# IMPLEMENTATION OF DEFENSE NUCLEAR FACILITY SAFETY BOARD RECOMMENDATION 2000-2 AT WIPP

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## ABSTRACT

The Defense Nuclear Safeties Board (DNFSB) issued Recommendation 2000-2 on March 8, 2000, concerning the degrading conditions of vital safety systems, or systems important to nuclear safety, at DOE sites across the nation. The Board recommended that the DOE take action to assess the condition of its nuclear systems to ensure continued operational readiness of vital safety systems that are important for safely accomplishing the DOE's mission. To verify the readiness of vital safety systems, a two-phased approach was established. Phase I consisted of a qualitative assessment to approved criteria of the defined vital safety systems by operating contractor personnel, overseen by Federal field office personnel.

Based on Phase I Assessment results, vital safety systems with significant deficiencies would be further assessed in Phase II, a more extensive quantitative assessment, by a contractor and Federal team, using a second set of criteria. In addition, Defense Nuclear Facility Safety Board Recommendation 2000-2 concluded that the degradation of confinement ventilation systems was of major concern, and issued a separate set of criteria to perform a Phase II Assessment on confinement ventilation systems.

Staff of the DOE Carlsbad Field Office and personnel of the Waste Isolation Pilot Plant (WIPP) M&O Contractor, Westinghouse TRU Solutions, formulated a strategy to perform the requirements outlined in the Defense Nuclear Facility Safety Board Recommendation 2000-2. A team approach was utilized to conduct Phase I assessments on eight vital safety systems important to ensuring the safety of personnel and the environment at the WIPP Site.

The Phase I Assessment verified that all eight vital safety systems are operational and that personnel and processes are in place to ensure its continued operational readiness, due to strong maintenance and configuration management programs. The WIPP team also evaluated the WIPP Cognizant Engineer Program and found that it meets the requirements for systems engineers as defined in the Defense Nuclear Facility Safety Board Recommendation 2000-2.

A Phase II Assessment was later performed against the Waste Handling Building HVAC. This assessment confirmed the results of the Phase I Assessment, and predicted that the system can be expected the last the projected lifetime of the facility, with continued maintenance.

The success of completing a Phase I and II intensive review and assessment were attributed to implementation of Integrated Safety Management at WIPP, clear directions and guidance on conducting a Phase I and II assessment provided by DOE Headquarters, and teamwork between Carlsbad Field Office and M&O Contractor personnel. WIPP senior management commitment and support also contributed to the effectiveness and efficiency of the team.

## INTRODUCTION

The Defense Nuclear Facility Safeties Board (DNFSB) issued Recommendation 2000-2 (1) on March 8, 2000, concerning the degrading conditions of vital safety systems, or systems important to nuclear safety, at Department of Energy (DOE) sites across the nation. The Board recommended that the DOE take action to assess the condition of its nuclear systems to ensure continued operational readiness of vital safety systems that are important for safely accomplishing the DOE's mission. To verify the readiness of vital safety systems, a two-phased approach was established. Phase I consisted of a qualitative assessment to approved criteria of the defined vital safety systems by operating contractor personnel, overseen by Federal field office personnel.

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## PROBLEM DESCRIPTION

The purpose of performing a Phase I assessment was to determine if selected systems were operable, and if personnel and processes were in place to ensure its continued operational readiness. A five-step approach was utilized by the WIPP site to determine if the systems and processes met the assessment objectives. This included: deriving the WIPP specific vital safety systems; performing a Phase I Assessment; analyzing the results from Phase I; performing a follow-on Phase II Assessment if any Phase I results indicated a problem area; and initiating corrective action for any deficiency identified during the Phase I or Phase II Assessment.

## Derivation of WIPP Vital Safety Systems

To successfully perform the requirements set forth in Recommendation 2000-2, the WIPP Site had to determine which systems fit the description of vital safety systems. The DOE Implementation Plan for Defense Nuclear Facility Safety Board Recommendation 2000-2 defined vital safety systems as the following:

> "The term vital safety systems, as used within this implementation plan, is understood to mean safety-class systems, safety-significant system, and other systems that perform an important defense in depth safety function." (1)

A general list was provided by the DOE of expected systems that should be included from each site specific vital safety system list. WIPP determined that there were eight systems that met the requirement of a vital safety system. These eight systems and a brief description of their function is described below:

1. **Waste Handling Building Heating, Ventilation, and Air Conditioning (WHB HVAC)** – a continuously HEPA filtered system that provides negative differential pressure between the Waste Handling Building and the outside atmosphere to provide confinement barriers to limit the release of contaminants to the environment.

2. **Waste Handling Building Tornado Doors** – a facility confinement system that through static barriers minimizes the spread of radioactive and other hazardous materials, and limits the release of contaminants resulting from a Design Basis Earthquake or natural phenomena.

3. **Central Monitoring System (CMS)** – a monitoring and data collection system that provides the infrastructure of processing units and network connections to automatically shift the underground ventilation system to the filtration mode to mitigate any accidental releases of contaminants to the environment.

4. **Underground Ventilation and Filtration System (UVFS)** – a subsurface ventilation system that serves the underground facility, and has the capability to direct airflow through a HEPA filtered system in the event of an accident to mitigate any accidental releases of contaminants to the environment.

5. **Underground Room Exit Continuous Air Monitors (CAMs)** – a monitoring system that provides a shift to filtration signal to the CMS upon detecting radiation levels that exceed a predetermined threshold.

6. **Waste Handling Building Fire Protection System** – fire detection and suppression equipment that ensure personnel safety, mission continuity, and property conservation in the event of a fire.

7. **Waste Hoist** – a conveyance to transport personnel and materials to the underground facility, which includes a braking system to prevent uncontrolled movement of the hoist.

8. **Waste Handling Equipment** – equipment to safely process and dispose of transuranic and transuranic-mixed waste, that by design reduce the probability of an accident.

## PHASE I ASSESSMENT

The WIPP Site established a team made up of personnel from the DOE Carlsbad Field Office and the M&O Contractor, Westinghouse TRU Solutions, to lead the Phase I effort. On February 6, 2001 a meeting was held with WTS and DOE personnel to brief the participants on the purpose and scope of Defense Nuclear Facility Safety Boards Recommendation 2000-2 and the Implementation Plan.

The Phase I assessment consisted of an initial qualitative assessment of vital safety systems using approved criteria termed Criteria, Review, and Approach Documents (CRADs) (2), to qualitatively determine the readiness state of each system. Four primary areas were assessed in the Phase I Assessment, which included design documentation, maintenance program, configuration management, and operability. WIPP assigned the responsible cognizant engineer to perform the Phase I Assessment and develop a report of the findings. The cognizant engineer program at WIPP assigns technically competent individuals to an assigned system, and associated responsibilities to ensure their systems are maintained operable. These responsibilities include configuration management activities to ensure design changes are approved and documented, evaluation of system status and performance, technical support for operations and maintenance activities, and evaluation of potential inoperability when a safety function appears compromised.

The lead team established a schedule and a review and approval process for the CRADs. All CRADs were reviewed and approved by the WTS Plant Management Team (PMT), and the DOE site office. The PMT is comprised of Senior Management from Operations, Engineering, Safety, and Quality Assurance. The following schedule milestones were set:

1. All eight vital safety system CRADs due by March 15, 2001.
2. Final report, including results, due to DOE CBFO by April 30, 2001.
3. Report transmitted by DOE Headquarters by June 30, 2001.

### Criteria and Review Approach

Each vital safety system was assessed by the cognizant engineer, with support from operations and maintenance, using the criteria and instructions set forth in the CRAD. A set of four questions was utilized in the CRAD to qualitatively assess program areas to determine if there were any deficiencies associated with that vital safety system. The following discusses the four objective criteria and review approaches:

1. VSS safety functions are defined and understood by responsible line managers, and supporting information/documentation is available and adequate. System testing is adequate to ensure operability – evaluated by:
   a. Reviewing the DOE-approved safety analysis, including normal, abnormal, and accident conditions, and the associated functional requirements and performance criteria.
   b. Identifying the acceptance criteria from surveillance tests to verify the system is capable of accomplishing its safety functions, and reviewing acceptance criteria against the performance criteria.
   c. Evaluating the frequency of surveillance tests and ensuring the tests are required by the safety analysis
   d. Reviewing system configuration drawings
2. The backlog for surveillance tests, inspections, maintenance, repair, upgrades, or other work on the system is managed and kept to an appropriate minimum – evaluated by:
   a. Identifying the current backlog for the systems such as preventive, corrective, and modification maintenance
3. Configuration management and maintenance programs effectively ensure operational availability of the system – evaluated by:
   a. Identifying formally scheduled activities that are intended to help ensure reliable performance of the system, including preventive maintenance, walkdowns, inspections, and assessments.
   b. Reviewing the application of processes used to ensure that work on the system and changes to the system are properly controlled
   c. Determining whether procedures and drawings are controlled under a formal document control process.
4. The system is operable and available to fulfill its safety function when required – evaluated by:
   a. Identifying for the past three years the number of times that the system has failed to meet its test acceptance criteria, or failed in response to facility operating conditions, or the percentage of time that the system was not capable of accomplishing its safety functions.
   b. Identifying any systems and equipment that directly support the operation of the vital safety system being assessed, and their operability.

## Performing the Phase I Assessment

All eight vital safety systems were assessed using the established criteria and review approach. The Phase I assessment evaluation and compilation of supporting documentation averaged 48 hours per vital safety system. As each Phase I assessment was completed, the cognizant engineer presented their findings to the PMT and DOE. The PMT and DOE reviewed the results, and discussed any concerns. The final vital safety system CRAD was completed, reviewed, and approved by the PMT and DOE on March 14, 2001.

## Discussion of Phase I Assessment Results

The results of the Phase I assessment verified all eight systems are operational and personnel and processes are in place to ensure their continued operational readiness. The results revealed that the configuration management and design documentation program was rigorous. Configuration management procedures are in place to provide a process to approve, control, document, and review changes to ensure the integrity of the safety and design basis. In addition, a formal review process is utilized to ensure modifications are consistent with the facility mission. To support maintenance and review of design changes, operating and maintenance manuals, vendor specifications, and controlled drawings are available for each system. Periodic reviews are conducted to verify accuracy of design documentation. Annual walkdowns are performed for each system by the cognizant engineer and the Condition Assessment Survey team. Any deficiencies noted are tracked to completion.

In addition, the Phase I assessment evidence showed that the maintenance program was exemplary. A computerized maintenance system schedules and tracks preventive, corrective, and modification maintenance. The system performs trending on historical data to alert the maintenance department of a potentially failing component. Corrective maintenance was completed quickly on any vital safety system that was inoperable, and equipment operated with high reliability due to an effective preventive maintenance program. The maintenance program also ensured reliability of support systems.

In the past three years, only two cases were identified that resulted in the system being inoperable. One system failed to accomplish its safety function when required. The CMS was down for three hours, while maintenance replaced a failed component. The other case involved the UVFS failing its monthly operability test. An investigation revealed that the control power was tagged out of service, resulting in the control logic for the system to fail due to a loss of indication. A modification was performed in a timely manner to ensure the control logic continued to function when power was removed. The Phase I assessment also revealed there were no current work orders identified for any vital safety system which could cause a system to be inoperable.

No significant findings were identified. Minor observations were noted concerning long term reliability and operability of the systems. Due to the age of the CMS and Underground CAMs, there are issues with availability of spare parts. Outyear projects were in place before the Phase I Assessment began to upgrade the components, and are on track for completion in 2002. The other minor issue identified involved the Fire Protection System. The domestic water storage tanks that supply fire water to the WHB need to be repainted internally. That project was identified before the assessment, and is planned for 2002.

The results of the Phase I Assessment and supporting documentation are attached (3). The Phase I Assessment report was forwarded to CBFO on April 17, 2001. The final report was provided to DOE Headquarters on May 1, 2001.

## PHASE II ASSESSMENT

The implementation plan required a more extensive quantitative assessment in the event any significant concerns were identified in the Phase I Assessment. Because there were only minor observations identified in the Phase I Assessment, the WIPP was not required to continue a Phase II assessment for any system due to a major deficiency.

However, the DOE determined that WIPP should perform a Phase II Assessment based on feedback from the Defense Nuclear Facility Safety Board. Their direction was to quantitatively assess one system, or an attribute of all systems to add value and provide lessons learned to other organizations. The WIPP team decided to evaluate the WHB HVAC. The Phase II Assessment on the WHB HVAC (4) was performed December 3 through December 6, 2001. The assessment team was comprised of personnel from DOE Headquarters, DOE CBFO, WTS, Carlsbad Field Office Technical Assistance Contractor, and a Battelle contractor. A separate CRAD (5) specific to confinement ventilation systems was developed to assist the team in performing their assessment. Four specific areas were assessed including safety function definition, configuration management, system maintenance, and system surveillance and testing.

### Discussion of Phase II Assessment Results

The assessed criteria for safety function, configuration management, system maintenance, and system testing and surveillance of the CH HVAC 01 confinement ventilation system were found to be adequate, implemented, and effective. An assessment of life expectancy was also determined. The Phase II Team determined that with continued nominal corrective maintenance, preventive maintenance, and upgrade of applied technology, as parts become obsolete or defective and are replaced, the confinement ventilation system can be expected to last the projected lifetime of the facility, which is currently about 35 years. A summary of the four assessed areas is as follows:

Safety Function Definition

Respective to the safety function area, Safety Analysis Report (SAR) documentation was found to be thorough and provided detailed descriptions of the CH HVAC functions, operational characteristics, and mitigative features. The team recommended that consideration should be given to the formation of an institutionalized group to continue vital safety system assessments, or to integrate the assessment process into an existing one.

Configuration Management

The configuration management program for the HV01 upgrade project at the WIPP facility was judged as being proactive in managing changes to safety-basis related requirements, documents, system configuration, and installation upgrade of system components. The procedures, administrative controls, upgraded program organization, personnel and proactive upgrade to digital controls have created an effective and efficient

safety-system HV01 upgrade program that has resulted in savings of time, manpower, more efficient use of energy and, decreased cost of maintaining the system.

The current HV01 upgrade program is approaching completion of digital-based controls installation and integration of instrumentation and controls (I&C) logic diagrams into facility as-built drawings. The administration, management and coordination of upgrades to the HV01 system should be considered a model program within the DOE.

System Maintenance

The assessment criteria for the system maintenance area were satisfied, with no exceptions found. A robust maintenance program is in place that includes corrective, preventive, and predictive maintenance to ensure sustained operation of the CH HVAC. Maintenance and cognizant engineers are well trained to identify trends and take appropriate corrective action. Procedures are in place for all aspects of the maintenance program. Mechanical, electrical, and instrumentation and control maintenance groups are integrated with the corresponding cognizant engineering functions to streamline maintenance operations and ensure open communication between engineering and the maintenance craft.

System Surveillance and Testing

Assessment criteria were satisfied in the system surveillance and testing area. A well defined and administered maintenance program, with operability testing, is in place to ensure sustained operations of the CH HVAC. The CH HVAC was found to be in good condition. Preventive maintenance is performed annually on all components associated with this system. The assessment team participated in a technical walkdown with plant personnel. Facility operators were trained and knowledgeable on the tests to ensure operability. The assessment criteria also focused on HEPA filter testing, due to the increase of HEPA failure occurrences across the complex. An annual HEPA filter testing program is performed at WIPP on all HEPA filters to verify system operation and integrity.

Lessons learned were developed by the team after completing the Phase II Assessment. The following outlines the noteworthy practices, and opportunities for improvement:

**Noteworthy Practices**

- The WIPP confinement ventilation system upgrade has pursued digital controls as a part of an upgrade to prevent parts obsolescence, resulting in decreased operational and maintenance costs with an increased efficiency.

- The management practice of co-locating waste handling engineers, cognizant engineers, and radiological technical personnel under the Waste Handling group reduced barriers to communication and effectively integrated systems experts with hands-on operations.

- When mature, this configuration management approach can be extended to digitally controlled software and is recommended as a credible method of software logic configuration control.

### Opportunities for Improvement

- There are two areas that were identified for improvement. WIPP Management recognized the need for and appointed a digital data administrator for software configuration controls. This position has only recently been formally established with responsibilities over the installation and maintenance of software control logic and documentation. The first area for improvement is to continue troubleshooting minor logic bugs. Secondly, some set point values in software as-built drawings are not default values as stated in the System Design Descriptions. The system administrator has been assigned both tasks to improve system operation.

## CONCLUSIONS

The Phase I Assessment provided the framework for the WIPP site to assess the condition of their vital safety systems to ensure sustained operability and reliability of equipment important to ensuring the health and safety to the workers and environment. Implementation of Defense Nuclear Facility Safety Boards Recommendation 2000-2 was successful at WIPP. The success of completing an intensive review and assessment were attributed to implementation of Integrated Safety Management at WIPP, clear directions and guidance on conducting a Phase I and II assessment provided by DOE Headquarters, and teamwork between Carlsbad Field Office and M&O Contractor personnel. WIPP senior management commitment and support also contributed to the effectiveness and efficiency of the team. The strategy of the WIPP management team is to integrate the Defense Nuclear Facility Safety Boards Recommendation 2000-2 step by step process into existing assessments, to ensure problem areas are quickly identified and corrected before a system becomes inoperable.

This program can be adapted for any company. Production facilities, laboratories, or engineering design companies have similar requirements to ensure their company remains functional. Following the step by step process outlined by the DOE can verify systems are operable, or identify problem areas that need corrective action. Regardless of the business enterprise, the systems required to maintain the mission must remain operational to ensure financial success.

## DEFINITIONS

**Safety Class Structures, Systems, and Components (SSCs)** – means the structures, systems, or components, including portions of process systems, whose preventive or mitigative function is necessary to limit radioactive hazardous material exposure to the public as identified by documented safety analysis.

**Safety Significant Systems, Structures, and Components** – means the structures, systems and components which are not designated as safety class SSCs, but whose preventive or mitigative function is a major contributor to defense in depth and/or worker safety as determined from safety analysis.

**Defense in Depth** – a concept that includes siting, minimization of material at risk, the use of conservative design margins and quality assurance; the use of successive physical barriers for protection against the release of radioactivity; the provision of multiple means to ensure critical safety functions, the use of equipment and administrative controls which restrict deviations form normal operations and provide for recovery from accidents to achieve a safety conditions; means to monitor accident releases required for emergency response; and the provision of emergency plans for minimizing the effects of an accident.

## REFERENCES

1. Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2000-2, United States Department of Energy (2000).
2. Criteria, Review, and Approach Document for the Assessment of Operational Readiness of Vital Safety Systems (VSS), United States Department of Energy (2001).
3. Defense Nuclear Facility Safety Board Recommendation 2000-2, Configuration Management Vital Safety Systems, Phase I Operability Assessment Report for the Waste Isolation Pilot Plan, United States Department of Energy and Westinghouse TRU Solutions (2001).
4. Defense Nuclear Facility Safety Board Recommendation 2000-2, Configuration Management Vital Safety Systems, Phase II Operability Assessment Report of the Waste Handling Building HVAC, United States Department of Energy and Westinghouse TRU Solutions (2001).
5. Model Assessment Criteria and Guidelines for Performing Phase II Assessments of Safety Systems at Defense Nuclear Facilities, United States Department of Energy (2001).