FEATURE

Perspectives on chemical hazard characterization and analysis process at DOE

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The United States (U.S.) Department of Energy (DOE) has a policy of Integrated Safety Management System (ISMS) that requires a hazard analysis and implementation of controls to protect the workers and public in an authorized hazard facility. The ISMS applies to all DOE facilities through DOE P 450.4, *Safety Management System Policy*, and DOE Acquisition Regulation (DEAR) clause 48 CFR 970.5223-1, *Integration of Environment, Safety, and Health into Work Planning and Execution*.

However, no DOE-order or standard currently exists that provides specific guidance for the development of safety basis (SB) documentation for non-nuclear facilities. Various DOE sites over the years have adopted individual site-specific chemical SB processes and documentation resulting in wide variations across the DOE complex. The CSTC Phase 1 report, *Current Chemical Hazard Characterization Practices in the DOE Complex* summarizes the variations in the DOE complex (CSTC 2003-C).[1]

In order to provide a common understanding of non-nuclear SB for chemical facilities, this report identifies various steps involved in developing a safety document that includes essential features of the five core steps of the ISMS. The SB development is an iterative process, but in general order of process completion, the listed steps for chemical, non-nuclear facility safety document are:

- Facility and work description;
- Hazard identification;
- Facility hazard classification – industry Process Safety Management (PSM) based versus DOE traditional based high/moderate/low classification;
- Hazard analysis – qualitative and/or semi quantitative;
- Identification of controls;
- Commitments to safety management programs (SMP);
- Document and approval process.

The non-nuclear SB process – (a) looks at different methodologies including hazard analysis from the chemical industry and DOE-STD-3009 nuclear facility-like approaches that can be used to implement each step, and (b) describes the advantages and disadvantages of various implementing methodologies that are either already in use or could be used by non-nuclear facilities.

To note, this report is *not* a proposed standard or guidance for chemical, non-nuclear safety document. This report outlines various steps and methodologies together with advantages and disadvantages associated with

Abbreviations: ACGIH, American Conference of Governmental Industrial Hygienists; AEGL, Acute Exposure Guidelines Level; AIChE, American Institute of Chemical Engineers; ALOHA, Areal Locations of Hazardous Atmospheres; ARCHIE, Automated Resource for Chemical Hazard Incident Evaluation; CBDPP, Chronic Beryllium Disease Prevention Program; CCPS, Center for Chemical Process Safety; CHC, Chemical Hazard Classification; ChSR, Chemical Safety Requirements; CSTC, Chemical Safety Topical Committee; DEAR, DOE Acquisition Regulations; DOE, Department of Energy; DSA, Documented Safety Analysis; EAL, Emergency Action Level; EG, Evaluation Guideline; EMP, Emergency Management Program; EPHA, Emergency Planning Hazards Assessment; EPA, Environmental Protection Agency; EPI (code), Emergency Prediction Information (Code); EPZ, Emergency Planning Zone; ERPG, Emergency Response Planning Guideline; ES&H, Environment; Safety and Health; ETA, Event Tree Analysis; FMEA, Failure Modes and Effects Analysis; FSP, Facility Safety Plan; FTA, Fault Tree Analysis; HAZOP, Hazard and Operability Study; HCP, Hazards Control Plan; HMIS, Hazardous Materials Identification System; IDLH, Immediately Dangerous to Life or Health; ISMS, Integrated Safety Management System; MACCS2, MELCOR Accident Consequence Code System; NIOSH, National Institute for Occupational Safety and Health; NNSA, National Nuclear Security Administration; OSHA, Occupational Safety and Health Administration; OSR, Operational Safety Requirements; PAC, Protective Action Criteria; PrHA, Process Hazard Analysis; PSM, Process Safety Management; RMP, Risk Management Program; RQ, Reportable Quantity; SAC, Specific Administrative Control; SAD, Safety Analysis Document; SB, Safety Basis; SC, Screening Criteria; SCAPA, Subcommittee on Consequence Assessment and Protective Actions; SER, Safety Evaluation Report; SMP, Safety Management Program; SSCs, Structures, Systems, and Components; TEDE, Total Effective Dose Equivalent; TEEL, Temporary Emergency Exposure Limit; TPQ, Threshold Planning Quantity; TQ, Threshold Quantity.

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them. Each DOE/NNSA facility or site can determine the appropriate course of action based on the merits and demerits of each approach. Adoption of any step of the safety document is voluntary.

While intended for chemical, non-nuclear SB applications, the report may be useful in other related areas such as the emergency management program as required by DOE O 151.1C and explosive operations as required by 29 CFR 1910.109.

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INTRODUCTION

Under the United States (U.S.) Department of Energy (DOE) Integrated Safety Management System (ISMS), DOE sites must ensure that hazards are identified and analyzed, engineering and administrative controls are implemented to protect the workers and public, and operations are properly authorized in an appropriately hazard classified facility. In essence, the ISMS provides the overarching authorization basis requirements to both nuclear and non-nuclear facilities as ISMS applies to all DOE facilities in accordance with DOE-P-450.4, *Safety Management System Policy*, and DOE Acquisition Regulations (DEAR) clause 48 CFR 970.5223-1, *Integration of Environment, Safety, and Health into Work Planning and Execution*. The DEAR clause requires contractors to apply the following guiding principles that relate to authorization basis:

- **Planning:** "Before work is performed, the associated hazards are evaluated and an agreed-upon set of ES&H standards and requirements are established which, if properly implemented, provide adequate assurance that employees, the public, and the environment are protected from adverse consequences".
- **Hazard Controls:** "Administrative and engineering controls to prevent and mitigate hazards are tailored to the work being performed and associated hazards". Emphasis should be on designing the work and/or controls to reduce or eliminate the hazards and to prevent accidents and unplanned releases and exposures.
- **Operations Authorization:** "The conditions and requirements to be satisfied for operations to be initiated and conducted are established and agreed upon". These agreed-upon conditions by DOE and the contractor are requirements of the contract and binding by the contractor. The extent of documentation and level of authority for agreement shall be tailored to the complexity and hazards associated with the work and shall be established in a Safety Management System.

The operations authorization basis consists of safety basis (SB) requirements and environmental protection requirements. This report focuses only on the SB requirements or safety document that includes hazard identification, screening criteria, hazard analysis (qualitative and quantitative), selection of controls, and approval process.

Although, this report focuses on SB that is part of the ISMS, industrial hazards that are covered by Federal regulations and consensus standards also need to be addressed as part of the ISMS.

For nuclear facilities, 10 CFR 830, *Nuclear Safety Management*, Subpart B, adopted in January 2001, replaces earlier DOE Orders 5480.21, *Unreviewed Safety Questions*, 5480.22, *Technical Safety Requirement*, and 5480.23, *Nuclear Safety Analysis Report.*

For non-nuclear facilities, DOE Order 5481.1B, *Safety Analysis and Review System*, was cancelled in September 1995, and DOE-EM-STD-5502-94, *Hazard Baseline Documentation*, was cancelled in October 2001. As a result, there has been minimal guidance on SB for chemical, non-nuclear facilities. Various DOE sites over the years have adopted site-specific chemical SB processes and documentation that have resulted in wide variations across the DOE complex (Phase 1 report, CSTC 2003-C).[1]

The purpose of this report is to identify those steps involved in the SB process or development of the