

**EM SAFETY INNOVATIONS AIM TOWARD SAFER TECHNOLOGIES  
AND BETTER INFORMATION FOR USERS**

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**ABSTRACT**

Beginning in 2000, the Department of Energy's Office of Environmental Management (EM), Office of Science and Technology (OST) has substantially re-examined and improved our approach to worker safety and health. Consistent with OST's responsibilities for safety, these initiatives can be categorized generally as: (1) Making our technologies inherently safer to use; and (2) Providing useful safety and health information about our technologies to the sites and technology operators. This evolved through a collaborative process by the EM Office of Safety, Health and Security, the EM Office of Science and Technology, EM Focus Areas and others. It was, initially, largely in response to a set of eight recommendations by the Environmental Management Advisory Board (EMAB) and to lessons learned from a serious accident in August, 2000 involving an OST-funded new technology. The cornerstone of this effort is the *Policy for Occupational Safety and Health in EM's Science and Technology Program*, issued in January 2001.

DOE Focus Areas are focusing more attention on worker safety and health in their solicitations and procurement documents for new technology research and development (R&D) projects. EM Headquarters is working with Focus Areas, site environmental contractors, technology developers, and their respective DOE field organizations to ensure that roles and responsibilities for worker safety and health are clearly defined when a new technology is demonstrated at an environmental management site. The peer review process administered by the American Society of Mechanical Engineers (ASME) now requires technology developers to think through their approach to safety and health in a more detailed, focused way than previously. In Innovative Technology Summary Reports (ITSRs), developers are comparing their new technologies to baseline technologies on the basis of safety and health. Technology Safety Data Sheets (TSDSs) are being prepared for new technologies when they reach the appropriate stage of development.

These and other process adjustments encourage technology developers to incorporate an iterative hazard analysis approach throughout their R&D processes. This is good, sound engineering practice which, we are confident, is helping developers to make design decisions that lead to inherently safer technologies for site contractors and workers, and ultimately to lower life-cycle costs for the technologies. Importantly, all of this is being accomplished with minimal bureaucracy by working within OST's existing management practices to reinforce desired behaviors and instill new values. Some business process documents are being "tweaked." But there are no new Orders or Directives, no new personnel, and only minimal changes in reporting and documentation. The real changes are coming about because of subtle changes in our processes, and very significantly—changes in the culture.

**BACKGROUND**

The Department of Energy's (DOE's) Office of Environmental Management (EM) is committed to maintaining a program that is second to none in the dedication and skill with which it

promotes occupational safety and health in all phases of development and deployment of new environmental remediation technologies.

Since 1995, the EM Office of Science and Technology (OST) has conducted a program with the International Union of Operating Engineers (IUOE) to include occupational safety and health (OSH) considerations in the EM technology development program.

In April 2000, the Environmental Management Advisory Board (EMAB) adopted a Resolution on the Consideration of Occupational Safety and Health in the EM-OST Technology Development Program. The EMAB stated that the OST program addresses occupational safety and health more comprehensively than other federal agencies with development programs in the remediation technology sector, and offered eight recommendations aimed primarily at further enhancing occupational safety and health in OST's technology development program. These were:

- OSH guidelines to developer community
- Guidance on OSH in peer reviews performed by the American Society of Mechanical Engineers (ASME) for OST
- More detailed guidelines on OSH in OST's Stage-Gate procedure (which OST uses to measure the developmental progress of the technologies it supports)
- TSDS for every technology at mid-stage review
- Include OSH compliance costs in technology cost performance data
- "Safer" technologies: identify and disseminate information
- Heat Stress Management Development program
- Contract language to promote use of new technologies supported by OST in the EM environmental cleanup program (This was aimed at enhancing OST overall, not necessarily focused on OSH.)

On August 22, 2000, a worker was seriously burned at the Portsmouth Gaseous Diffusion Plant near Piketon, Ohio as the result of a violent exothermic chemical reaction during a demonstration of an innovative remediation technology funded by OST. A Type B Accident Investigation was conducted by the Oak Ridge Operations Office. The Investigation Board identified four root causes for the accident. In summary, these are:

- Failure to analyze the hazards for all field activities;
- Failure to implement the hazard controls and requirements stated in the project documents;
- Failure to establish clear roles and responsibilities for the planning, execution, and oversight of the project; and
- Failure to establish or ensure a safety culture that implements Integrated Safety Management (ISM) and encourages personnel to stop and re-enter the analysis phase when a change or unexpected condition arises.

A common and reoccurring causal factor cited throughout the investigation report was a lack of clearly understood and executed worker safety roles and responsibilities for all parties involved in the demonstration.

The EMAB Resolution, the accident at Portsmouth, and other subsequent events provided substantial impetus for OST to re-examine and improve our approach to worker safety and health. This begins with the way we operate-- our agreements and relationships with end-users, technology developers and others.

This process of self-examination and renewal began with the development of a new *Office of Environmental Management Policy for Occupational Safety and Health in EM's Science and Technology Program*. This policy document was developed over a period of months of study by a diverse team representing OST, the EM Office of Safety, Health and Security, Focus Areas, the Environmental Management Advisory Board and others with an interest in our activities. It went through an extensive concurrence process throughout the Office of Environmental Management. The Policy lays the groundwork for the initiatives described herein. A very important feature of both the Policy and of the steps taken to implement it is that— again consistent with Integrated Safety Management-- everything is being done within the existing framework of OST management practices and guidance.

The initiatives that have come from our self-examination can be categorized generally as:

- Making our technologies inherently safer to use; and
- Providing useful safety and health information about our technologies to the sites and technology operators

## **METHODS**

### **Making OST Technologies Inherently Safer**

OST's efforts to produce technologies that are inherently safer by design now begin with the first peer review of proposals, and continue through all stages of development, demonstration, and deployment. The DOE Chicago Office, which administers the ASME peer review process for OST nationally; the American Society of Mechanical Engineers; and the Institute for Regulatory Science, which administers the program on behalf of ASME have all been enthusiastic partners in this effort. During the summer of 2001 we revised the *Implementation Guidance for the Technical Peer Review Process* and the ASME criteria for peer review panels. We also now require an individual with appropriate safety and health expertise on each review panel. Among the safety and health criteria against which peer reviewers gauge proposals are:

- Is there sufficient evidence that the principles of “inherently safer” design have been considered in the design of the proposed technology?
- Is it clear that the project team will have access to sufficient safety and health expertise as the technology is developed and demonstrated?

- Will operating and maintenance workers who service the proposed technology be at reduced risk from occupational health and safety hazards as compared to the baseline technology that it will replace?

Similar and more detailed criteria are peer reviewed at later developmental stages.

The emphasis on inherently safer technologies that begins with peer review is reinforced as technologies are subjected to stage/gate reviews, particularly at Mid-Year Reviews by Focus Areas. In *Tracking Technology Maturity in DOE's Environmental Management Science and Technology Program Revision 1*, issued January 31, 2001, OST states,

Greater emphasis on occupational safety and health issues will be verified during the mid-year review process to ensure selection and development of technologies that have optimal safety and health characteristics. Focus Areas will also be expected to note in their Mid-Year Review Reports progress of technologies on safety and health related to the questions in Section 1.3, 2.3 or 3.3 of Appendix C of the policy document . . .

Timing issues limited the ability of the Focus Areas to fully implement this for the 2001 Mid-Year Reviews, but we look forward to more attention to safety and health in the 2002 Mid-Year Reviews.

A key to inherently safer technologies, by design, is continued hazard analysis throughout the technology development process. In our scheme, the most visible “driver” for hazard analysis is the need to produce a Technology Safety Data Sheet (TSDS). OST commissioned a series of pilots by the International Union of Operating Engineers to gauge the feasibility of producing TSDSs at the mid-stages of technology development. In October, 2000, the IUOE reported their conclusion:

Based on the TSDS pilot, it is felt that a technology needs to be at Gate 4, Engineering Development, before enough technology information is available to produce a TSDS. However, gates prior to Gate 4 should be used as opportunities to start designing out safety and health hazards using thought stimulators and “tools” designed to guide the process of incorporating safety and health into the design.

The EM Policy states that TSDSs will be required for all technologies reaching Gate 4 for which a TSDS is determined to be appropriate. This is further supported through the FY 2002 Program Execution Guidance (PEG) and the FY 2002 Annual Performance Plan Guidance. In June, 2001 the OST PEG Development Handbook FY 2002 Work Authorization was issued with the following milestone requirement for Technical Task Plans (TTPs): “A Technology Safety Data Sheet (TSDS) should be available (in draft at Gate 4, final at Gate 5, and revised at Gate 6) for any technology reaching this stage of development, for which there exist any worker safety and health issues.” This was reiterated in the Annual Performance Plan (APP) Guidance. The Focus Areas provided lists in their FY 2002 Annual Performance Plans of technologies for which TSDSs would be needed during FY 2002.

The actual production of new TSDSs is a sizable endeavor, and it will take time to gear up for this activity. It is critical that technology developers and Focus Areas take ownership of the

TSDSs. Currently the IUOE provides most of the safety and health expertise to produce TSDSs; but ultimately, we hope to enable developers to create TSDSs themselves.

### **Providing Useful Safety and Health Information About OST Technologies**

Technology Safety Data Sheets are summary reports designed to provide workers with useful, intelligible safety and health information about the technologies they are working with or will work with. In the DOE-EM context, it is desirable to provide this information in a way that supports site Integrated Safety Management activities. Workers and managers at all levels are, of course, involved in these activities.

Because there has not heretofore been a single, recognized format or set of content requirements for TSDSs, we have undertaken a pilot project involving both technology developers and site end-users to develop TSDSs that provide the most useful information in the most useful format, for workers and managers in their ISM activities. We began this process with the Pit Viper technology (Tanks Focus Area) and with two technologies funded by the Subsurface Contaminants Focus Area. Uncertainties related to funding of the technologies and other factors have slowed these pilots, but we expect to complete the project in the near future.

Related to this pilot is a draft document, *How to Prepare Technology Safety Data Sheets*. This was drafted and refined in 2001, as two successive drafts were circulated among Focus Areas and others in the OST community for comment. We envision this as a “living” document that is likely to continue to evolve as we learn more and more about the process of developing TSDSs, and about how they are used by technology users. A technical workshop is planned to evaluate TSDS format and content after completion of approximately 50-60 TSDSs.

OST uses Innovative Technology Summary Reports (ITSRs) to communicate the advantages of innovative technologies to end-users. ITSRS provide a means for technology developers to summarize their technologies, potential applications, cost and performance data, and other pertinent information concisely and consistently. They are also an excellent means for developers to trumpet the safety and health advantages of their technologies. In 2001, OST revised our *Preparation Guidance for Innovative Technology Summary Reports* to include more attention to occupational safety and health information, and especially to instruct developers on comparing their innovative technologies to baseline or competing technologies in terms of safety and health. Because innovative technologies are often safer than baseline technologies, we believe that calling attention to these safety advantages can be an important selling point in favor of the new technologies. In addition, the TSDS—where one is appropriate—is required to be included in an appendix to the ITSR.

It is understood that inherently safer technologies are likely to have reduced costs for compliance with occupational safety and health requirements compared to baseline or competing technologies. This was the topic of one of the EMAB's recommendations in 2000. A National Technical Workshop was held in October, 2000: "Assessing the Full Costs of New Remediation Technologies: Guidelines for Identifying Occupational Safety and Health Costs for Environmental Remediation Technologies." Many of the recommendations in the workshop report are addressed in other OST safety and health activities described herein, but we do not currently have the ability to systematically quantify differences in safety and health costs in a way that is useful to prospective technology users.

### **Changing OST Business Practices**

The aftermath of the August 22, 2000 accident in Portsmouth, Ohio involving an OST-supported technology showed us the need to address contracting and other management issues relating to safety and health. At a meeting in Oak Ridge in April 2001, Deputy Assistant Secretary Gerald Boyd identified two new paths forward:

- Develop means to establish clear contractual lines of responsibility for occupational safety and health when new technologies are demonstrated or deployed in the field.
- Examine OST's management practices for opportunities to better address worker safety and health.

Interim guidance to address the first of these points was issued in the FY 2002 PEG Handbook:

Finally, when an innovative technology is approaching the point where it will be ready for 'live' demonstration at a DOE-EM field location, the developer must contact the site M&I or other controlling contractor to work out a clear understanding of the roles and responsibilities for worker safety and health: including effective flow-down, with oversight, of ISM and other safety and health requirements to subcontractors who may be involved in the technology demonstration.

Further analysis indicates that these important elements should be considered:

- a. Under what company's ISM program will the demonstration work be performed, and how will these requirements be clearly and unambiguously transmitted to any subcontractors and subcontractor employees?
- b. If the demonstration work will be performed pursuant to a Radiological Protection Program, how will this flow down to the contractor and employees performing the demonstration work, and what company will be responsible for radiological protection?
- c. What are the parameters in terms of time, geographic area, and work content covered by the agreement?
- d. How will information about worker safety and health roles and responsibilities "flow down," or be communicated to the subcontractors to both parties?

- e. What worker training and procedures will be used? For example “stop work,” occurrence reporting, emergency response and notification, etc.

We are still in the process of carefully reviewing OST's management practices, as outlined in the *OST Management Plan*, with respect to safety and health. This review may lead to additional adjustments in our business practices and guidance documents over the next year.

## CONCLUSION

The EM Office of Science and Technology, in partnership with the EM Office of Safety, Health and Security, the EM Focus Areas, EM field organizations, and developers and users of our technologies, has made significant progress in constructing a new approach to worker safety and health in OST-supported technology development. In the course of this effort, we have also found additional needs and opportunities to improve safety and health with respect to our technologies.

Importantly, we have managed to accomplish most of this by working within our existing business practices to reinforce desired behaviors and instill new values. We have largely avoided creating new programs or bureaucratic requirements. We are convinced that, through this approach, we are effectuating the most lasting change-- and change that best supports the mission of EM and its Science and Technology program.

We are very aware that “saying it doesn't make it so.” By developing the Policy and adjusting OST management practices consistent with the Policy, we have begun a process of change. We are now in the process of providing continuous monitoring, evaluation, reinforcement and undoubtedly “tweaking” to see these changes take firm root within the culture of OST and EM. In the process, we expect to update the Policy in 2002 and periodically thereafter. As time goes by, we expect that the safety enhancements in management practices will become status quo— and that, as a result, the innovative technologies that are successfully developed with OST support will be inherently safer and end users will receive better safety information.