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# **Action Memorandum for the F-Complex at the Knolls Atomic Power Laboratory**

July 2023

Prepared for:  
U.S. Department of Energy  
Environmental Management Consolidated Business Center –  
New York Project Support Office

Prepared by:



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## LIST OF ACRONYMS

ACM	Asbestos-Containing Material
ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
FCPE	Full Core Physics Experiment
FPR	Flexible Plastic Reactor
ft	foot (feet)
HSA	Historical Site Assessment
LFM	Legacy Facility Management
M	Million
NEPA	National Environmental Policy Act of 1970
NR	Naval Reactors
NTCRA	Non-Time-Critical Removal Action
NY	New York
NYSDEC	New York State Department of Environmental Conservation
NYSHPO	New York State Historic Preservation Office
PCB	Polychlorinated Biphenyl
RCRA	Resource Conservation and Recovery Act of 1976
Rm	Room
RmAO	Removal Action Objective
SWMU	Solid Waste Management Unit
TTR	Thermal Test Reactor

## EXECUTIVE SUMMARY

This Action Memorandum has been prepared for the U.S. Department of Energy (DOE) and Office of Naval Reactors (NR) at the Knolls Atomic Power Laboratory (Knolls Laboratory) in Niskayuna, NY, to identify the selected alternative for disposition of the F-Complex. As the F-Complex has reached the end of its mission and cannot be reused by the Knolls Laboratory in its present state, DOE no longer has a need for the buildings and is following a process to select a disposition alternative that is protective of human health and the environment while balancing its effectiveness, implementability, and cost.

Disposition of the F-Complex is being planned as a Non-Time-Critical Removal Action (NTCRA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. In addition, National Environmental Policy Act (NEPA) values are incorporated into the CERCLA process, in accordance with DOE NEPA policy (DOE 2002).

The F-Complex, located in the northwest portion of the upper level of the Knolls Laboratory site, consists of five integrally connected buildings referred to as F1, F2, F3, F4, and F6 (F5 was demolished in 1978). The buildings were constructed between 1951 and 1970 and have been used for various missions over their lifetime. From the early 1950s to the 1980s, the buildings housed a variety of test research reactors. At the end of the research phase for each reactor, the nuclear fuel was removed leaving all or portions of the “reactor assembly” in place. The F-Complex has three inactive, defueled research reactors, referred to in this document as “defueled assemblies.”

A Historical Site Assessment (HSA) has been prepared (DOE 2022a) to document the presence of residual contamination within the F-Complex. Low levels of radioactive contamination are present on inaccessible building surfaces. In addition, regulated and hazardous materials are present in areas throughout the buildings, including friable and non-friable asbestos-containing materials (ACM). Chemical contamination includes beryllium in overhead areas (primarily in inaccessible locations); lead in paint and shielding around reactor components; and polychlorinated biphenyls (PCBs) in paints and light ballasts.

While the buildings continue to be maintained in a safe condition, the potential for a release to the environment increases as the facilities age and deteriorate. Therefore, DOE prepared an Engineering Evaluation/Cost Analysis (EE/CA) (DOE 2022b) that evaluated three alternatives for addressing the residual contamination in the F-Complex. A qualitative risk evaluation was also completed as part of the EE/CA to identify potential risks to human health or the environment and to justify the need for a removal action. The three removal action alternatives are summarized in Table 1. Both the HSA and EE/CA are part of the project Administrative Record.

<b>Alternative</b>	<b>Description</b>
Alternative 1 – Continued Legacy Facility Management (LFM) (“No Action” alternative)	Under this alternative, the buildings and defueled assemblies would remain in their current state while LFM activities would continue.
Alternative 2 – Cleanout of Defueled Assemblies	This alternative would involve removal of tanks, equipment, and piping associated with the defueled assemblies and decontamination and removal of the defueled assemblies. LFM activities would continue.
Alternative 3 – Demolition of F-Complex	This alternative would involve removal of tanks, equipment, and piping associated with the defueled assemblies, decontamination and removal of the defueled assemblies, and demolition of all five buildings within the F-Complex.

DOE's goal for the F-Complex is to implement a removal action that is consistent with its continuing research mission at the Knolls Laboratory and is protective of human health and the environment. In the EE/CA, DOE evaluated the three removal action alternatives in terms of effectiveness, implementability, and cost. The advantages and disadvantages of each alternative were analyzed relative to one another to identify key tradeoffs that would affect the remedy selection. As a result of that analysis, DOE recommends that Alternative 3, Demolition of F-Complex, be selected as the preferred removal action. Demolition would be a permanent and effective remedy that is readily implemented with demonstrated technologies and would make the building footprint available for future use by DOE in continuing its research mission at the Knolls Laboratory.

The EE/CA was issued for public comment on January 5, 2023, with a public comment period from January 6 to February 6, 2023. A public meeting was held at the Niskayuna, NY Town Center, on January 19, 2023. Approximately fifty-five people participated virtually and in person at the meeting. DOE gave a presentation on the history of the F-Complex, residual contamination, and the removal alternatives. A question-and-answer session followed the presentation. Formal comments received during the public comment period are described in the Responsiveness Summary (Appendix A). There were two public comments, both indicating support for DOE's preferred removal action alternative.

This Action Memorandum is prepared in accordance with *Superfund Removal Guidance for Preparing Action Memoranda* (Environmental Protection Agency [EPA] 2009) and presents the rationale for selecting the proposed removal action alternative.

## 1.0 PURPOSE

The purpose of this Action Memorandum is to document the selection of a removal action for disposition of the F-Complex, located at the Knolls Laboratory in Niskayuna, NY. DOE no longer has a need for the F-Complex, which was formerly used by NR to conduct research on nuclear reactors to be used in aircraft carriers and submarines. DOE, using its authority under CERCLA, is pursuing disposition of the F-Complex using the NTCRA process. Due to residual contamination in the buildings, the F-Complex cannot be reused by the Knolls Laboratory in its present state. While the F-Complex continues to be maintained in a safe condition, the potential for a release to the environment increases as the facilities age and deteriorate.

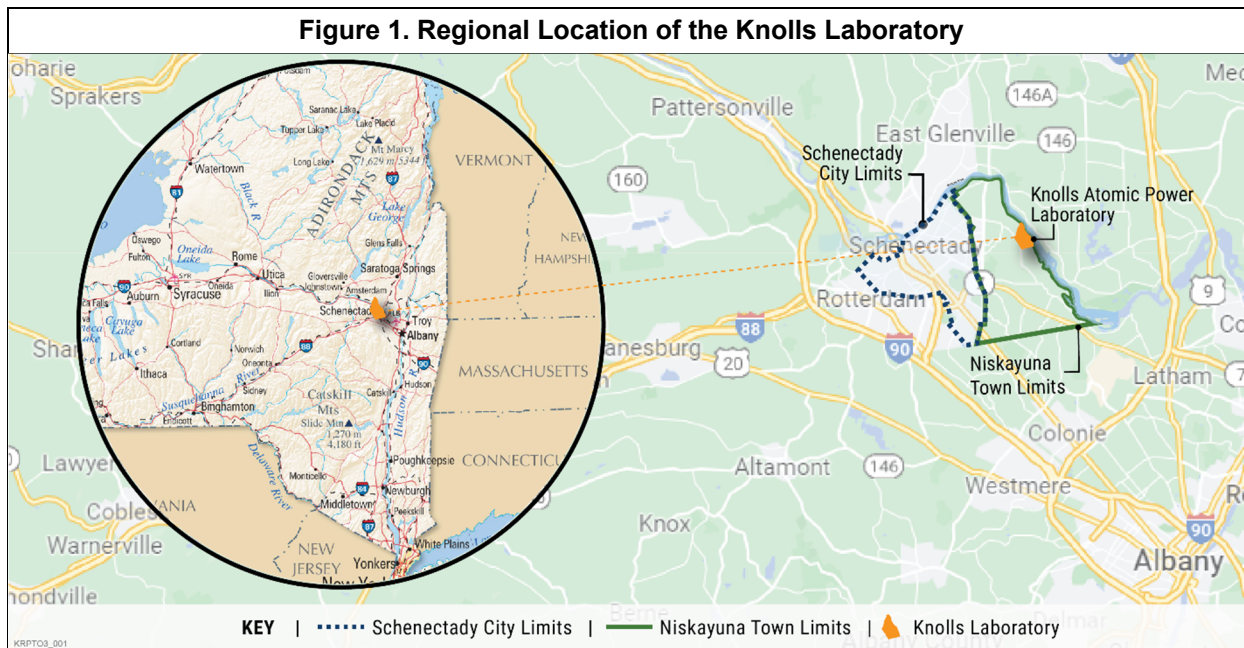
## 2.0 SITE CONDITIONS AND BACKGROUND

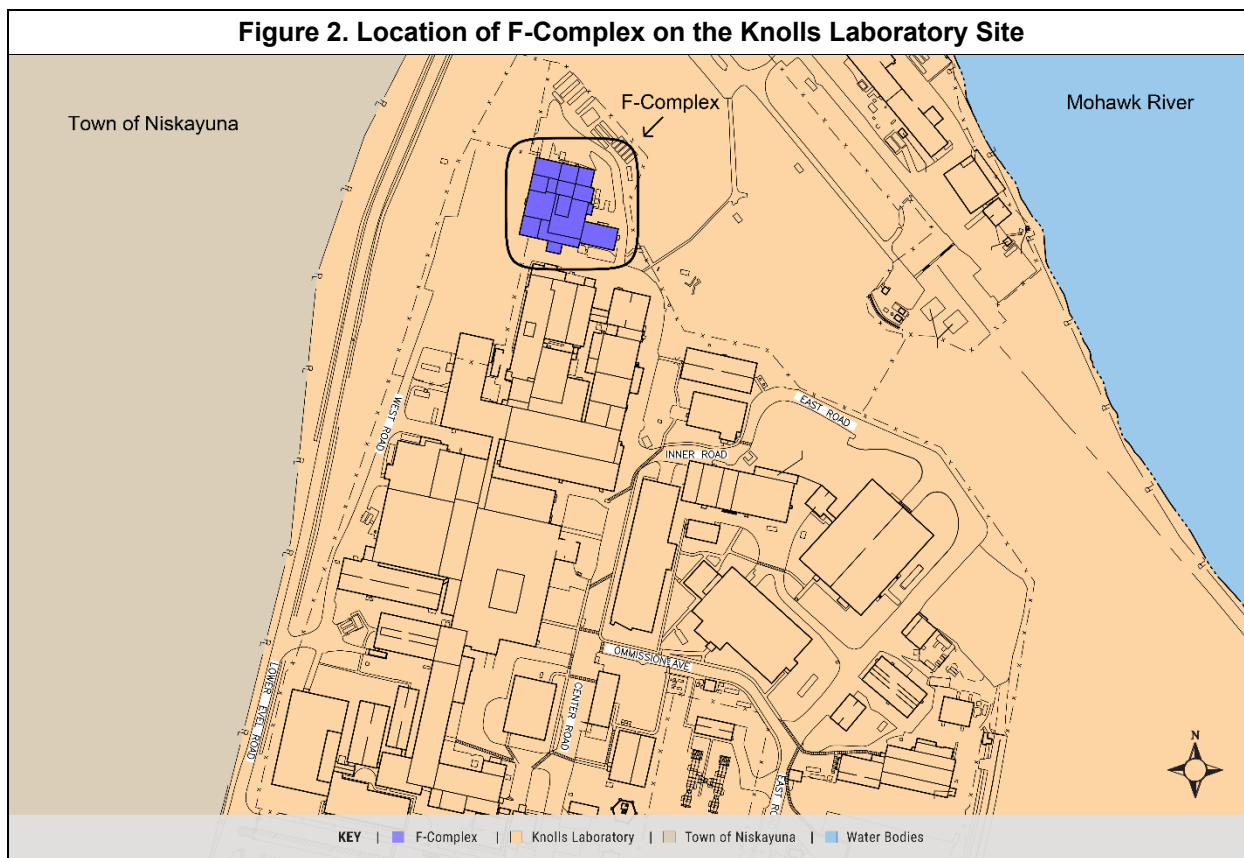
### 2.1 Site Description

The Knolls Laboratory site, located in Niskayuna, NY (Figure 1), was established in May 1946. The principal function at the Knolls Laboratory is research and development in the design and operation of naval nuclear propulsion plants. The F-Complex is physically located in the northwest portion of the upper level area at the Knolls Laboratory site (Figure 2).

As a part of the CERCLA process, DOE prepared an HSA (DOE 2022a) and an EE/CA (DOE 2022b). The HSA contains detailed information on the history, use, and environmental condition of the F-Complex. The EE/CA presents the alternatives identified and analyzed to address the environmental conditions described in the HSA. More details on the F-Complex are found within these documents.

The F-Complex comprises five buildings (F1, F2, F3, F4, and F6; F5 was demolished in 1978), as shown in Figure 3. From the early 1950s to the 1980s, the F-Complex housed a variety of test research reactors. The assemblies of three of these reactors remain in place—the Thermal Test Reactor (TTR) located in Building F2; the Flexible Plastic Reactor (FPR) located in Building F6; and the Full Core Physics Experiment (FCPE) located in Building F2. These reactors have been defueled and placed in an inactive condition designed to minimize the required level of attention.





Several areas within or near the F-Complex that formerly stored or managed solid waste are identified as Solid Waste Management Units (SWMUs) in the Hazardous Waste Management Permit (6 New York Codes, Rules and Regulations Part 373 Resource Conservation Recovery Act [RCRA] Permit) for the Knolls Laboratory. The location of four of these SWMUs interior to F-Complex are shown on Figure 3. The disposition of the SWMUs is addressed under the Corrective Action provisions of the Knolls Laboratory RCRA permit.

The buildings within the F-Complex are currently vacant, having been emptied of their contents, except for the three defueled assemblies. Various quantities of hazardous substances are present throughout the buildings including friable and non-friable asbestos containing materials (ACM). Chemical contamination includes beryllium in overhead areas (primarily in inaccessible locations), lead in paint and shielding around reactor components, and polychlorinated biphenyls (PCBs) in paints and light ballasts. Radioactivity is present; the highest radioactivity levels are associated with the defueled assemblies. There is also potential for low, but detectable, levels of radioactive contamination on inaccessible surfaces. Based on historical information and predictive modeling, the total activity contained within the F-Complex is estimated at approximately 1 Curie.

Ongoing activities in the F-Complex are associated with Legacy Facilities Management (LFM). LFM activities maintain the environmental, structural, and system integrity of the buildings through walkdowns, condition assessments, surveys, inspections, and system checks to ensure that conditions are safe and protective of human health and the environment.

Neither the Knolls Laboratory nor the F-Complex are listed or proposed for listing on the National Priorities List. DOE provides the EPA and the New York State Department of Environmental Conservation (NYSDEC) with ongoing information on the project, including project documents, and the process being followed. DOE has the lead for NTCRA at DOE facilities and provides the EPA and the State with information on the actions.

Figure 3. Layout of the F-Complex



KRPT03\_003

KEY | ■ Defueled Assemblies



## 2.2 Previous Actions

All but three of the earlier test reactors in the F-Complex were removed as their research phase ended. The TTR and FCPE assemblies in Building F2 have been defueled and deactivated, and the fluid systems have been drained. The FPR in Building F6, which had no fluid system, has also been defueled and deactivated. The former fuel vaults in Buildings F1 and F3 have been emptied. The buildings within the F-Complex are currently vacant, having been emptied of their contents in 2022, except for the three defueled assemblies.

Four former SWMUs located within the F-Complex footprint have been closed. The NYSDEC has determined that no further action is required.

## 3.0 THREATS TO PUBLIC HEALTH, WELFARE, AND/OR THE ENVIRONMENT

As discussed in Section 2.1, the F-Complex contains varying levels of radiological and chemical contamination, hazardous substances, and potentially hazardous materials. These could cause potential risk to human health, welfare, and/or the environment.

The potential threats of a release causing an unacceptable risk to human health, welfare, and/or the environment are currently low as a result of shielding, access controls, maintenance, and monitoring that are routinely performed within the F-Complex and are protective in the short term (the 30-year LFM planning period). As the facilities continue to age, the threat of a release of radiological and hazardous substances increases with time, and containing these materials and preventing them from being released to the environment becomes more difficult. An objective of CERCLA is the long-term effectiveness and permanence of a remedy to address hazardous substances or contaminants (EPA 2021b). Neither Alternative 1 nor Alternative 2 provide a permanent remedy. For both Alternatives 1 and 2, residual contamination would ultimately need to be removed to achieve permanent site closure. A removal action is warranted to minimize those potential threats.

## 4.0 ENDANGERMENT DETERMINATION

This section provides a summary of any known and potential radiological and chemical contamination associated with the F-Complex. A detailed description of the nature and extent of hazardous substances and potentially hazardous materials within the F-Complex is found in the F-Complex HSA, including radiological contamination, chemical contamination, contaminated materials, and construction materials such as asbestos containing floor tile (DOE 2022a).

**Known and Potential Radiological Contamination.** Based on historical information and predictive modeling, the total activity contained within the F-Complex is estimated at approximately 1 Curie. One-half a Curie is estimated to exist within the defueled assemblies, and one-half a Curie from known fixed contamination, inaccessible areas, pipe runs, and closed tank systems. The highest radioactivity levels are associated with the defueled assemblies housed within the buildings. There is potential for low, but detectable, levels of radioactive contamination on surfaces that may become newly exposed.

**Chemical Contamination.** Various quantities of hazardous substances (e.g., lead, PCBs, and beryllium), contaminated materials, and potentially hazardous materials (e.g., asbestos, beryllium, lead, and PCBs) are present in discrete areas throughout the buildings and in some piping and ventilation systems. Friable and non-friable asbestos is present in thermal insulation, floor and ceiling tiles, transite, paint, and caulk/sealant. A former machine shop area in Building F1 has low, but detectable beryllium dust contamination in the overhead areas (ceiling) primarily on overhead beams, ductwork, and other

inaccessible locations. Lead is present in lead shielding around reactor components, lead anchors in masonry walls, lead-based paint, and various equipment (switches, relays, wiring, piping, meters, fluorescent lamps, batteries). PCBs are present in some paints and in light ballasts. Mercury contamination is likely to be found in old utility switches and gauges throughout the F-Complex.

Contaminants within F-Complex are contained by the structures themselves; therefore, current risks to the environment and on-site personnel who do not enter the buildings are negligible. However, the probability of future contaminant release to the environment will increase over time if building deterioration continued, which could lead to structural failure and subsequent contaminant release. As a part of the EE/CA (DOE 2022b), DOE qualitatively evaluated the potential risks to identify the relative levels of risk (“low,” “medium,” or “high”) that could be encountered. The risk evaluation used available sampling and survey data from the site to identify the specific contaminants of concern, provided an estimate of how and to what extent people might be exposed to them, and provided an assessment of the health effects associated with them. This risk evaluation approach is consistent with 40 Code of Federal Regulations (CFR) 300.415, the National Contingency Plan “Removal Action” authorities (EPA 2021a).

Risks to the F-Complex from fire and adverse weather that could cause contaminants to be released, causing danger to public health, welfare, and/or the environment, are managed through the ongoing LFM program activities such as walkdowns, inspections, and overall building maintenance. Although the magnitude of risk to human health and the environment is considered small, the intent of CERCLA is to eliminate the potential for future releases. The controlled removal of the F-Complex will ensure that the intent of CERCLA is met.

## **5.0 SELECTED ACTION ALTERNATIVE AND ESTIMATED COSTS**

### **5.1 Selected Action Alternative**

The selected removal action alternative involves cleanout of the three defueled assemblies and demolition of F-Complex Buildings F1, F2, F3, F4, and F6. The F-Complex EE/CA (DOE 2022b) identified and evaluated three alternatives to address the environmental condition of the F-Complex. The EE/CA recommended that Alternative 3 (“Demolition of F-Complex”) be selected as the preferred alternative. This Action Memorandum is the decision document for the F-Complex NTCRA process and names the preferred alternative in the EE/CA as the selected action alternative. For purposes of the selected action, “cleanout” entails dismantling the tanks, equipment, and piping within the defueled assemblies followed by decontamination of the reactor cells prior to removing the defueled assemblies and the radiological contamination associated with them. This alternative will fully satisfy the removal action objectives (RmAOs) by eliminating the sources of contamination, both radiological and chemical. All applicable or relevant and appropriate requirements (ARARs) will be attained.

**TTR Cleanout.** Facility surveys, sampling, and analysis will be performed to characterize the former TTR reactor cell in detail to support cleanout and waste disposition. Following cleanout of the TTR, the area would be surveyed and areas identified as needing decontamination would be decontaminated to reduce levels of both removable and fixed contamination.

**FCPE Cleanout.** The FCPE is the largest of the three former reactors housed within the F-Complex, requiring considerable planning and engineering during final design. Facility surveys, sampling, and analysis will be performed to characterize the former FCPE reactor cell in detail to support cleanout and waste disposition. DOE anticipates that portions of Building F2, and possibly Building F4, will be removed to allow the reactor vessel and associated support systems to be removed. After the reactor vessel and FCPE support equipment have been removed, the area would be surveyed to determine the extent of any decontamination required and any identified areas will be decontaminated to reduce levels of both removable and fixed contamination.

**FPR Cleanout.** Facility surveys, sampling, and analysis will be performed to characterize the former FPR reactor cell in detail to support cleanout and waste disposition. Following cleanout of the FPR, areas would be surveyed and those identified as needing decontamination will be decontaminated to reduce levels of both removable and fixed contamination.

**F-Complex Building Demolition.** Prior to building demolition, existing utilities and service systems (e.g., water, sewer, drain lines, air and gas lines, fire protection services, electrical service systems, ventilation systems, etc.) will be rerouted and/or isolated to separate the F-Complex from other active facilities at the Knolls Laboratory. Facility surveys, sampling, and analysis will be performed to characterize the buildings in detail to support demolition and waste disposition. Asbestos abatement will be performed in accordance with requirements under the Clean Air Act of 1970 for asbestos control to remove all friable or non-friable ACM prior to demolition. Any other potentially hazardous materials (e.g., PCB light ballasts) will also be removed during the pre-demolition activities.

Building demolition will involve systematic dismantling and removing all utilities and service systems and demolishing the roofs and walls. Robust building demolition will include demolition of the 2- to 5-foot thick walls surrounding the former reactors and former fuel vault. The building slabs will be removed, including basement structures. Slab removal will include removal of incidental soil adjacent to the slabs or footings. Subgrade demolition will also involve removal of utilities that have been isolated and/or rerouted.

**Sampling, Excavation, and Backfilling.** Once the building, rubble, and incidental soil are removed, the soil will be surveyed, sampled, and characterized to identify any areas of residual contamination. Further excavation of soil to remediate the F-Complex area to meet cleanup standards will be implemented, pending the soil characterization results. The building footprint will then be backfilled with compacted clean backfill material to support future development of the site by DOE.

**Waste Generation and Disposal.** Wastes generated during this removal action alternative will be characterized and segregated by waste type (e.g., low-level radioactive, mixed low-level radioactive, regulated/hazardous, and nonhazardous debris). All wastes will be containerized according to U.S. Department of Transportation requirements and will be transported offsite using established commercial truck routes. Each waste type will be disposed of at a permitted disposal facility specifically authorized to accept the waste generated. Additional waste management optimization measures, such as segregating wastes by waste type, treatment where appropriate, and recycling materials to the extent practicable, would be implemented.

## 5.2 Schedule

DOE will pursue a procurement action to award the scope of work for the F-Complex removal action alternative. This process is anticipated to take 12 months. Upon completion of the full scope of the removal action, the F-Complex site would be returned to the NR program.

## 5.3 Estimated Costs

Capital costs associated with demolition of the F-Complex include costs to clean out the radiologically contaminated defueled assemblies, tanks, equipment, and piping within the former reactor cells; remove the chemically contaminated building materials, hazardous substances, and other potentially hazardous materials; demolish the structure; dispose of the associated wastes; and excavate and backfill. Capital costs are estimated at \$68.4 M. There are no long-term operation and maintenance costs associated with the proposed removal action. Correspondingly, the total present worth cost is estimated at \$68.4 M. Table 2 summarizes the estimated costs associated with the selected removal action alternative.

<b>Table 2. Estimated Costs of the Selected Removal Action Alternative</b>	
<b>Cost Category</b>	<b>Estimated Costs</b>
<b>Capital Costs</b>	
TTR Cleanout	\$3,560,000
FCPE Cleanout	\$16,974,000
FPR Cleanout	\$1,819,000
F-Complex Building Demolition	\$42,202,000
Sampling, Excavation, and Backfilling	\$3,830,000
<b>Total Capital Cost</b>	<b>\$68,385,000</b>
<b>Operation and Maintenance Costs</b>	
<b>Total Operation and Maintenance Costs</b>	<b>\$0</b>
<b>Present Worth Costs</b>	
<b>Total Present Worth Costs</b>	<b>\$68,385,000</b>

## **6.0 EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN**

Should the proposed removal action be delayed or not taken, DOE would be required to continue surveillance and maintenance activities within the F-Complex buildings to prevent unacceptable exposures to on-site personnel or inadvertent release of contaminants to the environment. All structures and former reactors would remain in their current state and all contamination within the buildings would remain unchanged. Routine surveillance activities would include access controls, radiation monitoring, air monitoring, and personnel monitoring. Maintenance activities would include necessary repairs and routine maintenance activities.

## **7.0 OUTSTANDING POLICY ISSUES**

There are no outstanding policy issues.

## **8.0 ENFORCEMENT**

The DOE Environmental Management Consolidated Business Center New York Project Support Office is conducting this removal action as the lead agency under the authority of 40 CFR 300.5, "Definitions," (EPA 2021c) and 40 CFR 300.415, "Removal Action (EPA 2021a)."

## **9.0 RATIONALE FOR SELECTION**

DOE has followed the CERCLA process in evaluating removal action alternatives in the EE/CA (DOE 2022b) and in evaluating public input received during the public review process. Based on those evaluations, DOE has selected the Demolition of the F-Complex as the preferred removal action alternative. Although it will cost more than other options and will take longer to complete the capital construction activities, it will be an effective and permanent remedy that is readily implemented with demonstrated technologies, will not require any post-construction long-term monitoring or maintenance, and will make the building footprint available for future development by DOE in continuing its research mission at the Knolls Laboratory. Demolition of the F-Complex fully satisfies RMAOs by eliminating the

sources of contamination, both radiological and chemical. There will be no residual risk once the demolition is complete. The two formal public comments on the EE/CA received during the public comment period both indicated support for DOE's preferred RmAO.

While it is recognized that this alternative presents a greater potential for certain impacts such as noise and waste transportation traffic than the other alternatives, the majority of the impacts (e.g., impacts to air quality, water quality, soil or groundwater, or aesthetics), are negligible or minor. Numerous best management practices would be employed to mitigate project impacts and to comply with regulations, referred to as ARARs. Potential noise impacts during demolition are expected to be minor due to the location of the F-Complex at the northern end upper level of the Knolls Laboratory, away from any residential areas. These impacts would be managed by scheduling work during hours consistent with local ordinances. Potential air quality impacts during asbestos removal and building demolition would be minimized through use of appropriate engineering controls and compliance with ARARs to protect against offsite release. Potential offsite impacts would be negligible, as the removed equipment, waste, and debris would be disposed of in existing, permitted, facilities authorized to accept such wastes. Potential transportation impacts and risks would be greater than other alternatives due to the greater volume of wastes to be disposed offsite and the greater number of trips. However, transportation risks would be minimized by using established haul routes. Traffic impacts would be minimized by scheduling trips in consideration of commuting peak times, school bus routes and schedules, road and street maintenance, etc.

The recommended alternative would be planned, designed, and implemented to achieve compliance with action-specific ARARs governing general construction practices, building demolition, waste management, and waste transportation.

The alternative would comply with radiation protection requirements in controlling radiation exposures to as low as reasonably achievable. The alternative would comply with the location-specific ARAR for the National Historic Preservation Act of 1966, notably through completing the mitigation measures identified in the Knolls Laboratory Programmatic Agreement (NYSHPO 2017) to mitigate any adverse effects that the demolition of the buildings would have on the Historic District. All the stipulated measures will be complete prior to implementation of the selected alternative.

## **10.0 AUTHORIZING SIGNATURES**

This document presents the selected removal action for the F-Complex within the Knolls Laboratory site located in Niskayuna, NY, developed in accordance with CERCLA. This decision is based on the Administrative Record for the site.

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John Zimmerman, Environmental Management  
Consolidate Business Center, Director

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G. F. Holden, Assistant Manager for Operations,  
Naval Reactors Laboratory Field Office

## REFERENCES

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- DOE 2022a *Historical Site Assessment for the F-Complex*. DOE Environmental Management Consolidated Business Center – New York Project Support Office. December 2022.
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- EPA 2021c 40 Code of Federal Regulations, Part 300.5. “Definitions.” Office of the Federal Register, July 2021.
- NYSHPO 2017 *Programmatic Agreement Among the U.S. Department of Energy – Naval Reactors Laboratory Field Office at the Knolls Atomic Power Laboratory and the New York State Historic Preservation Office*. New York State Historic Preservation Office, signed by M. Lynch, Director, Division for Historic Preservation. February 17, 2017.

## **APPENDIX A**

### **RESPONSIVENESS SUMMARY**

Two comments were received during the public comment period for the EE/CA. The two comments were both supportive of the preferred alternative and did not include recommendations for modifications to the preferred alternative. See the Executive Summary and Section 9.0 for a description of the public involvement process employed for the F-Complex action.