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Final Removal Action Report for the LOFT Facility

January 2008

Idaho Cleanup Project

DOE/ID-11321

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Prepared for the
U.S. Department of Energy
DOE Idaho Operations Office

ABSTRACT

This Final Removal Action Report describes the actions that were taken under the non-time-critical removal action recommended in the *Action Memorandum for Decommissioning of TAN-630 and TAN-650 at the Loss-of-Fluid Test (LOFT) Area* as evaluated in the *Engineering Evaluation/Cost Analysis (EE/CA) for Decommissioning of TAN-630 and TAN-650 at the Loss-of-Fluid Test (LOFT) Area*. The Removal Action implemented the removal of above ground structures and components associated with TAN-630 and TAN-650, the removal of below ground components with the exception of the TAN-650 lower containment system, filling the upper and lower containment building sumps with solid inert material, capping appropriate pipe penetrations, filling the lower containment building proper with solid inert material, and the construction of a long-term viable cover overlaying the TAN-650 upper and lower containment building.

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ACRONYMS

ANPP	Aircraft Nuclear Propulsion Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
DOE-ID	U.S. Department of Energy Idaho Operations Office
EE/CA	Engineering Evaluation/Cost Analysis
FET	Flight Engine Test
HWMA	Hazardous Waste Management Act
ICDF	Idaho CERCLA Disposal Facility
IDEQ	Idaho Department of Environmental Quality
INL	Idaho National Laboratory (formerly INEEL)
LCRE	Lithium Cooled Reactor Experiment
LOFT	Loss-of-Fluid Test
PBS	polymeric barrier system
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RWMC	Radioactive Waste Management Complex
SMC	Specific Manufacturing Capabilities
TAN	Test Area North
USC	*United States Code*
WAG	Waste Area Group

Final Removal Action Report for the LOFT Facility

1. INTRODUCTION

1.1 Purpose and Objective

This Final Removal Action Report describes the actions taken under the non-time-critical removal action recommended in the *Action Memorandum for Decommissioning of TAN-630 and TAN-650 at the Loss-of-Fluid Test (LOFT) Area* (DOE-ID 2006) as evaluated in the *Engineering Evaluation/Cost Analysis (EE/CA) for Decommissioning of TAN-630 and TAN-650 at the Loss-of-Fluid Test (LOFT) Area* (DOE-ID 2006). The Removal Action implemented alternative 2, which was removing above ground structures and components associated with TAN-630 and TAN-650, removing below ground components with the exception of the TAN-650 lower containment system, filling the upper and lower containment building sumps with solid inert material, capping appropriate pipe penetrations, filling the lower containment building proper with solid inert material, and constructing a long-term viable cover overlaying the TAN-650 upper and lower containment building. The action was taken as described in the *Engineering Evaluation/Cost Analysis (EE/CA) for Decommissioning of TAN-630 and TAN-650 at the Loss-of-Fluid Test (LOFT) Area* — conducted pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 United States Codes [USC] § 9601 et seq.) See Figure 1 for before and after photos.

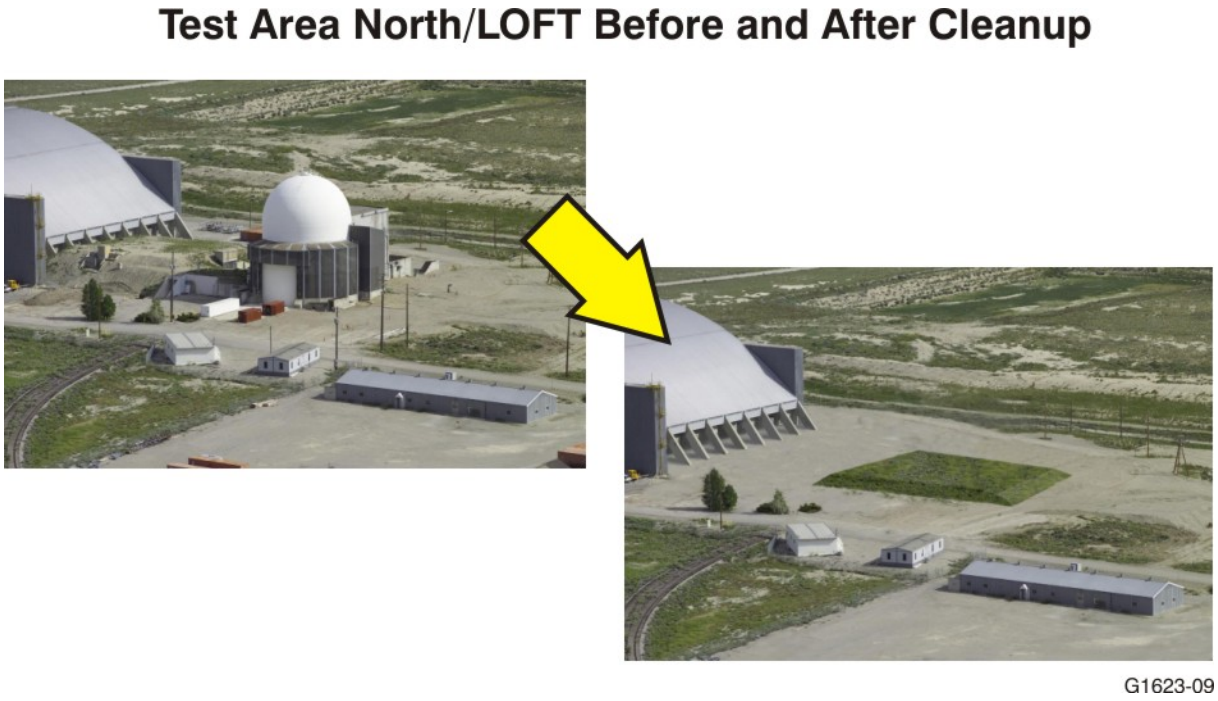

Figure 1. Implementation of preferred alternative.

1.2 Scope

Preparation activities for demolition consisted of the following: decontamination and equipment removal; removal and staging of shielding soil from TAN-630, TAN-650, and Room 219; closure of Specific Manufacturing Capability (SMC) tunnels; confirmation of electrical isolations from SMC;

construction of an access road to the tunnel east of TAN-650; removal of lighter-weight equipment from the facility; removal of the TAN-650 northwest hatch; removal of the boilers from TAN-630; preparation of the generator, borated water tank, and other large equipment for removal; removal of the off-gas system from the containment vessel; and other miscellaneous equipment removal for storage, disposal, or recycle.

Demolition phases were sequenced so that access to difficult areas could be achieved with overall productivity maintained. Phase 1 demolition activities focused on the single level structures and below grade areas. Phase 2 demolition activities focused on the multi-level TAN-650 structures. Phase 3 demolition activities focused on the containment vessel structure. Demolition activities are discussed further in Section 2 of this document.

1.3 Removal Action Objectives

The removal action was consistent with the remedial action objectives established in the Record of Decision (ROD) (DOE-ID 1999) and as identified in the engineering evaluation/cost analysis (EE/CA). As such, the removal action is consistent with and will contribute to the overall closure of Test Area North (TAN) under CERCLA (42 USC § 9601 et seq.).

The removal action objectives are described in Section 4.2 of the Action Memorandum (DOE-ID 2006). The mechanisms implemented under this non-time-critical removal action that achieved Removal Action Objectives are described in Section 3 of this document.

1.4 Facility Background and Description

TAN-630, the Loss-of-Fluid Test (LOFT) Control building, was constructed in 1959 as an integral part of the Flight Engine Test (FET) facility. The FET mission was to prove the feasibility of nuclear powered flight and the TAN-630 structure was constructed to house remote control, measuring, and data analysis associated with the nuclear airplane. The project was cancelled in 1961 before the airplane was built and TAN-630 was never used for its originally intended purpose. Several other activities were conducted at TAN-630 between 1961 until the early 1970's.

In 1972, other structures adjacent to TAN-630 were completed to support reactor loss-of-fluid testing. These new structures included a containment building, TAN-650, that housed the pressurized water reactor and its related components. The experiments were originally intended to simulate large break loss-of-coolant-accidents. The experiments and equipment were subsequently reconfigured to simulate small break accidents like the one that occurred in 1978 at the Three Mile Island Nuclear Power Plant in Pennsylvania. To demonstrate its ability to achieve shutdown in a runaway situation, the reactor core was intentionally destroyed in the mid-1980s. From 1975 through July 1985, a total of 44 significant experiments were conducted at LOFT. In 1986 at the conclusion of the LOFT project, the decontamination and inactivation effort resulted in the removal of the reactor and other radioactive components from the containment building, decontamination and clean-up, and plant shutdown. TAN-630 and TAN-650 remained in a deactivated condition until this removal action was completed.

2. REMOVAL ACTION WORK ACTIVITIES

The actions addressed under this removal action were consistent with Alternative 2 described in the Engineering Evaluation/Cost Analysis (DOE-ID 2006).

2.1 Actions Completed Prior to Non-Time-Critical Removal Action Implementation

A significant amount of deactivation took place prior to implementation of the removal action. Eighteen tank systems comprising 79 tanks were addressed under the Voluntary Consent Order, an enforceable agreement with the IDEQ that addressed several RCRA compliance issues. Seventeen of the tank systems (75 tanks) were characterized as RCRA non-hazardous or empty. One tank system was characterized as hazardous and the RCRA closure was completed in 2005.

Also during 2004 and 2005, major system components at TAN-630 AND TAN-650 were either removed or decontaminated. RCRA regulated components (e.g., silver and lead found in the contact points of high voltage breakers, lead contaminated brass and bronze in the form of sprinkler heads and valves) in TAN-630 and TAN-650 were removed and managed in accordance with federal, state, and local regulations and disposed off-site. During that timeframe, asbestos abatement was also performed in both TAN-630 and TAN-650.

2.2 Demolition Activities Associated with the Non-Time-Critical Removal Action

Preparation activities were followed by three demolition phases. Demolition phases were sequenced so that access to difficult areas could be achieved with overall productivity maintained.

Phase 1 demolition activities focused on the single level structures and below grade areas as follows: processing and disposal of TAN-630 structure; processing and packaging TAN-650 single level structures and below grade areas in the vicinity of the containment vessel; backfilling of areas to proper grade; construction of soil ramp to access upper structures; removal of equipment and piping; completion of SMC tunnel opening closures; and filling of containment vessel annulus, lower containment vessel, and sumps with solid inert material.

Phase 2 demolition activities focused on the multi-level TAN-650 structures as follows: removal of the roof and upper north and east cinder block walls to access the borated water tank; removal of the borated water tank; processing and packaging the remaining structure, equipment, and piping; backfilling of remaining areas to grade; and isolation of the containment vessel.

Phase 3 demolition activities focused on the containment vessel structure as follows: taking down the polar crane and containment vessel; removing the containment vessel door weather cover; removing the containment vessel railroad door; processing, segregating, and packaging containment vessel material; backfilling of remaining areas to grade; and constructing the final cover over the containment vessel area.

2.3 Final Status

Removal action work activities were successfully completed in November 2006.

2.3.1 Waste Disposition

Radiological surveying techniques resulted in the release of more potentially radiologically contaminated debris than was originally estimated. This resulted in the ability to use the adjacent TAN Demolition Landfill for a significant portion of the demolition waste. The use of a polymeric barrier system (PBS) as a lock-down fixative reduced the cost of size reduction efforts and waste containers. The use of a processor for handling large debris pieces eliminated time consuming hoisting and rigging efforts.

The volume of waste generated as part of this non-time-critical removal action is as follows:

- Clean waste dispositioned to the TAN Demolition Landfill: 14,966 yd^3
- Radiologically contaminated waste dispositioned to the ICDF Landfill: 1,186 yds^3
- Asbestos waste dispositioned to the CFA Landfill: 180 ft^3.

2.3.2 Radiation Levels

A Hummer drive over survey was conducted in October 2006 to ascertain the radiological conditions in the LOFT area. Current radiological conditions obtained from a site survey are shown in Figure 2. All areas were less than 1.1 pCi/g.

2.3.3 Cost

Demolition started after the Action Memorandum (DOE-ID 2006) was approved in March 2006. Demolition was completed in November 2006 upon seeding of the final cover over the containment vessel area. Total project cost for demolition activities associated with non-time-critical removal action implementation was $5.6 million.

3. Achieving the Removal Action Objectives

Implementation of this removal action is consistent with the remedial action objectives established in the OU1-10 ROD. As such, the removal action is consistent with and will contribute to the overall closure of TAN under CERCLA (42 USC § 9601 *et seq*.). The removal action objective identified in Section 4.2 of the Action Memorandum (DOE-ID 2006) was to reduce the risk from external radiation exposure from Cs-137 to a total excess cancer risk of less than 1 in 10,000 for a hypothetical resident 100 years in the future from the year 1995 and the current and future worker. Per the OU 1-10 ROD, the LOFT area will be under the control of the government until 2095. In addition, at the Idaho National Laboratory (INL), the standard for protecting the Snake River Plain aquifer is to prevent any release that could result in exceedances of the maximum contaminant level and ensure that the site is available for unrestricted use in the future. If such a standard is not met then institutional controls will have to remain in place. The removal action objectives were met as follows:

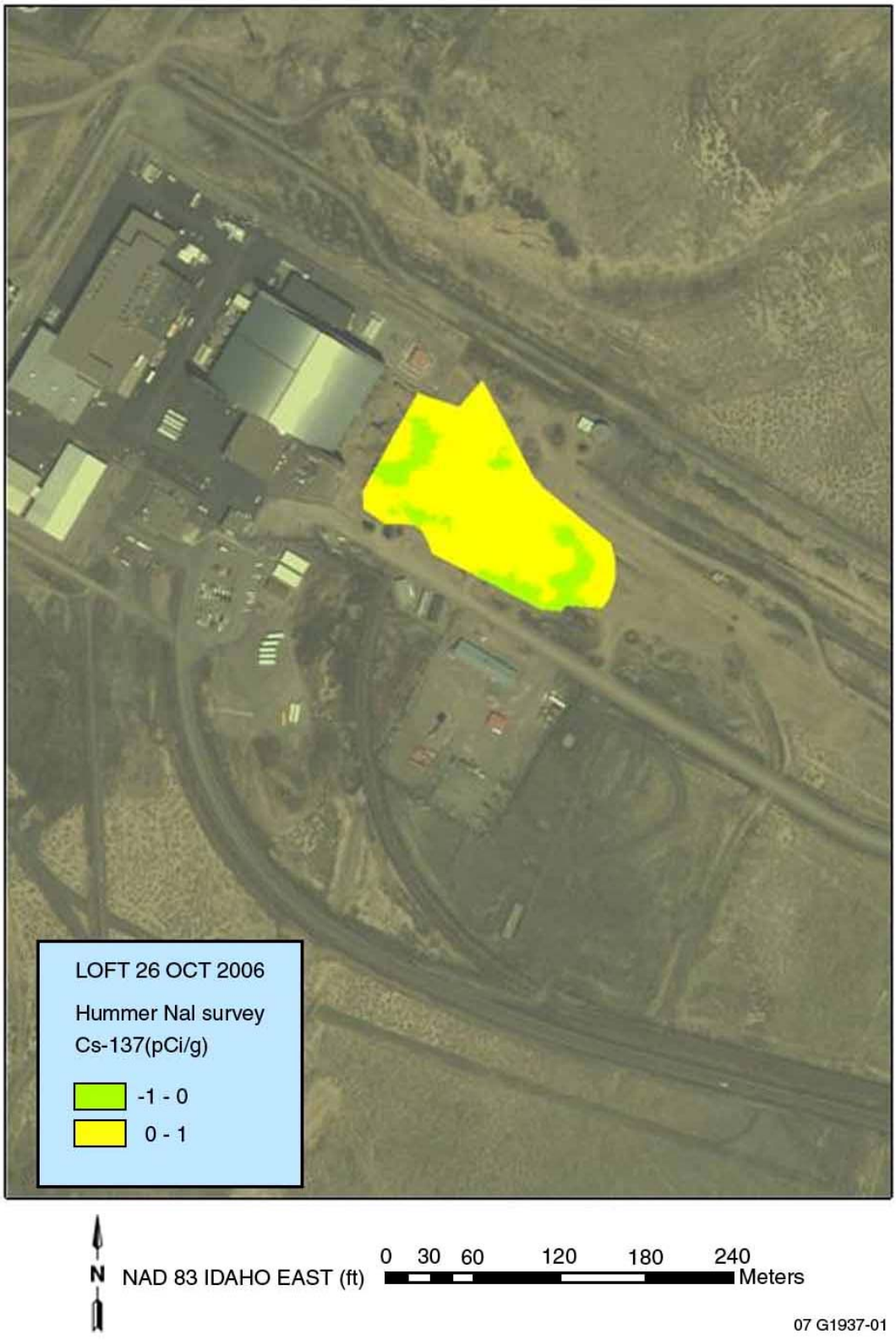

Figure 2. Survey Results in pCi/g.

- Reduction of the risk to the Snake River Plain Aquifer was achieved by removing above ground components and structures, collapsing and removing floors to 3 feet below grade for TAN-630 and TAN-650 miscellaneous, filling TAN-630 and TAN-650 to grade with solid inert material, and filling containment vessel sumps, annulus, and lower containment to grade with solid inert material (i.e., low-slump grout).

- The risk posed by contaminants associated with embedded piping, sumps, and drains beneath the containment vessel was evaluated in the EE/CA (DOE-ID 2006). A worst case risk assumption from radiological contamination was evaluated by considering an upper bound contaminant source term and exposure scenario associated with Alternative 2. The source term for the risk assessment was estimated by assuming the piping, sumps, and drains beneath TAN-650 were filled with liquids and sludge contaminated to the same degree as the material assumed to remain in the high-level waste sump piping and drains. These sumps, embedded pipes, and drains were assumed to contain the worst contamination that might be left in place after the proposed removal action was completed. The streamlined risk assessment demonstrated that the risk did not exceed a cumulative carcinogenic risk level of 1×10^{-4} for future residents in 2095 and for current workers.

4. Photos

Additional photo documentation of preparatory activities and demolition activities associated with implementation of the non-time-critical removal action is contained within the *LOFT Demolition Completion Report* (DOE-ID 2006).

Photo 1. Boilers being removed from TAN-630.

Photo 2. Removing CV off-gas (east side).

Photo 3. Processing TAN-630 to 3 feet below grade.

Photo 4. Constructing soil ramp at TAN-650.

Photo 5. Borated water tank removal.

Photo 6. Lower CV before grouting.

Photo 7. Lower CV after grouting.

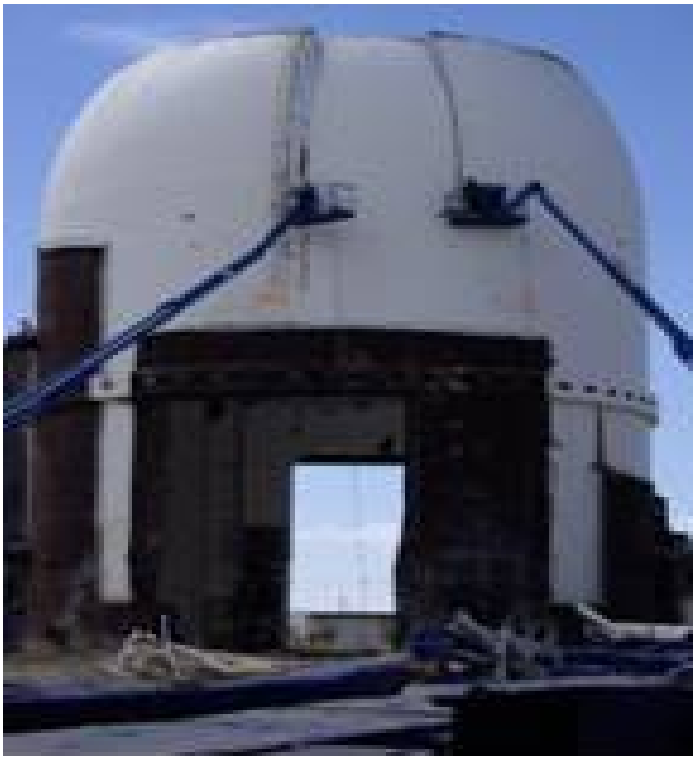

Photo 8. Cutting CV dome.

Photo 9. Cutting CV cap.

Photo 10. CV railroad doors on ground.

Photo 11. Backfilling remaining LOFT areas to grade.

Photo 12. Cement cover on upper CV.

Photo 13. Final cover over CV floor.

5. Lessons Learned

Throughout the implementation of the Removal Action, challenges and problems were encountered that were not foreseen during the planning and scheduling phases. Provided below are some of the more significant issues encountered during the implementation of the Removal Action and the corrective actions taken to overcome the problems.

5.1 Demolition of TAN-630 and TAN-650

Transportation of rubble to the TAN Demolition Landfill via the traditional route proved troublesome due to travel distance and interaction with pedestrian traffic. Facility personnel identified an alternative route to the TAN Demolition Landfill that was both a shorter distance and avoided pedestrian traffic areas. Obtaining the proper heavy equipment with proper attachments and adequate support resources optimized transport of rubble to the TAN Demolition Landfill.

Confusion associated with structure elements, foundations, slabs, and equipment was alleviated by having large size drawings of all facilities available for pre-job briefings and field demolition activities. A binder of the old construction photos also assisted in quick identification of buried items.

5.2 Demolition of the Containment Vessel

The dome did not fall during the initial blast as the explosive pressure lifted the severed 5/8-inch-thick steel dome causing the dome to shift and deform, thereby hanging at two points. Potential solutions were considered. The dome was ultimately successfully brought down by propane/oxygen torch cutting.

5.3 Waste Disposition

Time delays associated with packaging and transporting waste for disposal were experienced initially but were eventually minimized through the establishment of an interface agreement with Idaho CERCLA Disposal Facility (ICDF) for special handled waste and consistent communication between LOFT support personnel and ICDF personnel. The radiological technicians' usage of a gamma scan resulted in the release of more potentially radiologically contaminated debris than was originally estimated. This resulted in the ability to use the adjacent TAN Demolition Landfill for a significant portion of the demolition waste. The use of PBS as a lock-down fixative reduced the cost of size reduction efforts and waste containers. The use of a processor for handling large debris pieces eliminated time consuming hoisting and rigging efforts.

6. REFERENCES

DOE/ID-11253, Engineering Evaluation/Cost Analysis (EE/CA) for Decommissioning of TAN-630 and TAN-650 at the Loss-of-Fluid Test (LOFT) Area

DOE/ID-10682, Final Record of Decision, Test Area North, Operable Unit 1-10

DOE/ID-11276, Action Memorandum for Decommissioning of TAN-630 and TAN-650 at the Loss-of-Fluid Test (LOFT) Area

PLN-2096, LOFT Demolition Plan

RPT-312, LOFT Demolition Completion Report