A New DOE Standard for Transuranic Waste Nuclear Safety Analysis

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ABSTRACT

The DOE Office of Environmental Management (EM) observed through onsite assessments and a review of site-specific lessons learned that transuranic (TRU) waste operations could benefit from standardization of assumptions and approaches used to analyze hazards and select controls. EM collected and compared safety analysis information from DOE sites, including a comparison of the type of TRU waste accidents evaluated and controls selected, as well as specific Airborne Release Fractions (ARFs), Respirable Fractions (RFs), and Damage Ratios (DRs) assumed in accident analyses. This paper recounts the efforts by the DOE and its contractors to bring consistency to the safety analysis process supporting TRU waste operations through an integrated re-engineering effort.

EM embarked on a process to re-engineer and standardize TRU safety analysis activities complex-wide. The effort involved DOE headquarters, field offices, and contractors. Five teams were formed to analyze and develop the necessary technical basis for a DOE Technical Standard. The teams looked at general issues including Safety Basis (SB), drum integrity and inspection criteria, hazard controls and analysis, safety analysis review and approval process, and implementation of hazard controls.

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INTRODUCTION

More than 100,000 cubic meters of legacy TRU waste may be potentially disposed at the Waste Isolation Pilot Plant (WIPP). Prior to shipping this waste to WIPP, extensive handling and characterization activities must be conducted at each of more than 20 TRU waste sites across the country. TRU waste operations are similar at all these sites. All the waste must meet the same requirements for characterization and packaging; the wastes have similar hazards; and each site uses the same, or similar, equipment, processes, and procedures. While there are many similarities, the wastes vary in terms of the magnitude of radioactive source terms and the condition of aging waste containers that must be handled.

Despite the many similarities between the operations at these sites, there are significant variances in the approach to safety analyses across the sites. These analyses vary from ultraconservative to overly optimistic. This has a negative impact on TRU waste operations. There have been safety events and incidents, unnecessary delays and shutdowns, inconsistency in controls, increased costs, and reduced efficiencies.

The DOE wanted to standardize the approaches used to analyze and control hazards across the National TRU Program to support cost effective and efficient TRU waste operations, reduce duplication of effort, and ensure appropriate safety measures are in place. These efforts were intended to support existing DOE regulations and directives that establish a nuclear safety "licensing" basis, or safety basis as referred to in 10 CFR 830, Subpart B. In particular, the emphasis was on various analytical assumptions and controls that are necessary to develop a reasonably conservative safety basis (i.e., Documented Safety Analysis [DSA], basis of interim operations, Technical Safety Requirements [TSRs]). It also includes effective implementation of SB controls.).

This paper describes the process used to develop a new DOE standard for nuclear safety analysis, gives a brief overview of the standard, and discusses the concept of risk acceptance as it relates to reducing long term risks at TRU waste sites. In addition to this overview paper, the work is further described in more technical detail in the paper entitled, *"Development of Consistent Hazard Controls for DOE Transuranic Waste Operations"* (abstract number 7322).

PROCESS

In close partnership with the TRU waste generator sites and appropriate headquarter organizations, Dr. Inés Triay, the EM Chief Operating Officer, and Dae Chung, Deputy Assistant Secretary for Safety Management and Operations, formed an overall SB re-engineering team. An executive team that included safety basis managers from DOE headquarters, the Field Offices and the contractors led the re-engineering effort. This Executive Team provided policy guidance and oversight of the effort to develop the standard.

The re-engineering effort grew out of a Nuclear Safety Workshop that was held in March 2006. This workshop was well attended by DOE and contractor nuclear safety experts and operations managers from across the TRU complex. The workshop focused on:

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- Providing attendees the opportunity to discuss inconsistencies in TRU waste SB documents and their causes and potential solutions
- Framing the problem and identifying the negative impacts on TRU waste operations
- Identifying key areas to focus improvement efforts and selecting leaders and participants for each area

Four working groups were formed to address the issues identified at the workshop and to provide technical issue papers related to their issue. The four working groups were tasked to address:

- General Issues,
- Hazard analyses and controls,
- Review guidance, and
- Testing and experiments

These working groups were led by a DOE and contractor technical lead and had representatives from various sites. Each team met weekly via conference call to discuss issues and develop recommendations. The Executive Team met as major issues arose and at critical points during the process to provide direction and to interpret DOE policies as needed.

During the spring and summer of 2006, each team researched technical issues, the current approaches used at the TRU waste sites, and collected and analyzed data on the waste inventories at each site. Statistical analysis on the inventories were done to identify any issues that were site specific and to help the team understand the similarities and differences that needed to be addressed in the standard. Recommendations were developed for standardized solutions and draft technical position papers were written to support these recommendations.

At critical points in the working groups' deliberations, face-to-face meetings were held to discuss emerging issues and to develop consensus among the participants on a path forward. Because of the complexity of the issues, some groups broke into sub-groups to more fully discuss specific issues and identify more consistent recommendations.

As each working group drafted sections of the standard that related to their charter, these drafts were forwarded to all the other teams for internal review and to a writing team that consolidated these drafts into a draft standard. At a meeting of the National TRU Waste Corporate Board in July 2006, a workshop on the standard was held to discuss significant issues with members of the Board. This draft standard was then revised extensively based upon suggestions made at this workshop. In addition to presentations to the Corporate Board, the standard was also presented and discussed with the Defense Nuclear Safety Board staff.

In October 2006, the revised draft standard was sent to the DOE and contractor leads on the TRU waste Corporate Board and to working groups for internal peer review. Over 300 comments were received from representatives from the various TRU waste sites. A comment resolution process resulted in additions and changes to the standard.

This draft standard "Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities" was submitted to the DOE's formal RevCom process in November 2006, which is an automated process used for tracking comments and their resolutions prior to final release of a

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DOE directive. The RevCom process subjected the standard to review by all DOE Offices and by the DOE TRU waste sites. The standard is expected to be issued during the second quarter of FY07 for implementation at all DOE sites with TRU waste facilities.

Description of the Re-engineering Working Groups/Teams

Four working groups/teams and several subgroups were formed to address the issues that had been identified during the Nuclear Safety Workshop. Each team was led by a DOE safety basis expert and a contractor from one of the TRU waste sites. Team members came from both the nuclear safety and the operations personnel at the large TRU waste sites. Initially, the teams were formed from volunteers from both large and small TRU waste sites who had expressed interest in participating during the Nuclear Safety Workshop, but this group was expanded to include subject matter experts from the sites and to ensure that all the large TRU waste sites were represented on each team.

The Executive Team focused on the overarching issues associated with releasing a new standard that would be used by both DOE and the National Nuclear Security Administration (NNSA). These issues included the apparent differences in the way sites use of International Commission on Radiological Protection (ICRP) values and calculations. The DOE Office of Environment and Health was asked to provide guidance to help resolve those differences. In addition, this team addressed the philosophical issues associated with acceptance of some higher short-term risks necessary to achieve a major reduction in long-term risks associated with site handling and storage of TRU wastes.

The General Issues team worked on the technical basis for modeling drum deflagrations (a major accident concern due to hydrogen buildup in TRU waste containers); developing DRs (amount of target material available for release based on postulated accident stress) for drum drops and other accident stresses; defining drum integrity criteria; developing guidance for what challenges the DOE Evaluation Guideline (EG) of 25 rem in accident analyses; clarifying the use of ARFs for accident scenarios; and developing a methodology for defining Material-at-Risk (MAR) in an accident.

The Accident Analysis and Controls Team was tasked to define "unmitigated" analysis; define standard industrial hazards that don't require further analysis within the nuclear safety analysis process; clarify expected operational events versus accidents; develop a minimum set of accidents that should always be considered within TRU waste hazard analysis; and provide a standardized set of controls. Since the controls used by the sites varied widely for similar events, a large subgroup was formed that worked extensively on developing a standard set of preferred and alternative controls for preventing/mitigating hazards associated with TRU waste accidents.

The Review Guidance and Implementation team worked on developing a common policy for implementing the standard across different DOE Offices and sites. They also developed a safety controls implementation review process for use by the sites and the DOE.

A Testing and Experiments Team was formed to identify areas where new tests or experiments could provide data that could then be used by the DOE to reduce uncertainties in safety analyses.

This team also looked at data from experiments that had been done in the past to identify opportunities to expand or improve those data sets to provide additional technical justification for values used in the standard (e.g., provide data on different types of containers).

KEY ISSUES ADDRESSED IN THE STANDARD

Three key issues were identified during the Nuclear Safety Workshop – inconsistencies between sites in defining hazard controls, inconsistencies in assumptions used in defining the MAR, and inconsistencies in key hazard and accident analysis source term and dispersion factors. The standard provides a consistent approach for addressing each of these areas along with the rationale behind that approach.

Different approaches were used by the sites to define an appropriate safety control set for a postulated accident. Two contributing factors to this problem were the result of including different accidents in the analyses, and differing thresholds or criteria for establishing important nuclear safety controls. The new standard provides a standardized set of accidents that must be considered and adopts existing risk ranking/control selection guidelines found in DOE-STD-1120 [1]. These guidelines provide numerical guidelines based on consequences and risks to workers and the public.

A second set of issues surrounded the assumptions sites used in calculating the MAR. Underestimating the MAR had led to operations shutdowns and delays, because postulated accidents analyzed did not bound material inventory values found in some facility areas. The working group looked at a statistical breakdown of inventory data from all the DOE TRU waste sites to develop a new standardized approach that accounts for uncertainty and is statistically sensitive to the number of containers involved in an accident.

Finally, source term and dispersion factor used by the sites were variable for similar accident scenarios analyzed. Since various analytical assumptions can significantly affect the consequence analysis, it was important to provide a uniform set of damage ratios, release fractions and certain dispersion assumptions. For example, the standard presents a summary of DRs for specific container types and accident stresses that are based on data obtained from container testing and engineering studies. A DR of 1 is assumed for containers that don't meet the container integrity criteria. In some cases, this approach significantly reduced the DRs, but in others, additional testing is needed to better quantify an appropriate DR.

ORGANIZATION OF THE STANDARD

This standard provides detailed guidance for consistently analyzing hazards and selecting control for TRU waste activities. The hazards analysis, accident analysis, and controls for TRU waste activities must be integrated into the overall SB documents for DOE Category 1, 2, or 3 nuclear facilities. This standard also provides expectations for the formulation, implementation, and maintenance of TSRs associated with TRU waste activities.

The information contained in this standard is intended for use by all DOE and NNSA sites and all contractors for DOE or NNSA owned or leased, Hazard Category 1, 2, or 3 nuclear facilities or nuclear operations that involve retrieval, handling, storage and processing of TRU waste containers. This standard applies to Documented Safety Analyses (DSAs) complying with all the "safe harbor methods" of 10 CFR 830 [2] and the associated TSRs.

This standard includes information on the following topical areas that are important in developing an effective SB for TRU waste operations:

- Section 1.0, *"Introduction"*, provides a background and purpose for the standard.
- Section 2.0, "*Acronyms"*, provides easy access to definitions all acronyms used in the standard.
- Section 3.0, "*Identification and Evaluation of TRU Waste Events",* discusses the types of hazards expected during TRU waste operations, defines a minimal set of accidents to be evaluated in the DSA, and addresses DSA provisions for addressing incidents that are inherent to normal operations such that operational impacts from their occurrence are appropriately minimized.
- Section 4.0, "*TRU Waste Source Term Analysis"*, defines assumptions for unmitigated analysis and provides guidance on the various factors comprising source term estimates.
- Section 5.0, "*Consequence Analysis"*, provides guidance for evaluating accident consequences to all receptors.
- Section 6.0, "*TRU Waste Hazard Controls Selection and Standardization"*, provides guidelines for standardizing the hazard control selection process and gives specific controls that are appropriate for TRU waste operations.
- Section 7.0, "*Safety Basis Review and DOE Risk Acceptance"*, clarifies expectations for safety basis review and acceptance of risks.
- Section 8.0, "*Verification of Safety Basis Implementation*", describes general expectations for ensuring that new/revised SB documents are properly implemented.
- Section 9.0, *"References"***,** provides a list of all references cited in the standard.

In addition, the standard contains three appendices:

- Appendix 4.A, *"Container Deflagrations",* establishes the technical basis for the DRs for a deflagration within a TRU waste container.
- Appendix 4.B, "*Damage Ratios for Container Insults and Fires"*, provides the technical justifications for the DRs presented in the standard's sections on fire scenario DRs and DRs for mechanical insults.

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- Appendix 6.A, *“Criteria for TRU Waste Drums for Venting/ Purging Due to Elevated Internal Hydrogen Concentrations”*, provides a criterion for the level of hydrogen gas present in the free volume of a TRU waste drum that requires special treatment to remove the potential hazard of an internal deflagration.

RISK ACCEPTANCE

The concept of the DOE accepting higher short-term risks in some cases to reduce major long-term risks is an issue at TRU waste sites. The Defense Nuclear Safety Board has endorsed this concept during numerous interactions and in various documents. The standard provides an approach for evaluating risk.

Reasonable assurance of adequate public protection is provided through analysis of postulated facility accidents that could lead to significant offsite consequences. DOE-STD-3009 [3] defines an EG concept where unmitigated accidents with the potential to challenge this EG trigger a need for safety-class controls. The EG is compared to the unmitigated accident dose estimate of a maximally exposed individual assumed to stand at the site boundary for two to eight hours. DOE-STD-3009 [3] clearly states that it is inappropriate to apply the EG as a hard pass/fail design criterion. Where the unmitigated accident dose estimate is judged to challenge the EG, public protection is assured through safety related controls that prevent and/or mitigate these consequences. The accident is then evaluated to ensure that the controls sufficiently ameliorate the risk through a reduction of consequence and/or likelihood of occurrence. If this reduction in risk is adequate, DOE accepts the risk thru approval of the Safety Evaluation Report (SER)/SB. However, if DOE does not find the reduction in risk acceptable, alternate strategies will need to be sought out, such as additional controls prior to approval. Additionally, given the nature of certain operations, it is not possible to apply additional controls without a cost that outweighs the benefit (for example, seismic upgrades to a facility with a limited operational life left). In this case, DOE may choose to accept the significant risk that is left with controls in place. If DOE chooses to accept significant risk, this risk should be clearly identified in the SB and explicitly discussed and accepted in the SER.

It should be noted that the evaluation of the mitigated case (i.e., accident with controls applied) discussed above may range from a qualitative evaluation to a formal recalculation of doses. To some extent, this will be driven by the nature of the accident and the nature of the facility/activity. When re-evaluating dose consequences, caution is urged to not overestimate the credit given to particular controls without proper justification (i.e., data). Note that the safety related controls identified to ensure the offsite EG is no longer challenged would be safety class. If additional significant Defense in Depth is warranted, these significant Defense-in-Depth controls would be safety significant.

Thus, analysis of postulated accidents leads to an end state that assures adequate public protection for events that could lead to significant offsite consequences. When unmitigated dose estimates are judged to challenge the EG, there is no “hard” or absolute definition for how low mitigated results must be before adequate assurance of protection is received. However, one factor in determining whether an unmitigated accident consequence challenges the offsite EG or in determining whether a mitigated accident consequence no longer challenges the offsite EG is the overall conservatism in the accident progression and the dose calculation parameters (e.g., MAR, ARF, RF, meteorology assumed, etc.). In general, the more conservative the offsite dose calculation is performed, the higher the radiological dose could be and not "challenge" the offsite EG of 25 rem.

Reasonable assurance of adequate worker protection is not an end state clearly defined within any DOE regulation, directive, or standard. Workers, particularly those in close proximity to operations, are exposed to hazards from the release of materials during operational upsets and facility accidents. Radiological consequences of operational upsets such as spills or leaks, and design basis events are difficult to model and predict. The difficulty in estimating a worker's dose lies primarily in defining how and where hazards are released within the facility and the proximity of those hazards to the facility worker. Small changes (or uncertainties) in these assumptions can significantly affect calculated results. For example, how long would it take workers to recognize a TRU container drop or deflagration had occurred? The answer to this question drives how long the worker breathes air contaminated with materials released from the damaged container.

The sensitivity of results to changes in these variables is one of the primary reasons DOE-STD-3009 [3] discourages the practice of quantitative worker hazard analysis and does not require a set of "worker Design Basis Accident (DBA) analyses" (i.e., quantitative dose calculations for the involved facility workers). Such sensitivity (in calculation results) gives rise to the temptation to reevaluate until the results no longer indicate an unacceptable level of hazard exists. DOE-STD-3009 [3] requires analysis of accident scenarios for derivation of controls that provide reasonable assurance of adequate public protection, and limits derivation of worker protection controls to the Hazard Analysis (HA) process. Worker HA is a qualitative process to establish the need for controls to protect facility workers. Although this process is often supported with semi-quantitative analyses to guide decision-making, these supporting quantitative analyses are not normally expected to be as complex or detailed as the accident analyses for public hazards.

Many sites have used an analytical process to evaluate hazard significance to collocated workers. In this case, a 100 m EG (analogous to the public EG concept) is often chosen to assess the significance of potential unmitigated radiological/toxicological exposure to workers collocated to the subject facility. An unmitigated event with the potential to challenge this EG triggers a review for the need of safety-significant controls for worker protection. The section on hazard controls in the standard contains guidance on control selection, which uses an onsite evaluation point to establish controls for workers. While the standard makes the point that the guidance is to be used for control selection and does not represent risk acceptance guidelines, the concepts presented in the standard are useful in understanding selection and evaluation of controls to ameliorate accident scenarios.

Formal DBA analyses as required by DOE-STD-3009-94 represent an extensive and costly process employed to analyze conditions that could pose a significant hazard to the public that may warrant designation of safety-class controls. The DBA analysis is insensitive to many of the variables that would make a "worker DBA analysis" unnecessarily proscriptive. For example, offsite dispersion of a plume released from a TRU container explosion is fairly insensitive to the location within the facility. The DBA analyses would model the explosion as a point source release at the facility wall and disperse the resulting plume to the site boundary. On the other hand, a worker hazard analysis is very dependent upon the location of such an explosion within the facility. A bounding (i.e., worst case) “worker DBA analysis” for such an explosion would require an evaluation of each room with a set of assumptions concerning the location of workers, facility ventilation flows, and how long workers breathed the contaminated air. The resulting detail set of “worker DBA analyses” would define proscriptive conditions that would likely result in numerous unreviewed safety question determinations as new information is identified.

This standard encourages derivation of worker protection controls, both for the facility worker based on qualitative estimates of consequences as well as the collocated worker based on semi-quantitative estimates of consequences for those accidents that challenge the offsite EG, through use of the HA process rather than a set of “worker DBA analyses.” The DSA would then contain a summary level discussion of worker hazards and the controls/functions necessary to protect workers. TRU facilities can be expected to reduce costs by avoiding the expensive use of analytical results associated with developing “worker DBA analyses” for the DSA. This cost avoidance would be better invested in risk reduction associated with accelerating cleanup activities.

Given the wide range of DOE nuclear operations, it is not possible for the Nuclear Safety Rule (10 CFR 830 Subpart B [2]), its associated safe harbor provisions, and its implementation guidance to provide detailed discussion on what is reasonable or adequate when assuring public, worker, and environmental protection. However, some of these documents (e.g., DOE O 420.1B [4] and associated guides, DOE-STD-1120 [1] etc.) along with DOE-STD-1104 [5] do provide discussion that is useful in understanding DOE risk acceptance for nuclear operations. Accordingly, the Approval Authority is expected to apply some degree of judgment and discretion when determining whether control schemes selected to address accidents are adequate to provide reasonable public and worker protection.

DOE-STD-1104 [5] guides DOE analysts during the preparation of SERs. In reviewing and approving a SB document, DOE-STD-1104-96 [5] has the Approval Authority consider the extent to which the SB meets requirements established within 10 CFR 830 [2] and satisfies the provisions of safe harbor methodologies used to prepare the SB. This consideration is based upon five general bases for approval:

- Base information
- Hazard and accident analyses
- SSCs
- Derivation of TSR
- Safety management program characteristics

DOE determination as to whether safety related hazard controls provide reasonable assurance of adequate protection is based upon the totality of the documented review rather than any specific element or criteria considered during the SB review.

The Nuclear Safety Rule and DOE-STD-3009 [3] infer such judgment and discretion would be based upon an understanding of the facility hazards, complexity of operations, effectiveness of safety related controls, remaining operational lifetime, and degree to which Defense In Depth (DID) is ensured.

DOE review of the SB submitted for operation on a Hazard Category 2 or 3 TRU facility determines whether the controls established provide adequate protection. When issues are identified during this review, the Approval Authority maintains the authority to determine which are significant in terms of assuring adequate protection. Reviewers involved in the preparation of SERs must recognize that reasonable assurance of adequate protection involves some assumption of risk by DOE. As discussed above, any significant risk needs to discussed in the DSA (with appropriate justification) and explicitly accepted in the SER.

When evaluating the risk posed by nuclear operations, the Approval Authority (and to a lesser extent the DOE reviewers) must consider factors such as the degree of DID, remaining facility life (i.e., time at risk), worth of controls (i.e., how reliable and effective), safety margins, and relative risk posed by alternatives (e.g., risk tradeoff between faster TRU characterization and shipment to WIPP as compared to the risk of leaving TRU wastes on site for a longer period of time). There is no single solution using this approach to determining reasonable assurance of adequate protection. Sound and prudent application of judgment and discretion must be applied when evaluating options under this approach.

In general, the Nuclear Safety Rule and its safe harbor methodologies rely upon informed assessment for making safety decisions. The complexity, level of rigor, and prescriptive nature of this informed assessment increases as the risk of events to the public and workers increases. Hazard Analyses and DSA DBAs should clearly define the estimated likelihood and consequence of facility hazards. Within the DSA, hazard analysis results should be characterized in terms of DID, worker protection, and environmental protection. Assumed risk (hazard likelihood and consequence) is then based upon providing effective controls with sufficient DID. The degree of effectiveness (e.g., reliability) and layers of DID are then tailored to the risks. High risk hazards are then addressed with controls that provide more layers of defense and higher reliability as compared to lower risk hazards.

The SB derives the hazard controls necessary to ensure adequate protection and demonstrates the adequacy of those controls to eliminate, limit, or mitigate those hazards. Risks associated with these hazards are expected to be analyzed using the inputs, assumptions, and controls defined within this standard as part of an informed assessment approach. Sites are expected to use the inputs, assumptions, and controls defined within this standard. DOE reviewers are encouraged to make use of tools such as review guides, procedures, or checklists to ensure applicable information contained within this standard was considered during development of the TRU facility DSA.

This standard provides an appropriate level of rigor in the hazard analysis and control selection. However, it must be understood that no control can be 100% reliable or effective. Operational upsets (e.g., dropped pallet of TRU drums) and other events (e.g., pyrophoric reaction within a TRU container) may occur despite the rigor of analysis and applied controls. When these events

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occur, any decision related to the adequacy of HA and controls should be based upon a careful review of the facility condition/event. The review should investigate whether the occurrence and its initiator were identified within the HA; whether defined controls functioned as credited within the DSA to prevent or mitigate the event. No control is assumed to be completely effective and reliable, and attention should be given where controls were relied upon for hazard prevention, particularly when these controls are administrative in nature.

A properly documented and implemented DSA should not require an extended reanalysis when anticipated events are realized with the facility. Once facility management has carefully reviewed/critiqued circumstances related to the occurrence, determined hazards were addressed by events in the HA, and confirmed associated controls functioned as relied upon in the DSA, it can be reasonably concluded there is no need to revise the bounding analyses of the DSA. It would then be appropriate to resume operations once any clean up or recovery actions have been completed. Recurring events, although possibly evaluated at an anticipated frequency within the DSA, should be closely scrutinized to assess the need for additional preventive measures or layers of DID.

Summary

Recognizing the need to develop consistent approaches to SB for TRU waste facilities, DOE initiated a complex-wide process to re-engineer and standardize TRU waste AB complex-wide. To support this effort EM collected and compared safety analysis information from TRU waste sites, including a comparison of the type of TRU waste accidents, evaluated and controls selected, as well as specific ARFs, RFs, and DRs assumed in accident analysis.

Working groups were formed to discuss various issues, review site AB documents, and to develop consistent standardized approaches for retrieval, handling, storage, characterization, loading, and shipment of TRU waste.

The HA and Accident Analysis information described within this standard is intended for use during an informed assessment approach to evaluating TRU facility hazards and associated risks. Qualitative evaluation of worker hazards and derivation of associated controls (including any supporting quantitative analyses) should be addressed within the HA process rather than defining bounding worker DBAs within the DSA. This represents a more cost-effective approach to reasonable assurance of adequate worker protection.

The DSA Approval Authority maintains the authority to determine what level of risk is significant in terms of providing reasonable assurance of worker and public protection. Sound and prudent application of judgment and discretion by the Approval Authority is expected when evaluating HA and Accident Analysis results.

When events anticipated by the DSA occur, decisions related to the adequacy of Hazard and Accident Analyses should be based upon a careful review of the facility condition/event.

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