Niagara Falls Storage Site – Interim Waste Containment Structure

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ABSTRACT

The Niagara Falls Storage Site (NFSS) is a 77.3-hectare (ha) (191-acre) property that is owned by the
United States Government and located in the township of Lewiston, Niagara County, New York. The NFSS is part of the former Lake Ontario Ordnance Works (LOOW) that was used by the War Department beginning in 1942 for the production of trinitrotoluene (TNT). During the 1940s and 1950s, the Manhattan Engineer District and the Atomic Energy Commission brought various radioactive wastes and uranium processing byproducts (residues) resulting from our nation's atomic energy program to the LOOW for storage.

Site operations caused soil, sediment, and groundwater contamination that lead to several remedial actions, which culminated in the construction of the Interim Waste Containment Structure (IWCS) on the NFSS. The U. S. Army Corps of Engineers (USACE)-Buffalo District is the lead Federal agency for Formerly Utilized Sites Remedial Action Program (FUSRAP) remediation of the NFSS. As the lead agency, USACE is conducting a remedial investigation/feasibility study (RI/FS) pursuant to the protocols set forth in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA activities at the NFSS have transitioned from the site RI activities to the FS evaluation of potential remediation alternatives. USACE recognizes the need to implement a focused CERCLA FS process and, therefore, has established three separate operable units (OUs) for NFSS: the IWCS OU, the Balance of Plant (BOP) OU [i.e., all on-site areas outside the boundary of the IWCS], and the Groundwater OU.

This paper will discuss the following:

- Provide background information on the NFSS including the nature of the materials within the IWCS.
- Explain the steps of the CERCLA and associated processes the Formerly Utilized Sites Remedial Action Program (FUSRAP) employs.
- Describe the OUs for the NFSS property and the subunit designations used in the FS evaluations for the IWCS OU.
- Provide the current project status within the CERCLA framework and path forward for all OUs and Vicinity Properties (VPs). Identify the Applicable or Relevant and Appropriate Requirements (ARARs) preferred by USACE and the regulatory agencies and explain the differences between the two positions.
- Provide the comparative evaluation of the remedial alternatives assessed in the FS.

- Identify the justifications for the USACE - Buffalo District selecting the preferred remedial alternative within the Proposed Plan.

The remedial action objectives for the IWCS OU are designed to provide short- and long-term protection
of human health and the environment. CERCLA requires that any action taken be protective of human health and the environment as well as be compliant with identified ARARs. USACE evaluated "No Action" and four potential remedial alternatives for the IWCS OU that ranged from leaving all of the wastes in-place and installing a final cover to partial and full removal of the contents. The four alternatives met the remedial action objectives defined identified for the IWCS OU. In accordance with the statutory requirements of CERCLA Section 121, remedial alternatives must comply with two threshold criteria, overall protection of human health and the environment and compliance with ARARs, in order to be carried forward for further evaluation. If a remedial alternative meets the threshold criteria, it is evaluated against the following five balancing criteria:

- Long-term effectiveness and permanence;
- Reduction in toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability; and,
- Cost.

The Feasibility Study evaluation led to the preferred remedial alternative selection and this will be the focus of this paper.

INTRODUCTION

The Niagara Falls Storage Site (NFSS) is a 77.3-hectare (ha) (191-acre) property that is owned by the
United States Government and located in the township of Lewiston, Niagara County, New York. The NFSS is part of the former Lake Ontario Ordnance Works (LOOW) that was used by the War Department beginning in 1942 for the production of trinitrotoluene (TNT). During the 1940s and 1950s, the Manhattan Engineer District and the Atomic Energy Commission brought various radioactive wastes and uranium processing byproducts (residues) resulting from our nation's atomic energy program to the LOOW for storage.

Site operations caused soil, sediment, and groundwater contamination that lead to several remedial actions, which culminated in the construction of the Interim Waste Containment Structure (IWCS) on the NFSS. The U. S. Army Corps of Engineers (USACE)-Buffalo District is the lead Federal agency for Formerly Utilized Sites Remedial Action Program (FUSRAP) remediation of the NFSS. As the lead agency, USACE is conducting a remedial investigation/feasibility study (RI/FS) pursuant to the protocols set forth in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA activities at the NFSS have transitioned from the site RI activities to the FS evaluation of potential remediation alternatives. USACE recognizes the need to implement a focused CERCLA FS

process and, therefore, has established three separate operable units (OUs) for NFSS: the IWCS OU, the Balance of Plant (BOP) OU [i.e., all on-site areas outside the boundary of the IWCS], and the Groundwater OU.

USACE - Buffalo District recommended the preferred remedial alternative for the Interim Waste Containment Structure (IWCS) after performing a detailed evaluation of potential remedial alternatives within the FS in accordance with the protocols set forth in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The FS details and evaluates remedial alternatives, ranging from no action through complete removal of IWCS materials. Based on this evaluation, the PP selects complete removal and off-site disposal of the IWCS materials as the preferred remedial alternative for the IWCS OU.

Site Background: NFSS is located at 1397 Pletcher Road in the Town of Lewiston, Niagara County, New York, approximately 4 miles (mi) east of the Niagara River and 1.5 miles southeast of the Lewiston-Porter public school. The site is a 191-acre, federally owned portion of the former 7,500-acre Lake Ontario Ordnance Works (LOOW) and houses a 10-acre interim waste containment structure (IWCS) (Figure 1).

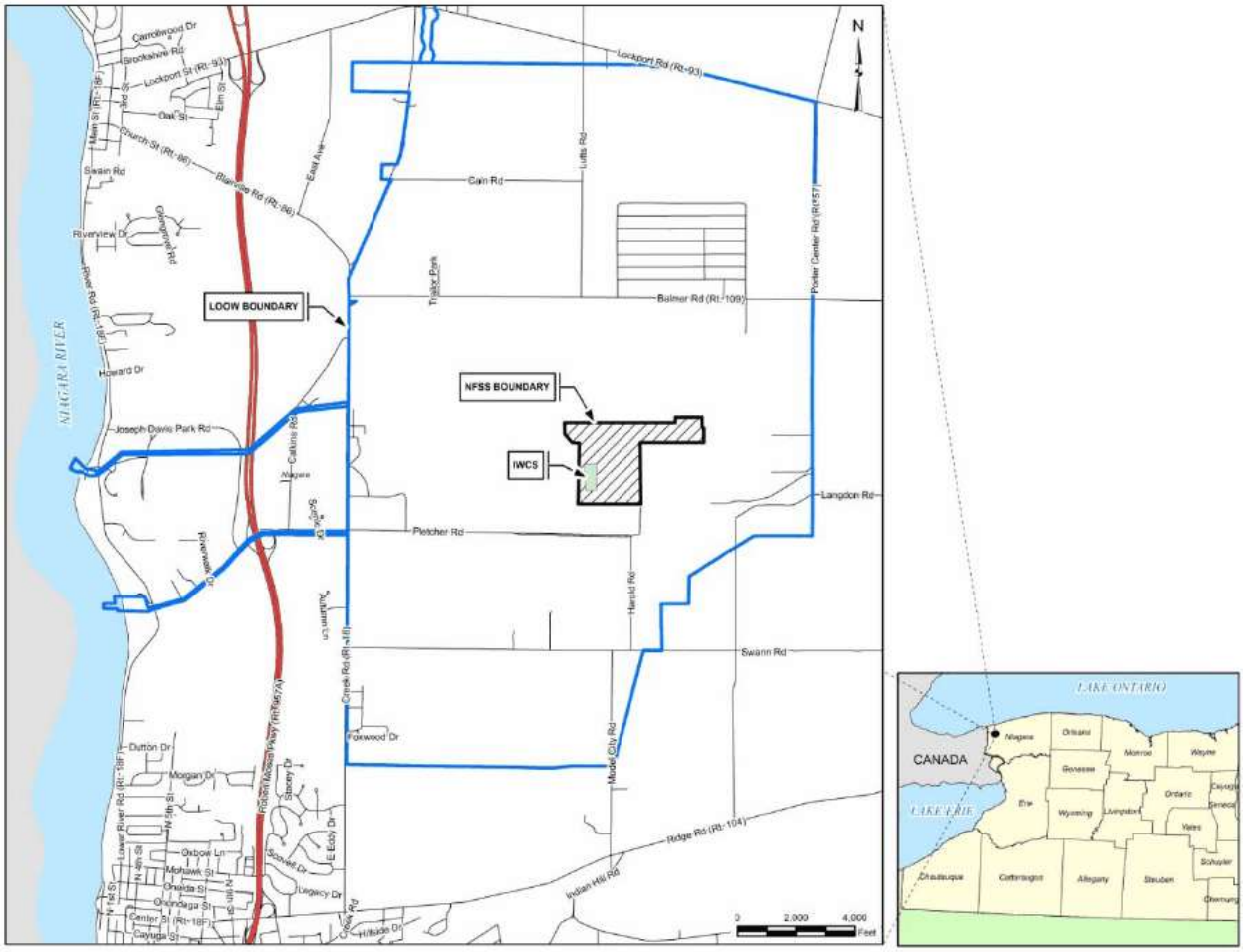

Figure 1: General Location of the Niagara Falls Storage Site

The LOOW property, which is currently being investigated under DERP-FUDS, was originally developed for the production of trinitrotoluene (TNT) during World War II. After the war, 6,000 acres of the former LOOW site were transferred or sold to a variety of federal and non-federal landowners. While still under government ownership, the remaining 1,500-acre portion of the former LOOW site became an interim radioactive waste storage facility, first receiving Manhattan Engineer District (MED) radioactive wastes and residues in 1944 and later used by the Atomic Energy Commission (AEC). Interim remedial actions that occurred during the 1970s and early 1980s consolidated radioactive residues stored throughout the LOOW on the NFSS property. In addition, these actions addressed impacted soils and on-site and off-site drainage areas that had been contaminated from migration of radioactive materials stored on the LOOW.

FUSRAP investigations continue on the NFSS, which is currently in FS phase of the CERCLA process. In addition, portions of the former LOOW (outside the NFSS) are the subject of on-going hazardous toxic and radioactive waste (HTRW) and/or potentially responsible party (PRP) projects under DERP-FUDS, which are also managed by the USACE Buffalo District.

The NFSS property is bordered on the north and northeast by Chemical Waste Management, LLC (CWM) (a hazardous waste disposal facility); on the east and south by the Modern Landfill, Inc. (a solid waste disposal facility); and on the west by a transmission corridor owned by National Grid (an electric supply company). All of the aforementioned properties were once part of the LOOW. Figure 2 is a site map showing the NFSS boundary, 10-acre IWCS boundary, and remaining vicinity properties (VPs) of the NFSS that require further radiological investigation by the USACE under FUSRAP. VPX is the 22-acre former waste water treatment plant for the LOOW site, which was transferred to the Town of Lewiston in the 1970s. VPE, VPE', VPG, and VPH' are currently owned by CWM.

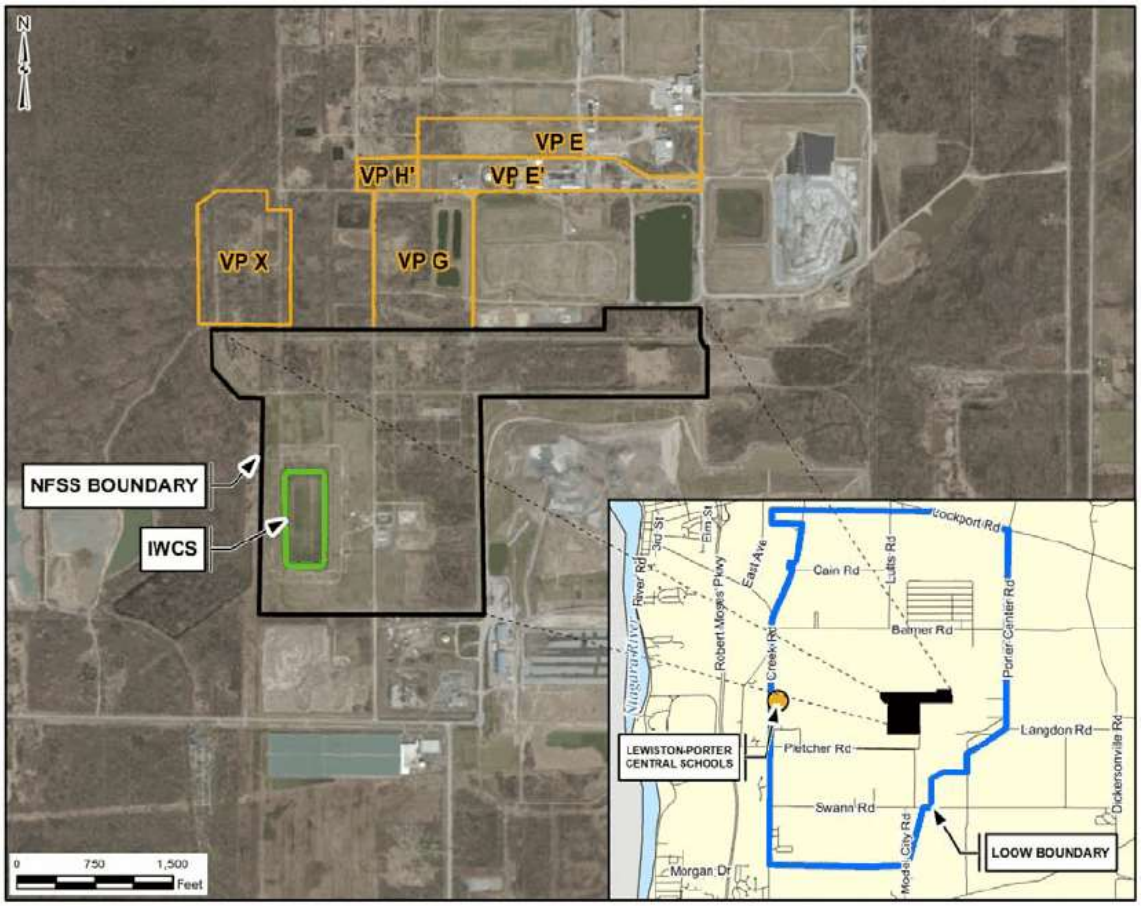

Figure 2: Location of the Niagara Falls Storage Site and associated Vicinity Properties

IWCS Background: During remedial actions conducted by the U.S. Department of Energy (USDOE) from 1982 to 1986, approximately 278,000 cubic yards of residues and wastes were consolidated in an engineered landfill known as the IWCS. The engineered IWCS is located in the southwest corner of the site as shown in Figure 3. The IWCS is a 10-acre engineered landfill surrounded by a clay dike/cut-off wall that is keyed into an underlying natural gray clay layer and covered with an interim clay cap (Figures 3, 4, and 5). Within the IWCS, the radioactive residues, K-65, L-30, L-50, and F-32 [i.e., pitchblende uranium ore residues], were placed in existing concrete structures that had been part of the freshwater treatment plant for the LOOW during the 1940s. The residues differ by ores processed and concentration of radioactive materials. The K-65 residues have the highest concentration of radon-generating radium and therefore of the most concern. These buildings, located in the southern end of the IWCS as shown in the left photo of Figure 3, were made of reinforced concrete and originally designed to securely hold liquids. The R-10 residues remain in a pile to the north of these buildings buried within the IWCS, where they were originally placed. In addition to the residues, soil and debris generated from historic USDOE cleanup activities at the site and nearby areas (the VPs) were placed over the residues and covered by a multi-layered cap. The USDOE intended to monitor this interim remedy until a final remedy was implemented.

Although the USDOE developed draft and final Environmental Impact Statements in 1984 and 1986, respectively, a Record of Decision (ROD) regarding the residues within the IWCS was never signed by the USDOE, due to strong opposition of their preferred plan (leave in place) by local, state, and federal political representatives, the United States Environmental Protection Agency (USEPA), and the New York State Department of Environmental Conservation (NYSDEC).

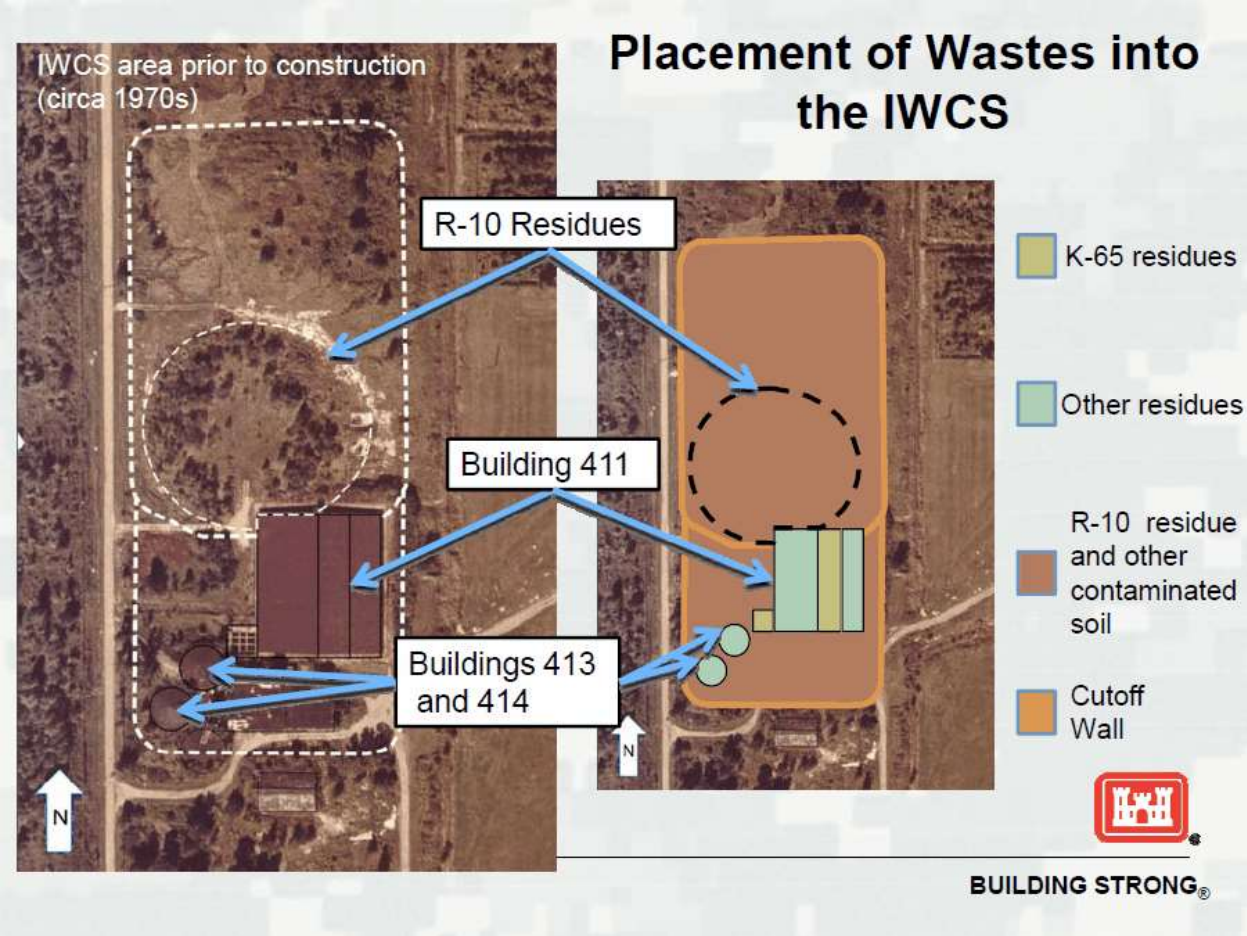

Figure 3: Placement of Wastes in the Interim Waste Containment Structure at the Niagara Falls Storage Site

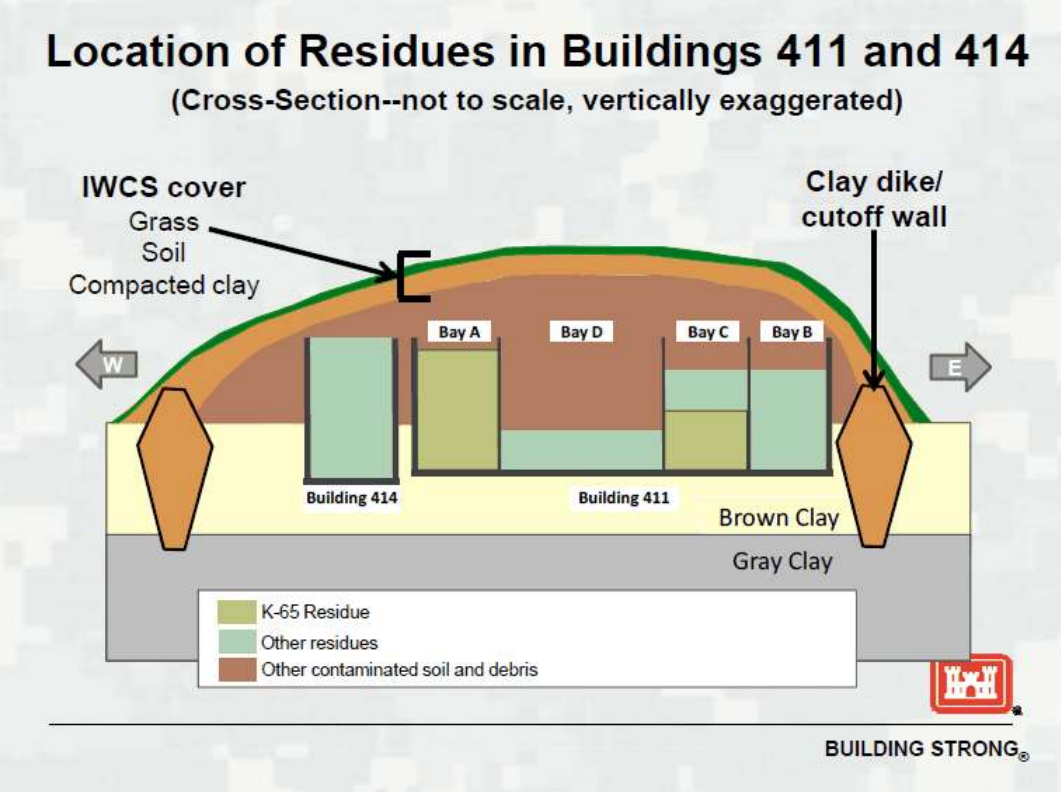

Figure 4: Cross Section (East-West) of the Interim Waste Containment Structure

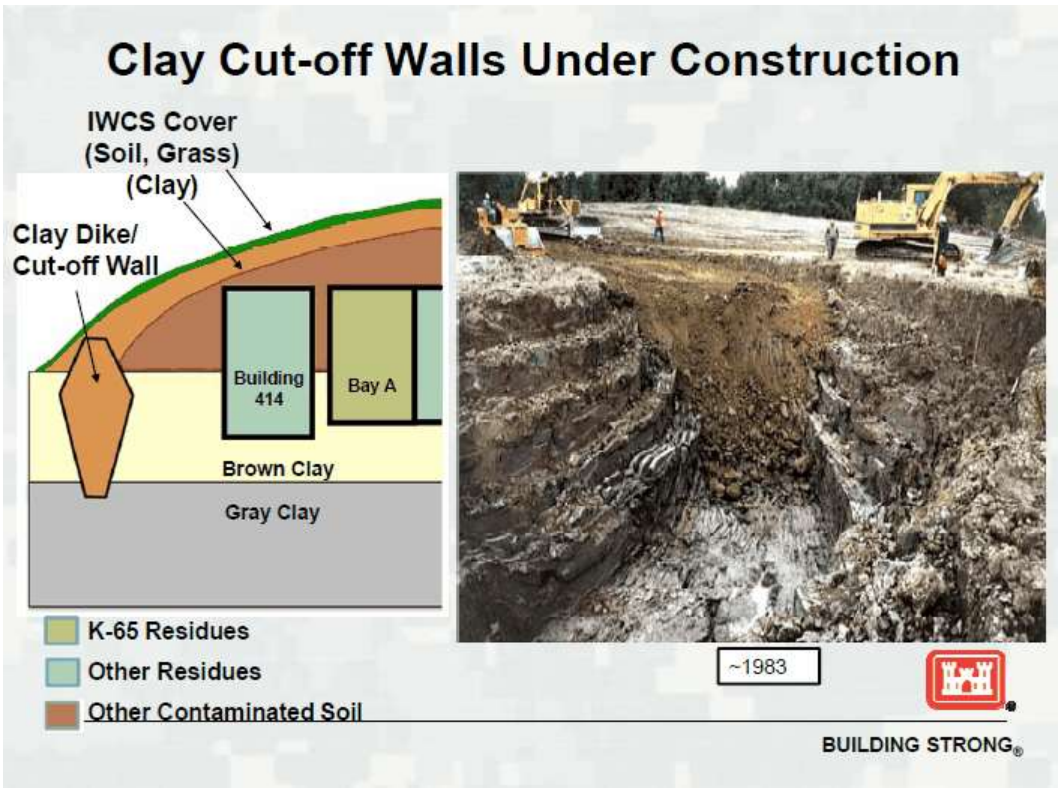

Figure 5: Clay Cutoff Wall Construction (South End) of the Interim Waste Containment Structure

The residues buried within the IWCS emit high levels of gamma radiation and produce radon gas from the decay of radium-226, both of which present a potential risk to human health and the environment. The IWCS is engineered to retard radon emissions, gamma emissions, infiltration from precipitation, and migration of contamination to groundwater. USDOE constructed the IWCS in the late 1980s by covering the most radioactive waste (the ore residues) with lower-activity waste from historic soils remediation and a multi-layer cap. The design life of the existing IWCS cap is 25 to 50 years, and the design life of the native clay bottom, clay dike, and clay cut-off wall is estimated to be 200 to 1,000 years. Several investigations have been conducted to review the physical integrity of the cap and dike/cut-off walls. These investigations have found that the IWCS is intact, is performing as designed, and presents no current risk to human health or the environment. Over 30 years of data collected for the Environmental Surveillance Program at the NFSS confirms that IWCS site controls are continuing to perform as designed and are fully protective of human health and the environment.

CERCLA Process: USACE is the lead federal agency for implementing FUSRAP according to protocols set forth in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), applying the standard criteria set forth in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA activities at the NFSS have transitioned into the FS evaluation of potential remedial alternatives for the first of three separate operable units (OUs), the IWCS OU. The remaining two OUs are the Balance of Plant (BOP) OU and the Groundwater OU. The NCP (Title 40 *Code of Federal Regulations [CFR]* Section 300.430[a][ii][A]) states that sites should generally be remediated in OUs when phased analysis is necessary given the size or complexity of a site.

Designating three separate OUs at the NFSS allows USACE to address the IWCS first because the IWCS poses the greatest potential future risk to human health and the environment if operation and maintenance of the IWCS were to cease. The definitions of the IWCS OU, BOP OU, and Groundwater OU are provided as follows and locations illustrated in Figure 6:

- IWCS OU - The waste material (i.e., uranium ore residues and other remedial action waste) placed in the engineered landfill within the diked area at the NFSS.
- Balance of Plant OU - All material at the NFSS not placed within the IWCS, excluding groundwater.
- Groundwater OU - Groundwater contamination remaining in the upper water-bearing zone after implementation of the selected remedial actions for the IWCS and Balance of Plant OUs.

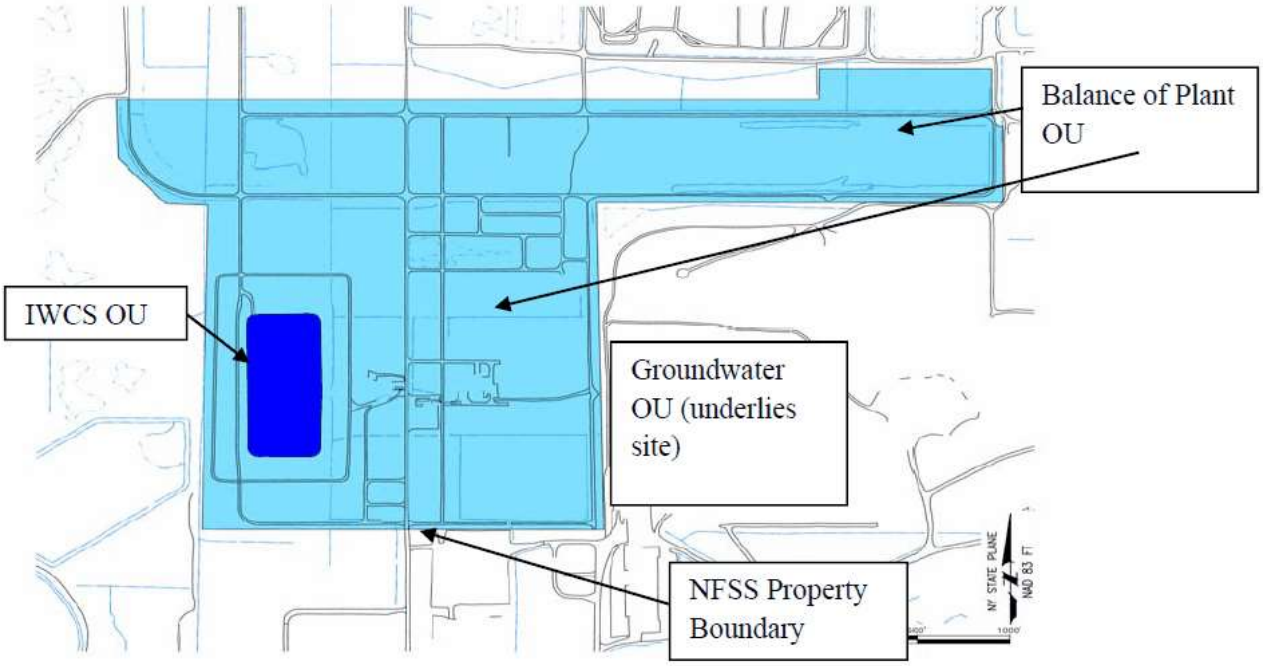

Figure 6: Operable Units at the Niagara Falls Storage Site

To facilitate the IWCS OU FS process, USACE developed a series of technical memoranda that allowed USACE to:

- Engage and inform the public on key technical issues in the early stages of the CERCLA FS process so that public concerns could be fully considered during the development of FS; and
- Allow the final IWCS OU FS publication to contain information and conclusions that incorporated previously received input from the public, thus promoting a more efficient public review process for the IWCS OU FS document.

The four technical memoranda and their dates of public release are as follows:

- *Waste Disposal Options and Fernald Lessons Learned* (July 2011)
- *Radon Assessment* (January 2012)
- *IWCS Health Effects* (February 2012)
- *Interim Waste Containment Structure Remedial Alternatives Technologies Development and Screening* (April 2013)

USACE - Buffalo District identified potential waste disposal options for the residue material within the IWCS during development of the *Waste Disposal Options and Fernald Lessons Learned Technical Memorandum*. Primary waste disposal conclusions were as follows:

- Waste Control Specialists (WCS) in Andrews, Texas is a viable option for permanent disposal of the K-65 residues in their Federal Disposal Facility 11e.(2) byproduct cell.
- WCS and the Texas Commission on Environmental Quality (TCEQ) have both indicated that the K-65 residues could be disposed in the byproduct cell during USACE - Buffalo District's development of the *Waste Disposal Options and Fernald Lessons Learned Technical Memorandum* in 2011 and a subsequent USACE audit of the WCS byproduct cell in February 2013.
- The byproduct disposal cell at WCS already contains the K-65 residues from the Fernald site (i.e., USDOE completed remedial actions at Fernald in 2006).
- Other disposal cells (e.g., Energy Solutions) are viable options for the remaining residues and IWCS materials.
- DOE will own the WCS byproduct cell upon closure.

The phases of the CERCLA process and current status for the IWCS OU are summarized in Figure 7.

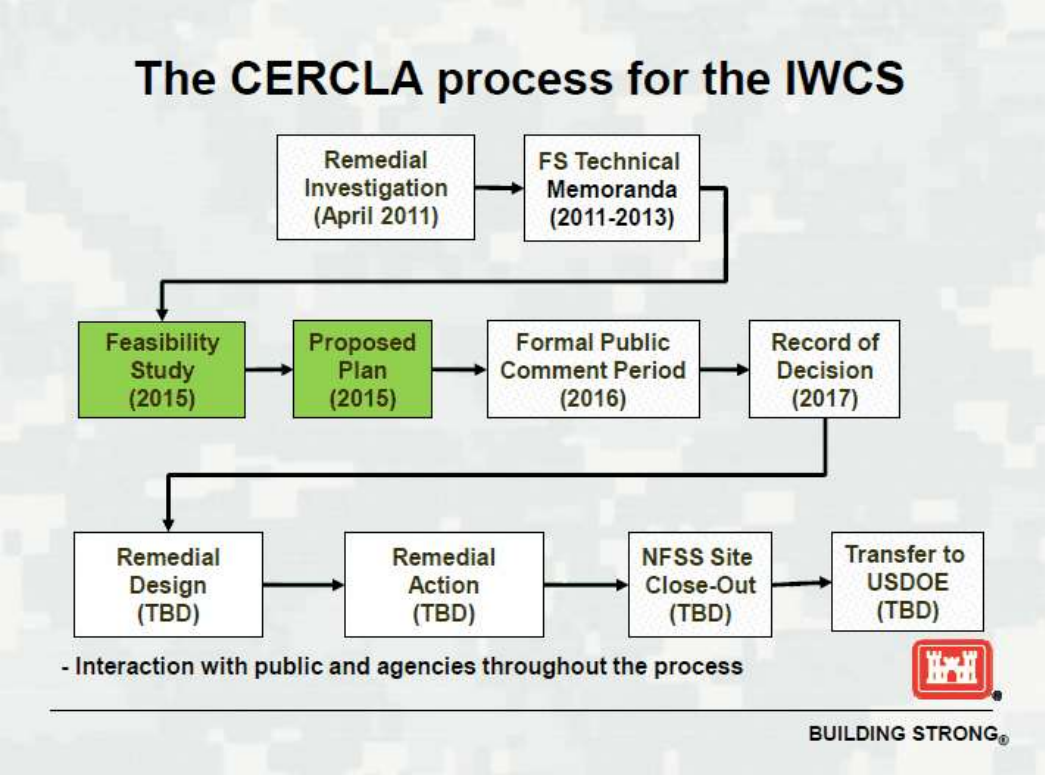

Figure 7: The CERCLA Process for the Interim Waste Containment Structure

The remedial alternative selected in the Record of Decision will be implemented through a detailed remedial design process and remedial action. It is possible that remedial action for some or all of the OUs and VPs will be done in a coordinated manner. Once remedial action is complete and all objectives are met, the site will go through closeout and will be transferred to the USDOE Office of Legacy Management for long-term stewardship.

Per the Memorandum of Understanding (MOU) between USACE and USDOE (1999), the USACE will transfer a completed FUSRAP site to the USDOE Office of Legacy Management two years after completion of the remedy using the following process:

- Provide the USDOE with a signed copy of the declaration of response action completion, Site Closeout Report, and any operations and maintenance and land-use control implementation plans required to ensure future protectiveness of the implemented remedy.
- Request and provide the USDOE with any letters from regulators, if available, acknowledging that remedial action goals have been met.
- Provide the USDOE with an estimate of annual out-year cost requirements, a general description of the remedial goals, and any restrictions remaining on the property.
- Notify and provide the effective transfer date to the USDOE Office of Legacy Management for their long-term stewardship. This notification will occur at least ninety days before the end of the two-year operations and maintenance period for which USACE is responsible. Property owners and regulators will also be notified of the site transfer date and requirements.
- Provide USDOE with the administrative record upon site transfer.

ARARs: ARARs define standards, requirements, criteria or limitation under any Federal environmental law, or a state environmental or siting law more stringent than the Federal standard. The requirements may be applicable to the site contaminants, OR, they may be relevant and appropriate. The lead agency, USACE, identifies the ARARs and all viable remedial alternatives evaluated within the FS, which must comply with these ARARs. CERCLA Section 121 (d) "Degree of cleanup" directs that any remedial action selected shall attain a degree of cleanup of hazardous substances, pollutants and contaminants released into the environment, or control of further release, that at a minimum assures the protection of human health and the environment. Such remedial actions shall also be relevant and appropriate under the circumstances *presented by the release* or threatened release of such substance, pollutant or contaminant. With respect to any hazardous substance, pollutant or contaminant *that will remain onsite* the remedy selected shall attain a standard, requirement, criteria or limitation under any federal environmental law *or* any promulgated standard, requirement, criteria, or limitation under a state environmental or facility siting law that is more stringent than the federal standard, and has been identified by the state in a timely manner, which is legally applicable to the hazardous substance or pollutant or contaminant concerned *or* is relevant and appropriate under the *circumstances of the release* or threatened release of such hazardous substance or pollutant or contaminant. The statute puts the emphasis on the degree of cleanup, or in other words, how clean is clean enough if a hazardous substance, pollutant or contaminant remains at the site.

USACE has reviewed potential ARARs for the IWCS OU at NFSS and identified the following promulgated regulations as ARARs:

- 10 CFR 40, Appendix A: Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material From Ores Processed Primarily for Their Source Material Content
  - Criterion 4, Site and Design Criteria
  - Criterion 6(1), 6(2), 6(3), 6(5), 6(6), and 6(7), Closure of Waste Disposal Areas
  - Criterion 12, Long-term Site Surveillance
  - 40 CFR 61: National Emissions Standards for Hazardous Air Pollutants; Subpart Q - National Emission Standards for Radon from Department of Energy Facilities

USACE's selected ARARs require the final remedy to provide 1,000 years of protectiveness for human health and the environment. The key elements considered during USACE's ARAR analysis are as follows:

- The majority of the radiological material stored in the IWCS consists of the residues, and material the residues may have contacted (e.g., contaminated soil).
- The residues are the waste generated by the processing of uranium ore and are commonly known as uranium mill tailings.
- The residues or uranium mill tailings in the IWCS were all generated before the Atomic Energy Act was modified in 1978 to authorize regulation of uranium mill tailings as 11e.(2) byproduct material. The USEPA was directed to develop "standards of general application…for the protection of the public health, safety, and the environment from radiological and non-radiological hazards associated with (uranium mill tailings)" for both the active and inactive processing sites (42 U.S.C. § 2022). Concurrently, USDOE was authorized to regulate uranium mill tailings associated with past operations, commonly referred to as Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I sites, and the Nuclear Regulatory Commission (NRC) was given the responsibility to regulate all existing and future uranium milling operations (Title II sites). The NFSS uranium mill tailings were not explicitly addressed by the Act.
- Section 312 of the Energy and Water Development Appropriations Act for the fiscal year ending September 30, 2004, states:

  "SEC.312. Notwithstanding any other provision of law, the material in the concrete silos at the Fernald uranium processing facility currently managed by the United States Department of Energy and the ore processing residual materials in the Niagara Falls Storage Site subsurface waste containment structure managed by the United States Army Corps of Engineers under the Formerly Utilized Sites Remedial Action Program will be considered 'byproduct material' as defined by section 11e.(2) of the Atomic Energy Act of 1954, as amended [42 U.S.C. 2014(e)(2)]. The Nuclear Regulatory Commission or an Agreement State, as appropriate, will regulate

the material as '11e.(2) byproduct material' for the purpose of disposition of the material in an NRC-regulated or Agreement State-regulated facility."

The 11e.(2) byproduct material is explicitly regulated as a separate class of waste, distinct from low-level radioactive waste, high-level waste, and transuranic (TRU) waste. These provisions authorize its disposal at properly licensed 11e.(2) disposal facilities.

Uranium ore processing residues such as those in the IWCS OU and addressed by the UMTRCA regulations:

- Exhibit radionuclide constituents that are well established, consisting of naturally occurring uranium, thorium and actinium decay series radionuclides with thorium-230 and radium-226 being the long-lived radionuclides of primary concern;
- Represent the constituents remaining after the extraction of uranium from ores that are processed primarily for their source material content and thus, the origin of the waste is substantially different than for TRU radioactive waste;
- Consist primarily of thorium-230 and radium-226 and progeny with concentrations of actinium-series radionuclides being on the order of 4.4 percent of the activity or uranium-series constituents;
- Have a small number of radionuclides that exhibit long half-lives: thorium-230 (75,380 years), radium-226 (1,601 years), protactinium-231 (32,400 years) and thorium-232 (14 billion years), with the latter being present at less than 5 percent of the activity of the other stated radionuclides; and,
- Are hazardous primarily due to radon decay products and external gamma emissions.

IWCS OU FS: USACE - Buffalo District divided the IWCS OU into three subunits:

- Subunit A - high activity residues including K-65 residues located in the southern half of the IWCS;
- Subunit B - debris/waste from the K-65 slurry operation that, along with Subunit A, occupy the entire southern half of the IWCS; and,
- Subunit C - low activity residues [known as R-10] and contaminated soils from vicinity property cleanups in 1980s that comprise the entire northern half of the IWCS.

The subunits are shown on the following figure:

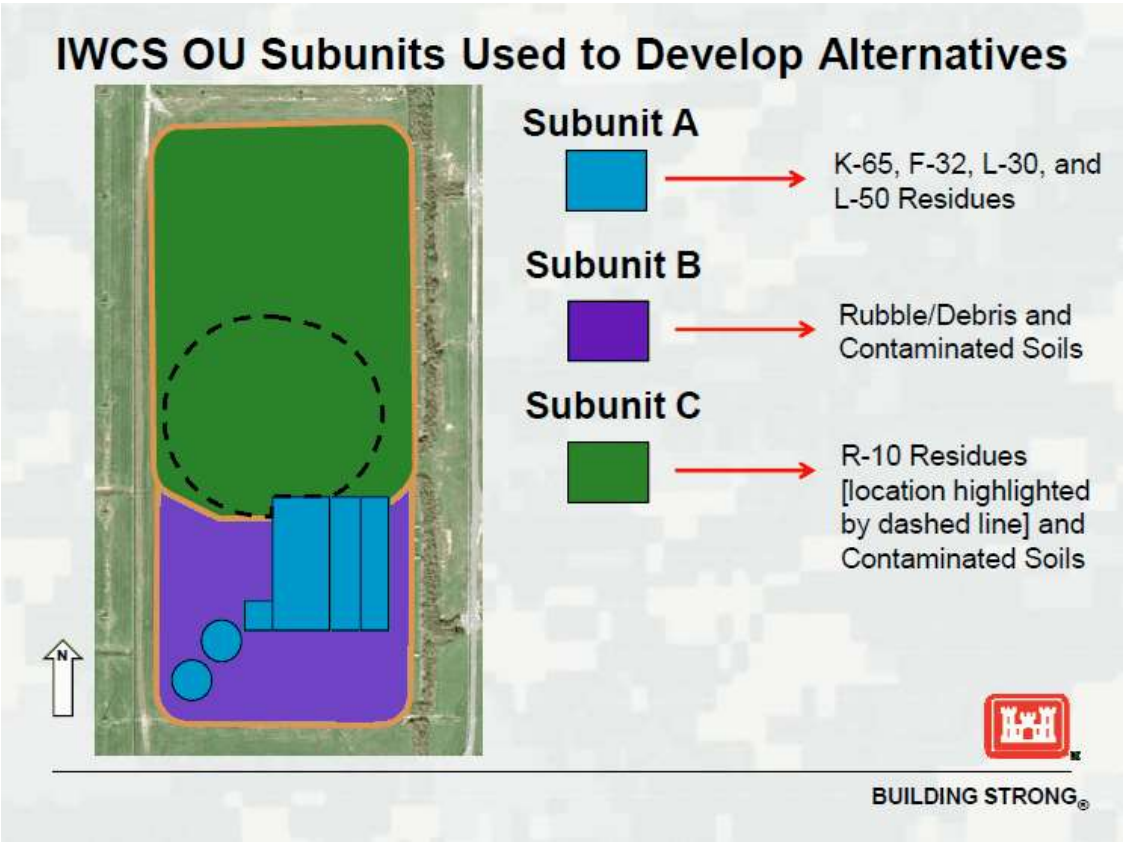

Figure 8: The Subunits for the Interim Waste Containment Structure

A remedial action objective is a specific goal that remedial alternatives must fulfill to be protective of human health and the environment. Remedial action objectives provide the basis for selecting remedial technologies and developing and evaluating remedial alternatives.

The remedial action objectives for the IWCS OU are designed to provide short- and long-term protection of human health and the environment based on plausible future land uses for the NFSS. CERCLA requires that any action taken be protective

of human health and the environment as well as be compliant with identified ARARs. The remedial action objectives for the IWCS OU are as follows:

- Prevent unacceptable exposure of receptors to the hazardous substances associated with uranium ore mill tailings (e.g., radium-226 and its short-lived decay products) inside the IWCS.
- Minimize/prevent the transport of hazardous substances within the IWCS to other environmental media (e.g., soil, groundwater, surface water, sediment, and air) outside of the IWCS.
- During implementation of the remedial alternatives(s), minimize/prevent releases and other impacts that could adversely affect human health and the environment, including ecological receptors.

USACE evaluated "No Action," which is required by CERCLA, and four potential remedial alternatives for the IWCS OU that ranged from leaving all of the wastes in-place and installing a final cover, to partial and full removal of the contents. The four alternatives met the remedial action objectives identified for the IWCS OU. The five remedial alternatives considered are as follows:

- Alternative 1 - No Action
- Alternative 2 - Enhanced containment of Subunits A, B, and C with land-use controls and monitoring
- Alternative 3A - Excavation, treatment, and off-site disposal of Subunit A; enhanced containment of Subunits B and C with land-use controls and monitoring
- Alternative 3B - Excavation, treatment, and off-site disposal of Subunit A; excavation and off-site disposal of Subunit B; enhanced containment of Subunit C with land-use controls and monitoring
- Alternative 4 - Excavation, treatment, and off-site disposal of Subunit A; excavation and off-site disposal of Subunits B and C

In accordance with the statutory requirements of CERCLA Section 121, remedial alternatives must comply with two threshold criteria: 1) overall protection of human health and the environment and 2) compliance with ARARs, in order to be carried forward for further evaluation. If a remedial alternative meets the threshold criteria, it is evaluated against the following five balancing criteria:

- Long-term effectiveness and permanence,
- Reduction in toxicity, mobility, or volume through treatment,
- Short-term effectiveness,
- Implementability, and
- Cost.

A summary of the remedial alternatives comparative evaluation against the two threshold and five balancing CERCLA criteria is as follows:

TABLE I: Comparative Analysis of Alternatives for the IWCS Feasibility Study

Criterion	Alternative 2 Enhanced containment of Subunits A, B, and C with land-use controls and monitoring	Alternative 3A- Excavation, Treatment, and Off-site Disposal of Subunit A; Enhanced Containment of Subunits B and C with Land-use controls and Monitoring	Alternative 3B- Excavation, Treatment, and Off-site Disposal of Subunit A; Excavation and Off-site Disposal of Subunit B; Enhanced Containment of Subunit C with Land-use controls and Monitoring	Alternative 4- Excavation, Treatment, and Off-site Disposal of Subunit A; Excavation and Off-site Disposal of Subunits B and C
Overall protection of human health and the environment	Yes	Yes	Yes	Yes
Compliance with ARARs	Yes	Yes	Yes	Yes
Long-term effectiveness and permanence	Moderate	High	High	High
Criterion	Alternative 2 Enhanced containment of Subunits A, B, and C with land-use controls and monitoring	Alternative 3A- Excavation, Treatment, and Off-site Disposal of Subunit A; Enhanced Containment of Subunits B and C with Land-use controls and Monitoring	Alternative 3B- Excavation, Treatment, and Off-site Disposal of Subunit A; Excavation and Off-site Disposal of Subunit B; Enhanced Containment of Subunit C with Land-use controls and Monitoring	Alternative 4- Excavation, Treatment, and Off-site Disposal of Subunit A; Excavation and Off-site Disposal of Subunits B and C
Reduction of toxicity, mobility, and volume through treatment	Low	Moderate	Moderate	Moderate
Short-term effectiveness	High	Moderate	Moderate	Low

Implementability	High	Moderate	Moderate	Moderate
Cost (capital)	$23.4M	$259.6M	$318.4M	$490.6M
Cost (O&M discounted)	$44.0M	$44.0M	$44.0M	$0
Total Discounted Cost	$67.4M	$303.6M	$362.4M	$490.6M
Total Non-Discounted Cost	$1.47B	$1.71B	$1.77B	$490.6M

O&M – operation and maintenance

NOTES: 1. Costs are based on a period of performance of 1,000 years consistent with USACE's preferred ARAR. 2. Discounted cost is used to evaluate expenditures that occur over different timeframes by turning all future dollar expenditures into a current dollar value. The discounted cost is the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial action over its planned life. Non-discounted costs are actual costs to the Federal Government, which include 1,000 years of operation, maintenance, and environmental surveillance for any of the leave in place remedial alternatives. 3. No action alternative was not included because it doesn't meet the threshold criteria nor does it have any associated costs.

Our technical team realized early on in the FS development that costs would be a major concern for our stakeholders. As a result, conceptual designs were developed for each remedial alternative within the FS to mitigate potential criticism from stakeholders and provide more cost certainty to make an informed decision on the final remedy selection. The conceptual designs are equivalent to at least a 30 percent design and provide a greater level of detail than is commonly provided in an FS with additional emphasis on the estimation of construction materials quantities and definition of work control requirements. They were developed in part by some of the technical experts involved in the DOE's previous successful remediation of the K-65 residues and other radioactive wastes removed from and managed on-site at the Fernald, Ohio site. In addition, the cost estimates include a formal analysis of cost and schedule risk and necessary contingencies to address those risks. Remedial alternative capital costs are inclusive of remedy implementation and include planning, design, remedial activities, waste packaging and transport, waste disposal, and site restoration. Operation and maintenance costs are the post-remediation costs for operating and maintaining the leave-in-place remedial alternatives for 1,000 years.

Key takeaways from this comparative evaluation are as follows:

- Enhanced Containment Actions (Alternative 2):
    - Although the existing cover on the IWCS is protective and effectively inhibits the release of radon and gamma emissions and minimizes the infiltration of water, the proposed new cover provides additional safeguards, such as a geosynthetic membrane (geomembrane) that

provides a barrier to water infiltration for hundreds of years; decreased side slopes that protect against damage from flood-induced erosion; a riprap layer that discourages intrusion; and, added thickness to guard against seismic activity.

- The key components of this alternative include land-use controls and monitoring. This means engineered and institutional/administrative controls must prevent human exposure to the material in the IWCS for 1,000 years. Additionally, five-year reviews will be required for 1,000 years to ensure the remedy remains protective of human health and the environment and compliant with ARARs.
- The Federal Government currently owns the NFSS property and will continue to own the property at least as long as the IWCS exists, or until a Federal interest is no longer required. If the IWCS continues to exist, the Federal Government is committed to ensuring the security of the site and maintaining the IWCS so that it continues to be protective of human health and the environment. This commitment remains even if the FS cost estimate proves erroneous whether it adjusts up or down.
- The K-65 residues will pose a potential risk to human health and the environment well beyond 1,000 years.
- Does not satisfy the preference in NCP for treatment of any amount of the waste.
- The current and enhanced containment cover is depicted as follows:

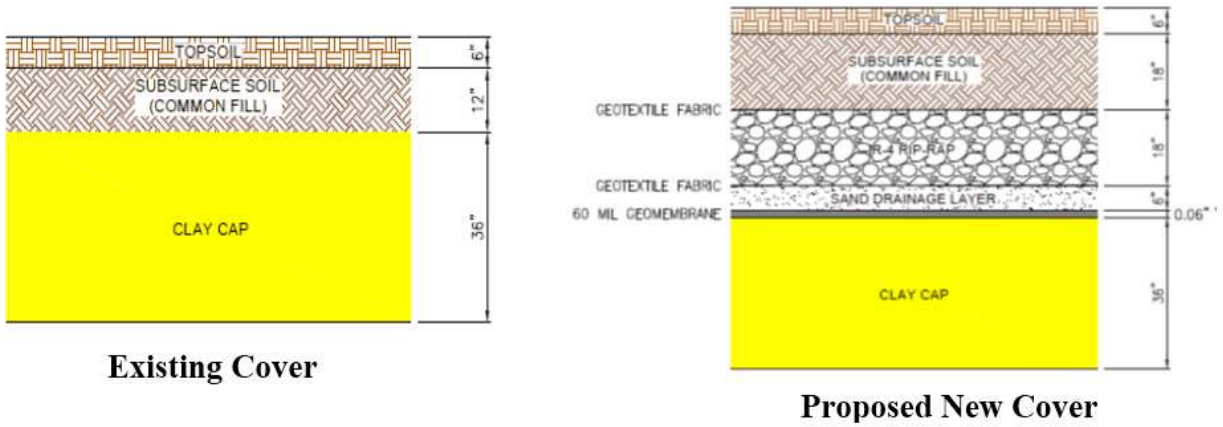

Figure 9: Details of the Existing Cover and Final Cover

- Partial to Full Removal Actions (Alternatives 3A, 3B and 4):

  - The K-65 residues are treated to make the contaminants less mobile and thereby satisfies the NCP's preference for treatment of hazardous substances.
  - All of the material in Subunit A (28,440 cubic yards), which contains the residues with the higher average radioactivity, will be excavated,

treated, and disposed. The treated K-65 residues will be placed in steel containers that will provide shielding for transport and ultimate disposal in the WCS 11e.(2) byproduct cell designed and proven to provide protection of human health and the environment for 10,000 years.

- K-65 residues account for only one percent of the volume but over 90 percent of the radioactivity (from radium-226) in the IWCS depicted as follows:

- The IWCS cap would be removed (partially or fully) and the wastes would be handled and transported to a licensed facility. These activities present potential short-term impacts to the community, workers, and the environment during remediation. To address these issues, controls have been included and added to the cost of the alternatives to minimize potential impacts. Fernald lessons learned provided the basis for designing and costing the necessary controls.
- The treated K-65 residues will exhibit reduced contaminant mobility and radon emanation.
- The risk for construction and vehicle related accidents would be increased due to volume of waste and materials requiring packaging and transport.

- The main difference between alternatives 3A, 3B and 4 is the volume of material excavated for off-site disposal or alternatively, the volume of material left in-place for long-term maintenance and monitoring. The total radium-226 radioactivity (curies) associated with these volumes are also a distinguishing factor, as is the total cost of each alternative. These details are presented in the following table:

TABLE II: Radioactivity Remaining for Evaluated Alternatives

No.	Alternative Description	Volume Excavated and Treated to Reduce Mobility[2] (curies removed/treated)	Volume Excavated[1] (curies removed)	Volume Left in-place with New Cover (curies remain)	Total Discounted Cost[3]
2	Enhanced containment of Subunits A, B, and C with land-use controls and monitoring	0	0	278,072 yd^3 (2,144 Ci)	$67.4M (capital: $23.4M)

					(O&M: $44M)
3A	Excavation, treatment, and off-site disposal of Subunit A[4]; enhanced containment of Subunits B and C with land-use controls and monitoring	6,030 yd^3 (1,950 Ci)	60,587 yd^3 (172 Ci)	211,455 yd^3 (22 Ci)	$303.6M (capital: $259.6M) (O&M: $44M)
No.	Alternative Description	Volume Excavated and Treated to Reduce Mobility[2] (curies removed/treated)	Volume Excavated[1] (curies removed)	Volume Left in-place with New Cover (curies remain)	Total Discounted Cost[3]
3B	Excavation, treatment, and off-site disposal of Subunit A[5]; excavation and off-site disposal of Subunit B; enhanced containment of Subunit C with land-use controls and monitoring	6,030 yd^3 (1,950 Ci)	90,878 yd^3 (190 Ci)	181,164 yd^3 (4 Ci)	$362.4M (capital: $318.4M) (O&M: $44M)
4	Excavation, treatment, and off-site disposal of Subunit A; excavation and off-site disposal of Subunits B and C	6,030 yd^3 (1,950 Ci)	272,042 yd^3 (194 Ci)	0	$490.6M (capital: $490.6M) (O&M: $0M)

TABLE II

- **[1]**Volumes include materials placed in the IWCS in addition to assumed volumes of potentially impacted clay surrounding the IWCS. Also, this total does not include the 6,030 cubic yards that also will be excavated because this volume will be treated and is included in the adjacent column.
- **[2]**Treatment includes stabilization, solidification, and containerization of K-65 and commingled L-50/F-32 residues in Subunit A.
- **[3]** Discounted costs assume Operation and Maintenance (O&M) costs over a period of 1,000 years.
- **[4]** It is assumed that 32,839 $yd^3$of Subunit B and 5,338 yd^3 of Subunit C will be excavated to access Subunit A.
- **[5]** It is assumed that 5,338 yd^3 of Subunit C will be excavated to access Subunit A.
- yd^3 – cubic yards
- Ci – curies
- M – million

Proposed Plan: All five remedial alternatives were retained for detailed evaluation in the IWCS OU Feasibility Study. These alternatives ranged from No Action (Alternative 1) to partial and complete removal of materials in the IWCS. The inclusion of the No Action Alternative is required by CERCLA, but since it was determined in the IWCS Feasibility Study to not be protective of human health, it will not be considered further in the Proposed Plan. The remaining four alternatives include:

- Alternative 2 - Enhanced containment of Subunits A, B, and C with land-use controls and monitoring
- Alternative 3A - Excavation, treatment, and off-site disposal of Subunit A; enhanced containment of Subunits B and C with land-use controls and monitoring
- Alternative 3B - Excavation, treatment, and off-site disposal of Subunit A; excavation and off-site disposal of Subunit B; enhanced containment of Subunit C with land-use controls and monitoring
- Alternative 4 - Excavation, treatment, and off-site disposal of Subunit A; excavation and off-site disposal of Subunits B and C

As indicated by the descriptions above, the remedial alternatives share several common elements including:

- Enhanced containment (new cover), land-use controls, and monitoring for a period of 1,000 years (Alternatives 2, 3A, and 3B), and
- Excavation, treatment/containerization of the K-65 and commingled L-50 and F-32 residues, and off-site disposal (Alternatives 3A, 3B, and 4).

The Preferred Alternative for the IWCS is Alternative 4, excavation, treatment, and off-site disposal of Subunit A and excavation and off-site disposal of Subunits B and C. This alternative satisfies the CERCLA threshold criteria and reduces risk through treatment of a portion of the Subunit A residues, thereby providing increased long-term protectiveness. The total discounted cost of Alternative 4, however, is the greatest among the four remedial actions evaluated since discounted costs turn all future dollar expenditures into a current dollar value in accordance with CERCLA requirements. The total non-discounted costs are a better indicator of the future Federal Government environmental liability.

Like Alternative 4, Alternatives 3A and 3B also include treatment of Subunit A residues, yet the long-term risk reduction of Alternatives 3A, 3B, and 4 are the same. In fact, the additional material removed under Alternative 4 (i.e., Subunits B and C) only increases the cost. No reduction of risk is realized because the IWCS materials that remain in-place under Alternatives 3A and 3B would be contained in an enhanced IWCS, which would offer the same level of protection as a permitted off-site disposal facility provided by Alternative 4.

Alternatives 3A, 3B, and 4 would satisfy stakeholders (e.g., regulators and community) who have long stated their desire that a portion of Subunit A (the K-65 residues) be removed from the IWCS. However, Alternative 4 is likely the preferred

alternative of the stakeholders based on over thirty years of correspondence from the regulators and community members. Selection of Alternative 2, enhanced containment of the IWCS, is the only alternative that would likely be contentious and would require considerable time and resources to defend.

Although Alternative 4 costs 38 percent more ($187M) than Alternative 3A and 26 percent more ($128.2M) than Alternative 3B, there are long-term benefits that should be considered when all material is removed from the IWCS. The benefits of Alternative 4 are appreciated from a long-term risk management perspective.

Under Alternative 4, the 11e.(2) byproduct waste in the IWCS would be consolidated with similar waste at an off-site government-owned or Nuclear Regulatory Commission-licensed 11e.(2) disposal facility. Under current regulation, post-operational long-term care following closure of 11e.(2) disposal facilities becomes the responsibility of either the state or ultimately, the Federal government (USDOE). While removing and consolidating the IWCS waste would require increased upfront capital costs, decreasing the overall number of 11e.(2) disposal facilities would reduce future spending on post-closure care of these facilities. It is also one of the stated goals of the Uranium Mill Tailings Radiation Control Act (UMTRCA) regulations, which discourages the "proliferation of small waste disposal sites," such as the IWCS, and encourages the reduction of "perpetual surveillance obligations." Consolidation of disposal sites also reduces the potential risk to the public from government-owned wastes.

Another significant benefit of the removal of all of the material in the IWCS under Alternative 4 is the opportunity to excess the NFSS property for beneficial re-use including the potential economic benefit for the local community. Optimizing the use of land and assets is in accordance with Goal 4 of USDOE's Legacy Management 2011-2020 Strategic Plan and is considered a national priority. The selection of Alternative 4 would achieve this goal.

Community and State input could alter or modify final remedy selection. There are nine CERCLA evaluation criteria grouped as threshold, balancing, and modifying. Threshold and balancing CERCLA evaluation criteria are evaluated in the FS. The modifying criteria, Community and State Acceptance, are evaluated during preparation of responses to public comments on the PP in order to make the final remedy determination in the Record of Decision (ROD). After reviewing and considering all information provided during the PP public review period, USACE may go forward with the PP, modify it, or select another remedial alternative documenting the final remedy selection in the ROD.

CONCLUSIONS

1. Eliminate a minimum of 1,000 years of operation, maintenance, and security and five year reviews documenting that the final remedy remains protective of human health and the environment.
2. Removal options will treat and solidify K-65 residues and place the treated K-65 residues in steel containers for disposal at WCS byproduct cell satisfying the NCP preference for treatment of hazardous substances.

3. K-65 residues are 1% of the total volume of the IWCS, however their removal decreases radium radioactivity by over 90%.
4. Decreasing the overall number of byproduct disposal facilities would reduce future spending on post-closure care of these facilities and is one of the stated goals of the UMTRCA regulations. These regulations discourage "proliferation of small waste disposal sites," such as the IWCS, and encourage the reduction of "perpetual surveillance obligations." Consolidation of disposal sites also reduces the potential risk to the public from government-owned wastes.
5. Removal of all of the IWCS material provides an opportunity to excess the NFSS property for beneficial re-use. The USDOE's Office of Legacy Management is the agency that will ultimately be responsible for the operation and maintenance of the IWCS two years after completion of CERCLA activities. Optimizing the use of land and assets is in accordance with a goal of DOE's Legacy Management 2011-2020 Strategic Plan and is considered a national priority.
6. Cost effective due to technological advances and implementation of lessons learned from the successful remediation of the K-65 residues at the Fernald Site.
7. The selection of complete removal of the IWCS materials is based on a detailed technical evaluation.
8. The USEPA and the NYSDEC will oppose any remedial alternative that does not include removal of the K-65 residues. The National Academy of Sciences, in their report evaluating the safety of the uranium ore residues at the NFSS, recommended removal of the residues (1995). The USACE has been actively engaging the community throughout the development of the FS. The community is adamant about the USACE removing the K-65 residues.

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