

Human Factors Assessment and the Safe Deployment of EM-50 Technologies

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Introduction

In the United States, environmental technology development programs have been undertaken by various government agencies. A report published in July 1995, "*Environmental Technology: Analysis of Selected Federal R&D Programs*" noted that in 1994, \$2.5 - \$3.5 billion was spent by these technology development programs. The Department of Energy (DOE) had the largest program followed by the Department of Defense (DoD) and the Environmental Protection Agency (EPA). The DOE has primarily devoted resources to the development of advanced remediation technologies, often specific to unique remediation mission requirements. The goals of this environmental technology spending include 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, and emphasis on development and utilization of innovative technologies for domestic and export markets. The DOE recognized the important role human factors and safety and health hazards could play in hindering or meeting the objectives of the innovative technology development program, and in 1995, entered into a cooperative agreement with the Operating Engineers National Hazmat Program, "Human Factors Assessment of Environmental Technologies".

Objectives

While more than a dozen government agencies have spent millions of dollars for these technology research and development (R&D) programs, none had addressed the human factors or safety and health issues associated with these innovative technologies. The DOE has recognized and is addressing these issues to assist in the successful deployment of innovative technologies. Safety and health hazards also have the potential to increase the project costs. Occupational injury and illness data for 1992 shows that there were 6,529 workplace fatalities, over 6 million disability injuries, and 862,000 new cases of occupational disease. The costs associated with these include \$145.4 billion for direct and indirect costs of the injuries and fatalities and \$25.5 billion for the occupational diseases.

A new or innovative technology must be deployed and utilized in the field to be termed successful. Acceptance in the field often includes factors that are not considered and/or addressed during development. Technology specific hazards and functional hindrances are two of the more prevalent of these factors.

The objectives of the “Human Factors Assessment of Environmental Technologies” are to facilitate the deployment of DOE EM-50 technologies by working with the developers to eliminate/mitigate hazards and operational hindrances and to assist the developers in providing structured information to the technology user and to aid transition from development to deployment.

Approach

The "Human Factors Assessment of Environmental Technologies" program focuses on the elimination of hazards prior to deployment. If the hazards are eliminated prior to deployment, the following can often be eliminated after deployment: 1) identification of hazards, 2) creation of operating procedures to protect workers from exposure to the hazard, 3) training regarding the hazard, and 4) payment of additional worker's compensation premiums.

The elimination of these hazards is best done “up front” during technology development as opposed to the way it is typically addressed, at the back end with costly re-engineering. The program has sponsored a National Technical Workshop to address these hazard issues. The report, “*New Environmental Remediation Technologies: Guidance Criteria for Occupational Safety and Health*” specifies recommendations on how to implement the guidance and checklists and other tools that can be used to address human factors and safety and health issues.

Project Description

In order to facilitate the human factors assessment process, the technologies have been divided into three categories: Type I, Type II, and Type III. Type I technologies are those that address worker protection issues, Type II technologies are those that are used for remediation, and Type III technologies are those that involve robotic systems. A generic assessment protocol has been established for each type of technology and is used as the basis for the development of technology specific assessment protocols. These protocols are then used for the conduct of the human factors assessment.

The human factors assessment is conducted to identify hazards associated with the specific technology. The assessment is conducted using a team approach. Team members may include but not be limited to the following: safety and health professionals, “field experienced” operators, and expertise specific to the technology. The assessment team interacts with the technology developer throughout the development and assessment process. Tools which the team uses to perform the human factors assessment include job safety analysis, checklists, process hazard analysis checklists, hazard and operability studies, failure mode and effects analysis, what if analysis, and fault tree analysis.

Results

The human factors assessment program has to date conducted fifty (50) assessments. The team approach used for these assessments provides technical safety and health guidance

as well as input from “field” experienced hazmat workers (operating engineers). Recommendations for elimination/mitigation of hazards has resulted in the reduction of potential ergonomic hazards, exposure risks, and safety hazards. Addressing safety and health concerns and potential hazards before a technology is deployed will result in less costly and more efficient remediation, better worker acceptance, less cost for re-engineering and/or retro-fitting, and less lost time accidents. In some cases addressing the safety and health issues could completely eliminate the need for costly safety and health programs associated with the hazard. Recommendations for elimination/mitigation of safety and health concerns provided to DOE sites and/or Focus Areas considering a technology for a large scale demonstration or use during a specific project, can assist in addressing issues that have the potential to slow down or stop the demonstration thereby causing an increase in cost and a loss of efficiency.

The products of the human factors assessments include a comprehensive technical report which contains a technology safety data sheet, job safety analysis, failure mode and effects analysis, and an emergency response data sheet (currently under development), a chapter for the “green book”, and a two-page summary. The technology safety data sheet (TSDS) is an innovative tool for reporting hazard information about a technology. The TSDS may be considered a central repository for hazard information about a technology. Ideally, the TSDS contains information accumulated throughout the entire process of development and commercialization. It is modeled after the Material Safety Data Sheet (MSDS) as required by OSHA’s Hazard Communication Standard and the TSDS should be incorporated into a site’s hazard communication and/or HAZWOPER informational program. In addition, the TSDS can be used to inform safety and health professionals of potential hazards and to enhance the site-specific elements of the required HAZWOPER training.

In addition to the National Technical Workshop, “*New Environmental Remediation Technologies: Guidance Criteria for Occupational Safety and Health*”, two other National Technical Workshops have been held and reports published, “*Minimum Personnel Qualifications for Operation and Maintenance of Robotic/Remote Systems in Hazardous Environments*” and “*Guidelines for the Development of Training Programs for the Operation and Maintenance of Robotic Equipment*”.

Application

Examples of identification of hazards and recommendations for elimination/mitigation of those hazards for specific technologies are shown in Attachment I. As previously stated, elimination of these hazards increases efficiency and reduces costs.

Future Activities

The Human Factors Assessment program will continue to work with EM-50, focus areas, and DOE sites to conduct human factors assessments for specified technologies.

Many times safety and health is considered hindering and costly when in reality, long term savings can be created. An initiative of the program is to bring together experts to develop guidelines for a cost compliance index. This index would give a potential user of a technology an estimated cost to comply with the safety and health standards and regulations as a consequence of the hazards presented by the technology.

WallWalker™

Pentek, Inc.



- Remotely operated, computer controlled positioning system interfaced with scabbler
- Motion control system, scabbler head interface, and HEPA vacuum system



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Human Factors Assessment



- No braking system on motors; head could strike personnel (in area) if power lost and released to ground
- Recommended braking system for the motors



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Technology Demo



- Argonne National Laboratory East C-Reactor at CP-5 in Chicago
- Redesign; brake system so now if loses power the scabbling head does not lower to ground level



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1

CENTRIFUGAL SHOT BLAST

Concrete Cleaning, Inc.



- Electronically operated shot blast machine
- Steel shot propelled at surface
- Dust and debris captured by vacuum system



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Human Factors Assessment

- Operator cannot see directly in front of machine
- Issues with striking someone/something
- Recommended camera on front of machine with viewing screen at the operator station



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Technology Demo

- Argonne National Laboratory
East CP-5 Research Reactor
- DOE Fernald Environmental Management Project



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MARCRIST DT-25 DIAMOND FLOOR SHAVING SYSTEM

Pegasus International, Inc.



- Self-propelled machine
- Cutting head: drum containing embedded diamonds



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Technology Demo

- Argonne National Laboratory CP-5 Research Reactor



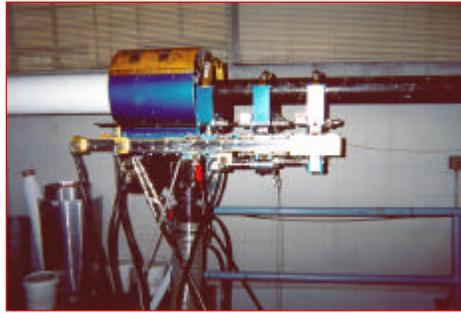
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BOA

Carnegie Mellon University



- Self-propelled automated mini enclosure
- Removes asbestos from 4" diameter pipe
- Wets and removes asbestos insulation



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Human Factors Assessment

- Recommended use of a “lazy-susan” type platform for reduction of ergonomic stressors at bagging unit



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Technology Demo

- Used “lazy-susan” platform during demo, Oak Ridge K-25 Facility
- Ergonomic stressors lessened
- Bag of waste could be wheeled to staging area



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