Implementing Controls for a Facility Within a Facility

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Abstract

The objective of this activity was the implementation of Documented Safety Analysis (DSA)-relevant controls to a Hazard Category 2 operation within a less-than-Category 3 facility in such a manner as to minimize impact on the non-Category 2 occupants and activities. The Molten Salt Reactor Experiment Conversion Project is an activity of limited duration involving handling Hazard Category 2 quantities of ^{233}U chemisorbed on sodium fluoride in individual "traps." The authorized scope was to depressurize the gas pressure buildup within 25 traps. Due to the trap's radiation field, this activity must be conducted within a hot cell environment. The facility selected for this activity was operating as a less-than-Category 3 facility, housing both radiological and clean research and development laboratories. Thus, the challenge was to create a DSA and Technical Safety Requirements document applicable to the Conversion Project and to structure it and its implementation in such a way that the Category 2 activity could be successfully approved and conducted while those unrelated activities in the building could carry on with minimum impact and burden. A key element was to designate and analyze a limited portion of the building as Category 2. From this facility designation split, administrative controls, programs, and interfaces were established appropriate to the hazards. This differentiation in controls was seen in the implementation of the Unreviewed Safety Question process, combustible controls, facility infrastructure interfaces, training, work controls, etc. The implementation of DSA controls for this project was also being performed during a period of increased rigor and uniformity with the creation of the Nonreactor Nuclear Facilities Division at Oak Ridge National Laboratory. All 25 traps have been depressurized without significant incident, and the facility has been returned to its less-than-Category 3 status pending further direction from its DOE sponsor.

Introduction

The originally identified mission of the Molten Salt Reactor Experiment (MSRE) Conversion Project was to extract uranium in the form of uranium hexafluoride (UF_6) adsorbed on sodium fluoride (NaF) pellets in individual traps and to transform it into a chemically stable uranium oxide (U_3O_8) by replacing fluorine with oxygen. The existing uranium-loaded NaF traps were generated by the MSRE Remediation Project and are not suitable for long-term storage due to pressurization from radiolytic gas generation (fluorine). The traps are constructed of 3 inch diameter, Schedule 10, Monel pipe about 17 inches long with a design pressure of 800 psig. These traps are contained in individual stainless steel overpacks. Based solely on radioactive

material inventory and not considering nuclear criticality, each trap is below the Category 2 threshold of DOE-STD-1027-92[1]. However, when the criticality threshold quantities are considered and the final release fractions are used, the final nuclear hazard categorization was determined to be Hazard Category 2 (reference the Building 4501 Conversion Project Safety Analysis Report[2]).

This trap handling activity, because of the radioactivity from the uranium decay daughters, needed to be conducted in a hot cell environment, and Building 4501 was identified as the most appropriate facility at Oak Ridge National Laboratory (ORNL). However, Building 4501 was a Radiological facility, i.e., less than nuclear Hazard Category 3, and had other radiological and non-radiological activities in progress. The challenge was to change the status of a portion of the building and to operate that portion as a nuclear Hazard Category 2 facility needed for the Conversion Project while minimizing the impact on the rest of the facility.

The original project plan was for the traps to be brought individually from storage in another facility at ORNL and then returned to that facility for storage after the conversion processing in Building 4501. Prior to startup of the activity, the work scope was reduced by Department of Energy-Environmental Management to not perform the conversion process at present but to limit the operation to depressurize the 25 MSRE traps and to add pressure transducers to two traps for subsequent pressure monitoring in their storage facility.

The Facility and Missions

Building 4501 is a medium-sized, three-story facility located in the central portion of the main ORNL complex. The facility contains offices, 33 laboratories, four hot cells, and a glovebox facility. A variety of research and development missions are conducted in the areas of nuclear medicine, separations chemistry, materials research, waste studies, reactor fuels, and fundamental chemistry. Some of the laboratories are radiological labs and some are not.

Hot Cell D was identified by the MSRE Conversion Project for its use. At the time of project design and construction, the scope was to perform the conversion process. A primary process system was set up for this conversion purpose inside the cell consisting of various vessels, piping, valves (solenoid and manual), pumps, heat tracing, and sensors. Control and monitoring was set up immediately outside the hot cell in the control room. Since trap depressurization was a step in the conversion process, there were no design, analysis, or construction changes needed for the reduced project scope to limit operational activities to depressurization of the traps. A special shielded carrier was constructed to safely transport the individual MSRE traps to and from the building and within the building to the hot cell loading position in the highbay area.

The Concept of a Nuclear Facility within a Radiological Facility

The Building 4501 Conversion Project Safety Analysis Report[2] provides the fundamental concepts for the application of the operations and analysis of this Hazard Category 2 activity within a less-than-Category 3 building.

> The concept of a separate area for the Conversion Project was applied to Building 4501 to define a boundary wherein TSR requirements, administrative programs, training, and documentation requirements for a Nuclear Category 2 facility are in place to support Conversion Project operations. The boundary is formed by the walls, doors, etc. within the building to provide a clear demarcation of the Conversion Project area. No credit is taken for the boundary to prevent or mitigate accidents that may occur during Conversion Project operations. This approach was applied to define specific area involving Conversion Project activities and to avoid placing excessive requirements on other facility operations that are not associated with the Conversion Project.

The area identified as the Category 2 nuclear space, in addition to the hot cell and control room, included the building areas in the pathway used by the MSRE carrier to reach the hot cell access. The hot cell exhaust ventilation filter room in the basement was also included in the Category 2 space. Approximately a fourth of the building was designated as the Hazard Category 2 facility.

Application of the Graded Approach to Controls

The basic approach for accommodating the MSRE Conversion Project was to apply the more rigorous controls to the defined nuclear facility space of the building and to mainly limit additional controls external to this space to those items of interface or potential impact. Specific applications of controls included the following.

Combustible Controls Program

Stringent combustible and flammable controls were developed and applied to the central hot cell area of the building and the path taken by the MSRE shielded carrier in the building. For example, the amount of flammable liquids was specifically and tightly limited in this space. A corridor area encircles the hot cell area and similar tight restrictions were applied in this area such that it would serve as a buffer area surrounding the space of the nuclear activity. For example, one restriction was that there be no flammable liquid storage cabinets in the corridors. Previous to the Conversion Project, the corridors had been a location for many flammable liquids storage cabinets. Somewhat less restrictive combustible controls were established for the area of the building that was outside the central nuclear space and buffer corridors. This level of control external to the nuclear space then had less impact on the research and development activities in the surrounding laboratories than would have existed if the controls had been applied uniformly throughout the building without this gradation. Inspections to the specific criteria for both the central nuclear space and the surrounding laboratory areas, including the exterior of the building, were performed monthly and documented.

Unreviewed Safety Question (USQ) Program

For the Category 2 nuclear facility space in the building, the ORNL USQ program was applied directly. That is, all changes were reviewed through the pre-screening, screening worksheet, or Unreviewed Safety Question Determination process as applicable. For those changes outside the

Category 2 facility, i.e., less than Hazard Category 3, the USQ process does not directly apply since this space is not a Hazard Category 1, 2, or 3 nuclear facility. However, recognizing that changes outside a nuclear facility can impact the facility, especially if they are in the same building, a graded approach was applied to examining changes outside the Category 2 space as well. For example, ORNL currently uses a procedural process referred to as a Research Safety Summary for reviewing and authorizing research activities. This Research Safety Summary document describes a laboratory research activity, documents its hazards, provides programmed guidance on the controls to be applied to that work, primarily by reference to ORNL's Standards Based Management System, and approves its conduct. All new, revised, or annually-updated Research Safety Summaries applicable to the building were evaluated from a USQ perspective during the document's review cycle. If the Research Safety Summary was for work that was within the Category 2 facility space, then the standard USQ review process was applied. If the Research Safety Summary was for work totally outside the Category 2 facility space, then the change would be evaluated to consider if it introduced new or increased hazards that could impact the Category 2 space. For these activities outside the Category 2 space, a brief documentation of this consideration and conclusion was recorded on the Research Safety Summary review if the conclusion was that it did not represent a new or increased hazard to the Category 2 space.

Work Control and Planning

The Plan-of-the-Day (POD) and Plan-of-the-Week (POW) planning and meetings focused on the MSRE Conversion Project with all of its activities, both craft work and operational activities, tightly controlled and scheduled. All work packages for work within the nuclear facility portion of the building required approval signature of the Conversion Project operations manager in addition to the facility manager. Also, both the Conversion Project operations manager and the facility manager approved the POD documents. Craft work within the building but outside the nuclear facility was also scheduled on the POW and POD. Particular attention was given activities that could cause conflicts with the Conversion Project, either work area conflicts, such as the common space traversed by the MSRE shielded carrier, or priorities in use of sharing limited staff resources. A less detailed scheduling was applied to the ongoing research and development activities in the laboratories outside the nuclear facility space. As mentioned above, these activities were governed by an enveloping Research Safety Summary document. Typically, the POD would show the individual active Research Safety Summaries as an ongoing activity, but not provide the day-to-day specifics of the laboratory activities. This approach allowed the research staff to have the maximum flexibility, but also provided common information on what laboratory work was in progress and the limits of that work scope.

Emergency Planning

Specific and detailed emergency response procedures were developed for response to alarms associated with the Conversion Project. These response actions were applicable to the Conversion Project operations staff who were trained in those actions. The response action applicable to those outside the nuclear facility space was limited to emergency evacuation, an action those personnel were already trained and drilled to perform. The existing emergency manual for the building was modified to incorporate the Emergency Action Levels associated

with the Conversion Project that were identified in the Project's Emergency Management Hazards Assessment document.

Procedures and Training

Specific procedures were developed and verified for the activities of the Conversion Project. Conversion Project operational procedures were written in a rigorous reader-worker style, and the operators were trained and qualified on those procedures. However, new requirements for additional or more rigorous procedures generally were not applied to the laboratory areas outside of the nuclear facility space. One example of this differentiation was in performing the building daily checks. The periodic checks needed for the Conversion Project, including of course the Surveillances specified by the nuclear facility's Technical Safety Requirements, were separated and addressed by new rigorous Conversion Project procedures. The other daily checks in the building not required for Conversion Project compliance were addressed separately. Correspondingly, this procedural differentiation between the Conversion Project and the Radiological portion of the building implied that additional training was not imposed on laboratory workers in the area outside the nuclear facility space.

Establishment of Nonreactor Nuclear Facilities Division

The planning, development, design, installation, testing, and readiness reviews for the MSRE Conversion Project occurred in a period when ORNL nuclear facility activities were the responsibility of the individual research divisions of ORNL. At approximately the time of the operational startup of the Conversion Project, ORNL created the Nonreactor Nuclear Facilities Division (NNFD). This new division was given the responsibility for operation of all ten of ORNL's nonreactor nuclear facilities including the Conversion Project facility. Along with the Project responsibility came the "landlord" responsibility for the entire building. The purpose of the new NNFD was to

- Free up research line management to focus on research
- Improve the operations of ORNL's nonreactor nuclear facilities
- Make the facilities safer, more efficient, and cost effective
- Operate hot cells as a Lab-wide resource

While the establishment and development of the new NNFD brought what could be expected in the way of transitional issues to be resolved, it also brought needed uniformity and general upgrade in the operations of those facilities. In particular for the MSRE Conversion Project, the establishment of NNFD responsibility for the entire building brought clarity in the in the responsibility relationships between the Project and other activities in the building, especially work control and planning. Due to the Conversion Project being a new activity and having been authorized to operate through a rigorous and recent readiness review process, there was relatively little impact on the Conversion Project procedures and activities resulting from the new standards of operations required by NNFD. For example, most of the Conversion Project operational procedures were simply "blue-sheeted" over to be identified as NNFD procedures. Also, the designation of the Conversion Project nuclear facility within Building 4501 did not

change. Consequently, there was no change to the Conversion Project safety basis other than to recognize the management change.

Results

The MSRE Conversion Project has successfully completed its authorized mission to depressurize the 25 MSRE traps, add pressure monitoring devices to two traps, and to return the traps to storage at another facility. This activity was conducted without significant incident and on schedule. The equipment for this project has been placed in a cold standby condition pending future guidance from the Department of Energy-Environmental Management. With no more MSRE traps in the building, the building's radiological inventory was determined to be less than a nuclear Hazard Category 3 level. The nuclear safety basis documents have been cancelled and the facility removed from responsibility of ORNL's NNFD.

Conclusion

This project has shown that a new higher hazard activity (Category 2) can be authorized and implemented within a lower hazard facility (Radiological) in a manner that minimizes the impact on the overall facility. This is important for consideration of new work and maximizing the use of existing DOE facilities while minimizing costs.

References

1. DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Report,* Change 1, U.S. Department of Energy, Washington, D.C., September 1997.

2. ORNL/4501CP/SAR, *Safety Analysis Report for the Building 4501 Conversion Project*, Revision 1, UT-Battelle, LLC, Oak Ridge National Laboratory, Oak Ridge, Tennessee, August 18, 2002.

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