

**USQ PROCESS IMPROVEMENTS: A STRATEGY FOR
REDUCING COST OF SAFETY BASIS ANALYSIS AND RESPONSE FOR THE
OFFICE OF RIVER PROTECTION AT HANFORD**

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ABSTRACT

The Office of River Protection (ORP) is considering changes to streamline and focus the DOE Unreviewed Safety Question (USQ) process being implemented by the contractor responsible for safe storage and retrieval of tank waste. The Office of River Protection is working with this contractor to develop a process for evaluating a proposed change or discovered condition that would include a determination of the significance of changes in associated accident estimated frequencies and consequences presented in the DOE approved Authorization Basis (AB). The process being developed is intended to incorporate USQ threshold criteria for determining changes of significance in a manner similar to that currently implemented at the Savannah River Site. This is expected to significantly reduce the number of USQ screenings and evaluations performed by the contractor (about 2500 per year in FY 1998 and 1999) and the number of positive USQ determinations that require action by ORP. Care has been taken in proposing these changes to ensure that there will be no actual reduction in the safety of tank farm operations for either continued interim storage of high-level waste (HLW) or in tank waste retrieval operations supporting treatment and disposal.

INTRODUCTION

As part of assessing the processes and constraints associated with implementing the Office of River Protection (ORP) Authorization Basis (AB) for the waste storage and retrieval function within Hanford tank farms and related facilities, the licensing strategy for these operations is being reevaluated. The AB for the tank farm related activities administratively divides control of operations into two responsibility areas. The Department of Energy (DOE) formally authorizes operations associated with work that requires equipment, engineered features, or operational controls and constraints in the Technical Safety Requirements (TSRs) (1) to prevent or mitigate the potential consequences of hazardous material releases. This set of requirements and controls that DOE relies on to authorize operations is established as the DOE approved AB, usually documented in the DOE Safety Evaluation Report (SER). In accordance with their corporate approach to risk avoidance, the tank farm operations contractor adds an additional set of defense-in-depth controls that do not require formal DOE approval. The contractor is also allowed to initiate new operations or change existing operations without formal DOE approval as long as the proposed change does not increase the risk previously assumed by DOE as presented in the DOE approved AB.

In general, DOE at Hanford uses the risk envelope established by the estimated consequences and quantitative frequencies for events determined through accident analyses as the basis for

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dividing administrative responsibilities for controls and requirements. This risk envelope provided the basis for performance of the USQ determination process. Proposed changes in operations or discovered conditions were assessed through the USQ process to determine if a challenge to this risk envelope was introduced. A challenge would result if the analysis determined that the proposed change or discovered condition introduced a new accident not previously analyzed, reduced a margin of safety, or increased the estimated frequency or consequence of an accident previously analyzed. A challenge to the DOE approved risk envelope would result in determination of the existence of a USQ. In addition, DOE approval prior to implementation of a proposed action is required if a TSR change is needed to support the proposed action.

Because DOE at Hanford did not define a level of significance of concern for increases in the estimated frequency or consequence of an accident previously analyzed, even minor increases to either of these two parameters would result in a positive USQ determination. In some cases very minor challenges to the risk envelope have caused initiation of the administrative process associated with developing and approving an AB amendment.

Under the newly formed ORP, DOE is working with the contractor responsible for the tank waste storage and retrieval function to introduce efficiencies and reduce constraints on operations. The overall intent is to establish an operating environment that allows for safe and reliable tank waste retrieval and transfer for treatment. These efforts include work in progress to consider refocusing the USQ determination process against a more broadly defined risk envelope as an AB by establishing USQ thresholds for action. These thresholds would provide a definition of what constitutes a significant challenge to the risk envelope. This will reduce the number of positive USQ determinations to those that identify a significant challenge to the risk envelope rather than those that identify any challenge to the risk envelope. This will in turn reduce the number of entries into the administrative process associated with developing and approving AB amendments. The end result will be an increase in efficiency and reliability of tank waste retrieval and transfer operations with no reduction in safety.

USQ PROCESS

Contractor operations are authorized by DOE in its nuclear facilities through a DOE approved AB established in accordance with the requirements of DOE 5480.23, *Nuclear Safety Analysis Reports* (2), and DOE 5480.22, *Technical Safety Requirements* (3). In consideration of allowing for flexibility and changes in operations without requiring DOE approval for each and every potential change, DOE has established a process as defined under DOE 5480.21, *Unreviewed Safety Questions* (4), for maintaining the integrity of the DOE approved AB (5). The concept of the USQ was established to allow contractors to make physical and procedural changes and to conduct tests and experiments without prior DOE approval as long as these changes do not explicitly or implicitly affect the AB. The order also requires the contractor to evaluate the discovery of new conditions associated with the facility or operation, or analytical errors and other analysis inadequacies for those analyses that support the AB to determine if the condition introduces a challenge to the AB.

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Under DOE 5480.21 (3), the contractor is required to perform an evaluation to determine if a USQ exists for the following circumstances:

- a. Temporary or permanent changes in the facility as described in the AB;
- b. Temporary or permanent changes in the operating procedures as described in the AB; or
- c. Tests or experiments not described in the AB.

It must be clearly understood that although the DOE Order discusses this evaluation in terms of a “safety evaluation,” this evaluation is not to be used as a basis for determination of safety for the proposed change or discovered condition. As presented in Chapter III.6 of the attachment to the Order, the process requirements identified under DOE 5480.21 are established only to determine if the situation being evaluated introduces a challenge to the DOE approved AB. The scope of this evaluation is restricted to comparison of the risk envelope under the proposed or discovered condition against the risk envelope previously assumed by DOE in authorization of the operation. The result of this process is only used to determine if DOE approval is required for the situation being evaluated. A situation involves a USQ for the following:

- a. The probability of occurrence or the consequences of an accident or malfunction of equipment important to safety as previously evaluated in the AB could be increased;
- b. The probability for an accident or malfunction of a different type than any evaluated previously in the AB could be created; or
- c. Any margin of safety as defined in the TSRs Bases could be reduced.

Chapter III.4 of DOE 5480.21 indicates that it is acceptable to use screening criteria to limit the number of proposed actions for which written evaluations must be performed provided the reasons for the exclusion are well documented and supported. Screening criteria are to be applied to those items that by broad definition enter into the USQ process as defined above but for which a detailed evaluation is not necessary. An extension of this is the categorical exclusion. A categorical exclusion represents identification and definition of a class of items that fall within the scope of the exclusion. The contractor then provides a detailed evaluation of why it is acceptable for screening out all future items from additional evaluation that fall within the scope of the categorical exclusion. The intent of allowing application of screening criteria and categorical exclusions under the USQ process is to reduce the efforts expended for issues of minor significance and focus efforts more fully on identification of challenges to the DOE approved AB.

In keeping with the expressed philosophy of focusing efforts expended under the USQ process, Chapter IV.3 provides some discussion on what an appropriate definition of an increase in the probability of occurrence of an accident may be. For application in the USQ determination process, this section indicates that the determination of a probability increase may well be based on a qualitative assessment using engineering evaluations consistent with the assumptions in the supporting basis for the approved AB. This qualitative evaluation can be applied to a set of qualitative classes of event frequencies to determine if a change from one frequency class to a more frequent class occurs. If the proposed change or discovered condition being evaluated

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increases the estimated qualitative frequency of any associated accident to a more frequent class, then a USQ would exist and DOE approval would be required for the situation being evaluated.

Chapter IV.5 provides some definition of what constitutes an increase in consequences of accidents or malfunctions of equipment important to safety. This section indicates that an increase in consequences must involve an increase in hazardous material releases and/or radioactive doses above the worst-case limiting consequences in the DOE approved AB that serves as the established limit. Additional discussion indicates that the limit may be established within the AB through reference to applicable standards such as 10 CFR 20, *Standards for Protection Against Radiation*, and 10 CFR 100, *Reactor Site Criteria*. A more restrictive limit than those contained within these regulations may be established through explicit identification in the DOE approved AB. In either case, the consequence limitations to be used in consideration of challenges to the DOE approved AB are usually identified in the DOE SER.

An increase in consequences resulting from a change, test, or experiment does not necessarily represent a challenge to the DOE approved AB. If the increased consequences were determined to be under the consequence limitations identified within the AB, the proposed activity or discovered condition would not be considered a USQ.

HANFORD AUTHORIZATION BASIS BACKGROUND

In general, DOE at Hanford has used the risk envelope established by the estimated consequences and quantitative frequencies for events determined through accident analyses as the basis for dividing administrative responsibilities for controls and requirements. This risk envelope provided the basis for performance of the USQ determination process. Proposed changes in operations or discovered conditions were assessed through the USQ process to determine if a challenge to this risk envelope was introduced. A challenge would result if the analysis determined that the proposed change or discovered condition introduced a new accident not previously analyzed or increased the estimated quantitative frequency or consequence of an accident previously analyzed.

Because DOE at Hanford did not define a mechanism for assessing accident frequencies under the USQ process qualitatively, any increase in estimated frequencies for accident events resulting from proposed changes or discovered conditions is considered a challenge to the DOE approved AB. Also, a consequence limitation within the AB is not defined as presented in the supporting accident analyses. Any increase in estimated consequences for accident events resulting from proposed changes or discovered conditions is considered a challenge to the DOE approved AB. Therefore, even minor increases to either of these two parameters results in the determination that a USQ exists. In some cases extremely minor challenges to the risk envelope have caused initiation of the administrative process associated with developing and approving an AB amendment.

For the tank waste storage and retrieval program, the combination of circumstances has led to a requirement for what ORP believes is an excessive number of USQ evaluations. Indeed during FY-1998 and FY-1999 the tank farm operating contractor performed about 2500 USQ screenings and evaluations per year. Almost none of these resulted in the determination that a USQ existed.

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But the negative determination for most of these was based on extensive quantitative analyses required to demonstrate the consequence and frequency limits established within the DOE approved AB were not exceeded. The extensive quantitative evaluation required by the current USQ process takes needed contractor resources away from activities such as safety issue closure with very little if any return provided with respect to maintaining the integrity of the DOE approved AB against potentially significant challenges.

A DOE approved AB was recently established for tank farm operations associated with tank waste safe storage and retrieval for treatment (6). With implementation of this AB in October 1999, ORP has an opportunity to work with the operating contractor to develop and institute a revised USQ determination process. The goal in development of this revised process is to reduce the amount of effort expended in addressing proposed operational changes and discovered conditions that are of minor significance in their potential for challenge of the DOE approved AB.

One consideration in this work in progress involves looking at appropriate use of categorical exclusions. Ensuring that categorical exclusions are developed and implemented to address certain defined types of facility maintenance and procedure changes that do not introduce significant impacts to the DOE approved AB will reduce the number of evaluations that are performed for these types of proposed changes.

Another use of screening criteria that is under consideration involves the development of threshold values for AB challenges that require detailed quantitative accident analyses as part of the evaluation process for determination of the existence of a USQ. Screening criteria could be developed that require only qualitative analyses for USQ evaluations in those cases where the proposed change or discovered condition could only result in minor challenge of the DOE approved AB.

The third major area of consideration in this work in progress involves developing a USQ determination process that is based on a DOE approved AB that establishes consequence limitations other than those presented as a result of the accident analyses in the Final Safety Analysis Report (FSAR). These could be established through reference to 10 CFR 20 and 10 CFR 100 as fixed consequence limitations applicable to appropriate potential receptor populations around tank farm operations. These could also be established through identification of relative consequence limitations determined as a percentage of the FSAR accident analyses results. Both approaches are being investigated to determine which will ultimately be applied in tank farms. A USQ would be determined to exist only if the potential consequences of accidents associated with a proposed change or discovered condition would exceed these consequence limitations. After final development the consequence limitations will be defined under the DOE approved AB in a revision to the DOE SER for tank farm operations.

The use of qualitative event frequency estimates for assessing whether accidents associated with proposed changes or discovered conditions challenge the DOE approved AB is also being considered. This includes establishing appropriate qualitative accident frequency classes under the DOE approved AB based on the supporting accident analyses. Proposed changes or

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discovered conditions that result in a change from one frequency class to a more frequent class for accidents would result in determination of the existence of a USQ.

The fifth area under consideration in this work in progress involves looking at the appropriateness of establishing a threshold consequence level below which DOE involvement in authorization of the operation is not required. Proposed changes or discovered conditions that do not introduce consequences above this threshold with existing controls would not be considered a USQ. This portion of the development activity is in the very rudimentary stages of conception.

Successful development and implementation of any of these five areas of effort will result in an improved USQ determination procedure that reduces the number of entries into the administrative process associated with developing and approving AB amendments. The end result will be an increase in efficiency and reliability of tank waste retrieval and transfer operations with no reduction in safety.

POTENTIALLY APPLICABLE SAVANNAH RIVER USQ GUIDELINES AND THRESHOLDS

As part of this activity, ORP personnel reviewed USQ determination procedures at other sites. The Savannah River Site (SRS) developed and implemented a new approach toward USQ evaluation and the use of USQ thresholds that includes some of the considerations being developed under the ORP work in progress (7,8).

The USQ determination process at SRS presents limitations and threshold criteria for potential accident consequences involving members of the general public as seen in Table I, as well as for potential accident consequences involving facility workers and co-located facility workers as seen in Table II. These criteria provide a point for consideration in the ORP USQ process development activity.

Table I. Savannah River Site Limitations for Public Consequence Considerations.

Focus	Positive USQ Thresholds
Radiological criteria	An increase in any accident consequence by >10% AND the increase must be >1 mSv (100 mrem). An increase in any accident frequency to a more frequent class by >10%. An increase in any accident frequency within a class by ≥ 15 times.
Chemical criteria	An increase in any accident consequence by an Emergency Response Planning Guideline (ERPG) level. Frequency criteria are the same as for radiological criteria.

Table II. Savannah River Site Limitations for Facility Worker and Co-Located Facility Worker Considerations.

Focus	Positive USQ Thresholds	
	Facility Worker	Co-Located Facility Worker
Radiological criteria	Any consequence >1 Sv (100 rem) for Extremely Unlikely events, OR >0.25 Sv (25 rem) for Unlikely or Anticipated events	Same as facility worker
Chemical criteria	Any consequence >ERPG-3 for Extremely Unlikely events, OR >ERPG-2 for Unlikely or Anticipated events	Same as facility worker PLUS, Any release \geq OSHA threshold quantities

NEWLY IMPLEMENTED FSAR BASED SER USQ LIMITATIONS

The FSAR associated with tank waste storage and retrieval operations presents a number of accident analyses with high consequences prior to the application of controls. The control strategy that has been developed for risk management in these operations is intended to either prevent the release of hazardous materials by preventing the accident or reduce the consequences from hazardous material releases during accidents. Based on validation calculations performed during the DOE FSAR approval review activity, some assumptions used in the FSAR accident analyses were determined to be overly conservative. This caused the DOE approval review team to conclude the consequences presented in the accident analyses are not representative of those that could be expected during the accidental release of hazardous material and subsequent exposures.

Because of this circumstance for most of the accident analyses, DOE defined a set of consequence limitations to be used by the operating contractor in the USQ determination process (see Table III). These consequence limitations consist of both fixed values and relative values for consideration. If a proposed change or discovered condition could result in accidents that have potential consequences above the fixed values, a USQ is determined to exist. If the potential accident consequences do not exceed the fixed values, but do result in an increase in consequences greater than 25% of those presented in the accident analyses supporting the DOE approved AB, a USQ is determined to exist.

The DOE approval review team also established a qualitative process for determining the significance of a change in estimated frequency of accidents resulting from a proposed change or discovered condition. An increase in frequency of the accidents associated with a proposed change or discovered condition to a more frequent class will cause a determination that a USQ exists. An increase in frequency of the accidents that does not result in a frequency class change

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but is greater than 15 times the estimated frequency presented in the accident analyses supporting the DOE approved AB will also cause a determination that a USQ exists.

These consequence limitations and qualitative frequency evaluation processes are established as part of the DOE approved AB through presentation in the DOE SER (9).

Table III. ORP Fixed and Relative Limitations.

Focus	USQ Threshold
Comparative relative consequence	The contractor is directed to declare a positive USQ with respect to dose consequences if the consequences calculated for a previously analyzed accident are <u>greater than 25%</u> of the baseline. However, exceeding the defined consequence limitations results in a positive USQ. For reanalyzed consequences of <u>less than or equal to 25%</u> of the baseline, the contractor will not declare a positive USQ, but a complete reevaluation of the hazards and assumptions for the accident will be done. This direction applies to all analyzed accidents in the FSAR. As directed (9), the baseline radiological dose consequences in the approved FSAR cannot be changed on a negative USQ evaluation. ^a
Comparative frequency	The current USQ procedure identifies any increase in frequency by a factor of 15 as “Significant.” This is an acceptable definition to account for uncertainty in accident probability. In addition, ORP believes that any increase from one frequency range (Anticipated, Unlikely, or Extremely Unlikely) to a more frequent class, even if less than a factor of 15 increase, is significant and will result in a positive USQ determination.
^a There are large uncertainties inherent in the current analyses. Without a detailed uncertainty analysis, DOE believes it prudent to consider any increase up to 25% over the consequence presented under the DOE approved AB to be within the uncertainty of that analysis. To preclude unintentional creep of consequences presented under the DOE approved AB, when a new analysis is performed and the consequence is increased by within 25%, the new consequence shall not be considered the new DOE approved AB consequence for purposes of USQ determinations. For USQ determinations, the ORP-accepted consequence remains that identified in the DOE approved AB.	

Two accident scenarios were excluded from use of the relative consequence limitations for USQ determination. These were the organic salt-nitrate reaction accident and the flammable gas accident. Since issuance of the DOE SER (9), the organic salt-nitrate reaction accident safety

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issue was closed by showing that this accident is not credible. The flammable gas accident analyses presented in the supporting basis for the DOE approved AB indicated a potential for high consequences. Application of the relative consequence increase could result in a proposed change or discovered condition that results in very high consequences without reaching the USQ determination threshold. Because of this, DOE did not consider it appropriate to allow the same latitude for application of a 25% relative consequence increase under the USQ determination process. Future proposed changes or discovered conditions that include this accident type must have a supporting basis that includes sufficient probabilistic analysis to establish the accident frequency is not increased when applying the same set of controls, and the consequences do not exceed the USQ fixed consequence limitations. If either of these cannot be shown for the proposed change or discovered condition, then a USQ is determined to exist. This requirement for quantitative flammable gas accident analysis as part of the USQ determination process will be removed when a more realistic flammable gas accident analysis replaces that presently provided to support the DOE approved AB.

This process was incorporated as a stop gap measure through implementation of the DOE approved AB for tank waste storage and retrieval operations. As ORP and the operating contractor continue the work in progress to develop a more efficient and meaningful USQ determination process, the current process will be replaced under the DOE approved AB through revisions to the DOE SER (9).

CONCLUSIONS

Under the newly formed ORP, DOE is working with the contractor responsible for the tank waste storage and retrieval function to introduce efficiencies and reduce constraints on operations. The overall intent is to establish an operating environment that allows for safe and reliable tank waste retrieval and transfer for treatment. These efforts include work in progress to consider refocusing the USQ determination process against a more broadly defined risk envelope as an AB by establishing USQ thresholds for action. These thresholds would provide a definition of what constitutes a significant challenge to the risk envelope. This will reduce the number of positive USQ determinations to those that identify a significant challenge to the risk envelope rather than those that identify any challenge to the risk envelope. This will in turn reduce the number of entries into the administrative process associated with developing and approving AB amendments. The end result will be an increase in efficiency and reliability of tank waste retrieval and transfer operations with no reduction in safety.

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