

Safety Culture at the WTP White Paper: Potential Attachment for Advice on Waste Treatment Plant Safety Culture

Introduction

This white paper provides context for the Hanford Advisory Board's (HAB) concerns regarding safety culture at the Waste Treatment Plant (WTP). This document is intended to clarify terminology associated with "safety culture" and to provide background about its conception, application, and development. The HAB has advised that a rigorous safety culture is essential to the successful design and operation of the WTP. The HAB finds it important to provide an in-depth discussion of what safety culture means, how safety culture, safety basis, and occupational safety differ, and how these apply to Hanford's WTP.

Background

The WTP is a first-of-its kind facility intended to perform the critical work to contain and stabilize Hanford's high-level nuclear waste in glass. The HAB believes that the critical work of building a safe and effective process that stabilizes high-level waste (HLW) in glass can be accomplished using systems engineering, effective project management, innovation, and a robust safety culture. A robust safety culture at the WTP must support and champion the practice of challenging the plant's design in order to expose its vulnerabilities and overcome them.

The Defense Nuclear Facilities Safety Board (DNFSB) has performed detailed oversight and review of the WTP. The DNFSB made recommendations on several issues that are of serious concern to the HAB. These relate to the technical adequacy of the design; construction decisions; safety culture and protection of workers, the public and the environment; and other issues.

The DNFSB issued three recommendations related to technical issues (2010-1 and 2010-2) and safety culture (2011-1) at the WTP. See [Defense Nuclear Safety Board Recommendations](#) below for details about these issues.

Among other recommendations, the DNFSB recommended that DOE conduct full-scale testing of the pulse jet mixers and develop waste simulants that envelope the complete range of physical properties of Hanford's HLW, including the unusual non-Newtonian behavior of Hanford wastes. The DNFSB asked DOE to identify any other technical and safety-related risks that remain unresolved upon completion of the large-scale testing.

In addition, the DNFSB cited specific concerns related to technical differences on the deposition velocity of particles released to the environment during an accident. This has importance for how far radioactive particles and materials might spread in an accident.

On Safety Culture, the DNFSB found that a chilled atmosphere adverse to safety exists, and that DOE and contractor management suppress technical dissent. The DNFSB recommended prompt, major improvement and indicated that corrective actions will only be successful and enduring if championed by the Secretary of Energy.

The DNFSB recommended that the Secretary of Energy: assert federal control at the highest level and direct, track, and validate the specific corrective actions to be taken to establish a strong safety culture consistent with DOE Policy 420.1 in both the contractor and federal workforces; conduct an extent of condition review to see if the issues extend beyond the WTP Project, and conduct a non-adversarial review of personnel treatment by both DOE and contractor management and how that is affecting the safety culture at WTP.

Initially, DOE managers replied that DOE must have a good safety culture, as evidenced by the low accident and injury rate. This response gives the HAB great concern, as it suggests a serious misunderstanding about safety culture.

In the fall of 2011, DOE and its contractors conducted a number of self assessments. The most recent "Independent Safety and Quality Culture Assessment" was selected and funded by the major contractor, Bechtel.

This review found:

- 1) *"No Widespread Evidence of a Chilled Atmosphere Adverse to Safety..."* and *"No Widespread Evidence that DOE and Contractor Management Suppress Technical Dissent,"*
- 2) *A "Lack of Effective and Timely Disposition of Technical and Safety Issues,"*
- 3) *"A lack of systematic integration of safety and design indicates a less than adequate safety construct and has itself negatively impacted the WTP safety culture,"*
- 4) *The "Safety Construct Implementation does not Support Project Schedule,"* and
- 5) *"Communications (are) not Fully Supportive of Safety Culture."*

In a December 5, 2011 memo to Department Heads, Secretary of Energy Stephen Chu and Deputy Secretary Daniel Poneman reaffirmed the Department's commitment to Safety Culture through standards and managing risk using Integrated Safety Management Systems, directives and expectations.

Safety Culture

"Safety Culture" as a term of art was created directly as a result of analysis of the Chernobyl disaster. Its principal focus and intent was to identify those aspects of design, construction, operation and organizational and personal culture that contribute to potential disasters impacting workers, the public and the environment. Safety Culture was not intended to refer to day-to-day occupational safety, but did not exclude it.

The efforts around establishing a robust safety culture were and are intended to focus on those aspects of design, construction, operation and organizational and personal culture that contribute to potential disasters that may lead to catastrophic harm impacting workers, the public and the environment to ensure they are found and eliminated, and if they cannot be eliminated that they are controlled to prevent such harm. Choosing mitigation rather than elimination can and often does create additional dangers.

Serious problems remain in understanding safety culture, as evidenced by the disasters involving Fukushima, the Columbia and Challenger Shuttles, the near miss at Davis-Besse, the flooding of Ft. Calhoun, the beyond-design basis earthquake damage at North Anna, and many others. Safety culture as originally envisioned remains a vitally important issue today.

“Safety Culture” is often used in concert with associated terms like “Safety Basis” and “Safety Construct.” Though there is no universally agreed upon definition, the term “Safety Culture” has been defined in several ways - including:

“That assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance.” (International Atomic Energy Agency, International Safety Groups’ (1988) ‘Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident’)

“The product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization’s health and safety management” (United Kingdom [Health and Safety Commission](#), 1993. Third report: organizing for safety. Advisory Committee on the Safety of Nuclear Installations Study Group on Human Factors. London, p. 23).

“The safety culture of an organization is the product of individual and group values, attitudes, perceptions, competencies and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization’s health and safety management.” (Advisory Committee on the Safety of Nuclear Installations (ACSNI))

“An organization’s values and behaviors modeled by its leaders and internalized by its members, which serve to make safe performance of work the overriding priority to protect the workers, public, and the environment.” (DOE Energy Facility Contractors Group (EFCOG), Glen Podansky, June 3, 2010 and DOE Policy)

As the above definitions suggest, safety culture today generally refers to the behavioral and cultural practices of organizations and individuals and how such practices interact with the technical work to ensure safety. This includes encouraging employees to raise concerns that expose design vulnerabilities to ensure issue resolution without fear of retaliation. Though not

excluded, it is all too easy using these definitions to forget the original intent – **disaster prevention**.

Safety Basis

Safety culture is to large degree codified under Federal Law as “Safety Basis.” The term “Safety Basis” refers to: *“The documented safety analysis and hazard controls that provide reasonable assurance that a DOE nuclear facility can be operated safely in a manner that adequately protects workers, the public and the environment [10 CFR 830.1].”*

When the Safety Basis excludes or limits evaluations of particular accident scenarios through the design basis (often based on estimates of probability that events might occur), it can lead to a greatly increased chance for catastrophic outcomes as occurred at Chernobyl and Fukushima. A good safety culture ensures the identification and elimination of high consequence, low probability events that are the greatest risks to the public, to workers and to the environment.

Safety Construct

The term safety construct is not broadly used, but is part of the recent Independent Safety and Quality Culture Assessment report. “Safety Construct,” can be defined as *“a hierarchical, techno-legal assembly of regulatory and operational safety systems ensuring the safe design, operation, and maintenance of nuclear power reactors for the benefit of the Nation.” (Nils Diaz, U.S. Nuclear Regulatory Commission)*

Integrated Safety Management System (ISMS)

As a core part of its safety controls, DOE and its contractors implement an “Integrated Safety Management System” (ISMS). ISMS attempts to encompass all aspects of safety culture, but is often primarily oriented to occupational safety issues.

Integrated Safety Management has two major components that are necessary for success:

1. The widely recognized process steps – defining the work scope, identifying hazards and hazard mitigation, hazard control, performance of work, and feedback, and;
2. Principles of behavior – the attitude of the managers and employees.

ISMS as a system can help provide a framework for incentivizing safety behaviors, but does not replace the need for establishing a robust safety culture. For example, ISMS may involve the identification of work place hazards but generally does not provide tools for reviewing management’s practice of encouraging or discouraging the reporting of concerns, nor does it necessarily driver and foster an environment where workers actively seek out ways the design or operations can lead to unrecognized disasters or hazards.

The HAB is concerned with all of these: Safety Culture, Safety Basis, Safety Construct, and ISMS. Taken together, these can either result in a robust system in which problems and issues are identified and effectively addressed or a broken system in which problems and issues are missed or suppressed.

DOE Action Plan

The HAB is further concerned that the comprehensive action plan proposed by DOE in its response to DNFSB Recommendation 2011-1 contains a number of elements that seem to be the standard actions performed every time a major safety issue emerges: Large group and all-employee meetings; train the supervisors; employ independent review teams; remodel the safety concern reporting process; designate “safe” safety spokespersons; and invoke ISMS. There is nothing new or unique in that approach that will change the safety culture and the safety culture issues that continue to emerge.

The HAB is concerned that there appears to be a need for a sincere effort to routinely engage management at the highest levels into the safety process with a demonstration that they are concerned and involved. This requires more than a monthly meeting where employees air their concerns, management listens, and few or no really positive actions result. Too often senior management rapidly reverts to cost, schedule, and fee concerns and to exerting pressure on the lower management chain to work faster and cheaper. The first line supervisor at the bottom of the management chain sometimes reacts by slighting safety, encouraging cutting corners, etc. The culture does not improve.

When a [2005 survey](http://www.hanfordchallenge.org/wp-content/uploads/2010/05/2005-o1.18-DOE-ECP-Letter.pdf) (<http://www.hanfordchallenge.org/wp-content/uploads/2010/05/2005-o1.18-DOE-ECP-Letter.pdf>) of the work site indicated serious problems with the safety culture among the represented workers at the WTP construction site, DOE initiated and supported a comprehensive effort to effect a paradigm change in the role of workers and managers in work-place safety. Workers were trained, encouraged and even required to raise concerns and stop work when it seemed that safety or the outcome of a task might be compromised. Managers of every level were trained and required to accept that workers are thinkers, too, which, for construction activity, was a significant shift in work place culture. Senior management actively and unflinchingly supported the activity.

Defense Nuclear Safety Board Recommendations:

1. In Recommendation 2010-1, the DNFSB raised concerns about DOE’s design “Safety Basis” and made recommendations regarding bounding accidents, regulations, criteria and requirements.
2. In Recommendation 2010-2, the DNFSB raised concerns about a series of technical issues involving design, testing and safety of pulse jet mixers, tanks, criticality control,

mixing, hydrogen gas generation, modeling, sampling, simulants and other issues. The DNFSB expressed concerns about:

- Design: The pulse jet mixers having sufficient power to adequately mix waste, safety concerns over accumulation of flammable gases, accumulation of solids at the bottom of the mixing tanks, and potential criticality accidents.
 - Criteria: To assess the degree of mixing
 - Adequacy of waste simulants: Whether the simulants used in small-scale tests accurately represent the real waste.
 - Scaling: Whether scaling up the small-scale tests would adequately reflect full-scale plant performance.
3. In Recommendation 2011-1, the DNFSB raised concerns about the DOE and contractor “Safety Culture”, about the technical and cultural issues. This recommendation was in large part triggered by the removal of a senior engineering manager, and is directly related to the technical issues in the previous two recommendations. The DNFSB made two findings:
- A Chilled Atmosphere Adverse to Safety Exists
 - DOE and Contractor Management Suppress Technical Dissent.