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Decommissioning Cost Estimate Update

for

Helion Fusion Power Plant

ES Project No. 164118

Prepared for:

Helion

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Acronyms and Abbreviations

AIF	Atomic Industrial Forum
ALARA	As Low as Reasonably Achievable
BCY/LCY	Bank/Loose Cubic Yards
BPE	Borated Polyethylene
CFR	Code of Federal Regulations
D&D	Decontamination & Decommissioning/Decommissioning & Dismantlement
DAW	Dry Active Waste
DCE	Decommissioning Cost Estimate
DCGL	Derived Concentration Guideline Limits
DOC/DGC	Decommissioning Operations Contractor/ Decommissioning General Contractor
DOE/DOL	U.S. Department of Energy/Labor
ES	Energy*Solutions* LLC
FGx	Fusion Generator Vessel
FSS	Final Status Survey
GTCC	Greater Than Class C Waste
HP/RP	Health Physics/Radiological Protection
HFPP	Helion Fusion Power Plant
IFB	Invitation For Bid
LLRW	Low-Level Radioactive Waste
LTP/LTA	License Termination Plan/Application
MARSAME	Multi-Agency Radiation Survey & Assessment of Materials & Equipment Manual
MARSSIM	Multi-Agency Radiation Survey & Site Investigation Manual
mr/mrem	milli-rem (1/1000 of Rem exposure measure)
Mtce & Ops	Maintenance and Operations
MWt/MWe	Megawatts Thermal / Megawatts Electric
NEIMA	Nuclear Energy Innovation and Modernization Act
NRC	Nuclear Regulatory Commission
ORISE	Oak Ridge Institute for Science and Education
PCB	Polychlorinated Biphenyl
P,T&D	Packaging, Transportation & Disposal (Waste)
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
R&D	Research and Development Operations
RFP/RFQ	Request for Proposal/Request for Quotation
SAFSTOR	Safe Store – a delayed decommissioning alternative / Dormancy
SAR	Safety Analysis Report
WAC	Waste Acceptance Criteria
WBS	Work Breakdown Structure
WCS	Waste Control Specialists LLC
UCF	Unit Cost Factor

1.0 EXECUTIVE SUMMARY

This report updates the Decommissioning Cost Estimate (DCE) for the Helion Fusion Power Plant, hereafter (HFPP), located in Washington state, owned and operated by Helion. The estimate assesses expected costs for decommissioning the HFPP after permanent cessation of power operations. The HFPP is expected to be an operational power plant that will also be actively engaged in R&D activities during the operation of the plant and for a period of approximately ten years following cessation of power operations. The update addresses current plant configurations, expected radiological waste quantities and disposal pathways, the Advance Act classification of fusion machines with particle accelerators, and a revised decommissioning timeline.

The estimate scope includes costs associated with an R&D period and potential brief dormancy after power operations are completed, License Termination including byproduct and RadWaste disposal, and Site Restoration to the greenfield conditions established by Helion in accordance with relevant regulatory standards. The estimate anticipates a decommissioning process following NUREG-1757 Vol 1, Rev. 2 Decommissioning Process for Materials Licensees, (Ref. No. 1); which classifies the HFPP as a Group Four decommissioning effort. While the estimate aligns with current decommissioning estimating practices outlined in AIF/NESP-036, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates" (Ref. No. 2), it recognizes that decommissioning a fusion power plant will be markedly different from the conditions encountered in power reactor decommissioning, particularly with respect to radiological conditions which are expected to be less severe. The Association for the Advancement of Cost Engineering recommended practice for Basis of Estimates 34r-05, (Ref. No. 3) provides a professional standard for estimating formats and processes

The DCE is based on the regulatory requirements that are expected to be applied to the decommissioning of fusion power facilities using proven decommissioning technologies**.** It is based on an execution approach employing a third-party Decommissioning Operations Contractor (DOC) and subcontractors providing decommissioning planning, engineering, procurement and decontamination and dismantlement services including waste disposal. In addition to decommissioning oversight as the Licensee, the execution approach assigns Helion with continued operational support including program management, licensing and regulatory relations, radiation protection and site security.

The cost estimate summary results are provided below in Table 1-1. Dormancy costs address up to a 10-year period following the cessation of power operations during which R&D activities are expected to be ongoing and during which regulatory oversight is maintained but prior to the start of active dismantlement. License Termination costs reflect the work required to terminate the NRC license and dispose of byproduct material and radiological waste. Site Restoration costs correspond to non-NRC license termination activities such as clean building demolition, disposal of non-contaminated materials and site grading.

TABLE 1-1: Summary of Estimated Project Costs

Helion Fusion Power Plant
Decommissioning Cost Estimate Summary
(thousands of 2023 US dollars w/ escalation to 2025 - rounded)

Dormancy	License Termination (Including Waste)	Site Restoration	Total
$3,100	$20,400	$8,100	$31,600

Inventory quantities, Energy*Solutions'* proprietary Unit Cost Factors (UCFs), industry references, historical data, and actual costs from recently completed nuclear decommissioning projects were factored to generate expected costs.

The estimated waste quantities for byproduct materials including material that may be disposed of as LLRW and clean building demolition debris are based on preliminary plant systems and buildings inventory provided by Helion. Table 1-2 provides a summary listing of expected byproduct, LLRW and clean waste quantities.

TABLE 1-2: Estimated Material Disposal Quantities, by Weight

Byproduct & Waste Class	Estimated Quantity (Lbs)	Tons
Class A	200,000	100
RCRA Subtitle C	15,000,000	7,500
Class B & C	0	0
GTCC	0	0
Clean/Recycled Waste	104,000,000	52,000

Expected man-hour requirements, material and equipment costs, subcontractor and DOC costs, and costs for licensee personnel are factored from Energy*Solutions'* historical data from recently completed decontamination and decommissioning projects, and from publicly available industry records and information. Estimated labor rates are developed from DOL labor wage determinations for Washington state, R. S. Means cost database information, and industry pay scales for industrial construction.

The HFPP decommissioning project timeline reflects cessation of operations at the end of the plant's useful life, preparations for up to a 10-year period following power operations allowing for continued R&D and decay of relatively short half-life isotopes, and delayed D&D. Currently, NRC regulations require decommissioning to be completed within 60 years of cessation of operations.

The estimate is based on a decommissioning operations contractor executing D&D with oversight by Helion who maintains custody of the NRC license throughout the evolution. Decommissioning and dismantlement are based on general industry practices for demolition and disposal of radiologically contaminated facilities without attempting decontamination techniques. The method generally results in lower overall costs because decontamination efforts are protracted and often require repeated and extended attempts to reduce contamination to free-release levels.

2.0 INTRODUCTION

2.1 Study Objective

This report presents a Decommissioning Cost Estimate Study for the Helion Fusion Power Plant owned and operated by Helion and located in Washington state. The study addresses: (1) the decommissioning and dismantlement of the HFPP to the extent required to terminate the plant's license, (2) disposal of byproduct material and radiological waste, and (3) demolition of uncontaminated structures and restoration of the site to a 'greenfield' status.

2.2 Regulatory Framework

On January 3, 2018, the United States Congress passed the Nuclear Energy Innovation and Modernization Act (NEIMA) that requires the NRC to develop and implement the necessary regulatory frameworks for fusion machines by December 31, 2027. Hence, the NRC is currently working to develop a clear and predictable regulatory framework for fusion machines.

Further, The Advance Act, (Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy Act of 2024) signed into law on July 9, 2024, adds clarity to the direction that future regulations are required to follow. The Advance Act amendments to the Atomic Energy Act added activated materials created by fusion machines to the byproduct material definition in the Atomic Energy Act Section 11e.(3)(b), which is a classification previously established for particle accelerators. These materials may be disposed of at RCRA subtitle C waste facilities provided the disposed materials meet the waste acceptance criteria of the disposal facility and are also allowed to be disposed of using LLRW pathways.

Rulemaking

On January 3, 2023, the NRC staff submitted SECY-23-0001, "Options for Licensing and Regulating Fusion Energy Systems," providing three options for Commission consideration. These options included:

> 1. Categorization of fusion systems as utilization facilities with the NRC staff developing a new framework to address the associated specific hazards.
>
> 2. A byproduct material approach augmenting the framework in 10 CFR Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material".
>
> 3. A hybrid framework with decision criteria, based on the potential risks and hazards of a specific fusion system to determine whether a byproduct material or a utilization facility approach is appropriate for that system.

On April 13, 2023, the Commission issued SRM-SECY-23-0001, "Staff Requirements – SECY-23-0001 – Options for Licensing and Regulating Fusion Energy Systems," (Ref. No. 4), approving the option for a limited-scope rulemaking to establish a regulatory framework for fusion systems that augments the NRC's byproduct material framework in 10 CFR Part 30. The Commission included additional directions for the staff stating:

> The staff should consider the existence of fusion systems that already have been licensed and are being regulated by the Agreement States, as well as those that may be licensed prior to the completion of the rulemaking.

The staff should develop a new volume of NUREG-1556, "Consolidated Guidance About Materials Licenses," dedicated to fusion systems, so as to provide consistent guidance across the National Materials Program.

The staff should evaluate whether controls-by-design approaches, export controls, or other controls are necessary for near-term fusion systems.

If in the future, the staff, in consultation with the Agreement States, determines that an anticipated fusion design presents hazards sufficiently beyond those of near-term fusion technologies, the staff should notify the Commission and make recommendations for taking appropriate action as needed.

The staff has developed the proposed rule and a draft new volume to NUREG-1556 and submitted them to the Commission in SECY-24-0085, “Proposed Rule: Regulatory Framework for Fusion Machines.” Both are expected to be issued for public comment later this year following Commission vote.

Agreement State Participation

Agreement States have entered into agreements with the NRC that give them the authority to license and inspect byproduct, source, or special nuclear materials used or possessed within their borders. Under this program, the NRC and Agreement States function as regulatory partners and work together on:

Development of regulatory guides and procedures

Development of regulations

Integrated Material Performance Evaluation Program (IMPEP)

The NRC will leverage this experience and work with all Agreement States to develop a comprehensive framework for regulation of Fusion Systems.

As the framework for fusion machines continues to be finalized, this DCE developed for the HFPP borrows some standard practices currently applied under existing D&D protocols for nuclear decommissioning. However, based on the known characteristic that fusion reactions generate considerably less hazardous radioactive isotopes than fission reactions, while presenting reduced hazards to the public and the environment, decommissioning operations for fusion facilities are expected to be less rigorous. Nonetheless, resources to provide license termination protocols, radiological control protocols, and FSS protocols are included in the estimate.

3.0 STUDY METHODOLOGY

3.1 General Description

Energy*Solutions* is well positioned to develop decommissioning cost models as it is engaged in a wide spectrum of nuclear decommissioning activities. In addition to maintaining proprietary legacy decommissioning cost models based upon the fundamental technical approach established in AIF/NESP-036, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," recent D&D projects have provided Energy*Solutions* with actual cost and productivity data to supplement theoretical models. These actuals are increasingly relied upon by ES to estimate future work. ES utilizes these historical costs to validate and update the proprietary UCFs.

The DCE categorizes costs as direct, indirect, and overhead. Direct costs are activity specific and include planning and preparation costs as well as costs for decontamination, packaging, disposal, and removal of major components and systems. For example, costs for the segmentation, packaging, and disposal of the

fusion generator are direct costs. Indirect and overhead costs are typically level-of-effort, time dependent costs such as licensee and decommissioning operations contractor staff labor, property taxes, insurance, regulatory fees and permits, energy costs, and security measures.

The methodology for preparing cost estimates for a selected decommissioning alternative involves the development of specific work sequences based upon the plant inventory, and assessing radiological conditions based on site characterization and the facility's operating history. The work sequence is used to define the labor, material, equipment, and duration required for specific scopes of work.

In the case of major components, consideration is given to the physical and radiological characteristics of the component and to the available packaging, transportation, and disposal options. Actual historical costs and productivity from recently completed D&D work are used to estimate resource requirements and expected durations.

In addition to actual historical costs and UCF models, the study also relies on information obtained for earlier decommissioning cost estimates from across the industry and from cost information derived for submitted proposals and bid results.

3.2 Schedule Considerations

As the work activity durations are estimated, schedule implications are considered to account for operational constraints and regulatory reviews. Schedule implications affect work sequences and may influence the durations of direct cost activities and indirect/overhead cost activities.

The costs and schedule for the HFPP decommissioning are divided into major project periods whose durations overlap. The total duration for the project, from pre-shutdown through continued R&D activities, potential brief Dormancy period, detailed planning, demolition and final site surveys and restoration is conservatively estimated to be up to 11 years.

Period 1: Decommissioning Planning, Shut down and Dormancy
Period 2: Dismantlement & License Termination
Period 3: Site Restoration

3.3 Decommissioning Staff

The execution strategy priced into the DCE includes oversight and continued operational support by Helion, augmented with the services of an experienced and qualified Decommissioning Operations Contractor (DOC). Services of a professional consulting engineering and licensing firm during planning and preparation phases are also included in the estimate pricing.

Energy*Solutions* developed the HFPP post-shut down staffing levels based on related experience for the termination of NRC licensing at fission facilities while recognizing that protocols for a fusion power plant are likely to be less rigorous and generally easier to implement. Expected licensee labor costs and DOC staffing and craft labor costs were developed using Energy*Solutions'* historical data and local wage determinations from DOL. Functions to be provided or overseen by the licensee include:

Project Management & Administration
Plant Maintenance and Security during Dormancy
Radiation Protection/Health Physics Oversight
Regulatory Affairs
Quality oversight

3.4 Byproduct Material and Waste Disposal

Byproduct materials and radiological waste management and disposal costs comprise a significant portion of decommissioning costs. At the same time, the future availability of disposal sites licensed for receipt of hazardous waste and radiological Class A, B and C wastes introduces potential uncertainty related to future disposal rates as existing rate structures may not accurately reflect future conditions. Energy*Solutions*' approach to estimating waste disposal costs is discussed in the following paragraphs.

Byproduct and Waste Classification

Regulations governing disposal of radioactive waste are developed to ensure control of the waste and to preclude adverse impact on public health and safety. Low-level radioactive waste (LLRW) disposal is controlled by 10 CFR 61 which stipulates criteria for the establishment and operation of shallow-land LLRW burial facilities. It includes criteria and classifications for packaging LLRW such that it is acceptable for burial at licensed LLRW disposal sites.

As noted above, byproduct materials from the operation of fusion facilities can be disposed of at RCRA Subtitle C sites if the site's waste acceptance criteria are met.

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

Based on preliminary activation studies performed by Helion, demolition debris from the HFPP is expected to be byproduct material or LLRW Class A with no Class B, Class C, or GTCC waste generated during the plant life cycle. Shielding materials and borated concrete is expected to meet waste acceptance criteria at RCRA subtitle C landfills.

Packaging

Estimates of the type and quantity of containers and modes of transport for wastes are based on industry standard packaging for handling and shipping in compliance with 10 CFR 61. The selection of container types for Class A waste is based on the transportation mode (rail, truck, etc.) and waste form. The quantity of Class A waste containers is determined by the most restrictive of either container weight limit or container volume limit. Large components, such as the fusion generator, may be segmented as necessary to meet shipping constraints and then may be shipped as its own container or packaged for additional shielding as required. Container costs are obtained from manufacturers specializing in the design and fabrication of storage and transport containers for nuclear materials and radiological waste.

Transportation

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

Class-A Disposal Options and Rates

Class A waste that meets disposal facility waste acceptance criteria may be disposed of at Energy*Solutions*' LLRW disposal facility in Clive, Utah; at the Waste Control Specialists (WCS) facility in Andrews County, Texas; or at the US Ecology site in Richland Washington. Estimated waste disposal costs include packaging, transportation and other applicable surcharges if known.

Class B and C Disposal Options and Rates

No Class B or Class C radiological waste is expected from the decommissioning of the HFPP.

Greater-Than-Class-C (GTCC)

No Greater Than Class C radiological waste is expected from the decommissioning of the HFPP.

LLRW Volume Reduction

Because current Class A LLRW disposal rates are significantly lower than on-site volume reduction, decontamination and recycling costs, EnergySolutions does not anticipate the use of significant on-site volume reduction techniques such as waste compaction or an aggressive decontamination, survey and release effort.

Byproduct materials permitted for disposal at RCRA Subtitle C landfills

Helion's analysis of expected waste classifications indicates that the concrete and polyethylene shielding from the HFPP dismantlement can be disposed of at RCRA Subtitle C facilities. Facilities in the region of western Washington state include the Waste Management site in Arlington OR, the US Ecology in Richland WA, and a US Ecology facility in Grandview ID. All these potential sites are fairly remote to the general areas being considered for the HFPP site location.

For this estimate a blended average rate for transportation and disposal has been developed from various pricing sources. Volume discounts available at the time of shipment, fuel surcharges, or future regulatory changes may significantly affect disposal rates, either up or down, in the future.

Non-Radioactive Non-Hazardous Waste Disposal

During demolition and dismantlement, non-radioactive scrap metal resulting from the decommissioning program will likely be turned over to a scrap metal dealer, however, the estimate does not include credits because scrap values are widely variable. Actual job experience has shown that the scrap value may only off-set the cost of removing the material from the site.

Universal and Other Hazardous Wastes

Universal waste includes batteries, pesticides, mercury-containing equipment, lamps and aerosol cans. Lacking any precise inventory for the HFPP, an allowance is included for the disposal of these types of waste materials based on our experience with the decommissioning of industrial facilities. As the HFPP is constructed after many known hazardous materials have been eliminated from construction materials, the basis does not include the disposal of PCBs or asbestos.

3.5 Final Status Survey

Methods and resultant costs for performing final status surveys (FSS) are based on NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," (Ref. No. 5). Estimates of MARSSIM Class I, II, and III survey designations are based on radiological assumptions regarding contamination or

activation resulting from historic plant operations. Estimated costs for NRC and Oak Ridge Institute for Science and Education (ORISE) verification are also included.

3.6 Contingency

Contingencies are applied to cost estimates primarily to allow for uncertain, unknown or unplanned occurrences during the actual program, e.g., increased radioactive waste volumes over expected quantities, equipment breakdowns, weather delays, and labor strikes. This is consistent with the definition provided in the DOE Cost Estimating Guide, DOE G 430.1-1 (Ref. No. 6), which states in part "…contingency covers costs that may result from incomplete design, unforeseen and unpredictable conditions, or uncertainties within the defined project scope. The amount of contingency depends on the status of design, procurement, and construction; and the complexity and uncertainties of the project."

DOE has established a recommended range of contingency percentages as a function of completeness of program design, ranging as:

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

For the HFPP decommissioning estimate, a contingency of 25% is applied to all line items.

3.7 Elements of Cost

Total project costs are aggregated from direct, indirect and overhead costs into the following cost elements: Labor, Materials and Equipment, Subcontracts, Fees & ODC's, and Waste Packaging, Transportation and Disposal (P,T,&D).

Subcontracts include all elements of costs that are delivered under a subcontract agreement by third-party firms. Fees and Other Costs include property and sales taxes, insurance, licensing, permits and utility costs, and DOC fees.

Labor costs include wages and benefits, payroll taxes and employer's insurance, employer's general and administrative costs, subcontractor mark-ups, and allowances for small tools, personal safety equipment, and consumables. Craft labor wages and benefits are derived from Department of Labor wage determinations for Washington state. DOC and Licensee labor rates are derived from Energy*Solutions*' historical cost records and publicly available wage survey information.

3.8 ALARA Considerations

As Low as Reasonably Achievable (ALARA) work practices govern exposure limits during plant decommissioning, just as they have during the plant's operational life. Prudent work methods, shielding and exposure limitations are considered when planning and executing work in order to maintain radiation exposure within the guidelines applied to operational units, i.e., with an administrative dose limit of 1,000 to 1,500 mrem per person per year. Actual person-rem accumulations during recent D&D projects have demonstrated that worker exposures can be maintained well under the expected dose budgets established as part of legacy cost estimates. A recently completed project resulted in about half the expected dose accumulation among workers. Hence, with competent work planning and execution, work exposure to

ionizing radiation is well maintained inside applicable limitations and this DCE estimate study does not include calculations of expected dose accruals for the work.

4.0 SPECIFIC TECHNICAL APPROACH

4.1 Plant Description & Inventory

The HFPP site in Washington state is expected to consist of a single-story, sheet metal or tilt-up concrete structure measuring approximately 500' by 200' with a sheet metal, built-up asphalt, or membrane roof. Eave height is approximately 60' resulting in a building volume of 6,000,000 cubic feet (170,000 m^3). The plant houses overhead cranes and electrical equipment to supply input power and harness output power from the fusion generator which is shielded in a concrete and borated polyethylene chamber. Several hundred square feet of staff support facilities are included for the plant operations staff.

Industrial facilities similar to the HFPP contain a wide variety of mechanical and electrical equipment to support and control plant operations and provide building heating, ventilation, lighting, communications, fire protection and radiological controls. Lacking a completed design or engineered bill of materials, the total installed weight of the HFPP is estimated at approximately 20 - 30 lbs/ft^3 (320 - 480 kg/m^3) which represents an industrial facility with a moderate density of mechanical, electrical, and structural elements.

Given the size of the Plant, the lower range is a more likely density load. Using 20 lbs/ft^3 and 6 million ft^3 volume yields a total expected quantity of 120 million pounds (60,000 tons) of building materials to dispose of. Helion's estimate of equipment and material that may be contaminated and require disposal as Class A waste is expected to total up to approximately 100 tons. This includes the fusion generator and tritium processing equipment as outlined in the preliminary Helion inventory below which has been conservatively estimated based on prior generation facilities:

Fusion Generator Components

Up to approximately 150,000 lbs /75 tons; expected Class A LLRW

Tritium Processing Components

Up to approximately 50,000 lbs /25 tons; expected Class A LLRW

Shielding (Concrete & BPE)

Up to approximately 100,000 ft^3, 15,000,000 lbs/7,500 tons; expected byproduct material for disposal at a RCRA Subtitle C site.

Balance of Plant

Up to approximately 52,000 tons (rounded, two significant figures) of non-hazardous/non-radiological materials for disposal at local landfills or recycled as scrap materials. (Sixty-thousand tons total plant weight less expected material disposed of as Class A LLRW and at RCRA Subtitle C sites.)

4.2 Decommissioning Periods

The decommissioning execution strategy includes the following major project periods and activities with estimated durations as indicated. Major activities within each period are outlined below. These major project periods identify key project milestones and significant work activities while enabling the aggregation of costs.

Period 1: Shut Down, R&D, and potential dormancy: (up to 10 years)

1. Preliminary planning for licensing changes and other regulatory impacts
2. Plant modifications to support Dormancy
3. Radiological and non-radiological preliminary site characterization
4. Dormancy

Period 2: Decommissioning Planning: (1 year - in last year of dormancy)

1. Initiation of Decommissioning Planning Services
2. Detailed execution planning, work package development, submittals to the regulators
3. IFB/RFP/RFQ procurement activities leading to selection of a DOC
4. Equipment identification and procurement
5. Historical Site Assessment and Site Characterization preparation and studies
6. Initiation of Community Outreach efforts and LTP/LTA preparation and submission

Period 3: Dismantlement, License Termination and Site Restoration (12 months)

1. Cold, dark and dry Plant modifications and site preparation for dismantlement
2. Fusion generator vessel dismantlement and removal
3. Demolition of the shield structure and contents
4. Shipment of byproduct and LLRW, Hazmat and Universal Waste to disposal facilities
5. Final Status Surveys and NRC/ORISE confirmatory surveys
6. Submission of final site survey report and License Termination Application to the NRC
7. Demolition of remaining clean building elements
8. Site environmental restoration
9. Finish grading

Indirect and Overhead Costs incurred throughout all periods:

- Owner (Licensee) Staff
- DOC Staff
- Security Guard Force
- Property Taxes
- Insurance
- Project HP Supplies, Materials and Services
- State Regulatory/NRC Fees
- Utilities (Energy, water, sewer, etc.)

4.3 Decommissioning Staff

Energy*Solutions* develops staffing profiles considering the decommissioning project is performed efficiently using project personnel experienced in decommissioning and large-scale project management. The DCE also assumes that the decommissioning work will be performed by an experienced and qualified Decommissioning Operations Contractor (DOC), with oversight by the licensee staff.

Estimated staff levels are provided in the notes column of the estimate spreadsheet contained in the Appendix A.

5.0 BASIS OF ESTIMATE, KEY ASSUMPTIONS AND CONVENTIONS

The basis and key assumptions for this site-specific decommissioning estimate are itemized below:

1. The decommissioning period is based upon a permanent shutdown of HFPP followed by an R&D and potential brief dormancy period up to 10-years and delayed D&D.
2. Regulatory reporting to local, state and NRC jurisdictions is required commensurate with a NUREG-1757 Group 4 decommissioning classification. Licensee staff, consultants and decommissioning operations contractor level-of-effort resources are included for these activities.
3. Revisions will be required for various licensing documents (e.g., state licenses, registrations and permits). Licensee staff, consultants and decommissioning operations contractor level-of-effort resources are included for these activities.
4. Decommissioning will be performed using currently available technologies.
5. This estimate is based on the building inventory outlined in Section 4.1 above.
6. Site infrastructure beyond the HFPP building itself is not included in the plant inventory or estimated for removal or remediation.
7. Transformers and other electrical equipment are assumed to be PCB-free and no costs for disposition of PCB contaminated transformers or other equipment are included. Transformers are expected to be salvaged at no cost or gain to the project.
8. Costs for transportation of clean scrap metal to a land fill or recycle facility are included in the estimate, however, except for transformers, as noted in the previous paragraph, no credit has been made to the estimate for scrap materials as our experience indicates that project receipts for recycled material are highly unpredictable and subject to cyclical pricing swings that cannot be realistically projected.
9. Non-radiologically impacted concrete debris and demolition debris that cannot be used for the backfill of building voids below grade is assumed to be removed from the site and disposed of at a local landfill.
10. Foundations and building exterior walls are removed to a nominal depth of three feet below grade, surveyed to establish limits within the DCGL criteria derived from MARSSIM methodologies, and backfilled with suitable fill material. The estimate does not include the remediation of subsurface environmental or radiological contamination as the HFPP technology is not considered to present hazards to groundwater or to the local environment.
11. The estimate is based on a final site restoration wherein the HFPP structure is removed to a depth of 3 feet below existing grade, backfilled and graded to original contours then hydroseeded.
12. An allowance for universal waste disposal in the amount of five tons is included. As noted earlier, asbestos, PCB's and other non-radiological hazardous wastes are not anticipated or priced in the estimate.
13. Costs for packaging, transportation and disposal of Class A waste are based on currently available commercial rates for disposal of LLRW at the US Ecology site in Richland WA. Costs for

byproduct materials disposed of at a RCRA site are based on available commercial rates for at various area facilities. Transportation is estimated based on truck transport of intermodal containers for concrete and debris from cast-in-place portions of the shield structure and the use of super-sack packaging for modular sections of the shield structure and components of the fusion generator with an expected round trip duration of 10 hours.

14. Class A waste includes Dry Active Waste (DAW) arising from the disposal of contaminated protective clothing and health physics supplies.

15. Radiological waste greater than Class A is not anticipated nor priced in the estimate.

16. Washington state and NRC fees are included and are based on fee structures factored from the D&D of licensed nuclear projects and client information.

17. Inspection fees are included during each decommissioning period based on the type and level of activities being performed.

18. Site operating expenses expected to be incurred during decommissioning are included in the estimate. In addition to security labor costs, these costs include utilities, communications and office equipment and computers, tools and equipment, and materials and services such as ground maintenance, snow removal, trash disposal and similar costs.

19. Craft labor rates are based on 2023 DOL Davis Bacon wage determinations for Snohomish County, decision number WA20230077 escalated to 2025 dollars at the rate of 2.9% from 2023 to 2024 and 2.5% allowance from 2024 to 2025. Labor rates include wages, benefits and $0.25/hr Hazmat project wage rider. Burdens include state and federal statutories, employer's salary related expenses including workman's compensation and general liability insurance, subcontractor's field supervision and field labor overhead of 30%, employer's overhead and profit allowances of 25% of total cost and a taxed small tools and project indirect cost component of $5.50/hr.

20. Licensee labor costs and DOC staffing costs were developed by factoring Energy*Solutions*' historical data and by reference to publicly available industry wage rates. DOC staffing wages and benefits are burdened with state and federal statutories, employer's salary related expenses including workman's compensation and general liability insurance, employer's general and administrative allowances of 20% of total cost and a taxed small tools and project indirect cost component of $5.50/hr for DOC employees and $1.50/hr for licensee employees.

21. ALARA occupational exposure principles are practiced during D&D project execution. Energy*Solutions'* experience on recent D&D work indicates that radiation exposure to workers is about ½ of what has been traditionally calculated for D&D projects under legacy decommissioning estimates. While it may be necessary for workers to use respiratory protection during initial dismantlement work, it is anticipated that workers will, for the most part, be adequately protected with a protective clothing ensemble that does not adversely affect work productivity. Personnel protective clothing (Tyvek™ type coveralls, etc.) to prevent contamination is priced in the estimate.

22. No significant amount of liquid radwaste is anticipated.

23. The costs of required safety analyses and safety measures for the protection of the general public, the environment, and decommissioning workers are included in the cost estimates as level of effort work by owner and DOC staff. This reflects the requirements of:

10 CFR 20	Standards for Protection Against Radiation
10 CFR 30	Domestic Licensing of Production and Utilization Facilities
10 CFR 61	Licensing Requirements for Land Disposal of Radioactive Waste
10 CFR 71	Packaging and Transportation of Radioactive Material
29 CFR 1910	Occupational Safety and Health Standards
49 CFR 170-189	Department of Transportation Regulations Governing the Transport of Hazardous Materials

31. The estimate subtotals and totals are rounded up to the nearest thousand dollars and tabulated to three significant figures. Costs are escalated from 2023 to 2025 US dollars.

32. Cost factors for commercial insurance, property taxes, energy costs, and corporate allocations at the time of shutdown were provided by Helion. A Washington state and local sales tax rate of 8.86%, based on taxfoundation.org data, has been applied to material purchases and rentals.

33. The D&D means and methods priced into the DCE follow general industrial demolition practice using large demolition equipment including demolition hammers and shears to size structures and components for shipment to designated landfills/disposal sites.

34. Dismantlement is complete when regulatory oversight confirms FSS results, and final reports are submitted and approved by Washington state or the NRC. The estimate includes allowances for an ORISE confirmatory inspection and NRC charges for review and processing of the license termination plan and application.

6.0 STUDY RESULTS

The cost estimate results are provided in Tables 6-1 and 6-2 below. A detailed spreadsheet is provided in the Appendix.

TABLE 6-1 Estimated Combined Costs for All Phases

Helion Fusion Power Plant Decommissioning Cost Summary (thousands of 2023 US dollars w/ escalation to 2025 - rounded)				
	Dormancy	License Termination	Site Restoration	Total
Costs	$ 2,300	$ 15,000	$ 5,900	$ 23,200
Contingency	$ 600	$ 3,800	$ 1,500	$ 5,900
DOC Mark-Ups	$ 200	$ 1,300	$ 500	$ 2,000
Escalation	$ 100	$ 300	$ 100	$ 500
Total	$ 3,200	$ 20,400	$ 8,000	$ 31,600

TABLE 6 – 2 Estimated Costs by Element of Cost

Helion Fusion Power Plant Decommissiong Costs Estimated Costs by Element of Costs (thousands of 2023 US Dollars w/ escalation to 2025, rounded)	
Labor Cost	$ 2,500
Materials & Equipment Cost	$ 700
Subcontract Costs	$ 6,300
Fees, Taxes & Other Direct Costs	$ 1,700
Waste Packaging,Transportation & Disposal	$ 12,100
Contingency & DOC Mark-Ups	$ 7,800
Escalation	$ 500
Total Cost	$ 31,600

Summary comments:

The decommissioning estimate is based on Helion's assessment of the expected disposal paths for waste materials which are considered by Helion to be conservative; so that, allowing for out-year escalation and excluding significant changes to extant regulatory and political environments, actual decommissioning costs can reasonably be anticipated to be less than the estimate. Still, factors may develop that result in actual costs exceeding the estimate. Changes in the political and regulatory environment at the local, state, and federal levels are perhaps the most significant risks over the long lifetime of the project.

Of course, as with all decommissioning cost estimates, the plant owner makes decisions regarding risk and strategic approaches. Helion Energy may choose to factor the estimate up or down to accommodate a risk

profile considered most relevant to the actual operational life and conditions of the plant. Helion may make less conservative assumptions regarding expected contamination levels, percentage of contaminated areas/materials and subsequent reductions in waste quantities that would significantly change the DCE.

Additionally, the ability to use non-radiologically contaminated concrete debris for backfill, and contamination levels at the plant's end-of-life that do not require all shielding structures to be disposed of as radiological or byproduct waste, can significantly reduce the actual cost of decommissioning.

Finally, Helion should consider performing pre-operational site characterization studies as part of the start-up exercises when the fusion Plant is commissioned. Such will obtain background level and insitu radiological isotope footprints prior to the start of the Plant's operational life cycle. This information can be invaluable when preparing license termination plans and license termination applications at the end of the plant life cycle.

7.0 REFERENCES

1. NUREG-1757 Consolidated Decommissioning Guidance, Decommissioning Process for Materials Licensees, Vol. 1, Rev 2. U.S. Nuclear Regulatory Commission Office of Nuclear Material Safety and Safeguards

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

3. Association for the Advancement of Cost Engineering recommended practice for Basis of Estimates 34r-05.

4. SRM-SECY-23-0001, Staff Requirements – SECY-23-0001 – Options for Licensing and Regulating Fusion Energy Systems.

5. U.S. Nuclear Regulatory Commission, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," NUREG-1575, Rev. 1, August 2000.

6. U.S. Department of Energy, "Cost Estimating Guide," DOE G 430.1-1, March 1997.

Appendix A: Update of 2023 HFPP Decommissioning Cost Estimate - Escalated to 2025 w/ Revisions to Waste Disposal Schemes and 10 yr dormancy

WBS	Description	Notes	QTY	UoM	Total Cost	Labor Hours (Note 1)	Labor	Materials & Equipment	Subcontracts	Fees, Taxes & Other Direct Costs	Waste Package, Transport & Disposal
	Helion Fusion Power Plant (HFPP) Decommissioning		1.00	LS	$31,566,483	22,765	$3,347,398	$993,016	$8,717,834	$2,107,355	$16,400,880
	DOC Mark-up & Fee 10% of DOC Costs	Fees for Decommissioning Operations Contractor (also referred to as a Decommissioning General Contractor) services. DOC SG&A fees are included in the labor rates. Subcontractor SG&A and Fees are included in the Subcontractor rates.	1.00	LS	$1,982,513		$129,403	$65,243	$548,128	$24,859	$1,214,880
	25% Contingency on D&D Costs	25% contingency on Facility D&D Cost Line Item.	1.00	LS	$5,812,985		$616,474	$177,734	$1,565,078	$416,499	$3,037,200
	Escalation of 5.5% on Labor, SubC, Equipment & Matl's		1.00	LS	$519,043		$135,624	$39,102	$344,317	$0	$0
1	**Helion Fusion Power Plant D&D Costs**	Roll-Up Cost Item Line item includes total costs less Decommissioning Operations Contractor's Fee at 10% of DOC Cost Items and Project Contingency at 25% of Total Cost	1.00	Each	$23,251,942	22,765	$2,465,897	$710,937	$6,260,311	$1,665,996	$12,148,800
1.1	PERIOD 1 - SHUTDOWN AND DORMNCY 10 years	Roll-Up Cost Line Item Period 1: Shut Down and Dormancy: (10 years) The Estimate Item includes the following: 1.Preliminary planning for licensing changes and other regulatory impacts 2.Facility modifications to support Dormancy 3.Dormancy	1.00	EA	$2,263,456	2,280	$384,820	$33,692	$534,032	$1,310,913	$0
1.1.1	Planning Prior to Shutdown	Allowance for a shutdown project manager for half-time for 12 months (1040 hrs) and subcontracted consultation on regulatory and environmental issues at half-time over 12 months (1040 hrs).	1.00	LS	$527,290	1,040	$161,730	$1,560	$364,000	$0	$0
1.1.2	Post Shutdown Deactivation & Modifications	Roll-Up Cost Line Item	1.00	EA	$150,840	240	$67,579	$30,632	$50,032	$2,597	$0
1.1.2.1	Building Mods & System Abandonment	Roll-Up cost line item	1.00	EA	$86,723	-	$48,039	$26,320	$10,032	$2,332	$0
1.1.2.1.1	ReRoof facility	Not required for shorter dormancy period.	1.00	EA	$0	-	$0	$0	$0	$0	$0
1.1.2.1.2	Establish Security Perimeter	To minimize security staffing requirements and eliminate a full-time guard presence, upgrade fencing and provide remote monitoring technologies. Allowance is for 1000 LF of 10' fence installation and 5 each video monitoring cameras with intrusion alarm system.	1.00	EA	$47,215	-	$20,000	$25,000	$0	$2,215	$0

Appendix A: Update of 2023 HFPP Decommissioning Cost Estimate - Escalated to 2025 w/ Revisions to Waste Disposal Schemes and 10 yr dormancy

WBS	Description	Notes	QTY	UoM	Total Cost	Labor Hours (Note 1)	Labor	Materials & Equipment	Subcontracts	Fees, Taxes & Other Direct Costs	Waste Package, Transport & Disposal
		Allowance to disconnect unused services and condition the facility for dormancy. Minimum lighting and security monitoring to remain active while other bldg. services to be put in safe conditions.									
1.1.2.1.3	Secure Utilities	Labor effort- 40 hrs each: 2 - Pipefitters 2 - Electricians 2- Laborers Priced as Subcontract Labor which includes subcontractors overhead and fees as well as fully burdened area union wage and benefits.	1.00	EA	$39,508	-	$28,039	$1,320	$10,032	$117	$0
1.1.2.2	Baseline Rad Surveys	Allowance for preliminary site surveys to establish as-left radiological conditions, compile a Historical Site Assessment and develop DCGL's for the License Termination Plan documentation Labor effort FSS/Rad Engineer - 80 hrs 2 - RP Techs80 hrs Subcontract sample/testing - 20 samples	1.00	EA	$64,117	240	$19,540	$4,312	$40,000	$265	$0
1.1.3	Dormancy	Roll-up Cost Line Item: Expected annualized costs for maintaining the facility in dormancy conditions for +/-10 years.	1.00	EA	$1,585,326	1,000	$155,510	$1,500	$120,000	$1,308,316	$0
1.1.3.1	Licensee Staff	Allowance for a designated supervisor/manager/oversight person, pro-rated at 5% of a full-time equivalent (FTE), 100 hrs/yr, for 10 years. (Last year of dormancy included in pre-planning for decommissioning. 1000 hrs over the dormancy period.	1.00	EA	$157,010	1,000	$155,510	$1,500	$0	$0	$0
1.1.3.2	Security Services	Subcontracted remote monitoring service- 10 yrs / 120 months	1.00	EA	$60,000	-	$0	$0	$60,000	$0	$0
1.1.3.3	Property Taxes	Internet price search estimates the average property tax rate in WA state is 1.10% of assessed value. Estimate by client is $60,000 / yr.	10.00	Yr	$600,000	-	$0	$0	$0	$600,000	$0
1.1.3.4	Insurance	Allowance per Client $60,000 / yr.	10.00	Yr	$600,000	-	$0	$0	$0	$600,000	$0
1.1.3.5	NRC Licensing and other regulatory/permitting fees or assessments	Allowance for WA state/NRC annual license fee estimated at $5,000/yr by client.	10.00	Yr	$50,000	-	$0	$0	$0	$50,000	$0
1.1.3.6	Energy/Utilities	Utility charges during dormancy	10.00	Yr	$53,000	-	$0	$0	$0	$53,000	$0
1.1.3.7	Misc Materials & Services	Allowance for miscellaneous services to the facility over 10 yr dormancy. Includes trouble calls, miscellaneous repairs, rodent extermination, annual inspections and similar costs at $500/month ($6,000/yr) plus sales tax.	1.00	EA	$65,316	-	$0	$0	$60,000	$5,316	$0

Appendix A: Update of 2023 HFPP Decommissioning Cost Estimate - Escalated to 2025 w/ Revisions to Waste Disposal Schemes and 10 yr dormancy

WBS	Description	Notes	QTY	UoM	Total Cost	Labor Hours (Note 1)	Labor	Materials & Equipment	Subcontracts	Fees, Taxes & Other Direct Costs	Waste Package, Transport & Disposal
1.2	PERIOD 2 - DECOMMISSIONING PLANNING - (1 year during last year of dormancy)	Roll-Up Cost Line Item Period 2: Decommissioning Planning: (1year) The estimate item includes the following: 1.Initiation of Decommissioning Planning Services 2.Detailed execution planning, work package development, submittals to regulators 3.IFB/RFP/RFQ procurement activities leading to selection of a Decommissioning Operations Contractor (DOC) 4.DOC planning for D&D activity 5. Site Characterization preparation and studies 6.Initiation of Community Outreach efforts and LTP/LTA preparation and submission	1.00	EA	$820,289	5,695	$554,597	$23,234	$242,000	$458	$0
1.2.1	Regulatory Preparations (LTP/LTA regulatory submittals, etc.)	Roll-up cost item Allowance for subcontracted consulting services for the preparation and submission of the License Termination Plan and License Termination Application to WA state/NRC.	1.00	EA	$588,426	3,615	$334,174	$11,794	$242,000	$458	$0
1.2.1.1	Consultant/License Preparation Services	Also includes effort to prepare environmental permits as may be required by state or regional authorities. Effort is estimated at 1/4 - FTE (520 hrs).	1.00	EA	$182,000	-	$0	$0	$182,000	$0	$0
1.2.1.2	Baseline Radiological Services & Site Characterization	Subcontracted Field Radiological Protection (RP) technicians and health physics (HP) technical support to obtain current site radiological conditions, take and analyze site samples, and perform other tasks to establish pre-demolition radiological signature of the site and confirm expected waste disposal characteristics and quantities. Radiological engineer and two RP technicians over a 1 month period, total of 165 crew hours	1.00	EA	$108,653	495	$40,301	$7,894	$60,000	$458	$0
1.2.1.3	Licensee Project Management	HELION project staff to include half/quarter -time effort over a period of 1-year. Quarter- time project manager - 520 hrs Half-time estimator/scheduler/planner - 1040 hrs Quarter-time administrative assistant - 520 hrs Quarter-time accountant & procurement support - 520 hrs	1.00	EA	$297,773	3,120	$293,873	$3,900	$0	$0	$0

Appendix A: Update of 2023 HFPP Decommissioning Cost Estimate - Escalated to 2025 w/ Revisions to Waste Disposal Schemes and 10 yr dormancy

WBS	Description	Notes	QTY	UoM	Total Cost	Labor Hours (Note 1)	Labor	Materials & Equipment	Subcontracts	Fees, Taxes & Other Direct Costs	Waste Package, Transport & Disposal
1.2.2	Decommissioning Operations Contractor (DOC) Selection and Preparations for Dismantlement	Decommissioning Operations Contractor (DOC) staff costs for 6 - month (1040 hrs) post-award planning and preparation work prior to site mobilization for D & D. Planning effort includes collaboration in the finalization of the draft LTP to assure the proposed LTP reflects expected field operations, specification and procedure development, subcontracting, etc. DOC staff includes: Half - time project manager Half-time planner/field-engineer/cost-engineer Half-time superintendent Quarter-time accounting/procurement staff Quarter-time administrator Quarter time scheduler	1.00	EA	$231,863	2,080	$220,423	$11,440	$0	$0	$0
1.2.3	Undistributed costs for Decommissioning Planning	Included in Dormancy period costs.	1.00	EA	$0	-	$0	$0	$0	$0	$0
1.3	PERIOD 3 - DISMANTLEMENT, LICENSE TERMINATION & SITE RESTORATION - 12 Months	Roll-Up Cost Line Item Period 3: Active demolition and dismantlement of the HFPP and isposal of radiological and non-radiological waste and debris. Also includes Final Site Surveys (FSS) for the termination of the WA State/NRC license. 12 Month duration includes 10 months of demolition, and 2 months of Final Site Surveys, regulatory filings, confirmatory surveys.	1.00	EA	$20,168,196	14,790	$1,526,481	$654,012	$5,484,279	$354,625	$12,148,800
1.3.1	Decommissioning and Dismantlement Mobilization	Roll-up Line Item Cost. DOC equipment mobilization/demobilization (6 mob/ 6 demob transports), office trailer, OSHA toilets, site utility/communications services, site office equipment, craft labor for cold & dark termination of utilities and set-up of temporary power.	1.00	EA	$1,042,396	-	$141,418	$486,820	$368,832	$43,225	$2,100

Appendix A: Update of 2023 HFPP Decommissioning Cost Estimate - Escalated to 2025 w/ Revisions to Waste Disposal Schemes and 10 yr dormancy

WBS	Description	Notes	QTY	UoM	Total Cost	Labor Hours (Note 1)	Labor	Materials & Equipment	Subcontracts	Fees, Taxes & Other Direct Costs	Waste Package, Transport & Disposal
1.3.1.1	Mobilize / Demobilize DOC	Equipment mobilization & demobilization. Decontamination of mobile equipment prior to demobilization. Labor to set up/take down infrastructure: Craft Labor Allowance at 60 hrs 2 - Electricians 2 - Pipefitters 2- Iron Workers 2 - Laborers 2 - OE 2 - Teamsters	1.00	EA	$305,899	-	$95,758	$4,620	$205,112	$409	$0
1.3.1.2	Site/ Project Infrastructure	Site trailers rentals, OSHA toilets, site office equipment, Portal Radiation monitor, Portable Truck Scales, Personnel portal monitors for Radiologically controlled area, temporary ventilation equipment & filters (Torit equipment), overhead crane recertification.	1.00	EA	$636,870	-	$0	$450,000	$147,000	$39,870	$0
1.3.1.3	Cold & Dark Preparations & Other Site Preparations	Prepare facility for bulk demolition to eliminate potential for accidental severing of live utility lines anywhere in the structure. Where site utility services are required, temporary power is provided through an 'Orange Cable' program. Material allowance for cabling and temporary panels/disconnects, etc.	1.00	EA	$97,434	-	$45,661	$32,200	$16,720	$2,853	$0
1.3.1.4	Universal Waste Remediation	DOC subcontracted Craft Labor 40 hrs 2 - IronWorkers 2 - Pipefitters 2 - Electricians 2 - Laborers 2 - OE's Allowance for disposal of 5 tons of universal wastes. Federal universal waste regulations include waste batteries, mercury-containing equipment, pesticides, and lamps.	1.00	EA	$2,193	-	$0	$0	$0	$93	$2,100
1.3.2	Fusion Generator(FGx)/Tritium Processing Dismantlement and Disposal	Roll-Up Cost Line Item Dismantle Fusion Generator and Tritium processing equipment and ship as radiological waste. Approximately 100 tons per Client Inventory	1.00	EA	$838,200	-	$0	$0	$42,000	$0	$796,200

Appendix A: Update of 2023 HFPP Decommissioning Cost Estimate - Escalated to 2025 w/ Revisions to Waste Disposal Schemes and 10 yr dormancy

WBS	Description	Notes	QTY	UoM	Total Cost	Labor Hours (Note 1)	Labor	Materials & Equipment	Subcontracts	Fees, Taxes & Other Direct Costs	Waste Package, Transport & Disposal
1.3.2.1	FGx/Tritium Processing Dismantlement/Segmentation	Dismantle fusion generator, package in super-sacs and load for transit to disposal site. Components are lifted from the shield structure using building overhead crane, packaged and loaded for shipment to disposal site. Adjacent areas to the shield structure are demolished to provide in-building work/load out area so that dismantlement work is protected from the elements. Total tonnage: approximately 100	1.00	EA	$42,000	-	$0	$0	$42,000	$0	$0
1.3.2.2	Package / Ship / Dispose of FGx/Tritium Processing Equipment	Packaging materials, transportation and disposal of radiological waste at US Ecology disposal facility in Richland, WA. Refer to Waste Summary Worksheet for details Estimated Fusion Generator and Tritium processing equipment weight is 100 Tons insitu	1.00	EA	$796,200	-	$0	$0	$0	$0	$796,200
1.3.3	FGx Shielding Structure Dismantlement and Disposal	Roll-Up Cost Line Item Dismantle Fusion Generator shielding structure, modular and cast in place portions as byproduct material to an EPA RCRA Subtitle C Hazmat disposal site. Approximately 7,500 tons	1.00	EA	$11,292,524	-	$0	$0	$1,875,000	$95,024	$9,322,500
1.3.3.1	Shielding Structure Dismantlement and Demolition	Demolition of cast-in-place and modular sections of the shielding structure, including borated polyethylene shielding materials. Demolition of rebar in foundation and cast in place portions of the shield structure, plus allowances for HVAC equipment, dry active waste (DAW) and miscellaneous materials/equipment contaminated during dismantlement. Total of 7,500 tons; 125,000 cf @ 120#/CF	1.00	EA	$1,875,000	-	$0	$0	$1,875,000	$0	$0

Appendix A: Update of 2023 HFPP Decommissioning Cost Estimate - Escalated to 2025 w/ Revisions to Waste Disposal Schemes and 10 yr dormancy

WBS	Description	Notes	QTY	UoM	Total Cost	Labor Hours (Note 1)	Labor	Materials & Equipment	Subcontracts	Fees, Taxes & Other Direct Costs	Waste Package, Transport & Disposal
		Packaging materials, transportation and disposal of radiological waste at the Richland Washington site.									
1.3.3.2	Package / Ship / Dispose of Shielding Structures	Estimated weight of shielding structure, including cast-in-place and modular sections foundation rebar is 7,500 Tons/125,000 CF, (shipping/disposal density of 120#/cf). Disposal estimated @ $62.50 + 5.27% per cubic foot= $66/CF ($1,100/ton) Estimated transport cost, round trip travel including fuel surcharge is $123/ton	1.00	EA	$9,417,524	-	$0	$0	$0	$95,024	$9,322,500
1.3.4	Radiological Waste & License Termination Support Activities	Roll-Up Cost Line Item	1.00	EA	$378,007	2,310	$199,257	$100,933	$70,000	$7,817	$0
1.3.4.1	Radiological Technician Support During Demolition & Dismantlement	Provides field RP staff during the demolition and load out radiological waste.	1.00	EA	$86,047	990	$80,602	$5,445	$0	$0	$0
1.3.4.2	Radiological Waste Broker Services During Demolition & Dismantlement	Provides field RadWaste broker and manifest staff during the demolition and load out of radiological waste: 1 broker, 2- RP Technicians for 2- months.	1.00	EA	$97,232	990	$91,787	$5,445	$0	$0	$0
1.3.4.3	Project HP Supplies	Disposable protective clothing for demolition and survey crews, markings and signs for radiologically controlled area, survey instrument rentals survey instruments on-site for 12 months Rad Protection supply allowance at $500/month plus taxes for 12 months PC's use at the rate of 45/day for over 6 months for demolition, 12/day over 2 months for FSS activity allowance of 6,200 sets	1.00	EA	$96,045	-	$0	$88,228	$0	$7,817	$0
1.3.4.4	Final Site Surveys	Provides field RP and FSS staff to complete site surveys and prepare final documentation for license termination.1 Radiological/FSS Engineer and 2 - RP/FSS Technicians for 2 months.	1.00	EA	$68,682	330	$26,867	$1,815	$40,000	$0	$0
1.3.4.5	ORISE Certification Survey	Allowance for a single site visit to confirm License Termination conditions. Also includes FSS staff support for the ORISE site survey team.	1.00	EA	$30,000	-	$0	$0	$30,000	$0	$0

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1.3.4.6	Radiological Waste Disposal Site Availability Charge	Reduced by reduced quantity of LLRW	0.00	EA	$0	-	$0	$0	$0	$0	$0
1.3.5	Building & Site Demolition and Disposal (non-Contaminated)	Roll-up Cost Line Item	1.00	EA	$5,249,358	-	$0	$0	$3,120,000	$101,358	$2,028,000
1.3.5.1	Building Demolition	Commercial demolition and recycling of non-contaminated demolition debris at a subcontracted rate of $60/ton. Approximately 52,000 tons	1.00	EA	$3,120,000	-	$0	$0	$3,120,000	$0	$0
1.3.5.2	Transportation & Disposal of non-Contaminated Material	Transportation and disposal of non-contaminated demolition debris at the rate of $41/ton. Approximately 52,000 tons	1.00	EA	$2,129,358	-	$0	$0	$0	$101,358	$2,028,000
1.3.6	Site Restoration	Roll-Up Cost Line Item	1.00	EA	$21,180	-	$1,365	$13,199	$5,447	$1,169	$0
1.3.6.1	Backfill Building Envelopes	Import and place material to fill construction voids. Allowance of 500 bank Cyds	1.00	EA	$15,733	-	$1,365	$13,199	$0	$1,169	$0
1.3.6.2	Finish Grade & Hydroseed Site	Hydroseed demolition site after finish grading. Allowance 1 acre	1.00	EA	$5,447	-	$0	$0	$5,447	$0	$0
1.3.7	Undistributed Costs for Dismantlement, License Termination & Site Restoration	Roll-Up Cost Line Item	1.00	EA	$1,346,532	12,480	$1,184,440	$53,060	$3,000	$106,032	$0
1.3.7.1	Licensee Staff	Licensee Staff oversight during dismantlement.12 month duration,2080 hrs Part & Full Time staff Administrative Assistant P/T Site oversight Manager F/T Project Controls P/T Project Manager P/T Safety and QS Oversight P/T Accountant/Biz Ops Staff P/T	1.00	EA	$459,898	5,200	$452,878	$7,020	$0	$0	$0
1.3.7.2	Site Security	Continue site surveillance for 6 months while radiological waste is removed from the site.	1.00	EA	$3,000	-	$0	$0	$3,000	$0	$0
1.3.7.3	Decommissioning Operations Contractor (DOC) Staff	DOC project staff for 12 months Full and Part-Time Staff for 12 months, 2,080hrs	1.00	EA	$771,602	7,280	$731,562	$40,040	$0	$0	$0
1.3.7.4	Property Taxes	Factored at 50% of pre-demolition rates...	1.00	EA	$15,000	-	$0	$0	$0	$15,000	$0
1.3.7.5	Insurance	Factored at 50% of pre-demolition rates.	1.00	EA	$30,000	-	$0	$0	$0	$30,000	$0
1.3.7.6	Licensing Fees	Regulatory fees for processing License Termination Plan and License Termination Amendment. Allowance for billed regulatory staff time @ 1 mn-month @ $300/hr. plus annual license fee estimated at $5,000/yr by client.	1.00	EA	$54,500	-	$0	$0	$0	$54,500	$0
1.3.7.7	Energy/Utilities	Construction/Demolition site utilities for 12 months.Includes electric, phone, fax, water etc.at $500/month	1.00	EA	$6,000	-	$0	$0	$0	$6,000	$0

Appendix A: Update of 2023 HFPP Decommissioning Cost Estimate - Escalated to 2025 w/ Revisions to Waste Disposal Schemes and 10 yr dormancy

WBS	Description	Notes	QTY	UoM	Total Cost	Labor Hours (Note 1)	Labor	Materials & Equipment	Subcontracts	Fees, Taxes & Other Direct Costs	Waste Package, Transport & Disposal
1.3.7.8	Misc Materials & Services	Miscellaneous materials and services supporting project/site staff and facilities at $500/month. Includes site vehicle, office supplies, phone line etc.	1.00	EA	$6,532	-	$0	$6,000	$0	$532	$0
62		**Totals, Rounded Including Mark-up, Contingency and Escalation>>>**			**$31,600,000**	**22,765**	**$3,300,000**	**$1,000,000**	**$8,700,000**	**$2,100,000**	**$16,400,000**

Note 1: Where 0 labor hrs are indicated w/ non-0 labor cost, labor is provided under a subcontractor arrangement

Appendix B

Summary of Waste Packaging, Transport and Disposal - Helion DCE										
Disposal Site	**Waste Form**	**Waste Class**	**Waste Wt (Lbs) (Rounded)**	**Waste Wt (Tons) (Rounded)**	**Type of Packaging**	**# of Packages or Truck Loads**	**Basis for Disposal Rate**	**PTD unit price $/Ton**		**NOTES**
	Cast-in-Place and Module Shielding - Concrete and BPE	RCRA	15,000,000	7,500	Truck Loads	250	volume, container & transport	$	1,224	Byproduct materials, concrete and BPE shielding meeting RCRA Subtitle C WAC criteria
US Ecology	Fusion Generator & Tritium Processing Components	Class A	200,000	100	Super Sacs	13	volume, container, transport, scheduled fees	$	5,168	Fusion Generator and tritium equipment disassembled, packaged and shipped
Local Landfill	Balance of Plant	non-Rad	104,000,000	52,000	Truck Loads	1,733	tons	$	41	non-contaminated demolition debris - disposal or recycle