Pool	-	25	3	4	7	47	-	20	106	106	-	-	75	137	-	-	-	-	11,869	429	-
2d.1.2	Totals	-	74	7	10	58	94	-	53	296	296	-	-	589	275	-	-	-	-	41,529	1,200	-
Decontamination of Site Buildings																						
2d.1.3.1	zPost Fuel (RB)	372	1,278	94	661	101	6,366	-	2,221	11,094	11,094	-	-	1,021	38,207	-	-	-	-	1,651,934	23,076	-
2d.1.3	Totals	372	1,278	94	661	101	6,366	-	2,221	11,094	11,094	-	-	1,021	38,207	-	-	-	-	1,651,934	23,076	-
2d.1.4	Scaffolding in support of decommissioning	-	206	1	0	5	1	-	53	266	266	-	-	42	4	-	-	-	-	2,142	4,386	-
2d.1	Subtotal Period 2d Activity Costs	1,658	1,695	480	896	164	9,710	-	3,887	18,489	18,489	-	-	1,652	48,043	-	-	-	-	2,302,732	31,295	-
Period 2d Additional Costs																						
2d.2.1	License Termination Survey Planning	-	-	-	-	-	-	1,152	346	1,498	1,498	-	-	-	-	-	-	-	-	-	-	6,240
2d.2.2	Operational Tools & Equipment	-	-	10	32	357	-	-	59	459	459	-	-	5,880	-	-	-	-	-	147,000	16	-
2d.2.3	Excavation of Underground Services	-	1,213	-	-	-	-	303	349	1,865	1,865	-	-	-	-	-	-	-	-	-	7,004	-
2d.2.4	Absorption Pond Remediation	-	249	47	901	-	6,124	-	1,690	9,011	9,011	-	-	-	31,050	-	-	-	-	2,421,900	678	-
2d.2.5	Contaminated Soil	-	280	121	2,334	-	15,974	-	4,315	23,026	23,026	-	-	-	81,000	-	-	-	-	6,318,000	1,947	-
2d.2.6	Remedial Action Surveys	-	-	-	-	-	-	1,053	316	1,369	1,369	-	-	-	-	-	-	-	-	-	16,287	-
2d.2	Subtotal Period 2d Additional Costs	-	1,742	178	3,267	357	22,098	2,508	7,075	37,226	37,226	-	-	5,880	112,050	-	-	-	-	8,886,900	25,932	6,240
Period 2d Collateral Costs																						
2d.3.1	Process decommissioning water waste	72	-	48	107	-	163	-	97	486	486	-	-	-	476	-	-	-	-	28,531	93	-
2d.3.2	Process decommissioning chemical flush waste	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2d.3.3	Small tool allowance	-	68	-	-	-	-	-	10	78	78	-	-	-	-	-	-	-	-	-	-	-
2d.3.4	Decommissioning Equipment Disposition	-	-	126	62	656	180	-	165	1,189	1,189	-	-	6,000	529	-	-	-	-	303,608	147	-
2d.3.5	Severance	-	-	-	-	-	-	506	76	582	582	-	-	-	-	-	-	-	-	-	-	-
2d.3.6	Tritium Monitoring	-	-	-	-	-	-	20	3	23	23	-	-	-	-	-	-	-	-	-	-	-
2d.3	Subtotal Period 2d Collateral Costs	72	68	173	169	656	342	526	352	2,358	2,358	-	-	6,000	1,005	-	-	-	-	332,139	240	-
Period 2d Period-Dependent Costs																						
2d.4.1	Decon supplies	97	-	-	-	-	-	-	24	121	121	-	-	-	-	-	-	-	-	-	-	-
2d.4.2	Insurance	-	-	-	-	-	-	392	39	432	432	-	-	-	-	-	-	-	-	-	-	-
2d.4.3	Property taxes	-	-	-	-	-	-	147	15	161	161	-	-	-	-	-	-	-	-	-	-	-
2d.4.4	Health physics supplies	-	712	-	-	-	-	-	178	890	890	-	-	-	-	-	-	-	-	-	-	-
2d.4.5	Heavy equipment rental	-	2,022	-	-	-	-	-	303	2,325	2,325	-	-	-	-	-	-	-	-	-	-	-
2d.4.6	Disposal of DAW generated	-	-	17	6	-	43	-	13	79	79	-	-	-	882	-	-	-	-	17,637	29	-
2d.4.7	Plant energy budget	-	-	-	-	-	-	592	89	681	681	-	-	-	-	-	-	-	-	-	-	-
2d.4.8	NRC Fees	-	-	-	-	-	-	496	50	545	545	-	-	-	-	-	-	-	-	-	-	-
2d.4.9	Emergency Planning Fees	-	-	-	-	-	-	51	5	56	-	56	-	-	-	-	-	-	-	-	-	-
2d.4.10	Site O&M Cost	-	-	-	-	-	-	287	43	330	330	-	-	-	-	-	-	-	-	-	-	-
2d.4.11	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	336	50	386	386	-	-	-	-	-	-	-	-	-	-	-
2d.4.12	ISFSI Operating Costs	-	-	-	-	-	-	45	7	51	-	51	-	-	-	-	-	-	-	-	-	-
2d.4.13	Corporate A&G Cost	-	-	-	-	-	-	1,090	163	1,253	1,253	-	-	-	-	-	-	-	-	-	-	-
2d.4.14	Security Staff Cost	-	-	-	-	-	-	3,823	573	4,397	4,397	-	-	-	-	-	-	-	-	-	-	67,637
2d.4.15	DOC Staff Cost	-	-	-	-	-	-	5,474	821	6,295	6,295	-	-	-	-	-	-	-	-	-	-	59,488
2d.4.16	Utility Staff Cost	-	-	-	-	-	-	8,050	1,208	9,258	8,795	463	-	-	-	-	-	-	-	-	-	98,603
2d.4	Subtotal Period 2d Period-Dependent Costs	97	2,734	17	6	-	43	20,782	3,582	27,260	26,691	570	-	-	882	-	-	-	-	17,637	29	225,728
2d.0	TOTAL PERIOD 2d COST	1,827	6,239	849	4,338	1,177	32,193	23,816	14,896	85,334	84,764	570	-	13,533	161,979	-	-	-	-	11,539,410	57,495	231,968
PERIOD 2e - Delay before License Termination																						
Period 2e Direct Decommissioning Activities																						
Period 2e Collateral Costs																						
2e.3.1	Tritium Monitoring	-	-	-	-	-	-	36	5	41	41	-	-	-	-	-	-	-	-	-	-	-
2e.3	Subtotal Period 2e Collateral Costs	-	-	-	-	-	-	36	5	41	41	-	-	-	-	-	-	-	-	-	-	-

Table C
DC Cook Unit 1
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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				Burial/Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours	
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet				
Period 2e Period-Dependent Costs																						
2e.4.1	Insurance	-	-	-	-	-	-	715	71	786	786	-	-	-	-	-	-	-	-	-	-	-
2e.4.2	Property taxes	-	-	-	-	-	-	267	27	294	294	-	-	-	-	-	-	-	-	-	-	-
2e.4.3	Health physics supplies	-	158	-	-	-	-	-	39	197	197	-	-	-	-	-	-	-	-	-	-	-
2e.4.4	Disposal of DAW generated	-	-	3	1	-	7	-	2	13	13	-	-	-	142	-	-	-	-	2,846	5	-
2e.4.5	Plant energy budget	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2e.4.6	NRC Fees	-	-	-	-	-	-	492	49	541	541	-	-	-	-	-	-	-	-	-	-	-
2e.4.7	Emergency Planning Fees	-	-	-	-	-	-	92	9	101	-	101	-	-	-	-	-	-	-	-	-	-
2e.4.8	Site O&M Cost	-	-	-	-	-	-	61	9	70	70	-	-	-	-	-	-	-	-	-	-	-
2e.4.9	ISFSI Operating Costs	-	-	-	-	-	-	81	12	93	-	93	-	-	-	-	-	-	-	-	-	-
2e.4.10	Corporate A&G Cost	-	-	-	-	-	-	230	34	264	264	-	-	-	-	-	-	-	-	-	-	-
2e.4.11	Security Staff Cost	-	-	-	-	-	-	6,964	1,045	8,009	8,009	-	-	-	-	-	-	-	-	-	-	123,213
2e.4.12	Utility Staff Cost	-	-	-	-	-	-	1,772	266	2,037	2,037	-	-	-	-	-	-	-	-	-	-	20,783
2e.4	Subtotal Period 2e Period-Dependent Costs	-	158	3	1	-	7	10,674	1,564	12,407	12,212	195	-	-	142	-	-	-	-	2,846	5	143,996
2e.0	TOTAL PERIOD 2e COST	-	158	3	1	-	7	10,710	1,570	12,448	12,253	195	-	-	142	-	-	-	-	2,846	5	143,996
PERIOD 2f - License Termination																						
Period 2f Direct Decommissioning Activities																						
2f.1.1	ORISE confirmatory survey	-	-	-	-	-	-	176	53	228	228	-	-	-	-	-	-	-	-	-	-	-
2f.1.2	Terminate license	-	-	-	-	-	-	-	-	a	-	-	-	-	-	-	-	-	-	-	-	-
2f.1	Subtotal Period 2f Activity Costs	-	-	-	-	-	-	176	53	228	228	-	-	-	-	-	-	-	-	-	-	-
Period 2f Additional Costs																						
2f.2.1	License Termination Survey	-	-	-	-	-	-	11,284	3,385	14,669	14,669	-	-	-	-	-	-	-	-	-	180,990	3,120
2f.2	Subtotal Period 2f Additional Costs	-	-	-	-	-	-	11,284	3,385	14,669	14,669	-	-	-	-	-	-	-	-	-	180,990	3,120
Period 2f Collateral Costs																						
2f.3.1	DOC staff relocation expenses	-	-	-	-	-	-	1,339	201	1,540	1,540	-	-	-	-	-	-	-	-	-	-	-
2f.3.2	Tritium Monitoring	-	-	-	-	-	-	19	3	22	22	-	-	-	-	-	-	-	-	-	-	-
2f.3	Subtotal Period 2f Collateral Costs	-	-	-	-	-	-	1,358	204	1,562	1,562	-	-	-	-	-	-	-	-	-	-	-
Period 2f Period-Dependent Costs																						
2f.4.1	Insurance	-	-	-	-	-	-	377	38	415	415	-	-	-	-	-	-	-	-	-	-	-
2f.4.2	Property taxes	-	-	-	-	-	-	141	14	155	155	-	-	-	-	-	-	-	-	-	-	-
2f.4.3	Health physics supplies	-	991	-	-	-	-	-	248	1,239	1,239	-	-	-	-	-	-	-	-	-	-	-
2f.4.4	Disposal of DAW generated	-	-	6	2	-	16	-	5	30	30	-	-	-	337	-	-	-	-	6,734	11	-
2f.4.5	Plant energy budget	-	-	-	-	-	-	285	43	327	327	-	-	-	-	-	-	-	-	-	-	-
2f.4.6	NRC Fees	-	-	-	-	-	-	478	48	526	526	-	-	-	-	-	-	-	-	-	-	-
2f.4.7	Emergency Planning Fees	-	-	-	-	-	-	49	5	53	-	53	-	-	-	-	-	-	-	-	-	-
2f.4.8	Site O&M Cost	-	-	-	-	-	-	175	26	201	201	-	-	-	-	-	-	-	-	-	-	-
2f.4.9	ISFSI Operating Costs	-	-	-	-	-	-	43	6	49	-	49	-	-	-	-	-	-	-	-	-	-
2f.4.10	Corporate A&G Cost	-	-	-	-	-	-	662	99	762	762	-	-	-	-	-	-	-	-	-	-	-
2f.4.11	Security Staff Cost	-	-	-	-	-	-	3,676	551	4,227	4,227	-	-	-	-	-	-	-	-	-	-	65,036
2f.4.12	DOC Staff Cost	-	-	-	-	-	-	4,510	677	5,187	5,187	-	-	-	-	-	-	-	-	-	-	46,622
2f.4.13	Utility Staff Cost	-	-	-	-	-	-	5,453	818	6,271	5,669	602	-	-	-	-	-	-	-	-	-	59,942
2f.4	Subtotal Period 2f Period-Dependent Costs	-	991	6	2	-	16	15,849	2,578	19,444	18,739	705	-	-	337	-	-	-	-	6,734	11	171,600
2f.0	TOTAL PERIOD 2f COST	-	991	6	2	-	16	28,667	6,220	35,903	35,198	705	-	-	337	-	-	-	-	6,734	181,001	174,720
PERIOD 2 TOTALS		4,016	60,717	24,567	12,915	12,822	91,712	348,294	112,958	668,001	564,436	96,916	6,648	141,731	268,824	963	813	2,061	24,620,840	783,957	2,499,653	
PERIOD 3b - Site Restoration																						
Period 3b Direct Decommissioning Activities																						
Demolition of Remaining Site Buildings																						
3b.1.1.1	Reactor	-	1,862	-	-	-	-	-	279	2,141	-	-	2,141	-	-	-	-	-	-	-	20,334	-
3b.1.1.2	RB Auxiliary	-	863	-	-	-	-	-	129	992	-	-	992	-	-	-	-	-	-	-	8,580	-
3b.1.1.3	Screenhouse Unit 1	-	506	-	-	-	-	-	76	581	-	-	581	-	-	-	-	-	-	-	4,071	-

Table C
DC Cook Unit 1
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours	
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet				
Demolition of Remaining Site Buildings (Continued)																						
3b.1.1.4	Turbine	-	4,000	-	-	-	-	-	600	4,600	-	-	4,600	-	-	-	-	-	-	-	38,327	-
3b.1.1	Totals	-	7,230	-	-	-	-	-	1,085	8,315	-	-	8,315	-	-	-	-	-	-	-	71,312	-
Site Closeout Activities																						
3b.1.2	Grade & landscape site	-	758	-	-	-	-	-	114	872	-	-	872	-	-	-	-	-	-	-	1,599	-
3b.1.3	Final report to NRC	-	-	-	-	-	-	212	32	243	243	-	-	-	-	-	-	-	-	-	-	1,560
3b.1	Subtotal Period 3b Activity Costs	-	7,988	-	-	-	-	212	1,230	9,430	243	-	9,187	-	-	-	-	-	-	-	72,911	1,560
Period 3b Additional Costs																						
3b.2.1	Concrete Crushing	-	370	-	-	-	-	3	56	429	-	-	429	-	-	-	-	-	-	-	1,601	-
3b.2.2	Construction Debris	-	-	-	-	-	-	50	8	58	-	-	58	-	-	-	-	-	-	-	-	-
3b.2	Subtotal Period 3b Additional Costs	-	370	-	-	-	-	53	63	486	-	-	486	-	-	-	-	-	-	-	1,601	-
Period 3b Collateral Costs																						
3b.3.1	Small tool allowance	-	75	-	-	-	-	-	11	87	-	-	87	-	-	-	-	-	-	-	-	-
3b.3.2	Tritium Monitoring	-	-	-	-	-	-	65	10	75	-	75	-	-	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	-	75	-	-	-	-	65	21	162	-	75	87	-	-	-	-	-	-	-	-	-
Period 3b Period-Dependent Costs																						
3b.4.1	Insurance	-	-	-	-	-	-	655	65	720	-	720	-	-	-	-	-	-	-	-	-	-
3b.4.2	Property taxes	-	-	-	-	-	-	510	51	561	-	561	-	-	-	-	-	-	-	-	-	-
3b.4.3	Heavy equipment rental	-	8,886	-	-	-	-	-	1,333	10,219	-	-	10,219	-	-	-	-	-	-	-	-	-
3b.4.4	Plant energy budget	-	-	-	-	-	-	494	74	568	-	568	-	-	-	-	-	-	-	-	-	-
3b.4.5	NRC ISFSI Fees	-	-	-	-	-	-	345	34	379	-	379	-	-	-	-	-	-	-	-	-	-
3b.4.6	Emergency Planning Fees	-	-	-	-	-	-	169	17	186	-	186	-	-	-	-	-	-	-	-	-	-
3b.4.7	Site O&M Cost	-	-	-	-	-	-	267	40	307	-	307	-	-	-	-	-	-	-	-	-	-
3b.4.8	ISFSI Operating Costs	-	-	-	-	-	-	149	22	171	-	171	-	-	-	-	-	-	-	-	-	-
3b.4.9	Corporate A&G Cost	-	-	-	-	-	-	1,014	152	1,166	-	1,166	-	-	-	-	-	-	-	-	-	-
3b.4.10	Security Staff Cost	-	-	-	-	-	-	5,047	757	5,804	-	-	5,804	-	-	-	-	-	-	-	-	86,984
3b.4.11	DOC Staff Cost	-	-	-	-	-	-	14,364	2,155	16,519	-	-	16,519	-	-	-	-	-	-	-	-	144,067
3b.4.12	Utility Staff Cost	-	-	-	-	-	-	8,292	1,244	9,536	0	2,098	7,438	-	-	-	-	-	-	-	-	91,741
3b.4	Subtotal Period 3b Period-Dependent Costs	-	8,886	-	-	-	-	31,304	5,945	46,135	0	6,155	39,979	-	-	-	-	-	-	-	-	322,792
3b.0	TOTAL PERIOD 3b COST	-	17,320	-	-	-	-	31,634	7,259	56,213	243	6,231	49,739	-	-	-	-	-	-	-	74,512	324,352
PERIOD 3 TOTALS		-	17,320	-	-	-	-	31,634	7,259	56,213	243	6,231	49,739	-	-	-	-	-	-	-	74,512	324,352
TOTAL COST TO DECOMMISSION		8,038	82,796	24,687	13,319	12,822	94,824	652,646	164,195	1,053,328	735,680	259,580	58,068	141,731	275,810	1,841	813	2,061	24,819,470	894,789	3,837,742	

TOTAL COST TO DECOMMISSION WITH 18.47% CONTINGENCY:	\$1,053,328	thousands of 2021 dollars
TOTAL NRC LICENSE TERMINATION COST IS 69.84% OR:	\$735,680	thousands of 2021 dollars
SPENT FUEL MANAGEMENT COST IS 24.64% OR:	\$259,580	thousands of 2021 dollars
NON-NUCLEAR DEMOLITION COST IS 5.51% OR:	\$58,068	thousands of 2021 dollars
TOTAL LOW-LEVEL RADIOACTIVE WASTE VOLUME BURIED (EXCLUDING GTCC):	278,464	Cubic Feet
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	2,061	Cubic Feet
TOTAL SCRAP METAL REMOVED:	25,449	Tons
TOTAL CRAFT LABOR REQUIREMENTS:	894,789	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

Table C
DC Cook Unit 2
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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					Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	GTCC Cu. Feet			
PERIOD 0a - Pre-Shutdown Early Planning																						
Period 0a Direct Decommissioning Activities																						
Period 0a Collateral Costs																						
0a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	78,499	11,775	90,274	-	90,274	-	-	-	-	-	-	-	-	-	-
0a.3	Subtotal Period 0a Collateral Costs	-	-	-	-	-	-	78,499	11,775	90,274	-	90,274	-	-	-	-	-	-	-	-	-	-
Period 0a Period-Dependent Costs																						
0a.4.1	Insurance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0a.4.2	Property taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0a.4.3	Plant energy budget	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0a.4.4	Utility Staff Cost	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0a.4	Subtotal Period 0a Period-Dependent Costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0a.0	TOTAL PERIOD 0a COST	-	-	-	-	-	-	78,499	11,775	90,274	-	90,274	-	-	-	-	-	-	-	-	-	-
PERIOD 1a - Shutdown through Transition																						
Period 1a Direct Decommissioning Activities																						
1a.1.1	Prepare preliminary decommissioning cost	-	-	-	-	-	-	75	11	87	87	-	-	-	-	-	-	-	-	-	-	556
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	-	-	-	-	-	-	116	17	134	134	-	-	-	-	-	-	-	-	-	-	856
1a.1.7	Review plant dwgs & specs.	-	-	-	-	-	-	267	40	307	307	-	-	-	-	-	-	-	-	-	-	1,969
1a.1.8	Perform detailed rad survey	-	-	-	-	-	-	-	-	a	-	-	-	-	-	-	-	-	-	-	-	-
1a.1.9	Estimate by-product inventory	-	-	-	-	-	-	58	9	67	67	-	-	-	-	-	-	-	-	-	-	428
1a.1.10	End product description	-	-	-	-	-	-	58	9	67	67	-	-	-	-	-	-	-	-	-	-	428
1a.1.11	Detailed by-product inventory	-	-	-	-	-	-	75	11	87	87	-	-	-	-	-	-	-	-	-	-	556
1a.1.12	Define major work sequence	-	-	-	-	-	-	436	65	501	501	-	-	-	-	-	-	-	-	-	-	3,210
1a.1.13	Perform SER and EA	-	-	-	-	-	-	180	27	207	207	-	-	-	-	-	-	-	-	-	-	1,327
1a.1.14	Prepare/submit Defueled Technical Specifications	-	-	-	-	-	-	436	65	501	501	-	-	-	-	-	-	-	-	-	-	3,210
1a.1.15	Perform Site-Specific Cost Study	-	-	-	-	-	-	290	44	334	334	-	-	-	-	-	-	-	-	-	-	2,140
1a.1.16	Prepare/submit Irradiated Fuel Management Plan	-	-	-	-	-	-	58	9	67	67	-	-	-	-	-	-	-	-	-	-	428
Activity Specifications																						
1a.1.17.1	Plant & temporary facilities	-	-	-	-	-	-	286	43	329	296	-	33	-	-	-	-	-	-	-	-	2,106
1a.1.17.2	Plant systems	-	-	-	-	-	-	242	36	278	250	-	28	-	-	-	-	-	-	-	-	1,783
1a.1.17.3	NSSS Decontamination Flush	-	-	-	-	-	-	29	4	33	33	-	-	-	-	-	-	-	-	-	-	214
1a.1.17.4	Reactor internals	-	-	-	-	-	-	412	62	474	474	-	-	-	-	-	-	-	-	-	-	3,039
1a.1.17.5	Reactor vessel	-	-	-	-	-	-	377	57	434	434	-	-	-	-	-	-	-	-	-	-	2,782
1a.1.17.6	Biological shield	-	-	-	-	-	-	29	4	33	33	-	-	-	-	-	-	-	-	-	-	214
1a.1.17.7	Steam generators	-	-	-	-	-	-	181	27	208	208	-	-	-	-	-	-	-	-	-	-	1,335
1a.1.17.8	Reinforced concrete	-	-	-	-	-	-	93	14	107	53	-	53	-	-	-	-	-	-	-	-	685
1a.1.17.9	Main Turbine	-	-	-	-	-	-	23	3	27	-	-	27	-	-	-	-	-	-	-	-	171
1a.1.17.10	Main Condensers	-	-	-	-	-	-	23	3	27	-	-	27	-	-	-	-	-	-	-	-	171
1a.1.17.11	Plant structures & buildings	-	-	-	-	-	-	181	27	208	104	-	104	-	-	-	-	-	-	-	-	1,335
1a.1.17.12	Waste management	-	-	-	-	-	-	267	40	307	307	-	-	-	-	-	-	-	-	-	-	1,969
1a.1.17.13	Facility & site closeout	-	-	-	-	-	-	52	8	60	30	-	30	-	-	-	-	-	-	-	-	385
1a.1.17	Total	-	-	-	-	-	-	2,197	330	2,526	2,225	-	302	-	-	-	-	-	-	-	-	16,190
Planning & Site Preparations																						
1a.1.18	Prepare dismantling sequence	-	-	-	-	-	-	139	21	160	160	-	-	-	-	-	-	-	-	-	-	1,027
1a.1.19	Plant prep. & temp. svces	-	-	-	-	-	-	3,600	540	4,140	4,140	-	-	-	-	-	-	-	-	-	-	-
1a.1.20	Design water clean-up system	-	-	-	-	-	-	81	12	94	94	-	-	-	-	-	-	-	-	-	-	599
1a.1.21	Rigging/Cont. Cntrl Envlp/ooling/etc.	-	-	-	-	-	-	2,400	360	2,760	2,760	-	-	-	-	-	-	-	-	-	-	-
1a.1.22	Procure casks/liners & containers	-	-	-	-	-	-	71	11	82	82	-	-	-	-	-	-	-	-	-	-	526
1a.1	Subtotal Period 1a Activity Costs	-	-	-	-	-	-	10,539	1,581	12,120	11,818	-	302	-	-	-	-	-	-	-	-	33,451

Table C
DC Cook Unit 2
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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					Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet				
Period 1a Collateral Costs																						
1a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	40,266	6,040	46,306	-	46,306	-	-	-	-	-	-	-	-	-	-
1a.3.2	Severance	-	-	-	-	-	-	20,611	3,092	23,702	23,702	-	-	-	-	-	-	-	-	-	-	-
1a.3.3	Tritium Monitoring	-	-	-	-	-	-	25	4	29	29	-	-	-	-	-	-	-	-	-	-	-
1a.3	Subtotal Period 1a Collateral Costs	-	-	-	-	-	-	60,902	9,135	70,037	23,731	46,306	-	-	-	-	-	-	-	-	-	-
Period 1a Period-Dependent Costs																						
1a.4.1	Insurance	-	-	-	-	-	-	1,967	197	2,163	2,163	-	-	-	-	-	-	-	-	-	-	-
1a.4.2	Property taxes	-	-	-	-	-	-	183	18	201	201	-	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	614	-	-	-	-	-	153	767	767	-	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	756	-	-	-	-	-	113	869	869	-	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	12	4	-	30	-	9	55	55	-	-	-	610	-	-	-	-	12,190	20	-
1a.4.6	Plant energy budget	-	-	-	-	-	-	1,951	293	2,244	2,244	-	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	711	71	782	782	-	-	-	-	-	-	-	-	-	-	-
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	736	74	810	-	810	-	-	-	-	-	-	-	-	-	-
1a.4.9	Site O&M Cost	-	-	-	-	-	-	1,230	184	1,414	1,414	-	-	-	-	-	-	-	-	-	-	-
1a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	426	64	490	-	490	-	-	-	-	-	-	-	-	-	-
1a.4.11	ISFSI Operating Costs	-	-	-	-	-	-	57	9	65	-	65	-	-	-	-	-	-	-	-	-	-
1a.4.12	Corporate A&G Cost	-	-	-	-	-	-	4,666	700	5,365	5,365	-	-	-	-	-	-	-	-	-	-	-
1a.4.13	Security Staff Cost	-	-	-	-	-	-	7,655	1,148	8,804	8,804	-	-	-	-	-	-	-	-	-	-	131,040
1a.4.14	Utility Staff Cost	-	-	-	-	-	-	36,155	5,423	41,578	41,578	-	-	-	-	-	-	-	-	-	-	422,240
1a.4	Subtotal Period 1a Period-Dependent Costs	-	1,370	12	4	-	30	55,736	8,457	65,608	64,243	1,365	-	-	610	-	-	-	-	12,190	20	553,280
1a.0	TOTAL PERIOD 1a COST	-	1,370	12	4	-	30	127,176	19,173	147,765	99,792	47,671	302	-	610	-	-	-	-	12,190	20	586,731
PERIOD 1b - Decommissioning Preparations																						
Period 1b Direct Decommissioning Activities																						
Detailed Work Procedures																						
1b.1.1.1	Plant systems	-	-	-	-	-	-	275	41	316	284	-	32	-	-	-	-	-	-	-	-	2,026
1b.1.1.2	NSSS Decontamination Flush	-	-	-	-	-	-	58	9	67	67	-	-	-	-	-	-	-	-	-	-	428
1b.1.1.3	Reactor internals	-	-	-	-	-	-	145	22	167	167	-	-	-	-	-	-	-	-	-	-	1,070
1b.1.1.4	Remaining buildings	-	-	-	-	-	-	78	12	90	23	-	68	-	-	-	-	-	-	-	-	578
1b.1.1.5	CRD cooling assembly	-	-	-	-	-	-	58	9	67	67	-	-	-	-	-	-	-	-	-	-	428
1b.1.1.6	CRD housings & ICI tubes	-	-	-	-	-	-	58	9	67	67	-	-	-	-	-	-	-	-	-	-	428
1b.1.1.7	Incore instrumentation	-	-	-	-	-	-	58	9	67	67	-	-	-	-	-	-	-	-	-	-	428
1b.1.1.8	Reactor vessel	-	-	-	-	-	-	211	32	242	242	-	-	-	-	-	-	-	-	-	-	1,554
1b.1.1.9	Facility closeout	-	-	-	-	-	-	70	10	80	40	-	40	-	-	-	-	-	-	-	-	514
1b.1.1.10	Missile shields	-	-	-	-	-	-	26	4	30	30	-	-	-	-	-	-	-	-	-	-	193
1b.1.1.11	Biological shield	-	-	-	-	-	-	70	10	80	80	-	-	-	-	-	-	-	-	-	-	514
1b.1.1.12	Steam generators	-	-	-	-	-	-	267	40	307	307	-	-	-	-	-	-	-	-	-	-	1,969
1b.1.1.13	Reinforced concrete	-	-	-	-	-	-	58	9	67	33	-	33	-	-	-	-	-	-	-	-	428
1b.1.1.14	Main Turbine	-	-	-	-	-	-	91	14	104	-	104	-	-	-	-	-	-	-	-	-	668
1b.1.1.15	Main Condensers	-	-	-	-	-	-	91	14	104	-	-	104	-	-	-	-	-	-	-	-	668
1b.1.1.16	Auxiliary building	-	-	-	-	-	-	159	24	182	164	-	18	-	-	-	-	-	-	-	-	1,168
1b.1.1.17	Reactor building	-	-	-	-	-	-	159	24	182	164	-	18	-	-	-	-	-	-	-	-	1,168
1b.1.1	Total	-	-	-	-	-	-	1,931	290	2,220	1,803	-	418	-	-	-	-	-	-	-	-	14,228
1b.1.2	Decon primary loop	795	-	-	-	-	-	-	397	1,192	1,192	-	-	-	-	-	-	-	-	-	1,067	-
1b.1	Subtotal Period 1b Activity Costs	795	-	-	-	-	-	1,931	687	3,412	2,995	-	418	-	-	-	-	-	-	-	1,067	14,228
Period 1b Additional Costs																						
1b.2.1	Spent Fuel Pool Isolation	-	-	-	-	-	-	12,893	1,934	14,827	14,827	-	-	-	-	-	-	-	-	-	-	-
1b.2.2	Site Characterization	-	-	-	-	-	-	1,856	557	2,412	2,412	-	-	-	-	-	-	-	-	-	9,818	3,794
1b.2.3	Asbestos Abatement	-	1,382	1	38	-	281	-	422	2,124	2,124	-	-	-	5,861	-	-	-	-	76,193	12,067	-
1b.2	Subtotal Period 1b Additional Costs	-	1,382	1	38	-	281	14,749	2,912	19,364	19,364	-	-	-	5,861	-	-	-	-	76,193	21,884	3,794
Period 1b Collateral Costs																						
1b.3.1	Decon equipment	1,073	-	-	-	-	-	-	161	1,234	1,234	-	-	-	-	-	-	-	-	-	-	-
1b.3.2	DOC staff relocation expenses	-	-	-	-	-	-	1,339	201	1,540	1,540	-	-	-	-	-	-	-	-	-	-	-
1b.3.3	Process decommissioning water waste	26	-	16	36	-	54	-	33	165	165	-	-	-	159	-	-	-	-	9,514	31	-
1b.3.4	Process decommissioning chemical flush waste	2	-	85	324	-	2,731	-	741	3,882	3,882	-	-	-	-	879	-	-	-	93,615	164	-
1b.3.5	Small tool allowance	-	17	-	-	-	-	-	3	20	20	-	-	-	-	-	-	-	-	-	-	-

Table C
DC Cook Unit 2
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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					Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet				
Period 1b Collateral Costs (Continued)																						
1b.3.6	Pipe cutting equipment	-	1,200	-	-	-	-	-	180	1,380	1,380	-	-	-	-	-	-	-	-	-	-	-
1b.3.7	Decon rig	2,088	-	-	-	-	-	-	313	2,401	2,401	-	-	-	-	-	-	-	-	-	-	
1b.3.8	Spent Fuel Capital and Transfer	-	-	-	-	-	-	23,031	3,455	26,486	-	26,486	-	-	-	-	-	-	-	-	-	
1b.3.9	Tritium Monitoring	-	-	-	-	-	-	12	2	14	14	-	-	-	-	-	-	-	-	-	-	
1b.3	Subtotal Period 1b Collateral Costs	3,189	1,218	101	359	-	2,785	24,383	5,088	37,123	10,637	26,486	-	-	159	879	-	-	103,129	195	-	
Period 1b Period-Dependent Costs																						
1b.4.1	Decon supplies	38	-	-	-	-	-	-	9	47	47	-	-	-	-	-	-	-	-	-	-	
1b.4.2	Insurance	-	-	-	-	-	-	981	98	1,079	1,079	-	-	-	-	-	-	-	-	-	-	
1b.4.3	Property taxes	-	-	-	-	-	-	93	9	103	103	-	-	-	-	-	-	-	-	-	-	
1b.4.4	Health physics supplies	-	412	-	-	-	-	-	103	515	515	-	-	-	-	-	-	-	-	-	-	
1b.4.5	Heavy equipment rental	-	377	-	-	-	-	-	57	434	434	-	-	-	-	-	-	-	-	-	-	
1b.4.6	Disposal of DAW generated	-	-	7	3	-	17	-	5	32	32	-	-	-	356	-	-	-	7,122	12	-	
1b.4.7	Plant energy budget	-	-	-	-	-	-	1,946	292	2,237	2,237	-	-	-	-	-	-	-	-	-	-	
1b.4.8	NRC Fees	-	-	-	-	-	-	228	23	251	251	-	-	-	-	-	-	-	-	-	-	
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	367	37	404	-	404	-	-	-	-	-	-	-	-	-	
1b.4.10	Site O&M Cost	-	-	-	-	-	-	616	92	709	709	-	-	-	-	-	-	-	-	-	-	
1b.4.11	Spent Fuel Pool O&M	-	-	-	-	-	-	213	32	244	-	244	-	-	-	-	-	-	-	-	-	
1b.4.12	ISFSI Operating Costs	-	-	-	-	-	-	28	4	33	-	33	-	-	-	-	-	-	-	-	-	
1b.4.13	Corporate A&G Cost	-	-	-	-	-	-	2,338	351	2,689	2,689	-	-	-	-	-	-	-	-	-	-	
1b.4.14	Security Staff Cost	-	-	-	-	-	-	3,817	573	4,390	4,390	-	-	-	-	-	-	-	-	-	65,341	
1b.4.15	DOC Staff Cost	-	-	-	-	-	-	6,286	943	7,229	7,229	-	-	-	-	-	-	-	-	-	63,266	
1b.4.16	Utility Staff Cost	-	-	-	-	-	-	18,130	2,720	20,850	20,850	-	-	-	-	-	-	-	-	-	211,579	
1b.4	Subtotal Period 1b Period-Dependent Costs	38	789	7	3	-	17	35,043	5,347	41,244	40,564	681	-	-	356	-	-	-	7,122	12	340,185	
1b.0	TOTAL PERIOD 1b COST	4,022	3,389	109	400	-	3,083	76,106	14,035	101,143	73,559	27,167	418	-	6,376	879	-	-	186,444	23,158	358,207	
PERIOD 1 TOTALS		4,022	4,759	120	404	-	3,113	203,282	33,208	248,908	173,350	74,838	719	-	6,985	879	-	-	198,634	23,178	944,938	
PERIOD 2a - Large Component Removal																						
Period 2a Direct Decommissioning Activities																						
Nuclear Steam Supply System Removal																						
2a.1.1.1	Reactor Coolant Piping	250	200	49	113	-	1,008	-	449	2,069	2,069	-	-	-	2,700	-	-	-	188,405	6,970	-	
2a.1.1.2	Pressurizer Relief Tank	39	31	11	24	-	217	-	86	408	408	-	-	-	581	-	-	-	40,513	1,082	-	
2a.1.1.3	Reactor Coolant Pumps & Motors	140	112	165	208	-	2,233	-	704	3,562	3,562	-	-	-	6,241	-	-	-	678,000	4,514	100	
2a.1.1.4	Pressurizer	-	71	584	132	-	1,150	-	384	2,321	2,321	-	-	-	3,215	-	-	-	312,462	1,666	938	
2a.1.1.5	Steam Generators	-	4,196	3,949	3,261	3,251	8,168	-	4,463	27,289	27,289	-	-	43,179	22,834	-	-	-	3,867,344	23,227	2,875	
2a.1.1.6	CRDMs/ICIs/Service Structure Removal	199	346	222	91	-	786	-	418	2,062	2,062	-	-	-	4,089	-	-	-	146,894	8,329	-	
2a.1.1.7	Reactor Vessel Internals	160	5,753	14,453	1,818	-	18,325	415	17,687	58,611	58,611	-	-	-	2,527	963	785	-	408,896	35,440	1,576	
2a.1.1.8	Vessel & Internals GTCC Disposal	-	-	-	-	-	10,273	-	1,541	11,814	11,814	-	-	-	-	-	-	2,061	410,142	-	-	
2a.1.1.9	Reactor Vessel	145	7,286	3,169	1,240	-	4,803	415	9,103	26,161	26,161	-	-	-	13,680	-	-	-	975,893	35,440	1,576	
2a.1.1	Totals	933	17,995	22,602	6,889	3,251	46,962	830	34,835	134,297	134,297	-	-	43,179	55,867	963	785	2,061	7,028,548	116,667	7,065	
Removal of Major Equipment																						
2a.1.2	Main Turbine/Generator	-	181	-	-	-	-	-	27	209	-	-	209	-	-	-	-	-	-	-	2,940	
2a.1.3	Main Condensers	-	436	-	-	-	-	-	65	501	-	-	501	-	-	-	-	-	-	-	7,130	
Cascading Costs from Clean Building Demolition																						
2a.1.4.1	Reactor	-	411	-	-	-	-	-	62	473	473	-	-	-	-	-	-	-	-	-	4,024	
2a.1.4.2	Auxiliary	-	1,629	-	-	-	-	-	244	1,874	1,874	-	-	-	-	-	-	-	-	-	16,203	
2a.1.4	Totals	-	2,040	-	-	-	-	-	306	2,346	2,346	-	-	-	-	-	-	-	-	-	20,227	
Disposal of Plant Systems																						
2a.1.5.1	Auxiliary Feedwater	-	116	-	-	-	-	-	17	133	-	-	133	-	-	-	-	-	-	-	1,950	
2a.1.5.2	Auxiliary Steam	-	63	-	-	-	-	-	10	73	-	-	73	-	-	-	-	-	-	-	1,132	
2a.1.5.3	Bleed Steam	-	30	-	-	-	-	-	5	35	-	-	35	-	-	-	-	-	-	-	564	
2a.1.5.4	Blowdown	-	1	-	-	-	-	-	0	1	-	-	1	-	-	-	-	-	-	-	19	
2a.1.5.5	Chemical Cleaning	-	11	-	-	-	-	-	2	13	-	-	13	-	-	-	-	-	-	-	195	
2a.1.5.6	Circulating Water	-	108	-	-	-	-	-	16	124	-	-	124	-	-	-	-	-	-	-	1,907	
2a.1.5.7	Condensate	-	188	-	-	-	-	-	28	216	-	-	216	-	-	-	-	-	-	-	3,343	
2a.1.5.8	Condenser Air Removal	-	11	-	-	-	-	-	2	13	-	-	13	-	-	-	-	-	-	-	205	

Table C
DC Cook Unit 2
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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					Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet				
Disposal of Plant Systems (Continued)																						
2a.1.5.9	Containment Equalization / Hyd	-	28	8	8	29	83	-	34	190	190	-	-	291	238	-	-	-	-	27,356	493	-
2a.1.5.10	Control & Instrumentation	-	1	-	-	-	-	-	0	1	-	-	1	-	-	-	-	-	-	-	19	-
2a.1.5.11	Control and Decontamination Air	-	27	-	-	-	-	-	4	31	-	-	31	-	-	-	-	-	-	-	484	-
2a.1.5.12	Demineralized Water	-	32	-	-	-	-	-	5	37	-	-	37	-	-	-	-	-	-	-	578	-
2a.1.5.13	HVAC Mechanical Maintenance	-	7	-	1	-	-	-	1	8	-	-	8	-	-	-	-	-	-	-	135	-
2a.1.5.14	HVAC Turbine	-	47	-	-	-	-	-	7	54	-	-	54	-	-	-	-	-	-	-	908	-
2a.1.5.15	Heaters Drains and Vents	-	52	-	-	-	-	-	8	60	-	-	60	-	-	-	-	-	-	-	978	-
2a.1.5.16	Main Feedwater	-	93	-	14	-	-	-	14	107	-	-	107	-	-	-	-	-	-	-	1,641	-
2a.1.5.17	Main Generator	-	46	-	-	-	-	-	7	53	-	-	53	-	-	-	-	-	-	-	834	-
2a.1.5.18	Main Turbine	-	95	-	-	-	-	-	14	109	-	-	109	-	-	-	-	-	-	-	1,660	-
2a.1.5.19	Non-Essential Service Water	-	79	-	-	-	-	-	12	91	-	-	91	-	-	-	-	-	-	-	1,426	-
2a.1.5.20	Plant Air	-	10	-	-	-	-	-	2	12	-	-	12	-	-	-	-	-	-	-	185	-
2a.1.5.21	Post Accident Ctmt H2 Monitoring	-	38	3	3	13	30	-	19	105	105	-	-	133	86	-	-	-	-	10,935	630	-
2a.1.5.22	Post Accident Sampling	-	4	0	0	1	0	-	1	7	7	-	-	15	1	-	-	-	-	678	68	-
2a.1.5.23	Reactor Hydrogen & Nitrogen	-	0	-	-	-	-	-	0	0	-	-	0	-	-	-	-	-	-	-	0	-
2a.1.5.24	Reactor Hydrogen & Nitrogen RCA	-	3	0	0	3	3	-	2	10	10	-	-	26	7	-	-	-	-	1,510	47	-
2a.1.5.25	Screen Wash	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2a.1.5.26	Secondary Sampling	-	5	-	-	-	-	-	1	6	-	-	6	-	-	-	-	-	-	-	96	-
2a.1.5.27	Sodium Hypochlorite System	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	-	138	-
2a.1.5.28	Station Drainage	-	16	-	-	-	-	-	2	18	-	-	18	-	-	-	-	-	-	-	283	-
2a.1.5.29	Turbine Auxiliary Cooling Water	-	24	-	-	-	-	-	4	27	-	-	27	-	-	-	-	-	-	-	433	-
2a.1.5	Totals	-	1,144	11	11	46	116	-	217	1,545	313	-	1,232	464	332	-	-	-	-	40,478	20,351	-
2a.1.6	Scaffolding in support of decommissioning	-	2,091	27	12	141	39	-	558	2,868	2,868	-	-	1,290	114	-	-	-	-	65,275	42,896	-
2a.1	Subtotal Period 2a Activity Costs	933	23,888	22,640	6,912	3,438	47,117	830	36,009	141,766	139,824	-	1,941	44,933	56,312	963	785	2,061	7,134,300	210,211	7,065	
Period 2a Additional Costs																						
2a.2.1	Remedial Action Surveys	-	-	-	-	-	-	2,474	742	3,216	3,216	-	-	-	-	-	-	-	-	-	38,270	-
2a.2	Subtotal Period 2a Additional Costs	-	-	-	-	-	-	2,474	742	3,216	3,216	-	-	-	-	-	-	-	-	-	38,270	-
Period 2a Collateral Costs																						
2a.3.1	Process decommissioning water waste	48	-	30	67	-	102	-	62	309	309	-	-	-	299	-	-	-	-	17,925	58	-
2a.3.2	Process decommissioning chemical flush waste	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2a.3.3	Small tool allowance	-	238	-	-	-	-	-	36	274	247	-	27	-	-	-	-	-	-	-	-	-
2a.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	70,876	10,631	81,507	-	81,507	-	-	-	-	-	-	-	-	-	-
2a.3.5	Severance	-	-	-	-	-	-	4,149	622	4,771	4,771	-	-	-	-	-	-	-	-	-	-	-
2a.3.6	Tritium Monitoring	-	-	-	-	-	-	46	7	53	53	-	-	-	-	-	-	-	-	-	-	-
2a.3.7	On-site survey and release of 14.82 tons clean metallic waste	-	-	-	-	-	-	22	2	24	24	-	-	-	-	-	-	-	-	-	-	-
2a.3	Subtotal Period 2a Collateral Costs	48	238	30	67	-	102	75,092	11,361	86,938	5,404	81,507	27	-	299	-	-	-	-	17,925	58	-
Period 2a Period-Dependent Costs																						
2a.4.1	Decon supplies	140	-	-	-	-	-	-	35	175	175	-	-	-	-	-	-	-	-	-	-	-
2a.4.2	Insurance	-	-	-	-	-	-	922	92	1,014	1,014	-	-	-	-	-	-	-	-	-	-	-
2a.4.3	Property taxes	-	-	-	-	-	-	344	34	378	378	-	-	-	-	-	-	-	-	-	-	-
2a.4.4	Health physics supplies	-	2,570	-	-	-	-	-	642	3,212	3,212	-	-	-	-	-	-	-	-	-	-	-
2a.4.5	Heavy equipment rental	-	4,629	-	-	-	-	-	694	5,323	5,323	-	-	-	-	-	-	-	-	-	-	-
2a.4.6	Disposal of DAW generated	-	-	87	32	-	221	-	69	409	409	-	-	-	4,543	-	-	-	-	90,869	148	-
2a.4.7	Plant energy budget	-	-	-	-	-	-	3,412	512	3,924	3,924	-	-	-	-	-	-	-	-	-	-	-
2a.4.8	NRC Fees	-	-	-	-	-	-	797	80	877	877	-	-	-	-	-	-	-	-	-	-	-
2a.4.9	Emergency Planning Fees	-	-	-	-	-	-	829	83	912	-	912	-	-	-	-	-	-	-	-	-	-
2a.4.10	Site O&M Cost	-	-	-	-	-	-	1,578	237	1,815	1,815	-	-	-	-	-	-	-	-	-	-	-
2a.4.11	Spent Fuel Pool O&M	-	-	-	-	-	-	785	118	903	-	903	-	-	-	-	-	-	-	-	-	-
2a.4.12	ISFSI Operating Costs	-	-	-	-	-	-	105	16	121	-	121	-	-	-	-	-	-	-	-	-	-
2a.4.13	Corporate A&G Cost	-	-	-	-	-	-	5,988	898	6,886	6,886	-	-	-	-	-	-	-	-	-	-	-
2a.4.14	Security Staff Cost	-	-	-	-	-	-	12,790	1,919	14,709	14,709	-	-	-	-	-	-	-	-	-	-	216,366
2a.4.15	DOC Staff Cost	-	-	-	-	-	-	28,219	4,233	32,451	-	-	-	-	-	-	-	-	-	-	-	291,040
2a.4.16	Utility Staff Cost	-	-	-	-	-	-	47,180	7,077	54,256	54,256	-	-	-	-	-	-	-	-	-	-	541,871
2a.4	Subtotal Period 2a Period-Dependent Costs	140	7,199	87	32	-	221	102,948	16,738	127,365	125,430	1,935	-	-	4,543	-	-	-	-	90,869	148	1,049,277
2a.0	TOTAL PERIOD 2a COST	1,120	31,325	22,757	7,011	3,438	47,439	181,344	64,850	359,285	273,875	83,442	1,969	44,933	61,155	963	785	2,061	7,243,095	248,687	1,056,342	

Table C
DC Cook Unit 2
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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					Burial / Processed Wt. Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet				
PERIOD 2b - Site Decontamination																						
Period 2b Direct Decommissioning Activities																						
2b.1.1	Remove spent fuel racks	1,285	137	378	224	-	3,248	-	1,560	6,833	6,833	-	-	-	9,557	-	-	-	-	607,127	2,632	-
Disposal of Plant Systems																						
2b.1.2.1	Auxiliary Feedwater RCA	-	14	2	3	24	21	-	13	78	78	-	-	247	60	-	-	-	-	13,932	235	-
2b.1.2.2	Auxiliary Steam RCA	-	24	2	2	21	13	-	13	75	75	-	-	215	39	-	-	-	-	11,259	403	-
2b.1.2.3	Blowdown RCA	-	37	4	5	38	31	-	24	138	138	-	-	382	89	-	-	-	-	21,366	618	-
2b.1.2.4	Bus Protection & Metering	-	276	-	-	-	-	-	41	318	-	-	318	-	-	-	-	-	-	-	4,732	-
2b.1.2.5	Chemical Volume Control System	-	673	80	101	352	1,135	-	528	2,869	2,869	-	-	3,563	3,315	-	-	-	-	356,857	11,324	-
2b.1.2.6	Component Cooling Water	-	244	37	65	531	436	-	263	1,578	1,578	-	-	5,384	1,277	-	-	-	-	300,220	4,235	-
2b.1.2.7	Condensate RCA	-	7	0	1	6	2	-	3	20	20	-	-	63	6	-	-	-	-	2,961	127	-
2b.1.2.8	Containment	-	163	32	36	65	464	-	175	936	936	-	-	656	1,354	-	-	-	-	113,433	2,727	-
2b.1.2.9	Containment Spray	-	432	40	60	407	490	-	305	1,733	1,733	-	-	4,122	1,429	-	-	-	-	258,983	7,283	-
2b.1.2.10	Control and Decontamination Air RCA	-	80	3	8	85	31	-	42	249	249	-	-	859	91	-	-	-	-	40,665	1,302	-
2b.1.2.11	Control and Instrumentation	-	18	-	-	-	-	-	3	21	-	-	21	-	-	-	-	-	-	-	320	-
2b.1.2.12	Demineralized Water RCA	-	10	1	1	5	7	-	5	28	28	-	-	46	21	-	-	-	-	3,222	157	-
2b.1.2.13	Electrical	-	1,539	-	-	-	-	-	231	1,770	-	-	1,770	-	-	-	-	-	-	-	27,320	-
2b.1.2.14	Electrical Distribution	-	506	-	-	-	-	-	76	582	-	-	582	-	-	-	-	-	-	-	8,751	-
2b.1.2.15	Electrical Distribution RCA	-	29	1	2	30	4	-	13	79	79	-	-	302	11	-	-	-	-	13,004	486	-
2b.1.2.16	Electrical RCA	-	5,132	99	282	3,779	502	-	2,027	11,821	11,821	-	-	38,294	1,477	-	-	-	-	1,649,001	77,265	-
2b.1.2.17	Elevator	-	0	-	-	-	-	-	0	0	-	-	0	-	-	-	-	-	-	-	3	-
2b.1.2.18	Emergency Core Cooling System	-	176	11	16	147	94	-	93	538	538	-	-	1,490	271	-	-	-	-	78,144	3,050	-
2b.1.2.19	Emergency Diesel Generator	-	89	-	-	-	-	-	13	102	-	-	102	-	-	-	-	-	-	-	1,568	-
2b.1.2.20	Engineered Safety Features Ventilation	-	30	1	1	20	3	-	11	65	65	-	-	201	8	-	-	-	-	8,644	509	-
2b.1.2.21	Essential Service Water	-	24	-	-	-	-	-	4	28	-	-	28	-	-	-	-	-	-	-	438	-
2b.1.2.22	Essential Service Water RCA	-	30	4	5	43	33	-	23	138	138	-	-	433	96	-	-	-	-	23,796	512	-
2b.1.2.23	Fire Protection	-	7,483	-	-	-	-	-	1,122	8,606	-	-	8,606	-	-	-	-	-	-	-	132,210	-
2b.1.2.24	Fire Protection RCA	-	91	4	8	91	33	-	46	274	274	-	-	920	95	-	-	-	-	43,499	1,568	-
2b.1.2.25	Fukushima	-	53	-	-	-	-	-	8	61	-	-	61	-	-	-	-	-	-	-	911	-
2b.1.2.26	HVAC Auxiliary	-	488	20	37	285	271	-	240	1,341	1,341	-	-	2,892	797	-	-	-	-	168,112	7,915	-
2b.1.2.27	HVAC Containment	-	137	17	27	165	239	-	124	709	709	-	-	1,667	700	-	-	-	-	112,281	2,256	-
2b.1.2.28	HVAC Control Room	-	21	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	-	380	-
2b.1.2.29	HVAC Miscellaneous	-	121	-	-	-	-	-	18	139	-	-	139	-	-	-	-	-	-	-	2,271	-
2b.1.2.30	HVAC Miscellaneous RCA	-	15	1	1	12	5	-	7	40	40	-	-	119	15	-	-	-	-	5,784	240	-
2b.1.2.31	HVAC Spent Fuel Pool	-	48	2	5	35	34	-	27	151	151	-	-	350	102	-	-	-	-	20,646	766	-
2b.1.2.32	HVAC Switchgear	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	-	113	-
2b.1.2.33	HVAC Technical Support Center	-	1	-	-	-	-	-	0	1	-	-	1	-	-	-	-	-	-	-	9	-
2b.1.2.34	Ice Condenser	-	225	10	15	101	126	-	106	584	584	-	-	1,024	366	-	-	-	-	65,108	3,908	-
2b.1.2.35	Main Feedwater RCA	-	30	4	8	77	50	-	33	203	203	-	-	777	147	-	-	-	-	40,904	543	-
2b.1.2.36	Main Steam	-	126	-	-	-	-	-	19	145	-	-	145	-	-	-	-	-	-	-	2,314	-
2b.1.2.37	Main Steam RCA	-	58	9	12	105	78	-	53	315	315	-	-	1,064	225	-	-	-	-	57,862	1,004	-
2b.1.2.38	Non-Essential Service Water RCA	-	93	9	11	83	84	-	59	341	341	-	-	841	240	-	-	-	-	49,863	1,554	-
2b.1.2.39	Nuclear Instrumentation	-	30	1	1	3	17	-	12	64	64	-	-	27	49	-	-	-	-	4,235	516	-
2b.1.2.40	Nuclear Sampling	-	8	0	0	1	4	-	3	16	16	-	-	8	11	-	-	-	-	1,003	137	-
2b.1.2.41	Offsite Power	-	44	-	-	-	-	-	7	51	-	-	51	-	-	-	-	-	-	-	751	-
2b.1.2.42	Pipe Clean - Insulated	-	1,958	-	-	-	-	-	294	2,252	-	-	2,252	-	-	-	-	-	-	-	36,415	-
2b.1.2.43	Pipe Clean - Non-Insulated	-	240	-	-	-	-	-	36	276	-	-	276	-	-	-	-	-	-	-	4,913	-
2b.1.2.44	Pipe Contaminated - Insulated	-	1,295	136	144	226	1,869	-	860	4,529	4,529	-	-	2,291	5,421	-	-	-	-	442,353	20,064	-
2b.1.2.45	Pipe Contaminated - Non-insulated	-	177	17	19	27	252	-	116	607	607	-	-	270	733	-	-	-	-	58,006	2,740	-
2b.1.2.46	Plant Air RCA	-	2	0	0	2	1	-	1	7	7	-	-	16	4	-	-	-	-	929	35	-
2b.1.2.47	Primary Water	-	261	20	35	254	263	-	177	1,011	1,011	-	-	2,577	772	-	-	-	-	153,833	4,372	-
2b.1.2.48	Process Drains - Miscellaneous	-	21	5	4	4	56	-	21	112	112	-	-	43	160	-	-	-	-	12,209	364	-
2b.1.2.49	Radiation Monitoring System	-	34	1	1	12	9	-	13	70	70	-	-	126	25	-	-	-	-	6,734	573	-
2b.1.2.50	Radioactive Waste Disposal	-	234	30	37	106	442	-	193	1,043	1,043	-	-	1,073	1,291	-	-	-	-	126,197	3,922	-
2b.1.2.51	Reactor Coolant System	-	75	5	8	29	81	-	45	244	244	-	-	297	239	-	-	-	-	27,268	1,333	-
2b.1.2.52	Refueling	-	90	7	11	45	109	-	59	320	320	-	-	461	322	-	-	-	-	39,143	1,530	-
2b.1.2.53	Residual Heat Removal	-	108	23	23	43	296	-	113	607	607	-	-	437	857	-	-	-	-	73,155	1,921	-
2b.1.2.54	Security	-	73	-	-	-	-	-	11	84	-	-	84	-	-	-	-	-	-	-	1,265	-
2b.1.2.55	Sewage Disposal and Treatment	-	47	-	-	-	-	-	7	54	-	-	54	-	-	-	-	-	-	-	811	-

Table C
DC Cook Unit 2
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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					Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet				
Disposal of Plant Systems(Continued)																						
2b.1.2.56	Spent Fuel Pool	-	86	17	21	38	269	-	99	531	531	-	-	384	787	-	-	-	-	65,908	1,496	-
2b.1.2.57	Station Drainage RCA	-	49	5	8	64	61	-	39	227	227	-	-	650	179	-	-	-	-	37,885	811	-
2b.1.2.58	Supplemental Diesel Generator	-	27	-	-	-	-	-	4	31	-	-	31	-	-	-	-	-	-	-	464	-
2b.1.2	Totals	-	23,389	661	1,028	7,359	7,918	-	7,886	48,240	33,689	-	14,552	74,572	23,080	-	-	-	-	4,508,405	395,763	-
2b.1.3	Scaffolding in support of decommissioning	-	3,137	41	18	212	58	-	837	4,302	4,302	-	-	1,935	171	-	-	-	-	97,912	64,344	-
Decontamination of Site Buildings																						
2b.1.4.1	Reactor	562	382	13	84	68	404	-	501	2,014	2,014	-	-	693	3,763	-	-	-	-	206,017	15,595	-
2b.1.4.2	Auxiliary	377	3,277	93	671	-	3,317	-	1,947	9,682	9,682	-	-	-	31,344	-	-	-	-	1,480,602	55,769	-
2b.1.4.3	Rad Material	63	424	11	78	2	386	-	247	1,212	1,212	-	-	19	3,644	-	-	-	-	172,874	7,539	-
2b.1.4.4	zPost Fuel (RB & SFP)	1,143	2,129	101	677	309	6,404	-	2,863	13,626	13,626	-	-	3,136	38,374	-	-	-	-	1,747,211	48,028	-
2b.1.4	Totals	2,145	6,212	217	1,510	380	10,510	-	5,558	26,533	26,533	-	-	3,848	77,124	-	-	-	-	3,606,704	126,931	-
2b.1.5	Prepare/submit License Termination Plan	-	-	-	-	-	-	238	36	274	274	-	-	-	-	-	-	-	-	-	-	1,753
2b.1.6	Receive NRC approval of termination plan	-	-	-	-	-	-	-	-	a	-	-	-	-	-	-	-	-	-	-	-	-
2b.1	Subtotal Period 2b Activity Costs	3,430	32,875	1,297	2,780	7,950	21,734	238	15,877	86,182	71,630	-	14,552	80,355	109,932	-	-	-	-	8,820,148	589,670	1,753
Period 2b Additional Costs																						
2b.2.1	License Termination Survey Planning	-	-	-	-	-	-	1,152	346	1,498	1,498	-	-	-	-	-	-	-	-	-	-	6,240
2b.2.2	Operational Tools & Equipment	-	-	10	32	357	-	-	59	459	459	-	-	5,880	-	-	-	-	-	147,000	16	-
2b.2.3	Excavation of Underground Services	-	1,213	-	-	-	-	303	349	1,865	1,865	-	-	-	-	-	-	-	-	-	7,004	-
2b.2.4	Absorption Pond Remediation	-	249	47	901	-	6,124	-	1,690	9,011	9,011	-	-	-	31,050	-	-	-	-	2,421,900	678	-
2b.2.5	Contaminated Soil	-	280	121	2,334	-	15,974	-	4,315	23,026	23,026	-	-	-	81,000	-	-	-	-	6,318,000	1,947	-
2b.2.6	Non Fuel Pool Item Disposal	-	31	45	37	-	337	-	102	551	551	-	-	-	-	-	-	28	-	4,322	347	-
2b.2.7	Remedial Action Surveys	-	-	-	-	-	-	2,971	891	3,863	3,863	-	-	-	-	-	-	-	-	-	45,958	-
2b.2	Subtotal Period 2b Additional Costs	-	1,773	223	3,304	357	22,435	4,426	7,753	40,271	40,271	-	-	5,880	112,050	-	-	28	-	8,891,222	55,949	6,240
Period 2b Collateral Costs																						
2b.3.1	Process decommissioning water waste	148	-	96	214	-	327	-	197	982	982	-	-	-	955	-	-	-	-	57,290	186	-
2b.3.2	Process decommissioning chemical flush waste	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2b.3.3	Small tool allowance	-	597	-	-	-	-	-	90	686	686	-	-	-	-	-	-	-	-	-	-	-
2b.3.4	Decommissioning Equipment Disposition	-	-	126	62	656	180	-	165	1,189	1,189	-	-	6,000	529	-	-	-	-	303,608	147	-
2b.3.5	Severance	-	-	-	-	-	-	1,518	228	1,746	1,746	-	-	-	-	-	-	-	-	-	-	-
2b.3.6	Tritium Monitoring	-	-	-	-	-	-	55	8	64	64	-	-	-	-	-	-	-	-	-	-	-
2b.3.7	On-site survey and release of 252.6 tons clean metallic waste	-	-	-	-	-	-	369	37	406	406	-	-	-	-	-	-	-	-	-	-	-
2b.3	Subtotal Period 2b Collateral Costs	148	597	222	276	656	506	1,942	725	5,072	5,072	-	-	6,000	1,484	-	-	-	-	360,898	333	-
Period 2b Period-Dependent Costs																						
2b.4.1	Decon supplies	1,564	-	-	-	-	-	-	391	1,955	1,955	-	-	-	-	-	-	-	-	-	-	-
2b.4.2	Insurance	-	-	-	-	-	-	1,107	111	1,218	1,218	-	-	-	-	-	-	-	-	-	-	-
2b.4.3	Property taxes	-	-	-	-	-	-	414	41	455	455	-	-	-	-	-	-	-	-	-	-	-
2b.4.4	Health physics supplies	-	4,979	-	-	-	-	-	1,245	6,224	6,224	-	-	-	-	-	-	-	-	-	-	-
2b.4.5	Heavy equipment rental	-	5,706	-	-	-	-	-	856	6,561	6,561	-	-	-	-	-	-	-	-	-	-	-
2b.4.6	Disposal of DAW generated	-	-	124	46	-	314	-	98	581	581	-	-	-	6,460	-	-	-	-	129,208	211	-
2b.4.7	Plant energy budget	-	-	-	-	-	-	3,235	485	3,720	3,720	-	-	-	-	-	-	-	-	-	-	-
2b.4.8	NRC Fees	-	-	-	-	-	-	957	96	1,053	1,053	-	-	-	-	-	-	-	-	-	-	-
2b.4.9	Emergency Planning Fees	-	-	-	-	-	-	143	14	157	-	157	-	-	-	-	-	-	-	-	-	-
2b.4.10	Site O&M Cost	-	-	-	-	-	-	1,594	239	1,833	1,833	-	-	-	-	-	-	-	-	-	-	-
2b.4.11	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	948	142	1,090	1,090	-	-	-	-	-	-	-	-	-	-	-
2b.4.12	ISFSI Operating Costs	-	-	-	-	-	-	126	19	145	-	145	-	-	-	-	-	-	-	-	-	-
2b.4.13	Corporate A&G Cost	-	-	-	-	-	-	6,047	907	6,954	6,954	-	-	-	-	-	-	-	-	-	-	-
2b.4.14	Security Staff Cost	-	-	-	-	-	-	10,788	1,618	12,406	12,406	-	-	-	-	-	-	-	-	-	-	190,850
2b.4.15	DOC Staff Cost	-	-	-	-	-	-	29,619	4,443	34,062	34,062	-	-	-	-	-	-	-	-	-	-	308,119
2b.4.16	Utility Staff Cost	-	-	-	-	-	-	47,411	7,112	54,523	54,523	-	-	-	-	-	-	-	-	-	-	547,257
2b.4	Subtotal Period 2b Period-Dependent Costs	1,564	10,685	124	46	-	314	102,388	17,817	132,937	132,635	302	-	-	6,460	-	-	-	-	129,208	211	1,046,226
2b.0	TOTAL PERIOD 2b COST	5,142	45,930	1,866	6,406	8,964	44,989	108,994	42,171	264,462	249,609	302	14,552	92,235	229,926	-	-	28	-	18,201,470	646,163	1,054,219

Table C
DC Cook Unit 2
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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					Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet				
PERIOD 2f - License Termination																						
Period 2f Direct Decommissioning Activities																						
2f.1.1	ORISE confirmatory survey	-	-	-	-	-	-	176	53	228	228	-	-	-	-	-	-	-	-	-	-	-
2f.1.2	Terminate license	-	-	-	-	-	-	-	-	a	-	-	-	-	-	-	-	-	-	-	-	-
2f.1	Subtotal Period 2f Activity Costs	-	-	-	-	-	-	176	53	228	228	-	-	-	-	-	-	-	-	-	-	-
Period 2f Additional Costs																						
2f.2.1	License Termination Survey	-	-	-	-	-	-	17,713	5,314	23,027	23,027	-	-	-	-	-	-	-	-	-	290,742	3,120
2f.2	Subtotal Period 2f Additional Costs	-	-	-	-	-	-	17,713	5,314	23,027	23,027	-	-	-	-	-	-	-	-	-	290,742	3,120
Period 2f Collateral Costs																						
2f.3.1	DOC staff relocation expenses	-	-	-	-	-	-	1,339	201	1,540	1,540	-	-	-	-	-	-	-	-	-	-	-
2f.3.2	Severance	-	-	-	-	-	-	8,028	1,204	9,233	9,233	-	-	-	-	-	-	-	-	-	-	-
2f.3.3	Tritium Monitoring	-	-	-	-	-	-	19	3	22	22	-	-	-	-	-	-	-	-	-	-	-
2f.3	Subtotal Period 2f Collateral Costs	-	-	-	-	-	-	9,386	1,408	10,794	10,794	-	-	-	-	-	-	-	-	-	-	-
Period 2f Period-Dependent Costs																						
2f.4.1	Insurance	-	-	-	-	-	-	377	38	415	415	-	-	-	-	-	-	-	-	-	-	-
2f.4.2	Property taxes	-	-	-	-	-	-	141	14	155	155	-	-	-	-	-	-	-	-	-	-	-
2f.4.3	Health physics supplies	-	1,372	-	-	-	-	-	343	1,715	1,715	-	-	-	-	-	-	-	-	-	-	-
2f.4.4	Disposal of DAW generated	-	-	6	2	-	16	-	5	30	30	-	-	-	337	-	-	-	-	6,734	11	-
2f.4.5	Plant energy budget	-	-	-	-	-	-	294	44	338	338	-	-	-	-	-	-	-	-	-	-	-
2f.4.6	NRC Fees	-	-	-	-	-	-	313	31	344	344	-	-	-	-	-	-	-	-	-	-	-
2f.4.7	Emergency Planning Fees	-	-	-	-	-	-	49	5	53	-	53	-	-	-	-	-	-	-	-	-	-
2f.4.8	Site O&M Cost	-	-	-	-	-	-	175	26	201	201	-	-	-	-	-	-	-	-	-	-	-
2f.4.9	ISFSI Operating Costs	-	-	-	-	-	-	43	6	49	-	49	-	-	-	-	-	-	-	-	-	-
2f.4.10	Corporate A&G Cost	-	-	-	-	-	-	662	99	762	762	-	-	-	-	-	-	-	-	-	-	-
2f.4.11	Security Staff Cost	-	-	-	-	-	-	3,676	551	4,227	4,227	-	-	-	-	-	-	-	-	-	-	65,036
2f.4.12	DOC Staff Cost	-	-	-	-	-	-	4,510	677	5,187	5,187	-	-	-	-	-	-	-	-	-	-	46,622
2f.4.13	Utility Staff Cost	-	-	-	-	-	-	5,453	818	6,271	5,669	602	-	-	-	-	-	-	-	-	-	59,942
2f.4	Subtotal Period 2f Period-Dependent Costs	-	1,372	6	2	-	16	15,693	2,658	19,748	19,043	705	-	-	337	-	-	-	-	6,734	11	171,600
2f.0	TOTAL PERIOD 2f COST	-	1,372	6	2	-	16	42,968	9,433	53,798	53,093	705	-	-	337	-	-	-	-	6,734	290,753	174,720
PERIOD 2 TOTALS		6,263	78,627	24,629	13,419	12,402	92,445	333,307	116,454	677,545	576,576	84,448	16,520	137,168	291,417	963	813	2,061	25,451,300	1,185,603	2,285,282	
PERIOD 3b - Site Restoration																						
Period 3b Direct Decommissioning Activities																						
Demolition of Remaining Site Buildings																						
3b.1.1.1	Reactor	-	2,336	-	-	-	-	-	350	2,687	-	-	2,687	-	-	-	-	-	-	-	22,918	-
3b.1.1.2	Additional Structures 2018	-	49	-	-	-	-	-	7	56	-	-	56	-	-	-	-	-	-	-	471	-
3b.1.1.3	Auxiliary	-	14,665	-	-	-	-	-	2,200	16,865	-	-	16,865	-	-	-	-	-	-	-	145,830	-
3b.1.1.4	Blast Paint Shop	-	23	-	-	-	-	-	3	26	-	-	26	-	-	-	-	-	-	-	302	-
3b.1.1.5	FLEX	-	70	-	-	-	-	-	11	81	-	-	81	-	-	-	-	-	-	-	776	-
3b.1.1.6	Office	-	232	-	-	-	-	-	35	266	-	-	266	-	-	-	-	-	-	-	2,625	-
3b.1.1.7	RB Auxiliary	-	863	-	-	-	-	-	129	992	-	-	992	-	-	-	-	-	-	-	8,580	-
3b.1.1.8	Rad Material	-	1,573	-	-	-	-	-	236	1,809	-	-	1,809	-	-	-	-	-	-	-	16,567	-
3b.1.1.9	Screenhouse Unit 2	-	445	-	-	-	-	-	67	512	-	-	512	-	-	-	-	-	-	-	3,725	-
3b.1.1.10	Service	-	485	-	-	-	-	-	73	558	-	-	558	-	-	-	-	-	-	-	4,284	-
3b.1.1.11	Sewage Treatment	-	87	-	-	-	-	-	13	100	-	-	100	-	-	-	-	-	-	-	1,006	-
3b.1.1.12	Site Rail Fences Pavement	-	347	-	-	-	-	-	52	399	-	-	399	-	-	-	-	-	-	-	3,444	-
3b.1.1.13	TSCNAB	-	148	-	-	-	-	-	22	171	-	-	171	-	-	-	-	-	-	-	1,520	-
3b.1.1.14	TSOC	-	220	-	-	-	-	-	33	252	-	-	252	-	-	-	-	-	-	-	2,650	-
3b.1.1.15	Tank Pads and Pipe Tunnels	-	98	-	-	-	-	-	15	113	-	-	113	-	-	-	-	-	-	-	937	-
3b.1.1.16	Turbine	-	4,000	-	-	-	-	-	600	4,600	-	-	4,600	-	-	-	-	-	-	-	38,327	-
3b.1.1.17	Warehouses	-	3,258	-	-	-	-	-	489	3,746	-	-	3,746	-	-	-	-	-	-	-	42,061	-
3b.1.1	Totals	-	28,899	-	-	-	-	-	4,335	33,234	-	-	33,234	-	-	-	-	-	-	-	296,023	-

Table C
DC Cook Unit 2
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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					Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours	
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	GTCC Cu. Feet				
Site Closeout Activities																							
3b.1.2	BackFill Site	-	1,851	-	-	-	-	-	278	2,128	-	-	2,128	-	-	-	-	-	-	-	-	2,654	-
3b.1.3	Grade & landscape site	-	758	-	-	-	-	-	114	872	-	-	872	-	-	-	-	-	-	-	-	1,599	-
3b.1.4	Final report to NRC	-	-	-	-	-	-	91	14	104	104	-	-	-	-	-	-	-	-	-	-	-	668
3b.1	Subtotal Period 3b Activity Costs	-	31,508	-	-	-	-	91	4,740	36,338	104	-	36,234	-	-	-	-	-	-	-	-	300,276	668
Period 3b Additional Costs																							
3b.2.1	Concrete Crushing	-	1,369	-	-	-	-	11	207	1,586	-	-	1,586	-	-	-	-	-	-	-	-	5,919	-
3b.2.2	Cofferdam Installation and Removal	-	442	-	-	-	-	-	66	508	-	-	508	-	-	-	-	-	-	-	-	3,552	-
3b.2.3	Construction Debris	-	-	-	-	-	-	1,030	155	1,185	-	-	1,185	-	-	-	-	-	-	-	-	-	-
3b.2	Subtotal Period 3b Additional Costs	-	1,810	-	-	-	-	1,041	428	3,279	-	-	3,279	-	-	-	-	-	-	-	-	9,471	-
Period 3b Collateral Costs																							
3b.3.1	Small tool allowance	-	315	-	-	-	-	-	47	363	-	-	363	-	-	-	-	-	-	-	-	-	-
3b.3.2	Tritium Monitoring	-	-	-	-	-	-	65	10	75	-	75	-	-	-	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	-	315	-	-	-	-	65	57	438	-	75	363	-	-	-	-	-	-	-	-	-	-
Period 3b Period-Dependent Costs																							
3b.4.1	Insurance	-	-	-	-	-	-	655	65	720	-	720	-	-	-	-	-	-	-	-	-	-	-
3b.4.2	Property taxes	-	-	-	-	-	-	510	51	561	-	561	-	-	-	-	-	-	-	-	-	-	-
3b.4.3	Heavy equipment rental	-	8,886	-	-	-	-	-	1,333	10,219	-	-	10,219	-	-	-	-	-	-	-	-	-	-
3b.4.4	Plant energy budget	-	-	-	-	-	-	510	76	586	-	586	-	-	-	-	-	-	-	-	-	-	-
3b.4.5	NRC ISFSI Fees	-	-	-	-	-	-	345	34	379	-	379	-	-	-	-	-	-	-	-	-	-	-
3b.4.6	Emergency Planning Fees	-	-	-	-	-	-	169	17	186	-	186	-	-	-	-	-	-	-	-	-	-	-
3b.4.7	Site O&M Cost	-	-	-	-	-	-	267	40	307	-	307	-	-	-	-	-	-	-	-	-	-	-
3b.4.8	ISFSI Operating Costs	-	-	-	-	-	-	149	22	171	-	171	-	-	-	-	-	-	-	-	-	-	-
3b.4.9	Corporate A&G Cost	-	-	-	-	-	-	1,014	152	1,166	-	1,166	-	-	-	-	-	-	-	-	-	-	-
3b.4.10	Security Staff Cost	-	-	-	-	-	-	5,047	757	5,804	-	-	5,804	-	-	-	-	-	-	-	-	-	86,984
3b.4.11	DOC Staff Cost	-	-	-	-	-	-	14,364	2,155	16,519	-	-	16,519	-	-	-	-	-	-	-	-	-	144,067
3b.4.12	Utility Staff Cost	-	-	-	-	-	-	8,292	1,244	9,536	0	2,098	7,438	-	-	-	-	-	-	-	-	-	91,741
3b.4	Subtotal Period 3b Period-Dependent Costs	-	8,886	-	-	-	-	31,320	5,947	46,153	0	6,174	39,979	-	-	0	-	-	-	-	-	-	322,792
3b.0	TOTAL PERIOD 3b COST	-	42,519	-	-	-	-	32,517	11,172	86,207	104	6,249	79,854	-	-	-	-	-	-	-	-	309,747	323,460
PERIOD 3 TOTALS		-	42,519	-	-	-	-	32,517	11,172	86,207	104	6,249	79,854	-	-	-	-	-	-	-	-	309,747	323,460
TOTAL COST TO DECOMMISSION		10,284	125,905	24,749	13,823	12,402	95,557	647,605	172,608	1,102,934	750,031	255,810	97,094	137,168	298,402	1,841	813	2,061	25,649,940	1,518,527	3,553,679		

TOTAL COST TO DECOMMISSION WITH 18.55% CONTINGENCY:	\$1,102,934	thousands of 2021 dollars
TOTAL NRC LICENSE TERMINATION COST IS 68% OR:	\$750,031	thousands of 2021 dollars
SPENT FUEL MANAGEMENT COST IS 23.19% OR:	\$255,809	thousands of 2021 dollars
NON-NUCLEAR DEMOLITION COST IS 8.8% OR:	\$97,094	thousands of 2021 dollars
TOTAL LOW-LEVEL RADIOACTIVE WASTE VOLUME BURIED (EXCLUDING GTCC):	301,057	Cubic Feet
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	2,061	Cubic Feet
TOTAL SCRAP METAL REMOVED:	58,035	Tons
TOTAL CRAFT LABOR REQUIREMENTS:	1,518,527	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

*D. C. Cook Nuclear Power Plant
Decommissioning Cost Study*

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APPENDIX D
ISFSI STORAGE ONLY

Table D
DC Cook Nuclear Power Plant
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours	
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet				
PERIOD 3c - Fuel Storage Operations/Shipping																						
Period 3c Direct Decommissioning Activities																						
Period 3c Collateral Costs																						
3c.3.1	Tritium Monitoring	-	-	-	-	-	-	50	8	58	-	58	-	-	-	-	-	-	-	-	-	-
3c.3	Subtotal Period 3c Collateral Costs	-	-	-	-	-	-	50	8	58	-	58	-	-	-	-	-	-	-	-	-	-
Period 3c Period-Dependent Costs																						
3c.4.1	Insurance	-	-	-	-	-	-	501	50	551	-	551	-	-	-	-	-	-	-	-	-	-
3c.4.2	Property taxes	-	-	-	-	-	-	3	0	3	-	3	-	-	-	-	-	-	-	-	-	-
3c.4.3	Plant energy budget	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3c.4.4	NRC ISFSI Fees	-	-	-	-	-	-	264	26	290	-	290	-	-	-	-	-	-	-	-	-	-
3c.4.5	Emergency Planning Fees	-	-	-	-	-	-	129	13	142	-	142	-	-	-	-	-	-	-	-	-	-
3c.4.6	Site O&M Cost	-	-	-	-	-	-	41	6	47	-	47	-	-	-	-	-	-	-	-	-	-
3c.4.7	ISFSI Operating Costs	-	-	-	-	-	-	114	17	131	-	131	-	-	-	-	-	-	-	-	-	-
3c.4.8	Corporate A&G Cost	-	-	-	-	-	-	155	23	178	-	178	-	-	-	-	-	-	-	-	-	-
3c.4.9	Security Staff Cost	-	-	-	-	-	-	3,862	579	4,441	-	4,441	-	-	-	-	-	-	-	-	-	66,560
3c.4.10	Utility Staff Cost	-	-	-	-	-	-	1,396	209	1,605	-	1,605	-	-	-	-	-	-	-	-	-	14,040
3c.4	Subtotal Period 3c Period-Dependent Costs	-	-	-	-	-	-	6,464	925	7,389	-	7,389	-	-	-	-	-	-	-	-	-	80,600
3c.0	TOTAL PERIOD 3c COST	-	-	-	-	-	-	6,514	932	7,446	-	7,446	-	-	-	-	-	-	-	-	-	80,600

*D. C. Cook Nuclear Power Plant
Decommissioning Cost Study*

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APPENDIX E
ISFSI LICENSE TERMINATION

Table E
DC Cook Nuclear Power Plant
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours	
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet				
PERIOD 3e - ISFSI Decontamination																						
Period 3e Direct Decommissioning Activities																						
No direct activities in this period																						
3e.1	Subtotal Period 3e Activity Costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Period 3e Additional Costs																						
3e.2.1	License Termination ISFSI	-	351	298	1,760	-	9,592	4,329	4,083	20,413	20,413	-	-	-	71,319	-	-	-	-	3,782,360	28,085	2,537
3e.2	Subtotal Period 3e Additional Costs	-	351	298	1,760	-	9,592	4,329	4,083	20,413	20,413	-	-	-	71,319	-	-	-	-	3,782,360	28,085	2,537
Period 3e Collateral Costs																						
3e.3.1	Tritium Monitoring	-	-	-	-	-	-	25	6	31	31	-	-	-	-	-	-	-	-	-	-	
3e.3	Subtotal Period 3e Collateral Costs	-	-	-	-	-	-	25	6	31	31	-	-	-	-	-	-	-	-	-	-	
Period 3e Period-Dependent Costs																						
3e.4.1	Insurance	-	-	-	-	-	-	219	55	274	274	-	-	-	-	-	-	-	-	-	-	
3e.4.2	Property taxes	-	-	-	-	-	-	1	0	2	2	-	-	-	-	-	-	-	-	-	-	
3e.4.3	Plant energy budget	-	-	-	-	-	-	19	5	24	24	-	-	-	-	-	-	-	-	-	-	
3e.4.4	NRC ISFSI Fees	-	-	-	-	-	-	130	13	143	-	143	-	-	-	-	-	-	-	-	-	
3e.4.5	Site O&M Cost	-	-	-	-	-	-	16	4	21	21	-	-	-	-	-	-	-	-	-	-	
3e.4.6	Corporate A&G Cost	-	-	-	-	-	-	62	16	78	78	-	-	-	-	-	-	-	-	-	-	
3e.4.7	Security Staff Cost	-	-	-	-	-	-	1,316	329	1,645	1,645	-	-	-	-	-	-	-	-	-	32,824	
3e.4.8	Utility Staff Cost	-	-	-	-	-	-	547	137	683	683	-	-	-	-	-	-	-	-	-	5,642	
3e.4	Subtotal Period 3e Period-Dependent Costs	-	-	-	-	-	-	2,311	558	2,870	2,727	143	-	-	-	-	-	-	-	-	38,466	
3e.0	TOTAL PERIOD 3e COST	-	351	298	1,760	-	9,592	6,665	4,647	23,313	23,170	143	-	-	71,319	-	-	-	-	3,782,360	28,085	41,003

*D. C. Cook Nuclear Power Plant
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APPENDIX F
ISFSI SITE RESTORATION

Table F
DC Cook Nuclear Power Plant
DECON Decommissioning Cost Estimate
 (Thousands of 2021 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours	
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet				
PERIOD 3f - ISFSI Site Restoration																						
Period 3f Direct Decommissioning Activities																						
No direct activities in this period																						
3f.1	Subtotal Period 3f Activity Costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Period 3f Additional Costs																						
3f.2.1	Demolition and Site Restoration ISFSI	-	7,317	-	-	-	-	941	1,239	9,497	-	-	9,497	-	-	-	-	-	-	-	87,657	160
3f.2	Subtotal Period 3f Additional Costs	-	7,317	-	-	-	-	941	1,239	9,497	-	-	9,497	-	-	-	-	-	-	-	87,657	160
Period 3f Collateral Costs																						
3f.3.1	Small tool allowance	-	93	-	-	-	-	-	14	107	-	-	107	-	-	-	-	-	-	-	-	-
3f.3.2	Tritium Monitoring	-	-	-	-	-	-	8	1	9	-	-	9	-	-	-	-	-	-	-	-	-
3f.3	Subtotal Period 3f Collateral Costs	-	93	-	-	-	-	8	15	117	-	-	117	-	-	-	-	-	-	-	-	-
Period 3f Period-Dependent Costs																						
3f.4.1	Insurance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3f.4.2	Property taxes	-	-	-	-	-	-	0	0	1	-	-	1	-	-	-	-	-	-	-	-	-
3f.4.3	Heavy equipment rental	-	113	-	-	-	-	-	17	130	-	-	130	-	-	-	-	-	-	-	-	-
3f.4.4	Plant energy budget	-	-	-	-	-	-	6	1	7	-	-	7	-	-	-	-	-	-	-	-	-
3f.4.5	Site O&M Cost	-	-	-	-	-	-	4	1	5	-	-	5	-	-	-	-	-	-	-	-	-
3f.4.6	Corporate A&G Cost	-	-	-	-	-	-	17	3	20	-	-	20	-	-	-	-	-	-	-	-	-
3f.4.7	Utility Staff Cost	-	-	-	-	-	-	146	22	168	-	-	168	-	-	-	-	-	-	-	-	1,539
3f.4	Subtotal Period 3f Period-Dependent Costs	-	113	-	-	-	-	175	43	331	-	-	331	-	-	-	-	-	-	-	-	1,539
3f.0	TOTAL PERIOD 3f COST	-	7,524	-	-	-	-	1,124	1,297	9,945	-	-	9,945	-	-	-	-	-	-	-	87,657	1,699

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APPENDIX G
DETAILED ASSUMPTIONS

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APPENDIX G
DETAILED ASSUMPTIONS

APPENDIX G DETAILED ASSUMPTIONS

Following is a list of assumptions developed by TLG in completing this study. These assumptions are based on the most current decommissioning methodologies and site-specific considerations.

1. Decommissioning costs are reported in the year of projected expenditure; however, the values are provided in 2021 dollars. Costs are not inflated, escalated, or discounted over the periods of performance.
2. The plant inventory, the basis for the decontamination and dismantling requirements and cost, and the decommissioning waste streams, were developed for this analysis. The inventory (pumps, valves, piping, electrical cable tray, etc.) of components for each plant system on site was developed from the site's data base, reports from which were provided to TLG by AEP. TLG personnel assigned the data into the TLG estimating categories. Plant inventory is based upon that developed for the 2018 cost study.
3. The building inventory (cubic yards of concrete, square foot of floor area, etc.) of components for each structure on site included in the cost analysis was extracted from D. C. Cook drawings, as well as other information provided by AEP. Building inventory is based upon that developed for the 2018 cost study.
4. The utility staff assumed for the 2021 cost study is to be the same as was in the 2018 cost study.
5. Subcontractor craft labor rates were supplied by IMPC. These rates are provided in the Master Services Agreement Contract Number 01598364.
6. Staff costs are based upon average salary information provided by AEP. Overhead costs are included for site and corporate support.
7. Security, while reduced from operating levels, is maintained throughout the decommissioning for access control, material control, and to safeguard the spent fuel (in accordance with the requirements of 10 CFR Part 37, Part 72, and Part 73). Security costs include provisions for recurring expenses. Security guards are assumed to be contract staff.

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8. Activity labor costs do not include any allowance for delays between activities, nor is there any cost allowance for craft labor retained on-site while waiting for work to become available.
9. AEP will hire a Decommissioning Operations Contractor (DOC) to manage the decommissioning. The utility, as licensee, will provide site security, radiological health and safety, quality assurance and overall site administration during the decommissioning and demolition phases.
10. The professional personnel used for the planning and preparation activities will be paid the CONUS per diem at the rate of \$160.00/day. Since the skilled laborers are being supplied by the local union hall, they will not be paid per diem.
11. The cost for Utility personnel assisting the DOC to develop decommissioning activity specifications is included in the Utility Staff costs.
12. Severance costs for utility staff personnel separated at Unit 1 and Unit 2 shutdown have been included in the estimate based on the current IMPC policy. Severance costs continue to be incurred during subsequent staff reductions and are included, as they are assumed to occur, in the estimate.
13. Health Physics technicians used during vessel and internal removal will be supplied by the Utility Staff.
14. The DOC staff cost, including overhead and profit, were determined by TLG.
15. Transportation costs are based on actual mileage from D. C. Cook to each disposal or processing facility utilized in the estimate.
16. Class B & C radioactive waste base disposal costs are based on the rates provided in the USA Agreement with the WCS facility in Andrews, TX.
17. Class A waste will be disposed of at the *EnergySolutions* facility in Utah or the *EnergySolutions* processing facility in Tennessee. Waste is assumed to be transported to the lowest cost facility for which it qualifies. Further details on these processes are presented in Section 3.4.6 and Section 5 of this report.
18. Clean waste is assumed to be disposed of at a local landfill at a cost of \$81.00 per ton.

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19. It is assumed, for purposes of this estimate, 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 and is not included in the estimate.
20. The concrete debris resulting from building demolition activities is crushed on site to reduce the size of the debris. The resulting crushed concrete is used to backfill below grade voids. The rebar removed from the concrete crushing process is disposed of as scrap steel in a similar fashion as other scrap metal as discussed previously.
21. It is assumed that all radioactive waste generated during operations and stored on-site will be disposed of prior to shutdown. The cost of disposal of this material is considered an operating expense and is assumed not to be a decommissioning cost.
22. Greater than Class C waste (GTCC) will be removed from the reactor vessel, segmented and packaged in containers of similar size and shape to the spent fuel assemblies. The containers will be transferred to the ISFSI. The additional containers are assumed to be shipped offsite with the spent fuel. Seven containers of GTCC will be filled per unit resulting in a total of 14 containers for both units.
23. The costs of all required safety analyses and safety measures for the protection of the general public, the environment, and decommissioning workers are included in the cost estimates.
24. All post shutdown costs necessitated by the presence of stored spent fuel are presented separately in Appendices D, E, and F.
25. It is assumed that Unit 1 will shutdown in October, 2034 and that Unit 2 will remain operational until December 2037.
26. On-site dry storage will utilize the Holtec Vertical Concrete Casks (VCC) and Multi-Purpose Canister (MPC) system. Each MPC is designed to store and transport 32 spent fuel assemblies each. Separate overpacks, provided by DOE, will be used for transportation and disposal.
27. It is assumed that spent fuel will cool for a minimum of 3.25 years in the spent fuel pool prior to being transferred to the ISFSI.
28. Only the costs for the expanded storage pad, canister and overpacks projected to be purchased after shutdown are included in this study as a spent fuel

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storage expense. Any canister and overpacks required during operations, in order to maintain full core discharge capabilities, are assumed to be an operations expense. The cost per canister and storage overpack is estimated to be \$2,927,925 including closure services.

29. This estimate is based on AEP's current spent fuel management plan. This plan assumes indefinite on-site storage for the D.C. Cook spent fuel.
30. Unit 1 decommissioning is assumed to commence immediately upon shutdown.
31. The Unit 1 and Unit 2 reactor vessel and internals are considered identical.
32. Curie contents of the vessel and internals at final shutdown were derived from those listed in NUREG/CR-3474. Actual estimates were derived from the curie/gram values contained therein and adjusted for the different mass of D. C. Cook components, projected operating life, and different periods of decay. Additional short-lived isotopes are derived from NUREG/CR-0130 and NUREG/CR-0672 and benchmarked to the long-lived values from NUREG/CR-3474.
33. A nominal property tax (land only) during the decommissioning period is considered in these estimates. A land only assessment cost of \$374,280/year is assumed through site restoration. An estimated cost of \$3,000 per year is assumed for the ISFSI only period.
34. FEMA fees associated with emergency planning are assumed to continue for approximately 18 months following the cessation of Unit 2 operations. At this time, the fees are discontinued, 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 remain at operating levels until all fuel has been transferred from the pool to the ISFSI. These fees are then eliminated. Local emergency planning fees continue until all fuel is removed from the site.
35. Costs for continuing coverage (nuclear liability and property insurance) following cessation of plant operations and during decommissioning are included and are based upon current operating premiums.
36. No PCBs will be on-site at shutdown.

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37. It is assumed that some remaining asbestos insulation will be on site at shutdown and will need to be remediated during decommissioning.
38. Clean building walls and foundations more than three feet below grade may be left in place if there are no voids.
39. The decommissioning will be performed under the current regulations. These regulations require a Post-Shutdown Decommissioning Activities Report (PSDAR) to be submitted prior to or within two years of shutdown. In addition, certificates for permanent cessation of operations and permanent removal of fuel from the vessel must be submitted to the NRC 90 days after the PSDAR submittal. Major decommissioning activities that meet the criteria of 10 CFR Part 50.59, may be performed provided NRC agrees with the PSDAR.
40. The estimate includes an allowance for the removal and disposal of contaminated soil from the absorption pond. In addition, certain areas of the critical dunes (as designated by Michigan regulations) and the Unit 1 and 2 tank yards contain low levels of 137Cs. The contaminated soil, approximately 6,000 cubic yards, associated with these areas will be removed and disposed of as part of the decommissioning.
41. The current tritium well monitoring program will continue through the decommissioning process. While at some point in the future, approximately 60 years, this program will be discontinued, a cost is included in the annual ISFSI storage cost.
42. A significant amount of the below grade piping is located around the perimeter of the power block. The estimate includes a cost to excavate this area to an average depth of six feet so as to expose and remove the piping, duct bank, conduit, and any near-surface grounding grid.