

P.3 Human Factors Assessment of Environmental Technologies: Integrating Safety and Health into the Design and Development of DOE Clean-up Technologies

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Abstract

The International Union of Operating Engineers (IUOE) has been involved with work at Department of Energy (DOE) sites since the Manhattan Project. A 1995 EPA/NIEHS Labor Market Study showed Operating Engineers to be the main labor force on environmental clean-up jobs throughout the country. Therefore, the IUOE with its intensive hands-on clean-up work force is often impacted by risk decisions such as clean-up vs. leave in place. This has resulted in a vested interest in understanding risk to the workers and their families.

To expedite and make environmental clean up more efficient, the federal government has been increasingly funding environmental technology research, development, and demonstration programs (RD&D) during the last decade. In July 1995 the Congressional Office of Science and Technology (OTA) issued a report entitled "Environmental Technology: Analysis of Selected Federal R&D Programs" (OA-ITC-155) that examined such programs within five departments and three agencies. The report estimates that during FY94, \$2.5-3.5 billion¹ was devoted to environmental technology RD&D. The largest agencies involved being the Environmental Protection Agency (EPA), Department of Defense (DoD), and the DOE. The DOE had, by far, the largest program reflecting the unique and demanding nature of the DOE Environmental Management (EM) environmental program, a point noted in the OTA report.

Traditionally, worker health and safety considerations, specific to the technologies developed through this R&D effort, have not been included in the mainstream of the R&D continuum. The DOE became the first agency to begin addressing these safety and health issues in 1995 with a cooperative agreement with the IUOE for the Human Factors Assessment of Environmental Technologies. This program uses a team approach of workers and expertise from appropriate disciplines to assess environmental technologies for safety and health hazards and make recommendations for mitigation/elimination of these hazards. Several of the products that have resulted from these evaluations and this program promise to have far-reaching impact for protecting workers during current clean up activities and to allow them to maintain their quality of life as they move through their careers.

¹ OTA (U.S. Congress. Office of Technology Assessment). Environmental technology: Analysis of selected federal R&D programs. OTA-ITC-155. July 1995. 2.

The partnership between the DOE Environmental Management organization and the IUOE has produced three important initiatives for protecting workers who will operate clean-up technologies on DOE sites through 2006 and beyond. The first initiative has been broad technical support of technology developers. The IUOE has evaluated over 50 technologies using teams of safety and health experts and “field experienced” HAZMAT workers, providing recommendations to the developers and to DOE. Common findings include high noise levels and poor ergonomic designs. The partnership has also produced three National Technical Workshops on improving the safety of new technologies, each workshop resulting in a major guidance document.

The second initiative has been the promotion of a new tool for communicating the potential hazards of technologies to a broad audience. Technology Safety Data Sheets (TSDSs) use the familiarity of Material Safety Data Sheets (MSDSs) to impart critical information about the risks to workers posed by new technologies. These along with other communication tools are being piloted with three EM funded technologies to determine their usefulness and value.

The third initiative has been a major effort to identify the costs of ignoring safety and health in the design and deployment of new technologies. The IUOE has invited national experts on the subject of compliance costs to develop a model for depicting the additional costs that will be passed along to the buyer if the developer does not, at a minimum, meet OSHA standards in designing their technology. The first step in identifying these costs is to assess the hazards of these technologies. To improve the hazard assessment practices of technology developers, the DOE-IUOE partnership has generated a series of checklists that will be made available to the entire technology development community.

This partnership of DOE-EM Office of Science and Technology (OST), the National Energy Technology Laboratory, and the IUOE has provided worker’s with a proactive effort to assure hazards and risks are addressed in the early phase of technology development. The ultimate goal is to design out the hazards and risks before anyone is exposed to them.

The products of the program discussed above are not the only way in which DOE EM-OST is making exceptional strides in this area. The IUOE through the Human Factors Assessment of Environmental Technology Program will be involved in the DOE Focus Area mid-year reviews to assure safety and health is considered during the technology development process. Discussion during this presentation will also include aspects of the newly developed EM-OST Policy to assure worker health and safety is addressed in the R&D continuum.

HUMAN FACTORS ASSESSMENT OF ENVIRONMENTAL TECHNOLOGIES: INTEGRATING SAFETY AND HEALTH



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In partnership with

DOE-NETL

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Significance of the Problem

- Manhattan project – 4 years, \$2 billion
- 120 million ft² of buildings and 3,750 square miles
- Cover Manhattan 5' deep with contaminated soil
- Cover Manhattan 135' deep with contaminated groundwater
- \$150-200 billion and 70 years to complete cleanup



Objectives of Environmental Technology Spending

- Clean up of particularly hazardous or radioactive waste
- Reduction of risks to clean up workers and the public
- Reduction of clean up costs
- Reduction of waste management compliance costs
- Utilization for domestic and export markets



HUMAN FACTORS ASSESSMENT PROGRAM

- Partnered with IUOE to evaluate environmental, safety, and health of DOE technologies
- Cooperative agreement with National Energy Technology Laboratory
- Establishes International Environmental Technology and Training Center to conduct Human Factors Assessments



Human Factors Assessment Program Objectives

- Enhance effectiveness of technologies and enhance desirable human traits
 - Job satisfaction
 - Improved quality of worker's life
- Facilitate deployment of DOE technologies by working with developers to eliminate/mitigate hazards and operational hindrances
- Assist developers to provide structured information to users of technologies



Technology Acceptance

- New technology must be deployed and utilized in the field to be termed successful
- Acceptance in the field often includes factors not addressed during development
 - technology specific hazards
 - functional hindrances

“The problem is that too many designers can look a hazard in the eye and never recognize it as such”.



Thomas Hunter, 1999
Safety Through Design, NSC



What Do Design Engineers Really Know About Safety?

- 80% of 528 engineers had never taken a safety course
- 60% had not taken any safety short courses
- Dichotomy: safety experts have the tools but are not involved in the design process, engineers are responsible but lack the tools

Is There Irresponsible Work?

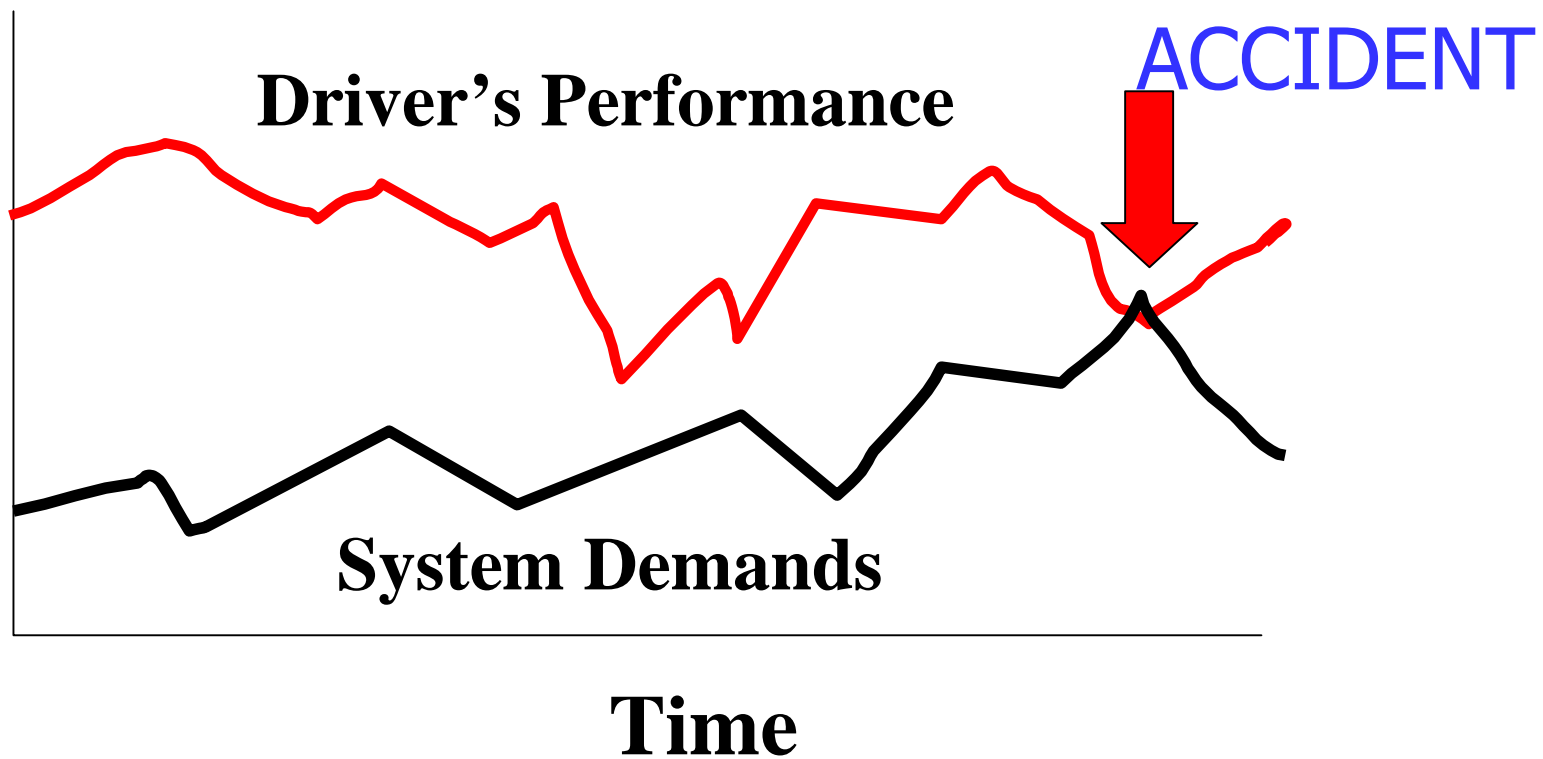


Yes, but is there error-prone design?

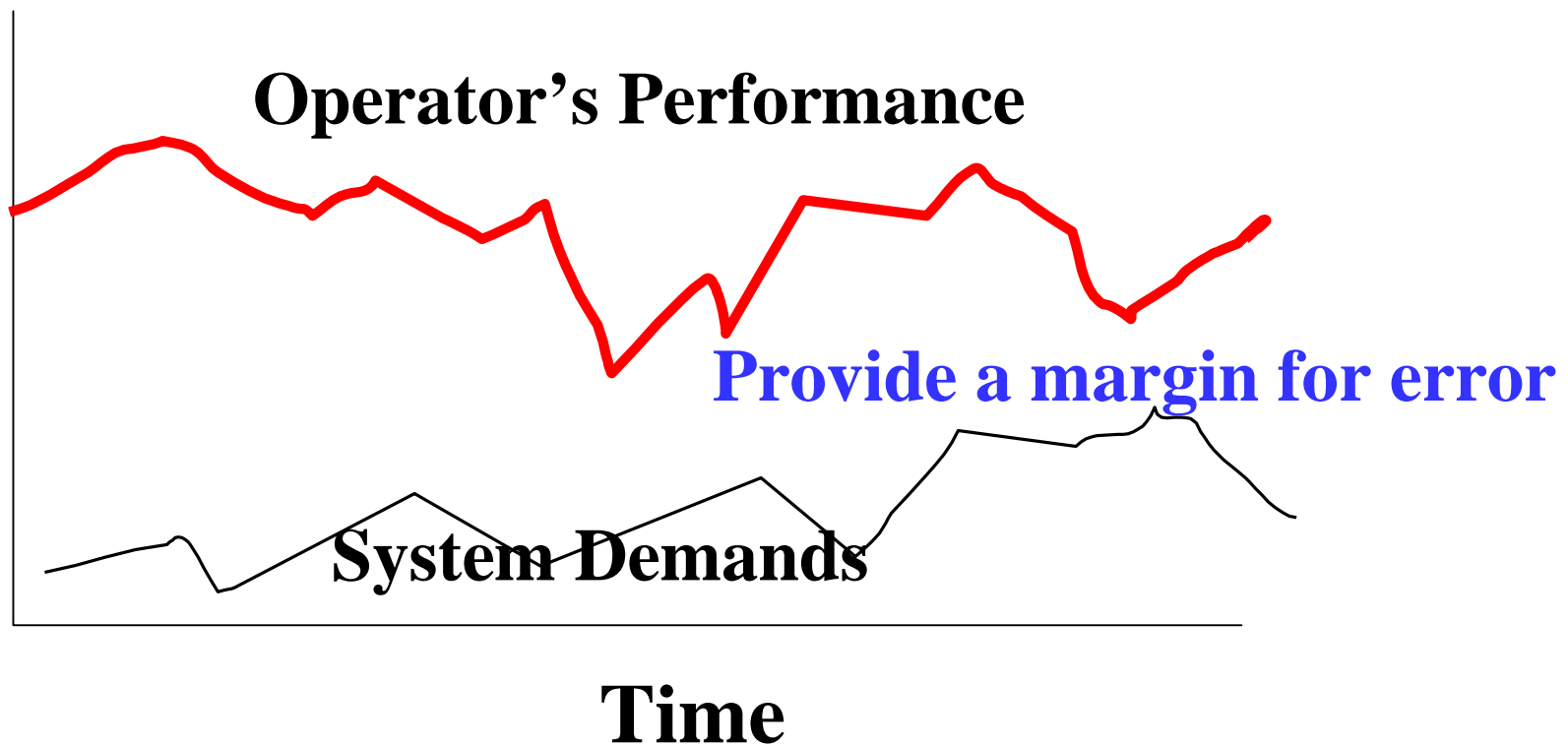


Diagram of Accident Occurrence for a Truck Driver

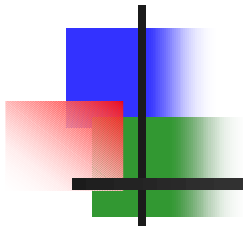
Blumenthal, 1968



Purpose for Conducting Human Factors Assessments



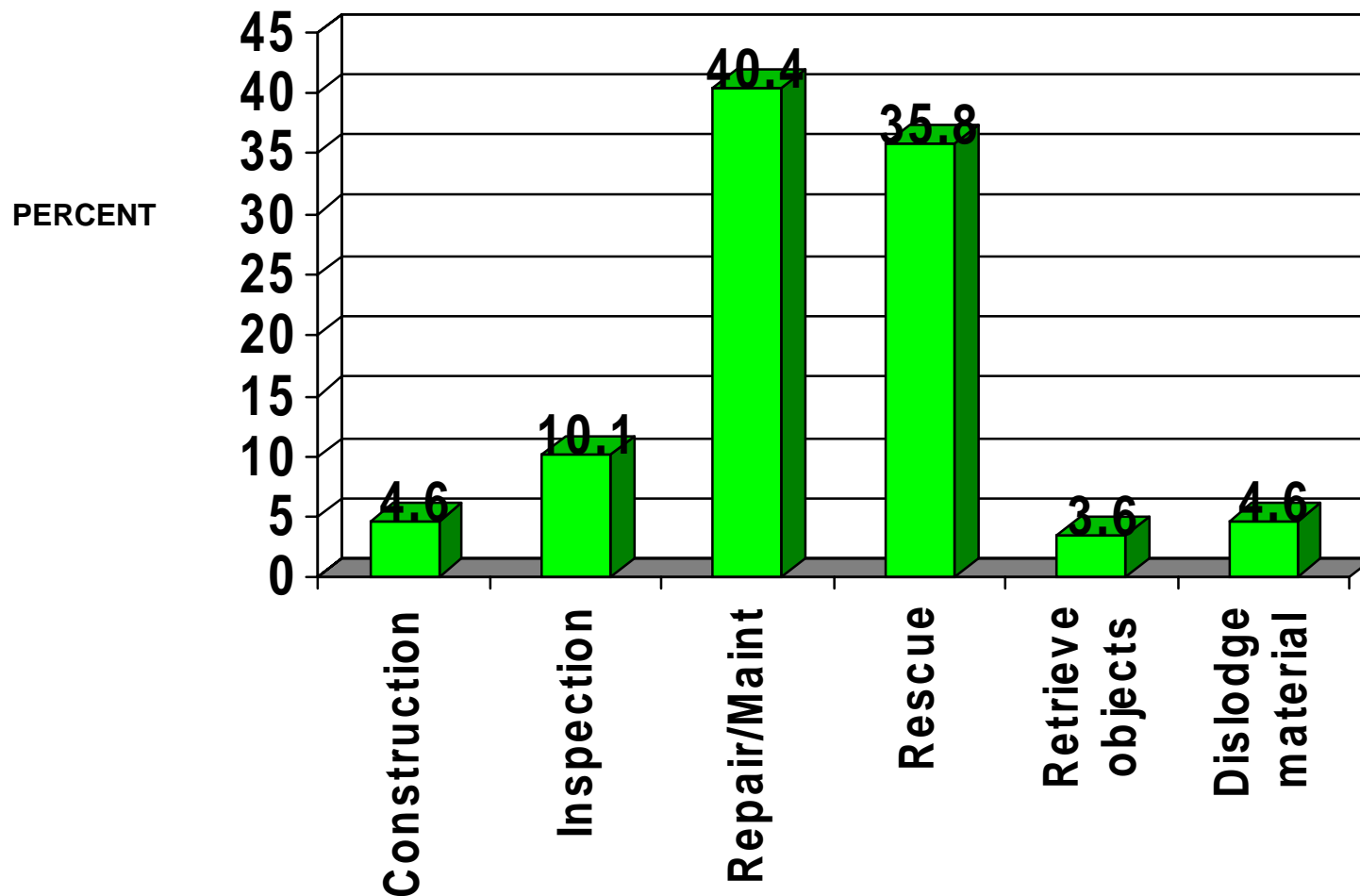
Elimination of Hazards



PROVIDE THE
MARGIN OF ERROR

Maintenance Work Presents Real Risks

NIOSH Evaluation, 109 Confined Space Fatalities (1983-1993)





Removal of Hazard Eliminates:

- Creation of operating procedures to protect workers from exposure to hazard
- Training regarding hazard
- Payment of additional worker's compensation premiums



Structured Information

- Comprehensive technical report
 - Technology Safety Data Sheet (TSDS)
 - Job Hazard Analysis (JHA)
 - Failure Mode and Effects Analysis (FMEA)
 - Emergency Response Data Sheet (ERDS)
- Chapter for ITSR
- Two-page summary



Human Factors Assessment

- Utilization of “generic” and “technology specific” assessment protocols
- Team approach
 - safety and health professionals
 - “field experienced” operators
 - specific expertise, as required
- Interaction with developer from design to deployment



DOE'S COMMITMENT TO SAFETY AND HEALTH

- EMAB Recommendations
 - Provide safety and health checklists / guidelines to the DOE developer community
 - Provide guidance for consideration of safety and health in ASME peer review process
 - Develop more detailed guidelines for the consideration of safety and health in the Stage-Gate procedure
 - Require a Technology Safety Data Sheet (TSDS) for every technology at mid-stage review



DOE'S COMMITMENT TO SAFETY AND HEALTH

- EMAB Recommendations
 - Consider approaches to including occupational safety and health compliance costs in technology cost performance data
 - Encourage the identification of “safer” technologies and dissemination of that information
 - Initiate a Heat Stress Management Development Program
 - Develop specific contract language that promotes use and/or implementation of new technologies



SAFETY AND HEALTH CHECKLISTS / GUIDELINES

- National Technical Workshop
 - New Environmental Remediation Technologies: Guidance Criteria for Occupational Safety and Health
- What is appropriate at different stages of development
- Never too early to consider safety and health



Technology Hazard Identification

- Job Hazard / Safety Analysis
- Checklists
- Process Hazard Analysis Checklists
- Hazard and Operability Study
- Failure Mode and Effects Analysis
- What if Analysis
- Fault Tree Analysis



TECHNOLOGY SAFETY DATA SHEET (TSDS)

- Technology specific document
- Provide the identity and relative risk of safety and health hazards associated with a technology
- TSDS Pilot
 - Stage-Gate Three appears to be too early
 - Stage-Gate Four enough information for good start
 - Completion after demonstration



TECHNOLOGY SAFETY DATA SHEET (TSDS)

- Additional questions
 - Resources needed
 - Value of TSDS for communicating safety and health information
 - What format would be most useful
 - Cost of developing TSDS
 - When should TSDS be updated



COMPLIANCE COSTS IN COST-PERFORMANCE DATA

- National Technical Workshop
 - Preliminary Guidelines for the Development and Application of Occupational Safety and Health Hazards Prevention Costs to Innovative Environmental Remediation Technologies
- Develop a consensus approach for the consideration of compliance cost information based upon hazard assessment of technology

HEAT STRESS MANAGEMENT DEVELOPMENT PROGRAM

- Identify need
 - Some previously identified
 - Worker discussion forum
- Initial Assessments





NEXT STEPS

- Distribute policy guidance to current and prospective technology developers
- Publish guidance for consideration of safety and health in ASME peer review
- Guidelines for safety and health for application in mid-year review
- Develop phased implementation plan for TSDS developemnt



NEXT STEPS

- Develop consensus on approach to include safety and health compliance costs in technology cost-performance data
- Improve safety and health information in ITSR and TMS
- Identify needs for heat stress management