THE CHEMICAL AND NON-NUCLEAR SAFETY BASIS PROCESS USED BY BECHTEL JACOBS COMPANY, LLC

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INTRODUCTION

The Bechtel Jacobs Company LLC* (BJC) develops safety basis (SB) documentation to address chemical and other non-nuclear hazards that exist within Department of Energy (DOE) facilities within their contract scope. SB documents for chemical and other non-nuclear hazards may be stand alone or combined with other nuclear SB documents based on the significance of the hazard and the facility's nuclear categorization. BJC recently modified the initial screening of chemical hazards within these SB documents to credit results from Emergency Management Hazard Surveys (EMHSs) prepared according to DOE Order 151.1C, Comprehensive Emergency Management System, DOE Order 151.1C, U.S. Department of Energy, Washington, D.C., approved November 2, 2006.

The DOE has granted BJC approval authority for SB documents developed for chemical facilities as well as for facilities that are less than category 3 by inventory alone. The approach used by BJC to manage chemical hazards takes advantage of this approval authority position by minimizing the number of SB documents that must be developed and submitted to the DOE for approval. BJC also uses a graded approach to develop chemical SB documents by tailoring the rigor of analysis and controls to the level of hazard present.

The process used by BJC to develop chemical SB documents has proven effective in supporting a complex variety of activities including decommissioning and dismantlement, surveillance and maintenance, waste management, environmental restoration, and others. Changes in the program to incorporate results from the EMHS to screen chemical hazards has improved consistency between SB documents and the Emergency Management Program.

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BACKGROUND

BJC is responsible to conduct facility operation, environmental remediation, decontamination and demolition, and other activities for over 250 less than category 3 and chemical facilities. Requirements for the development of SB documents for chemical facilities are contained within the BJC Accelerated Closure Contract. The contract establishes requirements to develop SB documents for these hazards and to provide for configuration management and change control of the documents.

SAFETY BASIS DOCUMENT TYPES USED BY BJC

BJC has developed two identifying nomenclature systems for each less than category 3 and chemical facility; a facility category, labeled radiological, other industrial (OI), or standard industrial (SI) and a facility classification, labeled as high, moderate, low, OI, or SI. The category compares the level of radiological material present within the facility to the DOE-STD-1027 hazard category 3 threshold quantities (TQs) and to reportable quantities (RQs) within 40 CFR 302.4. The facility classification compares non-nuclear consequences to limits contained within 29 CFR 1910.119, 40 CFR 68, 40 CFR 302.4, and other sources.

There are four primary SB documents types used by BJC for less than Category 3 and chemical facilities, the Process Hazard Assessment (PHS), the Hazard Assessment Document (HAD), the Safety Analysis Document (SAD), and the Inactive Waste Site (IWS) Document. These four document types have been developed to take advantage of the variations in categorization, classification, and approval authority present within the less than category 3 and chemical facilities program. A summary of each document type is provided below. A screening of chemical and other non-nuclear hazards is contained within each SB document type.

THE PHS

A PHS is the simplest and most common SB document used for less than category 3 and chemical facilities at BJC. A PHS serves as both a categorization and classification document. A PHS describes the facility, its operations, and identifies other hazards, if any. A PHS can only be used if the facility categorization and classification are both low or less. For example, the radiological inventory may not exceed the category 3 TQs based on inventory alone and the non-nuclear hazards may not result in significant consequences outside the facility boundary. Chemical and other non-nuclear hazard analysis contained in a PHS are usually qualitative in nature with detail analysis being reserved for other SB document types. The DOE has granted BJC the approval authority for facilities with initial radiological material inventories less than category 3 and for all chemical SB documents. Therefore, BJC is the approval authority for PHSs.

THE HAD

If a category 2 or 3 facility's radiological inventory releasable during an accident can be reduced to less than category 3 through analysis (such as by use of alternate release fractions), then a HAD is the required SB document. The HAD is primarily a categorization document, but can

serve as a classification document addressing chemical and other non-nuclear hazards provided the hazard consequences are low or less. Because the DOE has granted BJC as the approval authority for chemical facilities, BJC develops a separate SB document to address high or moderate chemical and other non-nuclear hazards that may exist within facilities requiring a HAD. Because the initial radiological inventory of the facility exceeds the category 3 TQ, a HAD requires DOE approval. The DOE generates a Safety Evaluation Report (SER) to approve a HAD. However, BJC is the approval authority for the companion SB document that may be developed in conjunction with a HAD to address high or moderate chemical and other non-nuclear hazards.

THE SAD

The SAD is used as the SB document when significant chemical or other non-nuclear hazards may be released beyond the facility boundary during an accident. A SAD can also address radiological hazards provided they are less than category 3 by inventory alone. The SAD is the most complex less than category 3 chemical SB document and resembles a Documented Safety Analysis (DSA) in level of detail for chemical analysis. The SAD includes accident analysis, consequence development, and control selection. If the initial radiological inventory of the facility exceeds the category 3 TQ and requires a HAD, but contains significant chemical or other non-nuclear hazards, then both a SAD and a HAD are produced. BJC is the approval authority for a SAD.

THE IWS

The IWS is the most unique and infrequent SB document type used by BJC. An IWS is a burial ground or other below ground waste site that contains the equivalent of a category 2 or 3 quantity of radiological material and other chemical and non-nuclear hazards. To qualify as an IWS the site must be covered with soil or other engineered barrier and be subject to physical access control. Because the radiological, chemical, and other non-nuclear hazards are not readily releasable, the site is treated as a less than category 3 nuclear facility. To qualify as an IWS, the site must be inactive. For this reason, an IWS SB document may not be used to conduct active remediation, decontamination and decommissioning, or to support operations other than routine surveillance and maintenance. The DOE established specific terms and conditions that must be met for a site to qualify as an IWS. BJC is only required to submit documentation that demonstrates compliance to the terms and conditions established by the DOE. Because the initial radiological inventory of the facility exceeds category 3 TQs, the DOE produces an IWS Compliance Report to approve IWS SB documents.

THE INITIAL SCREENING OF CHEMCIAL AND OTHER NON-NUCLEAR HAZARDS

BJC performs an initial screening of chemical and other hazards for all facilities in all four SB document types. The initial screening includes physical, chemical, toxicological, and other hazards. The screening is intended to identify those hazards that exceed Standard Industrial Hazards (SIH). The screening process has evolved over the years to integrate the latest

requirements presented from DOE orders, standards, and other sources. A copy of the initial screening criteria used by BJC is identified in Table I.

Table I. BJC Hazard Screening Criteria

Hazard	Criteria/Measure
Radiological Hazards	Exceed RQs from 40 CFR 302.4.
Criticality	Exceeds exemption criteria as defined by the BJC Criticality Safety Program.
Non-Radiological, Chemical and Toxicological Hazards	Any chemical or toxicological hazard that requires additional review as identified by an EMHS. As an alternate, comparison to RQs contained in 40 CFR 302.4 may be used.
X-Ray Equipment	Does not meet ANSI X-ray standards.
Flammable Materials	Consider any that may act as a contributor or initiator for fire events.
Reactive Material	Materials that may exceed RQ, TQ, TPQ screening values or SARA #00-26.
Chemical Compatibility	Materials that may exceed RQ, TQ, TPQ screening values or SARA #00-26.
Lasers	Class III non-enclosed beam Class IV Lasers.
Electrical	>600 volts or >600 volts and >24 milli-ampere or >50J stored energy at 600 volts.
Kinetic Energy	Unique or Unusual" high kinetic energy sources (such as high energy flywheels, large centrifuges).
Pressure	Stored energy > 0.1 lb TNT(1.4×10^5 ft-lb_f) or Pressure > 3000 psig.
Temperature	Temperatures which could act as an initiator to other events such overpressure, fires, or creation of toxic bi-products.
Biohazards	As identified by HP or Industrial Hygiene.
Asphyxiants	Oxygen content less than 18 %.

Table Acronyms:

ANS American Nuclear Society
ANSI American National Standard Institute
EMHS Emergency Management Hazard Survey
NEC National Electric Code
RQ Reportable Quantity
SIH Standard Industrial Hazard
TLV Threshold Limit Value
TPQ Threshold Planning Quantity
TQ Threshold Quantity

All SB documents produced by BJC contain a table similar to Table I that shows how hazards are screened in the facility. Those hazards found to exceed the screening criteria are analyzed further in a facility specific SB document. If no hazard within the facility exceeds the screening criteria then BJC documents results using a simple one page form. The form asks a series of simple questions and documents the requirement for an inventory control protocol. The form is

signed by the Facility Manager, the Nuclear Safety Manager, and the Project Manager. A copy of the one page form, the SI Form, is found in Table II.

Table II. SI Form

Standard Industrial (SI) Form

1. Does the facility require Radiation Protection access controls and supervision (beyond periodic surveillance surveys) in accordance with 10 CFR 835? Yes ☐ No ☐

2. Does the facility have any significant non-nuclear hazardous materials (HM) inventory, spilled or evidence of spilled HM, or visual residues of HM on equipment exterior surfaces or building interior or exterior surfaces? Yes ☐ No ☐

3. Does the facility have any equipment with significant residual HM hold-up or residue? Yes ☐ No ☐

4. Does the facility have any unique hazards that cannot be "screened out" on the Hazard Screening Worksheet? Yes ☐ No ☐

IF the answer to any Question 1 through 4 is "Yes," the facility cannot be considered SI.

IF the answers are all "No," the facility can be categorized and classified SI, and the following Protected Assumption must be in place to maintain SI status:

- The Facility Manager shall not permit the introduction of radioactive or other hazardous materials such that any "No" answer to these screening questions would be invalidated.
- Notify Nuclear Safety when this form is used to supersede an existing facility SB document (e.g., used to replace a HAD, SAD, PHS, etc.) so that the Safety Basis Document List can be updated.

If the facility is Category SI and Classified SI, no further action is required. If the facility cannot be categorized **AND** classified SI, a different type of SB document is required and this Screening document does not need approval and may be discarded.

Preparer Approval: _____

Nuclear Safety Approval: _____

Facility Manager Approval: _____

Project Manager Approval: _____

Prior to January 2007, BJC screened chemical and toxicological hazards (third row entry in Table I) by comparing the inventory of these hazards to RQs contained in 40 CFR 302.4. After January 2007, BJC modified the screening of chemical and toxicological hazards to credit results from EMHSs prepared according to DOE Order 151.1C in lieu of comparing the inventory of these hazards to RQs found in 40 CFR 302.4.

CREDITING RESULTS FROM THE EMHS TO SCREEN CHEMICAL AND TOXCOLOGICAL HAZARDS

In November 2006, the DOE approved DOE O 151.1C thus effecting significant revision to the Emergency Management System applicable to facilities across the DOE complex. The revised order requires that all contractors be in full compliance with the order within one year of its issuance. Changes made by this order revision are actively being implemented by BJC. One of the major changes made by this revision was to impact the EMHS process. In accordance with DOE Order 151.1C, an EMHS is now required to be developed for all facilities and activities. The order also establishes periodic review and update requirements for the EMHS and the DOE must now review and approve all EMHSs. In January 2006, BJC modified the screening of chemical and toxicological hazards contained in SB documents to credit results from the EMHS rather than to prepare a separate screen using different criteria. The local DOE was involved and informed of this change since the screening of chemical and toxicological hazards using the EMHS applies to all BJC facilities. Screening of chemical and toxicological hazards using results from the EMHS has the following specific benefits:

- the EMHS is a document prepared according to established DOE criteria,
- the EMHS is a document reviewed and approved by the DOE,
- using results form the EMHS eliminates the need for the safety analyst to prepare a second and redundant screen of chemical and toxicological hazards,
- consistency between the Emergency Management and Safety Management process is improved, and
- the EMHS identifies and screens hazards that pose a risk to the human receptor where-as the RQs screen hazards at a level to afford protection to the environment.

The preferred approach to screen chemical and toxicological hazards within BJC is now to use results from an EMHS. The safety analyst is encouraged to credit results from the EMHS directly without conducting an additional screen. An alternate approach is to compare the maximum expected quantity of chemical or toxicological hazards to RQs contained in 40 CFR 302.4. Screening to 40 CFR 302.4 RQs was used in many BJC historical SB documents and still remains a valid screening process. The historical process to screen chemical and toxicological hazards using RQs was retained to minimize the impact on existing and approved SB documents. The comparison to RQs results in a more conservative screen, e.g. fewer hazards will screen out, however, there is more data readily available for individual chemicals. For cases where a few chemicals exist and in low quantities, the use of RQs found in 40 CFR 302.4 may be a simpler screen to conduct.

THE EMHS SCREENING PROCESS

Preparation of the EMHS is the responsibility of the Emergency Management Organization using requirements described in DOE Order 151.1C. A guidance document, Emergency Management Guide, DOE-151.1 also exists to provide additional direction. The EMHS screening process focus on the identification of hazards that present an acute human toxicity of the substance by the airborne pathway (inhalation, dermal contact, absorption, etc). Hazards with local impacts on workers and responders in the immediate event scene are not the primary concern, but are among

the hazards addressed by the worker health and safety programs. The EMHS identifies hazards that may result in significant human toxicity from the substance resulting from an airborne release. The screening process examines potential chemical and toxicological hazards and eliminates materials from further consideration if they are commonly found in public use, are not readily dispersed in the atmosphere, are not hazardous (toxic) to humans, or exist in limited quantities. These criteria are consistent with the needs of the chemical safety program and represent an effective means to screen chemical and toxicological hazards. Any chemical or toxicological hazard that is found to exceed these criteria must be evaluated further and can not be screened out. The EMHS uses the five criteria to identify hazards that require further analysis. In cases where an EMHS is not yet available the safety analyst may use the five criteria described below or may screen hazards by comparing to RQs contained in 10 CFR 302.4.

A chemical or toxicological hazard is screened out if any of the following conditions apply (see DOE Order 151.1C or Guide DOE G 151.1 for additional details).

- Public Use – eliminate hazards commonly available to the public, provided the formulation, use, and concentration is the same as for products that are distributed to the public without significant restrictions.

- Dispersibility – eliminate from further consideration any material that does not present an airborne exposure due to its physical form, other factors, and interaction with events. Specific criteria include the following:

    - the substance is a solid at normal temperatures and does not contain or include a significant fraction of small particles (less than 10 micron) that can be readily suspended in air under the plausible release mechanisms, or
    - the substance is a liquid that exhibits a vapor pressure (or partial pressure of a solution) of less than 1mmHg at 25 degrees C.

- Human Health Hazard – eliminate chemicals with a National Fire Protection Association 704 health hazard category rating of 0, 1, or 2.

- Laboratory Scale Quantities – eliminate quantities of materials expected to be easily and safety manipulated by one person or laboratory scale. Recommended values include:

    - one pound for substances that, because of high acute toxicity and dispersiblity, may result in a significant toxic hazard beyond the local area,
    - five gallons for liquids,
    - 10 pounds for compresses gasses, and
    - 40 pounds for solids.

- Consequence – ERPG 2 / TEEL 2 or equivalent is not expected to be exceeded at 30 meters for a 60 minute exposure.

Application of the above has shown that it is best to begin with the screen for public use and end with the consequence evaluation with the idea to eliminate the hazard by applying the simpler

and lower order screens where possible. Additionally, some facilities benefit by continuing to screen chemical and toxicological hazards by comparing the quantity of material at risk to the RQs found in 40 CFR 302.4. This is true when there are only a few chemicals present and they exist in very low quantities.

The companion guide, DOE-G-151.1, identifies an additional requirement to consider the possible effect of a material as an initiator or promoter (for example combustion, explosive, corrosive) of another more hazardous material release. This last clause provides for application of the best judgment of the analyst to include a material in additional analysis even if the material passes the screening criteria described earlier. In practice, BJC has identified a few chemicals that exist in significant quantity that warrant further inclusion in facility SB documents even though they initially screened out using the EMHS criteria.

CONCLUSION

The BJC process to produce SB documents for chemical and other non-nuclear hazards has proven effective in addressing and managing these hazards in DOE facilities. BJC has also demonstrated that it is possible to credit screening of chemical and toxicological hazards using results from the EMHS directly. The EMHS provides a comprehensive and reliable process to screen chemical and toxicological hazards. Using results from the EMHS meets the need to screen chemical and toxicological hazards in SB documentation. One area of emphasis, however, is to ensure that Nuclear Safety personnel are involved during the preparation and review of Emergency Management documentation, such as the EMHS, to ensure that the EMHS is consistent with expectations of Nuclear Safety and that the EMHS accurately addresses all hazards present in the facility. Practice has also shown that it is preferred to continue to screen some chemical and toxicological hazards by comparing the material at risk to RQs in 40 CFR 302.4 where only a few chemical hazards exist and in very low quantities