Lessons Learned When Integrating Remote Handled and Contact Handled Transuranic Waste Documented Safety Analysis and Technical Safety Requirements – 9423

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ABSTRACT

The Waste Isolation Pilot Plant recently completed a project to: upgrade existing safety basis document to be compliant with governing regulations and U.S. Department of Energy standards; integrate multiple documents into a concise set of analyses, controls and commitments; and update key documents supporting the safety basis documents. This paper provides an overview of project activities and provides key lessons learned.

INTRODUCTION

Title 10 Code of Federal Regulations (CFR) Part 830, Subpart B, *Safety Basis Requirements*, requires contractors responsible for U.S. Department of Energy (DOE) nuclear facilities to develop a safety basis by analyzing hazardous conditions and establishing controls to ensure the protection of workers, public and the environment. The Rule also requires the documented safety analysis (DSA) be prepared in accordance with a safe harbor methodology. For the Waste Isolation Pilot Plant (WIPP) the safe harbor methodology governing the activity was DOE-STD-3009-1994, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses* [1].

WIPP had updated the DSAs for contact-handled (CH) and remote-handled (RH) in 2006. The DSAs and associated technical safety requirements (TSRs) were thought to be overly conservative in certain respects and did not have an adequate supporting hazards analysis. In addition, the control strategy for the TSRs was to prevent most accidents which resulted in over sixty specific administrative controls (SACs). The lack of a supporting hazards analysis and overly restrictive control set was not commensurate with the hazards at WIPP and made it more difficult to implement the unreviewed safety question (USQ) process. Another compounding issue was key supporting analyses used by the CH and RH DSAs (e.g., fire hazards analysis, criticality safety analyses, and emergency planning hazards analyses) were not adequately integrated or reflected in the safety basis documents.

Shortly after RH operations were authorized, DOE issued DOE-STD-5506-2007, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses* [2]. This standard was issued in order to standardize the methodologies and controls for transuranic (TRU) facilities across the DOE complex and augment safe harbor methodologies prescribed in DOE-STD-3009-94. WIPP prepared a gap analysis and identified significant discrepancies with DOE-STD-5506-2007 (e.g., missing accident event types, inappropriate use of accident analysis parameters). Based on the gap analysis and ongoing implementation issues, senior leadership from the Carlsbad Field Office (CBFO) and Washington TRU Solutions (WTS), LLC, determined that an upgrade to the existing DSAs was required to align with the new standard while complying with the safe harbor methodology. The upgrade would provide WIPP operations a rule compliant safety basis that could be efficiently and effectively implemented.

This paper provides an overview of the Waste Isolation Pilot Plant (WIPP) DSA upgrade project and key lessons learned at WIPP integrated several safety basis documents using the governing safe harbor methodology and recently issued standard for TRU waste safety analyses.

DSA UPGRADE PROJECT

CBFO and WTS agreed from the beginning that the upgrade activities needed to be managed as a project in order to ensure proper planning, execution, integration and communication. Senior sponsors from the DOE and contractor were identified to provide leadership and project management through the duration of upgrade and subsequent implementation activities.

Objectives

The primary objective of the DSA upgrade project was to upgrade the existing safety basis documents to be compliant with Title 10 Part 830, Subpart B and associated safe harbor methodology requirements provided in DOE-STD-3009, and to follow the additional guidance provided in DOE-STD-5506-2007 for transuranic (TRU) facilities. Other key objectives included: integrating the existing multiple safety basis documents into a concise set of hazards analysis, controls and commitments; updating and integrating the fire hazards analysis (FHA) using fire models common to the accident analyses; updating the criticality safety analyses while potentially eliminating some of the previously identified overly conservative margins and assumptions; use of the DOE toolbox modeling code MACCS2; and constituting a multiuse and systematic evaluation of hazards at the WIPP facility.

Integrated Project Team

CBFO and WTS established internal project teams to coordinate respective activities. CBFO established the safety basis review team (SBRT) which contained representatives from functional areas in the local DOE office and involved DOE headquarters (DOE-HQ) reviewers that would provide the final review for the DOE approval authority. WTS established an integrated team as well with representatives from each interfacing organization within WTS. Key interfacing organizations included: operations, safety, radiation protection, engineering, quality assurance, emergency preparedness, and security. Other subject matter experts were brought in as needed.

The team was led by nuclear safety. However, operations participated throughout the development of the hazard identification, hazard analysis and control selection. WTS augmented the internal team with multiple subcontractors which specialized in one or more subject areas.

To support the development activities and multiple work locations, WTS established a collaborative web site that met cyber security requirements. WTS, subcontractors, CBFO, and DOE reviewers had access to the web site from remote locations and could access, modify, or review documents in a controlled manner. This collaborative environment provided an effective tool for maintaining configuration management of the multiple work products and streamlined project costs by minimizing travel.

Methodology

WTS used standard hazard and accident analyses processes. However, the project lead supplemented those activities with lessons learned from managing similar projects at other facilities throughout the complex. Additional activities and expectations included: operations participation and ownership throughout the process; integration between functional areas, chapter authors, and TSR writers; and “in-process” reviews at critical stages of the project to ensure CBFO and DOE technical basis understanding and DOE reviewer buy-in and feedback.

The first step in the process was to develop an integrated hazard baseline document. This document was developed by the project team and included the required input from other disciplines (i.e., emergency planning, safety and health, work planning and worker protection). The hazards baseline document was developed using standard checklists for each building and/or work area for all locations at the WIPP site and in Carlsbad (i.e., office locations and support facilities to WIPP site operations) to ensure that the hazard identification process was comprehensive and addressed other sources of hazards that may have no impact on nuclear operations. The integrated team then screened the standard check lists to consistently determine if a hazard could be considered a standard industrial hazard (SIH) consistent with DOE-STD-3009-1994. SIHs were identified only to the degree they were initiators and contributors to potential WIPP accidents in main processes and activities. The hazard identification team lead applied consistent criteria based on the form and/or quantity of a hazard along with its ability to impact nuclear safety. The results were published in a standalone document to be referenced in the final DSA. The standalone format allows for periodic updates which will be screened using the USQ process to determine the impact on the safety basis and to be used when planning work in all locations and when performing design changes for systems and structures in all locations.

The second step in the process was the systematic evaluation of hazards. WTS and CBFO participated in several weeks of working sessions to step through the work activities and processes. From that process, the team identified over 600 hazardous conditions. Each hazardous condition was captured independent of frequency or consequence. The team leader for the systematic evaluation of hazards facilitated the development to ensure that the criteria for establishing unmitigated analyses were maintained. The team did not credit any passive or active safety features or administrative controls during this phase. Initial conditions considered only the capabilities of the transportation containers received at WIPP, waste containers packaged prior to arriving at WIPP, and the waste acceptance criteria used at each generator site to characterize and package waste. These initial conditions were carried forward throughout the analysis as government furnished items and services as WIPP has no direct control at any given generator site.

The third step in the process was the binning of the approximate 600 hazardous conditions. After eliminating duplicates, the remaining hazardous conditions were “binned” into “like” conditions for future evaluations and analysis using the accident analysis categories specified in DOE-STD-5506-2007. At this point the team assigned a unique identifier for each hazardous condition that directly correlated to the category and event numbers identified in DOE-STD-5506-2007, the specific process at WIPP (i.e., CH and/or RH) and the location. Some of the waste handling activities addressed in DOE-STD-5506-2007 do not occur at WIPP (e.g. events which resulted from packaging or repackaging activities) and were determined to be not applicable. Table 1 identifies the categories and events prescribed by DOE-

STD-5506-2007 and includes the WIPP specific events identified during the systematic evaluation of hazards.

Table 1. WIPP Events

Category	Number	Description
Fires	Event 1	Fuel Pool Fire
	Event 2	Small Fires
	Event 3	Enclosure Fires
	Event 4	Large Fires
Explosions	Event 5	Ignition of Fumes Results in an Explosion
	Event 6	Waste Container Deflagration
	Event 7	Multiple Waste Container Deflagration (N/A for WIPP)
	Event 8	Enclosure Deflagration (N/A for WIPP)
Loss of Confinement	Event 9	Vehicle/Equipment Impacts Waste/Waste Containers
	Event 10	Drop/Impact/Spill Due to Improperly Handled Containers
	Event 11	Collapse of Stacked Containers (N/A for WIPP)
	Event 12	Waste Container Over-Pressurization (N/A for WIPP)
Direct Exposure	Event 13	Direct Exposure to Radiation
Criticality	Event 14	Criticality Events
External	Event 15	Aircraft Impact with Fire
	Event 16	External Vehicle Accident
	Event 17	External Vehicle Accident with Fire
	Event 18	External Explosion
	Event 19	External Fire
Natural Phenomenon Hazards	Event 20	Lightning
	Event 21	High Wind
	Event 22	Tornado
	Event 23	Snow/Ice/Volcanic Ash Build-up
	Event 24	Seismic Event
	Event 25	Seismic Event with Fire
WIPP Specific	Event 26	External Flooding
	Event 27	Landslide of Soil Overburden on Salt Pile
	Event 28	Loss of Power
	Event 29	Loss of Ventilation
	Event 30	Roof Fall

An example of the unique identifier based on event list follows:

E01A-CH/RH-UG - This hazardous condition represents a fuel pool fire that could potentially involve CH and RH waste in the underground portion of the facility.

The binning of the approximate 600 hazardous conditions resulted in 148 bounding events requiring further evaluation. The 148 bounding events represented those events with potentially the highest risk. Each bounding event was captured in a database along with similar events (i.e., category and events specified in Table 1 above) to support the selection of bounding and representative controls later in the process. An important item to note here is the bounding case with similar representative controls were based on risk contribution and not solely on unmitigated consequences which resulted from application of the MACCS2 modeling tool.

The fourth step in the process was the accident analysis. Each of the 148 bounding events was evaluated using scoping calculations to provide a preliminary understanding of potential consequences. These preliminary results were compared to the risk bin guidelines. The accident analysis was an interactive and iterative process based on input from subject matter experts, operations, engineers, and oversight organizations. The accident analysis (e.g., calculations, scenario descriptions, hazardous conditions) were refined throughout the process based on input from peer reviews, independent reviews, working sessions, cross table reviews (which included CBFO), and field walkdowns to ensure that the accident analysis and resultant controls were technically accurate and implementable.

The final step was control selection. The team selected controls for the bounding events to prevent or mitigate potential consequences. A value of 10 rem was used to determine when a potential consequence was approaching the DOE evaluation guideline of 25 rem for the public. Controls were applied until a particular scenario was prevented or mitigated to acceptable levels. After selecting controls for the bounding case, the team reviewed other events in the bin and selected controls to address lower risk events as well. For example, underground fuel pool fires with similar initiators which contribute less risk than the bounding case were looked at in order to determine whether or not the control set for the bounding case adequately controlled (i.e., prevented or mitigated) lower risk hazardous conditions. The primary controls initially selected for underground fuel pool fires was to control access of liquid fueled vehicles from the waste face. When the team reviewed the initial control set, it was determined that initiators for engine compartment fires were not adequately represented and additional controls were added.

After the five key steps were completed, the balance of the activities included final document preparation and quality checks. The final submittal included an integrated DSA, one TSR document with a significantly reduced control set, the implementation verification review plan required by DOE-STD-5506-2007, and approximately twenty supporting documents.

DOE Involvement

CBFO was an integral part of the team throughout the process. They provided oversight on a daily basis consistent with DOE O 226.1A, *Implementation of DOE Oversight Policy*. SBRT members communicated potential issues and feedback early in product development which ensured that the final products would meet DOE expectations.

CBFO also coordinated several "in process" reviews of the DSA and TSRs during the development process at critical points of the project. During these reviews, formal comments were submitted and tracked to closure to provide objective evidence of DOE's oversight activities and WTS's formal disposition of each item. It also provided a working reference for the project history file which will be used throughout the independent verification and implementation phases.

LESSONS LEARNED

General

Manage the upgrade effort as a project with assigned roles, responsibilities, authorities, and accountabilities. Plan and resource load this activity well in advance to ensure resources are identified and secured.

Both DOE and the contractor should have dedicated teams identified prior to initiating the project to ensure resource availability.

Select the best available talent with proven track records. This includes the selection of internal resources, selection of subcontractors, and DOE support services contractor reviewers.

Establish a collaborative working environment in order to facilitate, track and maintain project activities. If this tool is selected, ensure all key participants and reviewers have unfettered access to work products at all stages and allow for completion his/her responsibilities.

Establish a common goal and objective between DOE and contractor. These goals and objectives need to be reinforced often and used to facilitate needed change. Key leads on both sides need to serve as change agents so that others can buy into implementation of the revised safety basis documentation. In the case of the WIPP Site, a very significant reduction of the SACs was a common goal that provided a focal point for the development and review teams.

Keep an open mind during the entire process. This open mind must consider the identification of the most appropriate and reasonably implementable controls. New and simple solutions may surface during the modeling and analytical phases and can come from within your nuclear safety team, the cognizant engineering staff, one of your subcontractors or from the experienced operating and maintenance staff.

Establish clear lines of communication and routine interface meetings between DOE and the contractor. Both teams need to work closely throughout the process and communicate often.

DOE must ensure that the facility representative, safety systems oversight personnel, operations personnel, programmatic elements, fire protection engineer, and quality assurance are involved and have access to the development work. Involvement from these key DOE organization ensures that potential issues are identified early which minimized rework.

Both DOE and the contractor ,must include emergency management personnel to ensure overall integration and communication of site activities which have important DOE-prescribed drivers other than just nuclear safety considerations.

Provide frequent updates and briefing to senior management and the authorizing approval authority. These communications reinforces support from the executive leadership and fosters awareness of upcoming changes.

Conduct routine self-assessments to ensure continual feedback throughout the project.

Document Preparation

Provide consistent leadership and criteria throughout the process. This provides continuity over the typically lengthy process, ensures consistent decisions are made, and fosters a team that remains comfortable when challenging each other throughout the process. The best critics are those on the team who can challenge each other while pushing for the best final product.

Begin with the end in mind, but start at the beginning. The team lead should ensure members follow the established process that has been used throughout the years and is based on hazard and accident analysis results. There is a tendency to select controls first and align the analysis. This does not ensure that the facility will have a bounding and representative control set in the end.

Conduct a comprehensive hazard identification process and systematic evaluation of hazards allowing for considerable time and resources to be spent on these front end phases as these two elements provide a foundation for every other aspect of the safety basis documents.

Establish a standard format for all calculations and supporting documents. Ensure that the document production team is adequately staffed during the final stages of document production.

Integrate the facility-specific FHA into the process as soon as possible. For WIPP the FHA was a key driver which contributed to several iterations late in the process based on changes in the fire modeling. Portions of the FHA can and should be done prior to the accident analysis stage (e.g., code compliance, facility performance evaluation, and fire prevention control set selection).

Establish a process to resolve differing technical opinions. The WIPP fuel pool fires in the underground were developed by a qualified fire protection engineer. However, the results of the modeling were not understood and/or accepted by all parties. The team should feel comfortable disagreeing with a decision and elevating the issue for continued discussion and resolution.

Establish a firm document production process and schedule (e.g., pens down, formal review times, comment resolution period).

Deliver an integrated set of documents for the final deliverable. Supporting documentation including an integrated FHA that provided the fire models, nuclear criticality safety evaluations, accident scenario models, were developed, submitted for review, revised as necessary and published so that the contents of the supporting documentation could be reviewed and compared to the content of both the DSA and TSR contents.

Document Review

Allow adequate time throughout the project timeline for peer, independent and DOE reviews. Establish a process up front to capture, document, disposition, and resolve comments.

Set up formal cross table meetings to discuss DOE comments and input at critical points in the project timeline. The WIPP DSA upgrade project used a cross table review after: initial preparation of the hazard and accident analysis; initial preparation of Chapters 3, 4, and 5; TSRs; and a final integrated cross table.

Establish a process to collect, resolve and document the disposition all comments. Comment disposition and incorporation should be tracked and discussed with the commenter to ensure the input is resolved.

Implementation Verification Review

Plan and resource load the Implementation Verification Review plan and schedule. Understand that DOE-STD-5506-2007 is more prescriptive as to what must be verified by both the Contractor and DOE field office. The plan needs to include key items identified during document preparation and review. For example, many of the WIPP safety management programs were modified during the DSA upgrade project. These key attributes must be verified prior to declaring the new safety basis documents implemented. Document through a formal means all activities in the implementation and verification processes.

Understand the scope of the safety basis change. WIPP supplemented the implementation phase, as generally described in Section 8 of DOE-STD-5506-2007 with additional detail based on the significance of the change.

DOE ensures a well documented process and resource loaded plan is in place prior to providing Independent Verification Review oversight.

DOE may consider performing operational or management assessment activities to not only provide documented means of IVR, but also to meet other assessment requirements such as ISMS, Independent Evaluation Programs, etc. One assessment of a particular Criterion Review and Approach Document (CRAD) could meet several assessment requirements over many programs.

CONCLUSIONS

All DOE sites or facilities that characterize, handle, and ship TRU Waste must develop or significantly revise their safety basis documentation to consider the nuclear safety rule, the safe harbor methodology prescribed in DOE-STD-3009 and the more prescriptive guidance provided in DOE-STD-5506 simultaneously while completing such tasks.

The experience gained at WIPP and the lessons learned when developing, reviewing, revising, issuing and implementing the first Documented Safety Basis and Technical Safety Requirements documents to be approved by DOE which comply with these three sets of TRU requirements will be of some value to others in the foreseeable future.

REFERENCES

1. U.S. Department of Energy, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, DOE-STD-3009-94, Change Notice No. 3, Washington DC, March 2006

2. U.S. Department of Energy, *Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities*, DOE-STD-5506-2007, Washington DC, April 2007.