Revision No 1
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SAFETY EVALUATION REPORT

For

Building 776/777 Documented Safety Analysis (DSA)

REVISION 1, May 2003

Rocky Flats Environmental Technology Site
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1.0 INTRODUCTION

This Safety Evaluation Report documents the Department of Energy Rocky Flats Field Office (DOE-RFFO) review and provides the rationale for the approval of the Building 776/777 Documented Safety Analysis Report (DSA), Revision 1 The DSA is a new Authorization Basis (AB) document for the Building 776/777 Complex at the Rocky Flats Environmental Technology Site (RFETS or Site) based on its conversion from a Hazard Category 2 (HC2) Nuclear Facility to a Hazard Category 3 (HC3) Nuclear Facility as the result of extensive Decontamination and Decommissioning (D&D)

The Building 776/777 DSA was prepared to satisfy the requirements in 10CFR830, Subpart B, *Safety Basis Requirements* (Reference 1) Reference 1 also identifies specific standards and guides to be used when preparing a Documented Safety Analysis The identified Department of Energy (DOE) standards are (1) DOE-STD-1027-92 *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480 23, Nuclear Safety Analysis Reports* (Reference 2), and (2) DOE-STD-3009-94, *Preparation Guide for U S Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports* (Reference 3) The identified DOE Guide is DOE G-421 1-2, *Implementation Guide for Use in Developing Documented Safety Analyses to Meet Subpart B of 10 CFR 830* (Reference 4) The same DOE standards and guides were also used by the Review Team to validate the hazard categorization and determine the information content of the DSA

The referenced DOE Standards are identified in 10CFR830 Subpart B as acceptable "safe harbor" methodologies for preparing a 10CFR830 compliant Documented Safety Analysis (DSA) for a Hazard Category 3 Nuclear Facility The referenced DOE guide provides additional expectations for DSA content to meet the requirements of Subpart B of 10CFR830 The *Authorization Basis Development* direction provided to Kaiser Hill L L C (K-H) was also used in determining the safety classification of various system and design features for the Building 776/777 Complex (Reference 5) The 776/777 DSA Technical Safety Requirements (TSRs), included as Appendix A of the DSA, comply with the 10CFR830 Subpart B, Safety Basis Requirements

The format and content of the Building 776/777 DSA Safety Evaluation Report (SER) was prepared in accordance with the guidance provided in DOE-STD-1104-96, *Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports* (Reference 6)

The development of the Building 776/777 DSA relied heavily on earlier hazards and accident analyses The approach is discussed in Section 5 1, *Hazards Analysis Methodology*, and Section 6 1, *Accident Analysis Methodology*, of the DSA and the development approach is appropriate for the complexities and hazards associated with Building 776/777 and its Closure mission

For each subsequent revision to the Building 776/777 DSA, an addendum will be added to this SER to provide the basis for approval

2.0 SUMMARY CONCLUSION

Consistent with the scope of the Site Closure mission, the current Building 776/777 mission deals with the disposition of the Building 776/777 Complex buildings and structures Disposition of Building 776/777 requires final recovery and processing (if necessary) of radioactive and chemical waste, deactivation and removal of facility systems, decontamination of rooms and equipment (as necessary to ensure worker safety and to support waste disposal), and decommissioning and demolition of the facility and its supporting structures The Building 776/777 Complex consists of buildings and structures 776, 777, 701 (office space and maintenance material storage), 710 (steam reducing station), and 730 (plenum drain pit)

Building 776/777 was built in the early 1950s and was formerly used for the processing, fabrication, and machining of plutonium components for nuclear weapons Operations at the facility continued until suspension in 1989 and subsequent discontinuation of the production mission in 1992 Since 1992, the facility has transitioned from a nuclear weapons production facility to an environmental restoration facility Of note are the removal of all production gloveboxes and the demolition of Buildings 702 and 703 (pump houses), 712 and 713 (cooling towers), 712A (propane valve house), 713A (valve pit), and 781 (helium pump building)

Several events of significance occurred during the life of the facility A major fire occurred in the facility in 1969 As a result of this fire, Building 776 was extensively contaminated and substantial portions of the utility systems within the building were severely damaged A second roof was added to the structure as a result of the fire and contaminated equipment was decommissioned, dismantled, and removed Also, the facility has nine Kathabar dehumidification units located on the second floor, which experienced several Kathene spills on the concrete flooring The Kathene solutions penetrated cracks in the concrete slab and eventually caused the corrosion of rebar and form decking located under the slab Installation of new steel beams and other support work has been performed to upgrade the second floor

The DOE-RFFO concludes that the Building 776/777 DSA adequately defines and documents the hazards of the facility and identifies the necessary safety features and controls to safely disposition the buildings and structures The safety features and controls adequately reduce the risk to the public, the workers (collocated workers and in-facility workers), and the environment consistent with the direction provided by Reference 5, and are acceptable to the DOE-RFFO This conclusion is based on Section 5, *Approval Basis*, of this SER

In developing the DSA, four risk classes of accident scenarios were defined Risk Class I (Major), Risk Class II (Serious), Risk Class III (marginal), and Risk Class IV (negligible) The Risk Classes are based on the frequency of occurrence of the event and the consequences of the event as defined in Table 2-1 below

Table 2-1: Risk Classes-Frequency versus Consequences

Receptor Consequence	Frequency Of Occurrence (per year)		
	Extremely Unlikely $<10^{-4}$	*Unlikely* 10^{-4} - 10^{-2}	*Anticipated* $>10^{-2}$
High	II	I	I
Moderate	III	II	I
Low	IV	III	III

Table 2-2 (Reference 5) shows how *High*, *Moderate*, and *Low* were defined for radiological accident consequences and Table 2-3 defines chemical accident consequence levels

Table 2-2. Radiological Accident Consequence Levels

Receptor Consequence	Receptor		
	Public Dose* (rem at 1,999 m)	**Collocated Worker Dose*** (rem at 100 m)	**Immediate Worker Dose**
High	> 5	> 25	prompt death
Moderate	> 0 5	≥ 5	serious injury or significant exposure
Low	< 0 5	< 5	less than Moderate

* Radiological doses based on 50-year Committed Effective Dose Equivalent (CEDE) or Total Effective Dose Equivalent (TEDE)

Table 2-3: Chemical Accident Consequence Levels

Receptor Consequence	Receptor		
	Public Exposure (at 1,999 m)	**Collocated Worker Exposure** (at 100 m)	**Immediate Worker Exposure**
High	> ERPG-2**	> ERPG-3**	prompt death
Moderate	N/A*	N/A*	serious injury or significant exposure
Low	ERPG-2**	ERPG-3**	less than Moderate

* N/A means Not Applicable

** ERPG refers to the Emergency Response Planning Guidelines published by the American Industrial Hygiene Association ERPG-2 and ERPG 3 define the air concentrations for each chemical corresponding to low, moderate, and severe health effects in humans exposed for greater than one hour

The DSA refers to the *Site Preliminary Hazards Analysis to Support Hazard Category 2 and 3 Nuclear Facilities' Authorization Basis Development*, Nuclear Safety Technical Report, NSTR-007-01 (Site PHA) (Reference 7) The Site PHA identifies and assesses hazards associated with most activities conducted at the Site and identifies a comprehensive set of available controls to prevent or mitigate the hazards The most appropriate controls are then selected for inclusion into the Building 776/777 DSA using the methodology provided in Reference 5 and summarized below

An unmitigated analysis of each identified accident scenario was performed to determine the baseline frequency of an event and the associated consequences For Risk Class I and II scenarios, safety features and/or controls are credited, where warranted, to reduce the risk of the accident to a Risk Class III or IV In some cases, there may not be any feasible or cost-effective controls to reduce a Risk Class I or II event to Risk Class III or IV These cases are known as Risk Dominant Accident Scenarios

There are six *unmitigated* Risk Class I or II scenarios identified for Building 776/777 Four *unmitigated* scenarios are high risk for the collocated worker (CW) medium fire, large fire, drum deflagration, and aircraft crash The immediate worker (IW) has the same four *unmitigated* high risk scenarios, but also includes two other scenarios explosion and seismic event There are three Risk Dominant Accident Scenarios following the application of controls The medium fire and aircraft crash remain high risk for the CW following application of controls and the seismic event remains high risk for the IW

There are no controls warranted at this stage in the facility lifecycle for reducing the risk from the aircraft crash and the seismic event The prudent approach is to remove the radioactive material from the facility to reduce the risk rather than to harden a building just prior to demolition These analyses are very conservative and represent bounding simplifications of the actual phenomena The CW radiological dose consequence for the aircraft crash is 26 rem, which just exceeds the *high* threshold of the Site Evaluation Guidelines (EGs) Removal of conservatism from the analysis would yield a lower dose consequence and make the scenario low risk for the CW In addition, the Site Fire Department is available for response to the event and can provide a defense-in-depth mitigative function that is not credited or acknowledged in the DSA The seismic event evaluation is also very conservative, it assumes a moderate release of radiological material that is predominantly fixed contamination

The remaining high-risk scenario deals with a medium fire impacting the CW The CW radiological dose consequence for this event is 8 6 rem The analysis of the fire is very conservative, it assumes that nearly all of the radiological material remaining in the facility is involved in the fire and that the CW will remain in the plume of a fire for the duration of the release rather than moving away from the smoke The analysis also does not consider the mitigative effect of the Fire Suppression System While crediting this system could reduce the CW consequence from this event and make the scenario low risk, the requirement for a TSR-controlled Fire Suppression System for the facility at this stage of decommissioning is not warranted given the conservatism in the analysis However, the Fire Suppression System will be maintained under the Fire Protection Safety Management Program (SMP) as long as possible until it becomes necessary to strip it out In addition, the Site Fire Department is available for response to the event and can provide a defense-in-depth mitigative function that is not credited or acknowledged in the DSA

Similarly, while the crediting of a high efficiency particulate air (HEPA) filtered exhaust from the facility would reduce the CW consequence from this event and make the scenario low risk, the requirement for a HEPA filtered exhaust for the facility at this stage of decommissioning is not warranted given the conservatism in the safety analysis However, the HEPA filtered exhaust will be maintained under the Radiological Protection SMP until radiological conditions in the facility no longer warrant it

One low-risk scenario deals with an *extremely unlikely*, large, engulfing pool fire The CW radiological dose consequence for this event is 24 8 rem While the CW consequence is *moderate*, it challenges the 25 rem threshold for *high* consequences Therefore, this scenario is also considered a high-risk scenario for the CW The analysis of this fire is both non-conservative and conservative The non-conservative aspects of the analysis are that it assumes that the fire lasts for 60 minutes (major fire) even though a fuel pool fire of this type would be significantly shorter in duration, and, unlike the medium fire, the material at risk (MAR) is assumed to be 450 grams rather than 900 grams This latter non-conservatism is only relative to other accident analyses, it could actually be argued that the MAR is still very conservative From the analysis conservatism standpoint, the scenario assumes that the CW will remain in the plume of a fire for the duration of the release rather than moving away from the smoke The analysis also does not consider the mitigative and/or preventive effect of the Fire Suppression System While crediting this system could reduce the CW consequence from this event and make the scenario low risk and/or make the scenario *beyond extremely unlikely*, the requirement for a TSR-controlled Fire Suppression System for the facility at this stage of decommissioning is not warranted given the conservatism in the analysis However, the Fire Suppression System will be maintained under the Fire Protection SMP as long as possible until it becomes necessary to strip it out In addition, the Site Fire Department is available for response to the event and can provide a defense-in-depth mitigative function that is not credited or acknowledged in the DSA While the crediting of a high efficiency particulate air (HEPA) filtered exhaust from the facility would reduce the CW consequence from this event, the requirement for a HEPA filtered exhaust for the facility at this stage of decommissioning is not warranted given the conservatism in the safety analysis However, the HEPA filtered exhaust will be maintained under the Radiological Protection SMP until radiological conditions in the facility no longer warrant it

Therefore, the risk from the three *mitigated* high-risk scenarios is acceptable with the available SMP and TSR controls based on the conservatism in the safety analysis of the events and on the current facility lifecycle stage approaching demolition of the facility Similarly, the risk from the low-risk scenario that challenges the EGs is also acceptable with the available SMP and TSR controls

The following discussion summarizes the significant issues identified during the review of the DSA and supporting documentation The issues are further discussed in Section 5 0, *Approval Basis*, of this report

Facility Hazard Categorization The DSA initially took an approach that a Material-at-Risk (MAR) limit for the facility of 900 grams of weapons grade plutonium would be imposed, which would justify the classification of the facility as a Hazard Category 3 Nuclear Facility per DOE-STD-1027-92 (Reference 2) In order to support an expedited implementation of this control, K-H proposed that the facility holdup inventory would be evaluated at a nominal value rather than the Site standard approach of using the 95% upper bound estimates for holdup measurements Without allowance to use the nominal values, the implementation of the DSA would be delayed until the inventory could be further reduced The DOE-RFFO acknowledged that the facility should be Hazard Category 3 but based on using a facility segmentation argument that considers the form of the remaining material (i e , generally non-dispersible holdup), the distribution of the material (i e , the remaining MAR is spread throughout the facility with very limited quantities in any specific location), and the approach to D&D (i e , the facility will not store waste containers but will remove them expeditiously, as they are created) By taking this approach to facility hazard categorization, the implementation of the DSA can be expedited and facility MAR does not have to be tracked The only requirement that would be imposed is the prohibition of bringing radioactive materials into the facility, other than those associated with returned containers for repackaging and radiological sources associated with instrumentation **Conclusion:** The DOE-RFFO supports the use of segmentation arguments in the determination of nuclear facility hazard categorization but does not support the use of nominal radiological holdup inventory values in that process

Safety Management Program Attributes The general approach taken in the development of the control set for the Building 776/777 Complex was to place more reliance on Administrative Controls and Safety Management Programs (SMPs) rather than crediting hardware controls to reduce risk The standard Heating, Ventilating, and Air Conditioning (HVAC) System filtered exhaust and Fire Suppression System controls are not credited to mitigate postulated accident consequences or reduce postulated accident frequency The decision to not credit these standard controls was made to support the D&D of the facility such that these engineered features could be removed, when appropriate, without requiring DOE-RFFO approval However, the DOE-RFFO anticipated that these systems would be maintained until necessary to remove as part of the Configuration Management, Radiological Protection, and Fire Protection SMPs The "facility-specific differences" and "nuclear safety attributes" discussions for the appropriate SMPs are expected to contain language committing to the maintenance of these systems for as long as is practical considering the hazards remaining and the actions necessary to decommission the facility In addition, commitments for minimum staffing requirements, description of the final facility demolition process using the Decommissioning Operations Plan (DOP), and commitments for Transuranic (TRU) waste staging and storage are expected to be included as part of the Conduct of Operations, Environmental Management, and Waste Management SMPs, respectively **Conclusion:** The DOE-RFFO supports the removal of many controls normally found in the TSRs for late stage D&D missions but expects that the controls will be explicitly captured in some manner under appropriate SMPs

Authorizing Use of Explosives for Demolition The DSA initially attempted to authorize the use of explosions for late stages of the demolition process without analyzing any specific configurations It was acknowledged that the specifics of the use of explosives in the facility could not be pre-defined The DOE-RFFO does not pre-authorize the use of explosives and expects the actual applications to be analyzed on a case-by-case basis The explosives hazard was to be removed from the hazards analysis to ensure that appropriate screening of explosives be performed prior to its use and that the DOE-RFFO is initially part of that activity

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Crediting of Combustible Material Controls for Fire Mitigation The DSA medium and large fire scenario analyses credited combustible material controls to limit the fire size to a small fire While the actual effect of a successful control implementation would limit fire size, the current Site approach credits the control to reduce the likelihood of the medium and large fires rather than mitigating the consequences of the fires This departure from the Site standard approach reduces the co-located worker risk class for the scenario from a Risk Class II to a Risk Class III event Using the normal approach for crediting of the control would not eliminate the high risk scenario The DOE-RFFO would prefer to retain the standard Site methodology and is willing to accept the higher risk due to the conservatism in the analysis and the understanding that the HVAC and Fire Suppression Systems would be maintained for as long as possible, which would lower the risk for these fires **Conclusion:** Departure from the Site standard approach on the crediting of combustible material controls to eliminate a high risk scenario is not acceptable, but the DOE-RFFO is willing to accept the high risk scenario given the analysis conservatism and the un-credited facility infrastructure

Revision 1 of the Building 776/777 DSA is approved with the technical direction included in Appendix A

3.0 REVIEW PROCESS

Building 776/777 was characterized, using DOE-STD-1027-92 (Reference 2) methodology, as a Hazard Category 3 (HC3) Nuclear Facility The DOE-RFFO has been delegated approval authority for a Documented Safety Analysis for Hazard Category 2 and 3 nuclear facilities (Reference 8)

An initial version of the DSA was submitted (Reference 9) to obtain DOE-RFFO approval The initial DSA Review was conducted over about a two-month period The Kaiser-Hill L L C approved Building 776/777 DSA was received by the DOE-RFFO for review in March 2003 After resolution of review comments, the DSA was revised and Revision 1 of the DSA was submitted to the DOE-RFFO in June 2003 (Reference 10)

The composition of the DOE-RFFO DSA Review Team consisted of personnel from the Nuclear Regulatory Division, supported by Subject Matter Experts from other disciplines, and Building 776/777 Facility Representatives Brad Ring from the Facility Assessment Division was initially the Team Leader for this review and was responsible for reviewing all the documents The team lead became Ron Bostic following the submittal of Revision 1 of the DSA The other team members were assigned specific areas based on their expertise The primary team members and their areas of review are as follows

- Dan Emch – Facility Description, Facility Activities, and TSRs,
- Bill Horton – Entire document with emphasis on Hazards and Accident Analyses,
- Robert Williams – Fire Protection SMP, Fire Scenarios, and the Fire Protection Controls,
- Robert Wilson - Criticality Safety SMP and Facility Activities

The Review Team members conducted independent technical reviews of the DSA, providing the Team Leader with formal written comments The comments were then consolidated, reviewed for consistency, and provided to the Contractor

A "cross-table" format was used to resolve DOE-RFFO comments, where the Review Team met with Kaiser-Hill, L L C and the Contractor author(s) of the DSA in April 2003 Major issues identified during the cross-table review are discussed and dispositioned in Section 5, *Approval Basis*, of this report

Comments generated during the cross-table review were tracked to closure, including validation of closure by the comment originator where possible Comments generated from the DOE-RFFO review of the DSA were provided to the contractor for incorporation into the DSA In addition, the DOE-RFFO supplied the contractor with a markup revision of the document to address editorial and some technical comments These changes were reviewed and are contained in the Revision 1 submittal of the DSA in June 2003

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4.0 DESCRIPTION OF FACILITY AND OPERATIONS

The Building 776/777 Complex consists of buildings and structures 776, 777, 701, 710, and 730. Building 701 contains office space and a storage area for maintenance materials. Building 710 is a former steam reducing station. The steam interface between this building and other facilities in the complex has been isolated. Building 730 is the drain pit for the HVAC Zone II plenum deluge. The main part of the complex is Building 776/777, which is the focus of the DSA.

Buildings 776 and 777 comprise a primarily concrete two-story structure with a partial basement and are adjoined with a common wall. The interface between the two buildings is via hallways and a tunnel. The first floor of the structure was the main processing area of the facilities. The second floor housed support utilities including the HVAC systems. The basement was previously used for glovebox process operations and three below-grade pits, which were heavily contaminated during the 1969 fire (see below), are filled with concrete. The facilities also have a tunnel interface with Building 771 and a hallway interface with Building 778.

A major fire in 1969 extensively contaminated the facility and severely damaged portions of the utility systems within the building. This event led to the addition of a second roof to the building structure and to the filling of several below-grade pits with concrete. Structural member contamination remains a potential issue with the eventual demolition of the facility.

The facility has also been structurally damaged by Kathene spills on the second floor from Kathabar dehumidification units. Several areas were damaged sufficiently to warrant remedial actions including installation of new steel beams and other support work. Access into some areas of the second floor is restricted due to weight limitations associated with the damaged flooring.

Building 776/777 is not seismically qualified to the levels associated with most of the other plutonium facilities at the Site. Facility collapse is expected following a significant seismic event (recurrence frequency of once every 730 years) and loss of confinement is expected for lesser seismic events (recurrence frequency of once every 230 years). This structural weakness is also evident in the facility susceptibility to high winds (135 mph winds are expected to cause significant damage) and snow loading (localized roof collapse due to snowdrifts is anticipated).

Gloveboxes, hoods, downdraft tables, and B-Boxes have been removed from the facilities. Any remaining confinement enclosures in the facilities are associated with the conduct of D&D activities. The Zone I ventilation systems are no longer in operation and are currently being dismantled. One of the Zone II ventilation systems (plenum PL–250) is currently operational and performs a confinement function for the conduct of D&D activities. The other Zone II ventilation systems (PL–251 and PL–252) are no longer in operation.

Automatic wet-pipe sprinkler systems exist in the facilities. These systems currently are alarmed and inform the Fire Dispatch Center (FDC) when water flows through the sprinkler systems. The operating exhaust filter plenum, PL–250, currently retains a filter plenum deluge system. The fire suppression systems receive water from the Site Domestic Cold Water System.

The facilities are currently operating on electric power from the Site Electric Power Distribution System but the use of temporary electric power will become more prevalent as D&D activities continue

The main activities to be conducted in the Building 776/777 Complex include

- Administrative Operations – administrative, training, and technical support activities
- General Facility Operations – activities needed to keep the facility safe, habitable, functional, or compliant with applicable requirements but do not involve hazardous or radiological materials other than minor quantities or contamination
- Hazardous Material Handling – activities using, handling, or moving hazardous chemicals and materials
- Radioactive Waste Generation and Handling – activities managing and moving radioactive waste containers
- Decommissioning – activities dealing with decontaminating, dismantling, and demolishing equipment and structures

Administrative Operations and General Facility Operations are activities that may continue following a TSR suspension of operations Hazardous Material Handling, Radioactive Waste Generation and Handling, and Decommissioning activities must be terminated under a TSR suspension of operations

Radioactive waste forms that will be generated during the conduct of the above activities include surface contaminated objects (SCO), low-level waste (LLW), low-level mixed waste (LLMW), transuranic (TRU) waste, and transuranic-mixed (TRM) waste Radioactive waste will primarily be contaminated metal, concrete, plastic, rubber, and glass Some radioactive liquids (both aqueous and organic) and sludge will also be encountered although the quantities are not expected to be significant

Structural demolition of Building 776/777 is not expected to occur until Resource Conservation and Recovery Act (RCRA) units have been closed, asbestos has been abated, and chemicals and other hazardous materials have been removed to the extent practical TRU waste, gloveboxes, and contaminated piping will also have been removed However, it is expected that some radiological contamination will remain at the time of demolition due to technical limitations on decontaminating or removing equipment or structures from some of the facility's inaccessible locations

5.0 APPROVAL BASIS

The Building 776/777 DSA satisfies the requirements of 10CFR830 to develop a Documented Safety Analysis and TSRs The level of detail and scope of the Building 776/777 DSA meets the 10CFR830 "safe harbor" method of DOE-STD-3009 Upon DOE approval and full implementation, the Building 776/777 DSA will become the Authorization Basis (AB) for the deactivation, decommissioning, and demolition of the Building 776/777 Complex

This Safety Evaluation Report was prepared in-accordance-with review criteria and guidance contained in DOE STD-1104 (Reference 6)

Reference 6 defines five approval bases for assessing the adequacy of a new AB document The five approval bases are presented below, along with an assessment of the adequacy of the Building 776/777 DSA in meeting the requirements stated in each approval basis A summary of the Building 776/777 DSA information dealing with each approval basis topic is also presented

5.1 Adequacy of Base Information

The criteria for accepting the adequacy of the base information is that it provides sufficient information to allow assessment of the other approval bases that rely on this information Base information contained in a DSA generally deals with technical information about facility and system configuration, current and past operation, and historical events of significance

Base information found in the Building 776/777 DSA consists of technical information contained in the *Executive Summary*, *Introduction* (Chapter 1), *Facility Description* (Chapter 2), *Facility Activities* (Chapter 4), and to a lesser extent, descriptive information in other chapters The following six criteria were utilized in assessing the adequacy of the base information contained in the Building 776/777 DSA

1) The facility mission(s) and scope of operations for which safety basis approval is being sought are clearly stated and reflected in the type and scope of operations analyzed in the DSA

   The facility mission is described in Chapter 2, *Facility Description*, of the DSA The scope of operations for which safety basis approval is being sought is discussed in Chapter 4, *Facility Activities*, of the DSA The analyzed operations are presented in Chapter 5, *Hazard Identification and Analysis*, and in Chapter 6, *Accident Analysis*

   Assessment The Building 776/777 Complex mission and scope of operations were explicitly discussed in Chapter 2 and Chapter 4 of the DSA As stated in Section 2 1, *Facility Mission*, of the DSA, the mission of the Building 776/777 Complex includes 1) activities necessary to maintain the facility in a safe and habitable condition and to comply with government regulations, and 2) activities necessary for system isolation and equipment removal, decontamination, waste disposal, decommissioning, and demolition

   The activities performed in the Building 776/777 Complex include facility D&D processes and activities, which are described in Chapter 4 of the DSA These activities were subsequently analyzed in the hazard and accident analyses found in the DSA

The definition and description of the activities serves three purposes in the DSA The first purpose is to define the set of activities being authorized by approval of the DSA The second is to provide an understanding of the processes and activities that will be conducted within the facility such that the hazards and the potential accident scenarios associated with the activities can be understood The third purpose corresponds to the development of the TSRs and relates to the partitioning of the activities into those that can be conducted during a Suspend Operations condition as part of TSR Required Actions versus those that must be suspended

The operations and activities defined and analyzed in the DSA are consistent with the stated missions For the most part, the listing of authorized activities is provided by way of example rather than explicit definition Determination of whether a new activity is authorized may require some subjective reasoning but the types of activities being performed are generally simplistic and such determinations should be straightforward using the Integrated Work Control Program (IWCP) process Therefore, the activities described in the DSA adequately define what is authorized in the facility

The descriptions of the activities in the DSA also contain sufficient detail to support the hazard identification processes summarized in Chapter 5 and to also support the subsequent accident analyses in Chapter 6 The activity descriptions tend to focus on those elements of the operations involving significant energy sources (e g , high pressures, high temperatures, etc) This supports the identification of activity related hazards and potential accident scenarios

Chapter 4 of the DSA identifies two general types of activities that can be conducted following the suspension of operations as part of a TSR Required Action 1) Administrative Operations, and 2) General Facility Operations All other activities defined in Chapter 4 must be suspended during a Suspend Operations condition These latter activities include higher hazards and/or actual manipulation of radiological materials. The activities to be terminated when operations are suspended include 1) Hazardous Material Handling, 2) Radioactive Waste Generation and Handling, and 3) Decommissioning – Decontaminate, Dismantle, and Demolish The activity partitioning adequately defines those activities that should be suspended as part of a TSR suspension of operations and the activities that can be performed following the suspension are adequately described by example

Conclusion The Building 776/777 DSA statements of the mission, scope of operations, and activities are sufficient to analyze the hazards of operations The scope of operations for which approval is being sought is reflected in the hazard evaluations and accident analyses of the DSA (see criterion discussions under Section 5 2, *Hazard and Accident Analyses*). The interface of the activity descriptions with the TSRs in Appendix A of the DSA is satisfactory. This criterion is adequately met

2) The descriptions of the facility, operations, and primary structures, systems, and components (SSCs) that are important to safety provide a knowledgeable reviewer sufficient background material to understand the major elements of the safety analysis

The Site is described in the Rocky Flats Environmental Technology Site Safety Analysis

Report (SSAR, Reference 11) and is provided in the DSA by reference The facility is described in Chapter 2, *Facility Description*, of the DSA The scope of operations for which safety basis approval is being sought is discussed in Chapter 4, *Activity Description*, of the DSA

Assessment The description of the Site is not assessed in this review other than for identification of any Site hazards or any potential interactions between Site operations and the Building 776/777 Complex The review of the Site description was performed during the approval of the SSAR

The DSA adequately justifies that there are no Safety Structures, Systems, and Components (SSCs) for the Building 776/777 Complex other than the "Waste Container Integrity" Design Feature. This Safety SSC is credited in the selection of waste container damage ratios used for the various accident scenarios evaluated in the safety analyses However, there are systems that provide functions important to safety These systems are the Heating, Ventilation, and Air Conditioning (HVAC) System and the Fire Suppression, Detection, and Alarm System (Fire System)

The HVAC System consists of supply and exhaust subsystems to maintain adequate airflow in the facility for habitability In addition, the HEPA filtered exhaust ventilation system does provide a non-credited, defense-in-depth safety function While there are no TSR controls related to this safety function, there is a commitment in the DSA to retain the system as part of the Radiological Protection Safety Management Program (SMP) until such time as the hazards in the facility no longer warrant the system

The Fire System provides various alarm capabilities that serve to notify the Fire Department of a problem in the facility This can result in earlier response to a fire and earlier suppression The Fire System sprinklers are especially important in minimizing the growth rate of fires, allowing additional time to safely evacuate, and even extinguishing some fires Therefore, the Fire System provides a non-credited, defense-in-depth safety function While there are no TSR controls related to this safety function, there is a commitment in the DSA to retain the system as part of the Fire Protection SMP until such time as the hazards in the facility no longer warrant the system

During the final review of Revision 1 of Chapter 2, the following technical issue was identified and is resolved in the attached red-lined markup changes in Appendix A

- In Section 2 3 3 3, *Fire Systems* The third paragraph from the end of the section beginning "The detection devices consist " was modified based on DOE-RFFO direction during cross-table review meetings However, the modification made was not sufficient and the text should read " of sprinkler water-pressure switches, which provide remote signals to the Fire Dispatch Center Local audible alarms are provided external to Building 776/777 near risers using riser water motor gongs and various other means are used to notify workers of facility conditions " rather than " of sprinkler water-pressure switches Local audible alarms are provided throughout Building 776/777 using riser water motor gongs and various other means are also used to notify workers of facility conditions "

Conclusion The descriptions of the facility, operations, and primary structures, systems, and components that are important to safety contained in the DSA are considered adequate This criterion is met

3) Correlation is established between actual facility arrangements and operations with those stated in the DSA (i e , the basic descriptions provided are fundamentally up-to-date and correct)

This criterion addresses the accuracy of the information primarily contained in Chapter 2, *Facility Description*, and Chapter 4, *Facility Activities*

Assessment. During the review process, members of the Review Team conducted walk-downs of the Building 776/777 Complex and held discussions with the DSA development team and other facility personnel The facility walk-downs and discussions provided Review Team members with sufficient information about the existing facility, planned locations for future activities, and the general approach for decommissioning the facility, to allow verification of the accuracy of the information contained in the DSA Two members of the Review Team are DOE Facility Representatives for the facility with extensive knowledge of the facility systems and operations

Conclusion The correlation between the actual facility arrangements and operations with those stated in the DSA were adequate This criterion is adequately met

4) The facility contractor development and approval processes demonstrate sufficient commitment to establish the facility safety basis

This criterion addresses the Contractor process used for development and internal approval of the DSA, rather than a specific chapter or aspect of the DSA The adequacy/inadequacy of the process is not necessarily reflective of the adequacy and quality of the product (i e , the Building 776/777 DSA) However, it is reflective of the efficiency of producing a quality document and the level of DOE involvement required in producing an acceptable Authorization Basis for the Building 776/777 Complex

Assessment The DOE-RFFO review of the first submittal of the DSA resulted in a moderate level of comments These comments led to a one-day cross-table between the DOE-RFFO and Kaiser-Hill for comment resolution and to a subsequent working meeting to develop final wording on hazard categorization and further comment resolution Those individuals working on the document showed strong commitment to the completion of the effort and resolution of DOE-RFFO issues The overall combined Kaiser-Hill and DOE-RFFO commitment to completion of the DSA was significant and resulted in substantial quality improvements to the document

Conclusion With some DOE-RFFO input in the form of technical and editorial comments and constructive interactions between Kaiser-Hill and the DOE-RFFO during the review process, an adequate safety basis development and approval process was achieved This criterion is adequately met

5) A description of the facility's life-cycle stage, mission(s), and operation(s) is presented, including explanation of the impact on the facility safety basis

The facility's life-cycle stage and missions are described in Chapter 2, *Facility Description*, of the DSA The scope of operations for which safety basis approval is being sought is discussed in Chapter 4, *Facility Activities*, of the DSA The design of SSCs that provide safety functions is discussed in Chapter 2, *Facility Description*, of the DSA, and the impact of these SSCs on the safety basis is described in Chapter 5, *Hazard Identification and Analysis*, and Chapter 6, *Accident Analysis*, of the DSA

Assessment Deactivation and decommissioning activities through demolition of the structure are authorized in the DSA The operations and D&D activities described are adequate to support the current missions of the facility The DSA identifies potential accident scenarios associated with the mission activities, and provides hazard and accident analysis to identify the controls necessary to minimize their risk The DSA clearly identifies activities that may be performed during a Suspension of Operations per the TSR requirements

The DSA also describes the design of the SSCs that perform safety functions and their relationship to the various operational and D&D activities being conducted in the facilities The applicability of these SSCs to the safety basis is described via the hazards identification and analysis and accident analysis processes in Chapters 5 and 6 of the DSA

Conclusion The DSA provides a clear description of the Building 776/777 Complex mission and planned activities to support D&D of the facility and eventual demolition This criterion is adequately met

6) Clear basis for and provisions of exemptions, consent agreements, and open issues are presented

This criterion evaluates the effects of any exemption, consent agreement, or other open issue as may be identified with regard to the DSA's approval and implementation This criterion is addressed in Section 2 2 3 2, *Significant/Open USQs [Unreviewed Safety Questions] and Safety-Related Findings/Events*, and Chapter 3, *Safety Management Programs*, of the DSA

Assessment AB issues of significance for the development of the DSA include those documents that are listed in Table 2-1, *USQ and JCO [Justification for Continued Operation] Evaluations of Significance to Building 776/777* The table identified the following documents as open or significant

1 A Site-wide JCO and corresponding USQD dealing with filter plenum deluge system operation during concurrent fire suppression system operation
2 A Site-wide USQD dealing with hydrogen gas and turbulent jet explosions
3 A Site-wide JCO and corresponding USQD dealing with 10-gallon drums that have the potential for hydrogen buildup

Item 1 was addressed by an engineering evaluation that provides documented evidence of the adequacy of the overall Fire Systems due to design redundancies Also, since the Fire

Systems are not Safety Significant in the DSA, the management of this issue as part of the Fire Protection SMP is considered adequate Item 2 was addressed by incorporation of appropriate explosion frequencies in the accident analyses of the DSA Item 3 is being addressed as part of the Waste Management SMP in enforcing the safety analysis assumption that no unvented Transuranic (TRU) waste containers will be used in the Building 776/777 Complex

Table 2-1 of the DSA addresses resolution of Item 3 above by referring to a control prohibiting use of 10-gallon drums This control was included in Revision 0 of the TSRs as Administrative Control AC 5 2 This control has since been deleted based on resolution of DOE-RFFO comments The text of Table 2-1 is to be revised per the red-lined markup provided in Appendix A to refer to a programmatic control rather than an AC control

No exemptions were requested in the DSA, however, the DSA does reference one approved exemption that affects the Building 776/777 Complex

- EX-001, Fire Dampers Within HVAC Ductwork – This exemption to the requirements of DOE Order 5480 7A, *Fire Protection*, was approved since the use of fire dampers within HVAC ductwork is appropriate for most industrial and/or commercial facilities but is inconsistent with good Health Physics practices for plutonium facilities

The listed exemption has no resultant compensatory actions and does not need any special consideration within the Fire Protection SMP or the accident analyses of the DSA

Conclusion The DSA adequately discusses provisions for exemptions and open issues are adequately addressed No consent agreements are explicitly addressed in the DSA and in general are addressed at the Safety Management Program level (e g , consent agreements with the State of Colorado would be captured in the Waste Management and Environmental Protection Program) This criterion is adequately met

5.2 Adequacy of Hazard and Accident Analyses

The hazard analyses and accident analyses contained in a DSA are the foundation upon which the remaining bases (i e , Safety SSCs, TSRs, and programmatic controls) rely Per DOE-STD-1104 (Reference 6), the objective of the DOE review of this portion of the DSA is that it contains sufficient information with appropriate references to supporting details to ensure the completeness of the hazards and accident analysis, and the consistency of the logic used throughout the analysis process

Per guidance from DOE-STD-1104, this section provides an overall summary of the methodology, assumptions, bases, conclusions, and commitments in the DSA and TSRs Significant issues or discrepancies were resolved as part of the DSA/TSR development process and incorporated into the final contractor submittal, thus are not elaborated further unless directed towards clarifying some specific aspect of approval, demonstrating understanding of some aspect of the facility safety basis, or clarifying essential aspects of important issues The adequacy of the hazard and accident analyses presented in the Building 776/777 DSA is determined for the following five conclusions from DOE-STD-1104

1) <u>The hazard analysis includes hazard identification that specifies or estimates the hazards relevant for DSA consideration in terms of type, quantity, and form, and also includes properly performed facility hazard classification</u>

This criterion primarily addresses Chapter 5, *Hazard Identification and Analysis*, but also covers statements made in the *Executive Summary* and Chapter 1, *Introduction*, dealing with the final facility hazard classification

<u>Assessment</u> The hazard identification process relied heavily on an earlier Building 776/777 Complex Preliminary Hazards Analysis (PHA) (Reference 12) and the Site PHA (Reference 7) These source documents identified an initial list of hazards that were reviewed for applicability to the current Building 776/777 mission and activities At this point, any new hazards posed by the D&D mission were incorporated into the identified hazards list In addition, the hazard identification checklists and methodology presented in the Safety Analysis and Risk Assessment Handbook (SARAH) (Reference 13) were consulted to ensure completeness

A part of the basic approach used in the hazard identification process was to utilize checklists The checklist presented in Table 5-1 of the DSA is not consistent with the Site PHA or the SARAH but the information presented is generally complete The actual listing of hazards found in Table 5-4 is comprehensive but is not consistent with the Site PHA categorization of hazards The hazard listing identifies the type and form of the hazards but does not consistently identify the "quantity" of the hazards While this appears to not meet this SER criterion, the hazard "quantity" information is generally understood sufficiently to relate the hazards to potential accident scenarios This is due to the relative simplicity of the activities being conducted and the limited exposure of radiological materials to high-energy hazards In addition, the hazard table in the DSA is consistent with other Decommissioning Basis for Interim Operation (DBIO) documents at the Site covering facilities with similar missions and activities

Facility hazard categorization information is found in the *Executive Summary*, Chapter 1, and Chapter 5 of the DSA The Building 776/777 Complex is classified as a Hazard Category 3 Nuclear Facility based on the limited inventory of radiological material and application of a segmentation argument dealing with the material distribution and lack of mechanisms for consolidation of the material While the Building 776/777 Complex will contain more radiological material than the DOE-STD-1027 (Reference 2) Hazard Category 2 threshold for Pu-239, the hazard classification is appropriate based on the rationale presented below

DOE-STD-1027 indicates "The concept of independent facility segments should be applied where facility features preclude bringing material together or causing harmful interaction from a common severe phenomenon It should be noted that DOE 5480 23 states that an analysis and categorization is be performed on 'processes operations, or activities' and not necessarily whole facilities For the purposes of hazard categorization and estimating hazardous material inventory, the objective is to understand the available hazards that could interact and cause harm to individuals or the environment"

The Standard also states " for final Categorization, for facilities initially classified as

Hazard Category 2, if the credible release fractions can be shown to be significantly different than [the airborne release fractions used in generating Threshold Quantity values for Category 2 in Table A 1 provided on Page A-9 of Attachment 1] based on physical and chemical form and available dispersive energy sources, the threshold inventory values for Category 2 in Table A 1 may be divided by the ratio of the maximum potential release fraction to that found on Page A-9 "

The approach taken in justifying that the Building 776/777 Complex should be categorized as a Hazard Category 3 Nuclear Facility utilizes elements of both of the DOE-STD-1027 concepts presented above It is argued that the remaining radiological material in the Complex is dispersed sufficiently and is in a form that precludes involvement of more than 900 grams of weapons grade plutonium (WGPu) in any single credible postulated accident scenario It will also be argued that the predominant form of the radiological material, at any one time in the remaining facility life, has a significantly lower airborne release fraction than that associated with the general solid/powder/liquid release fraction value of 1 0E-03 cited in the Standard for internal event scenarios that have the potential to involve large fractions of the material

The inventory of radiological material in the Building 776/777 Complex upon which the hazard categorization is based is less than 1,500 grams WGPu The material is basically in the form of holdup in ductwork, plenums, and painted contaminated concrete. Gloveboxes have been removed from the facility leaving some Heating, Ventilating, and Air Conditioning (HVAC) Zone 1 plenums and ductwork, the Zone 2 HVAC system, and some low contamination level piping systems The vast majority of the remaining radiological material is in the form of "fixed" contamination or holdup in ductwork and plenums

The radiological material in the facility is divided into three parts between the Building 776 and Building 777 1st floors and the combined 2nd floor of the facilities Postulated fires, spills, and explosions involving the remaining radiological material are evaluated in Chapter 6, *Accident Analysis*, to determine if any of these scenarios can involve a substantial fraction of the remaining material

Based on the significant decontamination experience of the facility to date, a large fraction of the remaining radiological material will be removed from the facility as surface-contaminated objects (SCO) rather than in TRU waste containers Consolidation of this SCO waste into a configuration in excess of 900 grams is not considered credible

The decontamination of remaining ductwork and plenums could generate TRU waste that may be disposed of in waste drums However, it is also not expected that sufficient numbers of waste containers will be generated and consolidated such that the combined inventory susceptible to an accident would exceed 900 grams Waste containers are expected to be removed from the facility as they are generated with limited residence time in staging areas Also, the actual loading of the waste containers is not likely to challenge waste container packaging limits (i e , 200 grams for drums and 325 grams for boxes) at this point in the D&D process due to the dispersal of the material throughout the facility Waste packaging at or near the limits of the containers generally requires highly contaminated components such that the secondary waste stream associated with decontamination deals with concentrated materials where the container limit is reached before the container is filled with waste materials

Fires, spills, and explosions are possible during the remaining life of the facility There is a postulated fire that could involve a majority of waste containers and duct/plenum holdup but it has a lower fire-related release fraction than that assumed in the DOE Standard Other fires with equivalent "footprints" would involve less material and larger fires involving more material are not considered credible Spills would impact much smaller amounts of radiological material than fires Explosions are similar to spills in many ways in that they cause waste containers to topple or be penetrated by missiles leading to spills However, postulated credible explosions do not impact as many waste containers as fires and have lower release fractions

The two dominant natural phenomena/external event scenarios that can impact large fractions of the remaining radiological material are the seismic and the aircraft crash scenarios Seismic events are expected to impact no more than 10% of the remaining facility inventory (i e , 150 grams) Aircraft crash events could impact localized, high concentrations of radiological materials, which are not expected to occur as discussed above In summary no credible accident scenario has been identified that could challenge the Hazard Category 3 classification of the facility

Because the Hazard Categorization is based on facility conditions that do not yet exist, there is a DOE-RFFO expectation to verify that the holdup in the facility is below 1,500 grams prior to DSA implementation This condition is expected to be met when most of the remaining high-holdup ductwork has been removed from the facility Appendix B states the expectation associated with implementation of this DSA

Conclusion Hazard identification for the Building 776/777 Complex was adequate for the analysis and derivation of TSR controls The hazard classification for the facility was adequately determined and justified as a Hazard Category 3 Nuclear Facility The DSA assumes that the facility inventory of radiological material is below 1,500 grams in order to support the hazard classification of the facility and this is imposed as a requirement prior to implementation This criterion is adequately met

2) The hazard analysis includes hazard evaluation that covers the activities for which approval is sought, is consistent in approach with established industrial methodologies, identifies preventive and mitigative features for the spectrum of events examined, and identifies dominant accident scenarios through ranking

This criterion deals with the content of Chapter 4 *Activity Description*, Chapter 5, *Hazard Identification and Analysis*, and Chapter 6, *Accident Analysis*, of the DSA

Assessment The proposed activities are described in Chapter 4 While the activities are defined primarily by example, the descriptions provide some information about potential hazardous materials and energy sources that may be associated with the activity The Chapter 4 hazard information is consistent with the hazards presented in Table 5-4 of the DSA No hazards associated with the activities for which authorization is being sought were identified that do not appear in the Chapter 5 hazards list and analysis However, there is no direct linkage between the hazards in Chapter 5 and the activities described in Chapter 4 While this linkage would be useful, the simplicity of the activities being performed make the linkage unnecessary since the activity hazards are relatively straightforward and generally understood

The approach taken for the hazards analysis is consistent with that used across the Site in the approved DBIOs This approach does not literally follow the approach described in DOE-STD-3009 (Reference 3) but yields satisfactory results The hazards analysis or evaluation described in the Standard is accomplished in the Building 776/777 DSA by the combination of the hazards analysis in Chapter 5 and the accident analysis in Chapter 6 Rather than using the hazards analysis to qualitatively assess receptor risk, the accident analysis is used to more quantitatively define the receptor risk TSR controls are defined almost exclusively in the accident analysis rather than being defined in both the hazards analysis and accident analysis By taking this approach, the relative ranking of hazards is not used as the basis for selection of dominant accident scenarios Rather, dominant accident scenarios are selected based on Site AB development experience over a number of years Again, due to the simplicity of the activities and the limited exposure of radiological materials to high-energy hazards associated with D&D operations, the selection of accidents for analysis is relatively straightforward and is well understood at the Site

Table 5-4 characterizes the hazards to each of the receptors by stating the concerns associated with the hazard The CW and MOI concerns are stated in terms of accident types The IW concerns are stated in terms of the type of harm or injury that can result from the hazard (e g , burn, hit/impact, toxic chemical uptake) In two cases, the IW concerns are inconsistent with the hazard For the 11 K Elevator hazard under the High Temperature and Pressure group of hazards, the "Worker concerns" should be "Missile impact" rather than "Chemical Exposure" For the 13 E Torqued Bolts hazard under the Potential Energy group of hazards, the "Worker concerns" should be "Missile impact" rather than "Falling objects" The text of Table 5-4 is to be revised per the red-lined markup provided in Appendix A to correctly present the IW concerns associated with the hazards

The hazards information in Table 5-4 provides some information on preventive and mitigative features that could be used to address each specific hazard However, the accident analysis in Chapter 6 explicitly defines the preventive and mitigative features that are credited with risk reduction and are relegated to the TSRs The candidate controls listed in Chapter 5 associated with each hazard are primarily focused on the Immediate Worker (IW) protection Between the controls listed in Chapter 5 corresponding to specific hazards and those defined/credited in Chapter 6 corresponding to specific accident scenarios, a comprehensive set of controls is provided covering the hazards associated with the Building 776/777 Complex This comprehensive set of controls is further supplemented by the Site PHA suite of engineered and administrative controls available to prevent accident scenarios and/or mitigate accident consequences for the immediate worker, co-located worker, and public in a generic fashion The Site PHA focused on the identification of controls to protect any of the receptors, based on a qualitative assessment of unmitigated frequencies, consequences, and risks from previously approved Authorization Bases

Conclusion The hazard analysis evaluated the hazards associated with the activities that will be performed in the Building 776/777 Complex and identified preventive and mitigative features for a full spectrum of events A standard set of Site D&D accident scenarios was further evaluated in the Chapter 6 accident analysis This criterion is adequately met

3) The analysis, identifies assumptions made in characterizing the response of controls for the set of dominant accident scenarios, and justifies the adequacy of existing controls or identifies specific commitments directed at further reducing facility risk, i e , describes the administrative controls, compensatory measures or restrictions on interim operations implemented as a result of identified vulnerabilities

This criterion deals primarily with DSA Chapter 6, *Accident Analysis*, and Chapter 7, *Derivation of Technical Safety Requirements*

Assessment The approach taken in the development of the recent DBIOs for D&D facilities removed the requirement to assess control set vulnerability to the accidents for which they are credited This DSA follows the DBIO approach and does not address this topic However, the only "hardware" control identified in the DSA was the "Waste Container Integrity" Design Feature The vulnerability of this safety feature is considered in the safety analysis either inherently (i e , damage ratios are based on the vulnerability of the container) or explicitly (i e , container vents reduce hydrogen deflagration frequency based on the likelihood of the failure of the vent)

The remaining controls are Administrative Controls (ACs) and the vulnerability of these controls is also addressed in the analysis In these cases, the Combustible Material Control vulnerability is explicitly credited with reducing the frequency of fires No other ACs are defined

The DSA does address ways of further reducing facility risk during discussions dealing with the three IW or CW high-risk scenarios It is acknowledged that the only practical way to reduce risk associated with the high-risk scenarios is to remove the remaining material-at-risk (MAR) from the facility and complete demolition of the complex

Conclusion The DSA accident scenarios for the Building 776/777 Complex adequately control vulnerabilities and ways to further reduce risk from high-risk scenarios This criterion is adequately met

4) The hazard analysis results are clearly characterized in terms of defense in depth, worker safety, and environmental protection and the logic behind assessing the results in terms of Safety Significant SSCs and designation of TSRs is understandable and internally consistent

This criterion deals with the content of Chapter 5, *Hazard Identification and Analysis*, Chapter 6, *Accident Analysis*, and Chapter 7, *Derivation of Technical Safety Requirements*, of the DSA

Assessment The hazard analysis results satisfying this Criterion are found in the Chapter 6, *Accident Analysis* Immediate worker information is provided in the scenario text discussion

For the MOI and CW, the results of the accident analysis are summarized on PHA-type tables Each table also summarizes the engineered features and the administrative controls that prevent or mitigate the consequences of a postulated accident The tables then define which controls are specifically credited in the analysis to lower the frequency of the accident (preventive) or to lower the consequences of the accident (mitigative) The tables also define controls that are not specifically credited to reduce frequency or consequences to the MOI or CW but are identified as defense-in-depth controls for that accident scenario

DOE-STD-3009 describes Defense in Depth in terms of protection to all facility, onsite, and offsite receptors, including protection of the environment The DSA application of the Nuclear Licensing Streamline Initiative (Reference 5) applies risk guidelines as a starting point for determination of when controls are warranted Other controls presented in the hazard description table in Chapter 5 may also provide Defense in Depth that protect one or more of the receptors, but these are generally required by SMPs and are not derived by the hazards analysis or accident analysis

SMPs were deemed adequate to protect the IW and no controls warranted elevation to TSRs to protect the IW beyond those required for protection of the MOI and the CW Also regarding worker safety for both the IW and CW, Chapter 3 of the DSA covers the SMPs whose construct is to establish disciplined methods of conducting business and operations Implementation of these programs result in an infrastructure to ensure that work is performed safely Therefore, worker safety is an integral part of these institutional processes

A purpose of the DSA is to demonstrate that the health and safety of the public is not adversely impacted from activities involving radioactive materials in the complex Thus, the DSA does analyze the environmental impact from accidental releases of radioactivity as far as the health and safety of the public is concerned The dose consequence from the direct inhalation pathway dominates dose contributions from all other pathways For conservatism in the consequence analysis, plume depletion mechanisms such as dry and wet deposition have not been included in the atmospheric dispersion model, which lead to increased airborne radioactive concentrations and no settling of radioactivity. However, the credited controls that prevent or mitigate the consequences of postulated accidents for the CW and the MOI will significantly reduce the potential for an uncontrolled release that could impact the environment Although the environmental protection is not explicitly evaluated in the DSA, the DOE-RFFO views those features that protect the health and safety of the public and the collocated workers are adequate to protect the environment

Chapter 7 of the DSA presents the approach for derivation of TSRs for engineered safety features identified in the accident analysis and mapped to Safety SSCs in the facility, and for Administrative Controls The only Safety SSC identified in the accident analyses is the Waste Container Integrity Design Feature, which is credited for reducing the frequency of container hydrogen deflagrations (due to venting) and is inherently credited in the determination of damage ratios used in the accident analyses for accidents impacting waste containers No other Safety SSCs were identified although the Fire Suppression System and the Filtered Exhaust Ventilation System are cited as Defense in Depth systems controlled via the Fire Protection and Radiological Protection Safety Management Programs

The single engineered safety feature identified in the accident analyses was categorized as a Safety-Significant SSC The MOI radiological dose consequences for all the evaluated scenarios never exceeded the 5 rem threshold, which is used to identify potential Safety-Class SSCs

Conclusion This criterion on Defense in Depth, worker safety, environmental protection, and Safety-Significant SSCs is adequately met

5) Subsequent accident analysis clearly substantiates the findings and delineations of hazard analysis for the subset of events examined, confirms their potential consequences, and for events potentially exceeding evaluation guidelines there is a clear identification of associated Safety Class SSCs and basis of TSR derivations

Chapter 6, *Accident Analysis*, and Chapter 7, *Derivation of TSRs,* of the DSA primarily address this criterion

Assessment The methodology for performing the accident analysis is described in Section 6 1, *Accident Analysis Methodology* Chapter 6, *Accident Analysis*, evaluated potential scenarios based on the D&D activities, identified hazards, and preventive and mitigative controls to assess risk to the public and collocated workers, and to derive TSR controls No specific criteria were established to select "representative or unique" bounding accidents from the Hazards Analysis for the DSA Accident Analysis Nine "representative or unique" bounding accident scenarios were evaluated in the Accident Analysis based on similar analyses performed for other D&D facilities and the previous Building 776/777 Complex PHA (Reference 12) The evaluated accident scenario risks were compared to the Site evaluation guidelines to identify situations that may warrant Safety SSCs and to establish TSR Limiting Conditions for Operation, Administrative Controls, or Design Features Each scenario description identifies the activities that are linked with the scenario, details the accident scenario, identifies scenario assumptions, establishes the accident frequency, defines the scenario MAR, performs a consequence and risk evaluation, establishes the credited control set, and identifies defense-in-depth controls In addition, other scenarios that are bounded by the evaluated scenario are identified, consequence and risk evaluations for the bounded scenarios are presented

The accident analysis results are documented on PHA-like tables The major elements of each scenario analyzed in the accident analysis are as follows

Scenario Descriptive Material including

- Hazard/MAR The specific radiological material form and MAR quantity
- Accident Type Fires, explosions, spills, natural phenomena events, and other external events
- Dominant Initiator Potential initiating events
- Vulnerable DSA Activities Activities during which the scenario can occur

Scenario Results including

- Receptor Public and Worker
- Scenario Frequency Both without prevention and with prevention
- Consequences Both without mitigation and with mitigation
- Risk Class Both without prevention/mitigation and with prevention/mitigation
- Credited Controls Safety SSCs or Administrative Controls to reduce frequency and/or reduce consequences
- Defense-in-Depth Controls SSCs or SMPs that are not credited but are potentially available to reduce frequency or consequences

The accident analysis approach is generally based on the *Safety Analysis and Risk Assessment Handbook* (SARAH) (Reference 13) Nine bounding accident scenarios were evaluated three fires (small, medium, and large), one spill, two explosions (container deflagration and flammable gas), two external events (crane drop and aircraft crash), and one natural phenomena event (seismic) In all cases, the MOI radiological dose consequences were *low* The CW consequences were *low* in five of the nine scenarios, *moderate* for three scenarios, and *high* for the remaining scenario The IW consequences were *low* for three scenarios, *moderate* for three scenarios, and *high* for the remaining three scenarios

Mitigative controls were not applied for any of the CW *moderate* or *high* consequence scenarios Two of the four CW high-risk scenarios were reduced to low-risk scenarios by frequency reductions associated with the Combustible Material Control AC in one case (large fire) and the Waste Container Integrity (venting) DF in the other case (container deflagration) The Combustible Material Control AC was also used to reduce the frequency of another of the CW high-risk scenarios (medium fire), lowering the Risk Class from I to II, but the scenario remained a high-risk scenario In the remaining CW high-risk scenario (aircraft crash), no controls were identified

SMPs were generally credited with reducing the IW *moderate* and *high* consequence scenarios In the cases of the medium and large fires and the container deflagration, which yielded *moderate* consequences for the IW, the SMPs (primarily Emergency Response and evacuation) reduced the consequences to *low* The flammable gas explosion scenario, which yielded *high* IW consequences, was also reduced to *low* consequences by SMPs (primarily Emergency Response and evacuation) Emergency Response and evacuation reduced IW consequences for the aircraft crash and the seismic event from *high* to *moderate* In the case of the aircraft crash (frequency is *extremely unlikely*), this also lowered a high-risk scenario to a low-risk scenario Only in the case of the seismic event did the IW Risk Class remain high

There are no controls warranted at this stage in the facility lifecycle for reducing the risk from the aircraft crash (CW high-risk scenario) and the seismic event (IW high-risk scenario) The prudent approach is to remove the radioactive material from the facility to reduce the risk rather than to harden a building just prior to demolition These analyses are very conservative and represent bounding simplifications of the actual phenomena The CW radiological dose consequence for the aircraft crash is 26 rem, which just exceeds the *high* threshold of the Site Evaluation Guidelines (EGs) Removal of conservatism from the analysis would yield a lower dose consequence and make the scenario low risk for the CW In addition, the Site Fire Department is available for response to the event and can provide a defense-in-depth mitigative function that is not credited or acknowledged in the DSA The seismic event evaluation is also very conservative in its evaluation of the IW consequences, it assumes a moderate release of radiological material that is predominantly fixed contamination

The remaining high-risk scenario deals with a medium fire impacting the CW The CW radiological dose consequence for this event is 8 6 rem The analysis of the fire is very conservative, it assumes that nearly all of the radiological material remaining in the facility is involved in the fire and that the CW will remain in the plume of a fire for the duration of the release rather than moving away from the smoke The analysis also does not consider the mitigative effect of the Fire Suppression System While crediting this system could reduce the CW consequence from this event and make the scenario low risk, the requirement for a TSR-controlled Fire Suppression System for the facility at this stage of decommissioning is not warranted given the conservatism in the analysis However, the Fire Suppression System will be maintained under the Fire Protection SMP as long as possible until it becomes necessary to strip it out In addition, the Site Fire Department is available for response to the event and can provide a defense-in-depth mitigative function that is not credited or acknowledged in the DSA While the crediting of a high efficiency particulate air (HEPA) filtered exhaust from the facility would reduce the CW consequence from this event and make the scenario low risk the requirement for a HEPA filtered exhaust for the facility at this stage of decommissioning is not warranted given the conservatism in the safety analysis However, the HEPA filtered exhaust will be maintained under the Radiological Protection SMP until radiological conditions in the facility no longer warrant it

One low-risk scenario deals with an *extremely unlikely*, large, engulfing pool fire The CW radiological dose consequence for this event is 24 8 rem While the CW consequence is *moderate*, it challenges the 25 rem threshold for *high* consequences Therefore, this scenario is also considered a high-risk scenario for the CW The analysis of this fire is both non-conservative and conservative The non-conservative aspects of the analysis are that it assumes that the fire lasts for 60 minutes (major fire) even though a fuel pool fire of this type would be significantly shorter in duration, and, unlike the medium fire, the material at risk (MAR) is assumed to be 450 grams rather than 900 grams This latter non-conservatism is only relative to other accident analyses, it could actually be argued that the MAR is still very conservative From the analysis conservatism standpoint, the scenario assumes that the CW will remain in the plume of a fire for the duration of the release rather than moving away from the smoke The analysis also does not consider the mitigative and/or preventive effect of the Fire Suppression System While crediting this system could reduce the CW consequence from this event and make the scenario low risk and/or make the scenario *beyond extremely unlikely*, the requirement for a TSR-controlled Fire Suppression System for the facility at this stage of decommissioning is not warranted given the conservatism in the analysis However, the Fire Suppression System will be maintained under the Fire Protection SMP as long as possible until it becomes necessary to strip it out In addition, the Site Fire Department is available for response to the event and can provide a defense-in-depth mitigative function that is not credited or acknowledged in the DSA While the crediting of a high efficiency particulate air (HEPA) filtered exhaust from the facility would reduce the CW consequence from this event, the requirement for a HEPA filtered exhaust for the facility at this stage of decommissioning is not warranted given the conservatism in the safety analysis However, the HEPA filtered exhaust is to be maintained under the Radiological Protection SMP until radiological conditions in the facility no longer warrant it

During the final review of Revision 1 of Chapter 6, the following technical issues were identified and are resolved in the attached red-lined markup changes in Appendix A

- In Section 6 2 1 3, *Large Fire, Engulfing Pool* The assumption dealing with fire duration should indicate that the fire burns for 60 minutes rather than 30 minutes based on the DSA supporting calculations [Editorial change also made per contractor request to change the sentence from "Per SARAH, the large fire burns " to "This large fire burns "]
- In Section 6 2 1 3, *Large Fire, Engulfing Pool* The assumption dealing with MAR should indicate that "55" gallons of contaminated oil is involved rather than "5" gallons of oil based on the DSA supporting calculations
- In Section 6 2 1 3, *Large Fire, Engulfing Pool* The last sentence in the Immediate Worker paragraph should indicate that the final Risk Class for the IW is "Risk Class IV" rather than "Risk Class III" based on an *extremely unlikely, low* consequence event
- In Section 6 2 3 1, *Overpressurization/Deflagration, Hydrogen* The third sentence in the Immediate Worker paragraph should indicate that the initial Risk Class for the IW is "Risk Class II" rather than "Risk Class I" based on an *unlikely, moderate* consequence event
- In Section 6 2 4 1, *Crane Drop – External Event* The damage ratio assumed for the analysis should be 1 0 rather than 10% per DOE–RFFO direction during the DSA cross-table review process
- In Table 6-15, *Crane Drop* The MAR assumed for the analysis should be "900 grams" rather than "800 grams" per contractor requested change
- In Table 6-15, *Crane Drop* The Public consequences should be "3 0E-2 rem" rather than "3 0E-3 rem" and the Worker consequences should be "3 1 rem" rather than "3 0E–1 rem" based on DOE–RFFO direction to change the scenario damage ratio to 1 0 rather than 10% These changes also apply to Table 6-20, *Summary of Accident Analyses*
- In Table 6-16, *Accidents Bounded by Scenario 6 2 4 1* The MAR assumed for the analysis should be "900 grams" rather than "500 grams" per contractor requested change
- In Section 6 2 4 3, *Earthquake – Natural Phenomena* The Public consequences should be "1 1E-2 rem" rather than "1 2E-2 rem" per contractor requested change This change also applies to Table 6-20, *Summary of Accident Analyses* [Editorial change also made in the last sentence before Table 6-18, which should read " controls for an earthquake are presented in Table 6-18 below " rather than " controls for an aircraft crash are presented in Table 6-19 below " and the title of Table 6-18 should be "EARTHQUAKE" rather than "EARTHQAKE"]

- In Table 6-19, *Accidents Bounded by Scenario 6.2.4.3*. The Public consequences for NP–2 should be "8.5E-6 rem" rather than "5.8E-4 rem" and the Worker consequences for NP–2 should be "1.1E-3 rem" rather than "7.5E-2 rem" based on the DSA supporting calculations. [Editorial change also made in MAR for NP–3 from "850 g" to "850 grams" for consistency.]
- In Table 6-20, *Summary of Accident Analyses*. The Worker Risk Class for the Aircraft Crash With Prevention & Mitigation should be "N/A" rather than "II" since there is no preventive or mitigative measures proposed.
- In Section 6.3, *High-Risk Scenarios*. The next to last sentence in the Aircraft Crash paragraph should read "When evaluated at an *EXTREMELY UNLIKELY* frequency, the event represents a *RISK CLASS III*." rather than "When evaluated at an *UNLIKELY* frequency, the event represents a *RISK CLASS II*."

<u>Conclusion</u>. Overall, the accident analysis is comprehensive and thorough, and evaluates a spectrum of accidents that provides a defendable basis for required controls and development of TSRs. This criterion is met.

5.3 Adequacy of Safety Structures, Systems, and Components

Identification of Safety Structures, Systems, and Components (SSCs) is a product of the hazard and accident analyses, which provide the bases for their designation. Determining the adequacy of safety SSCs defined by the accident analyses results in being able to conclude that the DSA contains sufficient documentation and basis to meet the following three criteria.

1) <u>The Safety SSCs identified and described are consistent with the logic presented in hazard and accident analyses.</u>

   This criterion addresses the Safety SSC identification process in Chapter 5, *Hazard Identification and Analysis*, Chapter 6, *Accident Analysis*, and Chapter 7, *Derivation of Technical Safety Requirements*, of the DSA.

   <u>Assessment</u>. The DOE-RFFO issued Reference 5 which is designed to provide a consistent methodology to define the minimum set of most significant SSCs, which will in turn, improve the implementation and maintenance of these controls without compromising safety. The terminology used in the DSA associated with defining Safety SSCs is consistent with the terminology used in 10 CFR 830 and Reference 5.

   Each accident scenario analyzed explicitly identifies the credited preventive and mitigative features, as well as those considered Defense in Depth. These features are classified per the criteria in Chapter 6 and the safety functions are delineated in the TSR Bases.

   The DSA defines Safety-Class SSCs as those SSCs whose preventive or mitigative function is necessary to limit radioactive hazardous material exposure to the public as identified by safety analysis. Limiting exposure means that the upper Evaluation Guideline (EG) is not exceeded, therefore Safety-Class SSCs are SSCs whose safety function is necessary to keep exposure to the public below the upper EG. The radiological EG used for this classification is 5 rem to the MOI based upon the Nuclear Licensing Streamline Initiative (Reference 5) There were no Safety-Class SSCs identified in the DSA, the analyzed MOI radiological dose consequences never exceeded the lower EG value of 0 5 rem

The DSA defines SSCs as Safety-Significant when their preventive or mitigative function is a major contributor to Defense in Depth and/or worker safety as determined by the safety analysis Safety-Significant SSC classifications based on Defense in Depth include those SSCs necessary to reduce dose consequences to the public to Risk Class III or IV, or are required for worker safety

All of the accident scenarios analyzed in the DSA yielded radiological dose consequences for the MOI that were below 0 5 rem (i e , *low*) and the corresponding risk class designations for the scenarios were either Risk Class III or IV Therefore, there were no Safety-Significant SSCs identified for the MOI other than the "Waste Container Integrity" Design Feature, which supports the safety analysis assumed damage ratios

The CW had several high risk scenarios that were mitigated to lower risk scenarios, primarily using Administrative Controls (Waste Container Integrity [vented containers] is used in one accident scenario to reduce risk) The two remaining CW high risk scenarios are conservative analyses and did not warrant further controls Fire Suppression Systems and Filtered Exhaust Ventilation Systems could have been credited as Safety-Significant SSCs and further reduced CW risk However, due to the life-cycle stage associated with the Building 776/777 Complex (i e , very near end of life and demolition) and due to the conservatism in the safety analysis (e g , assumptions that nearly all the remaining radiological material left in the facility is involved in each accident scenario), the decision was made to place those systems under the control of the Fire Protection and Radiological Protection Safety Management Programs (SMPs) This approach supports the reconfiguration of the systems as D&D progresses per the programs that are responsible for the corresponding safety functions provided by the systems

Therefore, only the Waste Container Integrity Design Feature is defined as a Safety-Significant SSC in the DSA Other systems that normally would be included as Safety SSCs are relegated to configuration control and maintenance under appropriate SMPs

<u>Conclusion</u> The single Safety SSC that is identified in the DSA is consistent with the logic presented in the safety analysis This criterion is adequately met

2) <u>Safety functions for Safety SSCs are defined with clarity and are consistent with the bases derived in the hazard and accident analyses</u>

This criterion is addressed by Chapter 7, *Derivation of Technical Safety Requirements*, and the TSR Bases for each Safety SSC contained in Appendix A, *Building 776/777 Documented Safety Analysis Technical Safety Requirements*

<u>Assessment</u> Only one Safety SSC is identified in the DSA and TSRs, the Waste Container Integrity Design Feature The description of the safety function provided by this Design Feature in the TSR Bases is consistent with the functions detailed in the accident analysis

Conclusion The safety function for the credited SSC is defined and is consistent with the safety bases defined in the accident analyses This criterion is adequately met

3) Functional requirements and system evaluations are derived from the safety functions and provide evidence that the safety functions can be performed

This criterion is addressed in the DSA Appendix A, *Building 776/777 Documented Safety Analysis Technical Safety Requirements*

Assessment There are no Safety SSCs identified for the Building 776/777 Complex other than the Waste Container Integrity Design Feature Functional requirements and surveillances associated with this Design Feature are established in Site programs

Conclusion The acceptance criteria for Safety SSCs are adequately defined by Site programs to ensure associated safety functions are maintained This criterion is adequately met

5.4 Adequacy of Derivation and Development of Technical Safety Requirements

Technical Safety Requirement (TSR) identification and derivation is a product of the hazard and accident analyses The TSRs are derived from the most significant preventive and mitigative features identified in the hazard and accident analyses and from the designation of Safety SSCs This section of the Safety Evaluation Report provides the bases for approval of the TSR derivation of the DSA as well as the Building 776/777 TSRs

1) The bases for deriving TSRs that are identified and described in the hazard and accident-analyses and safety SSC discussions are consistent with the logic and assumptions presented in the analyses

This criterion addresses the consistency and logic of taking the safety features (administrative and engineered) identified in Chapter 5, *Hazard Identification and Analysis*, and Chapter 6, *Accident Analysis*, of the DSA and mapping them to specific controls in the TSRs as accomplished in Chapter 7, *Derivation of Technical Safety Requirements*, of the DSA Chapter 7 lists the administrative controls, and design features derived from the accident analyses

Assessment Chapters 5 and 6 of the DSA define the controls credited for reducing the risk associated with each accident scenario for each receptor (public, co-located worker, and immediate worker) This information was summarized in Chapter 7 of the DSA

Chapter 5 basically identifies controls within Site Safety Management Programs (SMPs) for protection of the immediate worker against a variety of accident types No hardware controls are identified that warrant elevation to the TSRs Chapter 6 of the DSA also includes an evaluation of the immediate worker in each accident scenario

Controls identified in the accident analyses are either identified as specifically credited or Defense in Depth (DID) Accident analysis discussions summarize the controls that are credited and those available as DID and the accident descriptions identify the impact of these controls on the accident scenario likelihood or consequences The summary tables for each accident present the results with the full application of the credited controls for the CW No scenario warranted any TSR-level controls for the MOI The credited controls for each accident and receptor (other than the MOI) are listed below

- Small Fire – No credited controls for any receptor, SMPs generally cited as DID
- Medium Fire – Combustible Material Control credited for CW and IW for frequency reduction, Fire Protection (fire suppression) and Radiological Protection (confinement) SMPs cited as DID for CW, SMPs generally credited for IW
- Large Fire – Combustible Material Control credited for CW and IW for frequency reduction, Fire Protection (fire suppression) and Radiological Protection (confinement) SMPs cited as DID for CW, SMPs generally credited for IW
- Large Spill – No credited controls for any receptor, SMPs generally cited as DID
- Drum Deflagration – Container Integrity credited for CW and IW for frequency reduction, Radiological Protection (confinement) SMP cited as DID for CW, SMPs generally credited for IW
- Explosion – No credited controls for CW, SMPs generally credited for IW
- Crane Drop – No credited controls for any receptor, SMPs generally cited as DID
- Aircraft Crash – No credited controls for any receptor, SMPs cited as DID for CW and generally credited for IW
- Seismic Event – No credited controls for CW, SMPs generally credited for IW

As seen above, there are no credited controls, engineered or administrative for most events The Derivation of TSRs is very simple in that only ACs are needed, there are no Safety SSCs that require Limiting Conditions for Operation (LCO) statements The discussions provided in the DSA are adequate for understanding the controls selection

<u>Conclusion</u> The controls identified in Chapters 5 and 6 of the DSA are appropriately identified in Chapter 7 of the DSA as TSR controls This criterion is adequately met

2) <u>Bases for deriving safety limits, limiting control settings, limiting conditions for operation, surveillance requirements, and administrative controls are provided as appropriate</u>

This criterion is addressed in Chapter 5, *Hazards Identification and Analysis*, Chapter 6, *Accident Analysis*, and Chapter 7, *Derivation of TSRs*, and Appendix A, *Building 776/777 Documented Safety Analysis Technical Safety Requirements*, of the DSA

<u>Assessment</u> No Safety Limits, Limiting Control Settings, or Limiting Conditions for Operation were required based on the hazard and accident analyses performed in Chapters 5 and 6 of the DSA The logic and strategy for developing the TSRs is adequately discussed in Chapters 6 and 7 of the DSA and in the Base for the TSR in Appendix A of the DSA

The TSRs (Appendix A of the DSA) identify the Administrative Controls (ACs) necessary to implement specific attributes of SMPs credited in the accident analysis or to protect assumptions of the analysis The ACs provide Required Actions and associated Completion Times for the facility to enter upon discovery of an AC Noncompliance The AC Surveillance Requirements (SRs) provide assurance that these ACs are being adequately implemented in the facility Specific Bases for each AC and corresponding SR are provided in the TSRs

Conclusion The Bases for the ACs, and associated SRs relied upon in the accident analysis to ensure safe facility operations are adequate This criterion is adequately met

3) The controls are consistent with other Site AB documents, are consistent with controls established for other facilities, and are appropriate to maintain an acceptable operational safety envelope for the facility

This criterion is addressed in Chapter 5, *Hazards Identification and Analysis*, Chapter 6, *Accident Analysis*, and Chapter 7, *Derivation of TSRs*, and Appendix A, *Building 776/777 Documented Safety Analysis Technical Safety Requirements*, of the DSA

Assessment The DSA and associated TSRs establish a safety envelope commensurate with the low risk of facility operations at time of DSA approval The Building 776/777 TSRs represent the full set of controls (Administrative Controls only) required to ensure safety of all receptors during described operations

There are no Limiting Conditions for Operations (LCOs) contained in the TSRs

The following Administrative Controls (ACs) and associated Surveillance Requirements, and Design Feature (DF) specified in the TSRs define the specific attributes of programs identified within the safety analysis or relied upon to protect assumptions in the analysis

1 AC 5 1, Safety Management Programs (SMPs)
2 AC 5 3, Combustible Material and Hot Work Controls
3 DF 6 1, Waste Container Integrity

The ACs and DF adequately provide the program elements necessary for safe facility operation, Required Actions, Completion Times, Surveillance Requirements, and Bases Surveillance Requirements were specified in cases where it was practicable to inspect or measure a requirement/control

During the cross-table review of the initial submittal, the DOE-RFFO directed that the surveillance wording and acceptance criteria for SR 5 3 1 1 should be modified to make it clear that the inspection for un-allowed combustibles applies to the waste container storage/staging areas as well as the waste container storage/staging area buffer zones The wording was not changed in Revision 1 of the DSA Rather than directing a change, the DOE-RFFO is accepting the current wording with the expectation that the Surveillance will be interpreted to include the waste container storage/staging area itself in the inspection for un-allowed combustibles

Conclusion The TSRs were determined to prescribe an adequate set of controls consistent with the accident analysis, similar in nature to other facilities with the same or similar hazards, and sufficient to ensure the safety of all receptors for the analyzed events This criterion is adequately met

5.5 Adequacy of Programmatic Controls

Programmatic controls encompass the elements of institutional programs and facility management that are necessary to ensure safe operations based on assumptions made in the hazards and accident analyses In the Building 776/777 DSA, programmatic controls are identified as Safety Management Programs (SMPs)

The Safety Management Programs described in Chapter 3, *Safety Management Programs*, of the DSA provide worker protection and defense-in-depth The DSA emphasizes the entire program, which will ensure that not only the controls identified by the analyst are included, but also the programmatic controls that may have been overlooked or the controls that are indirectly involved but were not recognized would be included The program manager will be responsible to ensure the program is established, will track, trend and correct non-compliances, and perform periodic self-assessments to verify continuing compliance An Administrative Control, AC 5 1, Safety Management Programs, links the SMPs to the TSRs Also, the Safety Management Programs will be enforced through the Price Anderson Amendment Act

1) <u>The major programs needed to provide programmatic safety management are identified</u>

   This criterion is addressed in Chapter 3, *Safety Management Programs*, of the DSA

   <u>Assessment</u> Chapter 3 of the DSA describes and commits to the implementation of the Site Safety Management Programs within the Building 776/777 Complex The DSA evaluates each SMP at the Site level, and determines if there are any specific attributes of the SMP required in the accident analysis The DSA also identifies any facility-specific differences between the Site SMP and implementation in the facility The contract between the DOE and Kaiser-Hill identifies the Orders and requirements that are applicable The program manuals for the various Safety Management Programs provide the mechanism to flow requirements from orders and regulations down to any Contractor performing work at Rocky Flats The program manuals are implemented at the facility and project level The compliance status of facilities and projects is assured through internal and external assessments Administrative Control 5 1, Safety Management Program, also raises the commitment to maintain these programs to the TSR level thus providing greater assurance that they will be preserved Issues identified regarding compliance of the Safety Management Programs will be managed through established processes, such as corrective action process or exemption process, and enforced through the Price Anderson Amendment Act

   This DSA has an increased reliance on SMPs to perform safety functions In particular, the following SMPs have facility-specific differences covering items normally found in the TSRs

   1 Conduct of Operations – This SMP is relied upon to define the minimum staffing requirements
   2 Configuration Management – This SMP is relied upon in lieu of a configuration control AC
   3 Environmental Management – This SMP is relied upon to manage the requirements for the final demolition of the facility under the Decommissioning Operations Plan

4 Fire Protection – This SMP is relied upon to retain the Fire Systems in lieu of a Fire Suppression System Limiting Condition for Operation (LCO)
5 Radiological Protection - This SMP is relied upon to retain the HVAC Systems in lieu of a Filtered Exhaust Ventilation System LCO
6 Waste Management – This SMP is relied upon to manage factors affecting waste management in areas where work is being performed in lieu of an inventory management AC

The rationale for utilizing the SMPs for these normally TSR-controlled requirements is based on the hazard category of the facility and the facility's stage of its life-cycle

During the final review of Revision 1 of Chapter 3, the following technical issues were identified and are resolved in the attached red-lined markup changes in Appendix A

- In Section 3 8, *Fire Protection* The normally TSR-controlled safety functions provided by the fire suppression systems in the Building 776/777 Complex are captured in the Fire Protection SMP The DOE-RFFO expects these systems to be maintained for as long as is possible and directs that the justification for their removal be documented Therefore the fourth sentence of the Nuclear Safety Attributes paragraph should read, in part, " the hazard no longer warrants them as documented in a formal evaluation (tracking requirements for removal of systems are discussed in " rather than " the hazard no longer warrants them (removal of systems is discussed in "
- In Section 3 13 *Radiological Protection* The normally TSR-controlled safety functions provided by the filtered exhaust ventilation systems in the Building 776/777 Complex are captured in the Radiological Protection SMP The DOE-RFFO expects these systems to be maintained for as long as is possible and directs that their operation be monitored Therefore, the following sentence should be added to the end of the Nuclear Safety Attributes paragraph "Negative pressure differentials and adequate functioning of the ventilation systems are periodically monitored (e g , during Stationary Operating Engineer [SOE] rounds) to ensure that the confinement and filtration safety functions are provided "
- In Section 3 14, *Testing, Surveillance, and Maintenance* The first paragraph of the section was modified based on DOE-RFFO direction during cross-table review meetings However, the modification was made to the wrong paragraph The change is applicable to the first paragraph under Nuclear Safety Attributes rather than the introductory paragraph for the SMP The introductory paragraph should be restored to read ' The purpose of the Testing, Surveillance, and Maintenance (TSM) Program is to ensure that Safety SSCs continue to perform their intended functions by conducting (a) periodic surveillances of equipment performance, (b) predictive and/or preventive maintenance on a predetermined schedule, and (c) corrective maintenance upon discovery of conditions that render SSCs inoperable The TSM Program applies to " rather than "The Site Testing, Surveillance, and Maintenance (TSM) SMP applies to Safety SSCs, SMP provided SSCs, and systems critical to closure activities The TSM Program applies to "

  The Nuclear Safety Attributes paragraph should read "The Site TSM SMP applies to Safety SSCs, SMP provided SSCs, and systems critical to closure activities Systems that are identified by the " rather than "The Site Testing, Surveillance, and Maintenance SMP is graded to apply to credited safety SSCs as well as systems critical to closure activities No safety SSCs have been identified or credited in this DSA as major contributors to defense in depth or worker safety for Building 776/777 Systems that are identified by the "

- In Section 3 16, *Waste Management* The normally TSR-controlled safety functions provided by the Material Management Administrative Control in the Building 776/777 Complex are captured in the Waste Management SMP The DOE-RFFO expects elements of these previously-TSR requirements to be explicitly stated as objectives of the SMP Therefore, the following sentences should be added prior to the last sentence of the Facility-Specific Differences paragraph "Nuclear material is stored and staged in areas with confinement and fire suppression when feasible The time that Transuranic (TRU) waste is staged in designated outdoor shipment staging areas is minimized "

Conclusion The major programs and important safety attributes of those programs needed to provide safety management are specified This criterion is adequately met

2) The major safety programs are noted, and references to facility or site program documentation are provided

This criterion is addressed in Chapter 3, *Safety Management Programs*, of the DSA

Assessment The DSA discussed each SMP at the Site level and determined if there were any specific attributes of the SMP required in the accident analysis The Building 776/777 DSA also identifies any facility-specific differences between the Site SMP and implementation in the facility The Building 776/777 DSA established the link between the Site programs, the SSAR that formally implements the Site programs, and the SMP program owner's responsibilities

Conclusion The major safety programs are noted and references to Site SMPs are provided This criterion is adequately met

6.0 REFERENCES

1 *Safety Basis Requirements*, 10 CFR 830, Subpart B, Office of the Federal Register, National Archives and Records Administration, Washington, D C

2 *Hazard Characterization and Accident Analysis Techniques for Compliance with DOE Order 5480 23, Nuclear Safety Analysis Reports*, DOE-STD-1027-92, U S Department of Energy, Washington, DC, December 1992

3 *Preparation Guide for U S Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports*, DOE-STD-3009-94, U S Department of Energy, Washington, D C , July 1994

4 *Implementation Guide for Use in Developing Documented Safety Analyses to Meet Subpart B of 10 CFR 830*, DOE G 421 1-2, U S Department of Energy, Washington, D C , October 2001

5 Memorandum, Mazurowski to Card, AME NRD MP 00-02784, "Authorization Basis Development," June 12, 2000, U S Department of Energy, Rocky Flats Field Office, Golden, CO

6 *Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports*, DOE–STD–1104–96, U S Department of Energy, Washington, D C , February 1996

7 *Site Preliminary Hazards Analysis to Support Hazard Category 2 and 3 Nuclear Facilities' Authorization Basis Development*, NSTR-007-01, Nuclear Safety Technical Report, Kaiser-Hill, L L C , Revision 0, May 2001

8 Memorandum, Roberson to Schmitt, "Delegation of Authority", August 26, 2002, U S Department of Energy, Washington, D C

9 Memorandum, Ferri to Schmitt, "Transmittal of Building 776/777 Documented Safety Analysis", March 3, 2003, Kaiser-Hill Company, Rocky Flats Environmental Technology Site, Golden, CO

10 Memorandum, Ferri to Schmitt, "Transmittal of Building 776/777 Documented Safety Analysis, Rev 1", June 2, 2003, Kaiser-Hill Company, Rocky Flats Environmental Technology Site, Golden, CO

11 *Rocky Flats Environmental Technology Site Safety Analysis Report*, Revision 0, June 23, 1998, Kaiser-Hill Company, Rocky Flats Environmental Technology Site, Golden, CO

12 *Building 776/777 Complex Preliminary Hazards Analysis*, NSTR-007-98, Nuclear Safety Technical Report, Safe Sites of Colorado, Revision 0, February 1998

13 *Safety Analysis and Risk Assessment Handbook* (SARAH), RFP-5098, Revision 3, Rocky Flats Environmental Technology Site, Golden, CO, December 2001

APPENDIX A
DIRECTED CHANGES TO THE BUILDING 776/777 DSA

The following list presents changes that must be made to the Building 776/777 DSA as a condition for the Department of Energy Rocky Flats Field Office (DOE-RFFO) approval of the document

1 The DOE-RFFO approves the attached red-lined page changes for incorporation into the Building 776/777 DSA and TSRs As long as the attached red-lined revisions are used verbatim (other than pagination or minor document production changes as necessary), no further DOE-RFFO approval is required The red-lined page changes that are attached to this SER do not need to be included in the controlled distribution for the Building 776/777 DSA as part of the SER attachment

APPENDIX B
ISSUES TO BE ADDRESSED UPON BUILDING 776/777 DSA IMPLEMENTATION

The following list presents issues that shall be resolved during implementation of the Building 776/777 DSA

1 Because the Hazard Categorization is based on conditions in the facility that do not yet exist, Kaiser-Hill shall submit a data package for DOE-RFFO approval prior to DSA implementation documenting that the facility is less than 1,500 grams Pu equivalent and that high holdup duct areas have been removed This may include areas defined by holdup scans HMT 1079-1085 in Room 127, HMT 715-720 in Room 430, as needed removals in Room 134E, and removal of 2nd floor 201/203 exhaust ductwork from Room 237 back to Plenum 204 These are targeted areas of duct removal Removal may be performed to the extent necessary to achieve 1,500 grams Portions of the duct work may be inaccessible at this time and alternate sections may be targeted as needed

APPENDIX C
COMMENTS TO BE INCORPORATED IN THE ANNUAL UPDATE

The items listed below are items that the contractor is to ensure are correct in new authorization basis document submittals and to correct during the next annual update for existing authorization basis documents

None

ATTACHMENT TO THE DOE-RFFO SAFETY EVALUATION REPORT FOR BUILDING 776/777 DSA

DOE-RFFO APPROVED "RED-LINED" PAGE CHANGES TO THE BUILDING 776/777 DOCUMENTED SAFETY ANALYSIS AND TECHNICAL SAFETY REQUIREMENTS

TABLE 2-1. USQ AND JCO EVALUATIONS OF SIGNIFICANCE TO BUILDING 776/777 (continued)

ID/NUMBER	TITLE	SUMMARY DESCRIPTION/STATUS
USQD-RFP-02 1238-ARS (Ref 2-12)	10-Gallon Drum Leakage	A discovered condition involving assumptions associated with the permeability of 10-gallon drum seals and the probability of an explosion inside the drum Requirements None identified in the USQD Compensatory Actions None Identified in the USQD Disposition This USQD is addressed under JCO-RFP-02 1255-VWH, and subsequent revisions, as discussed below
JCO-RFP-02 1255-VWH (Ref 2-13)	JCO to Allow Interim Storage of 10-Gallon Drums that have the Potential for Hydrogen Buildup	This JCO addresses the interim storage of 10-gallon drums that have the potential for hydrogen buildup until remediation activities (including movements necessary for venting or re-packing) are complete Requirements This JCO is relevant to multiple facilities including Building 776/777 The JCO required Building 776/777 to complete the Compensatory Actions described below prior to April 1, 2002 Compensatory Actions The following Compensatory Actions were invoked in the JCO 1 Work involving unvented suspect drums will be discontinued, with the exception of drum venting or re-packing activities and drum movements for the purpose of venting or re-packing 2 No spark-, heat-, or flame-producing work will be conducted within 35 feet of unvented suspect 10-gallon drums unless the hot work area and drums are separated by a firewall 3 Walkdowns will be performed to verify that required combustible controls are effectively implemented in affected areas outside of approved storage vaults once per day 4 A procedure governing the venting or re-packing of the suspect drums will be utilized to ensure that the activity is performed in accordance with the Integrated Safety Management (ISM) philosophy Disposition ~~A control pro[illegible] [illegible]-gallon drums has been added to Administrative Control 5 2 (AC 5 2)~~ The Waste Management Program ensures that waste containers meet the assumptions of the safety analysis with respect to container behavior in accidents
USQD-776-03 0787-SRH (Ref 2-14)	Discovered Condition Involving a Non-Compliance to the Criticality Incredible Prerequisites	This USQD addresses the failure of Building 776/777 to adequately implement Criticality Safety Evaluation (CSE) JSC-042 Revision 2 (Ref 2-17) One Standard Waste Box (SWB) and several drums were determined to be out of compliance with the CSE and were missed during the implementation of the evaluation Actions were taken to remove or repack the non-compliant containers Requirements The accident analysis relies upon CSE JSC-042, Revision 2 to support the AB assumption that an inadvertent criticality is incredible Compensatory Actions 1) placing the facility in a safe configuration, and 2) "hands on" validation of waste packages in the facility Disposition No further actions identified

The Fire Detection and Alarm System includes detection devices, annunciation devices, and associated panels and circuitry This system continuously monitors building areas to detect fires When a fire is detected, the system provides local and remote alarm signals via wireless radio

The detection devices consist of sprinkler water-pressure switches which provide remote signals to the Fire Dispatch Center Local audible alarms are provided ~~throughout~~ external to Building 776/777 near risers using riser water motor gongs with the exception of Riser 776-C (inoperative, not to be repaired) Voice annunciation through the Life Safety/Disaster Warning (LS/DW) system, radios, and various other means are ~~also~~ used to notify workers of facility conditions

Building 776/777 Fire Systems receive water from the Site Domestic Cold Water (DCW) System through interconnecting piping between the water mains and the building risers Site engineering controls, found in the Site SAR, ensure the availability of firewater

Portable fire extinguishers are located in readily accessible areas throughout Building 776/777 The type of fire extinguishers provided is determined by the class of fire most likely to occur in a particular area There are also numerous wet-standpipe hose stations located throughout Building 776, although no fire hoses are installed The Rocky Flats Fire Department procedures call for carrying hoses into the building or using engine pre-connected hose if an interior hose stream is needed

2.3.3.4 Electrical Systems

Site Power Distribution System

The Site Power Distribution System normally provides power to Building 776/777 electrical loads Two offsite 115-kV alternating current (ac) power lines supply the Site ac ring bus Site substations transform the 115-kV ac to 13 8-kV ac that the Building 776/777 substations step down to 480-V ac for distribution to the switchgear (2400 V ac system is out-of-commission) Power is automatically transferred to the other source should a fault occur in one of the offsite sources

Nuclear Safety Attributes

The 776/777 DSA accident analysis specifically identifies program attributes of the Fire Protection Program (combustible material controls) for accident prevention in the medium and large fire scenarios The fire suppression system, as controlled through this SMP, is credited as defense-in-depth for all fire scenarios Combustible material controls are implemented in the facility to minimize the amount of combustibles, segregate radiological material from combustible material, and control ignition sources The fire suppression systems will be retained in the facility until such time as the hazard no longer warrants them as documented in a formal evaluation (tracking requirements for removal of systems ~~is~~ are discussed in the Configuration Management SMP) Robust controls and frequent work inspections are relied upon to maintain fire hazards at minimal levels

Facility-Specific Differences

In support of the Sitewide Fire Protection Program, a facility program will be implemented in Building 776/777 to manage factors affecting fire safety in areas where work is being performed The facility program will address the following facility-specific attributes important to Nuclear Safety

- Management of factors affecting fire safety, with the goal of preventing fire ignition and minimizing the impact if a fire does start
- Management of combustible materials, not necessary for ongoing activities, to prevent unnecessary accumulation in work areas
- Management of temporary equipment (e g , portable heaters, portable lighting, extension cords) to ensure applicable safety requirements (e g , manufacturer's instructions, Underwriters Laboratory [UL] labels, NFPA guidelines) are being met
- Management of combustible materials in work areas, to ensure they are cleaned up at the end of the workday
- Management of minor deviations, with respect to combustible material and ignition source controls, as they are created or identified
- Management of elimination of fire suppression systems The Fire Protection Program Manual (ref 3-5) identifies the requirements for the removal of portions of and entire fire suppression systems for Building 776/777

Nuclear Safety Attributes

The 776/777 DSA accident analysis assumes that workers in Building 776/777 are trained to perform their jobs in accordance with all applicable requirements The program is recognized to provide protection from SIHs, however, no worker protection controls were identified which warrant elevation to TSR level

Facility-Specific Differences

There are no facility-specific differences with the Training SMP described in the Site SAR

Exemptions

None

3.16 WASTE MANAGEMENT

The Waste Management Program establishes the Site processes to generate, characterize, package, and control hazardous, radioactive and mixed waste The program identifies the requirements to be followed that will ensure non-radioactive hazardous, radioactive, and mixed waste from the Site meets disposal sites' waste acceptance criteria (WAC) and that while wastes are onsite they are managed in compliance with applicable regulations

The Waste Management SMP is established and implemented in Building 776/777 consistent with the discussion provided in the Site SAR with facility-specific attributes or differences, as described below

Nuclear Safety Attributes

The 776/777 DSA accident analysis assumes that work in Building 776/777 is performed in accordance with the Waste Management Program Waste containers are credited design features that prevent and mitigate most of the accident scenarios involving waste The program is recognized to provide protection from SIHs, however, no worker protection controls were identified which warrant elevation to TSR level

Facility-Specific Differences

In support of the Waste Management SMP described in the Site SAR, a facility program will be implemented in Building 776/777 to manage factors affecting waste management in areas where work is being performed The configuration, location, and quantities of nuclear material in areas of confinement and fire suppression, inside the facility but outside confinement or fire suppression, and in a designated shipment staging area located outside the facility (as the programs deem necessary), are managed accordingly Nuclear material is stored and staged in areas with confinement and fire suppression when feasible The time that Transuranic (TRU) waste is staged in designated outdoor shipment staging areas is minimized Also, oils handled in the facility will be stored with secondary containment (minimum 2-inch height containment)

Exemptions

None

3.17 REFERENCES

3-1 *Rocky Flats Environmental Technology Site Safety Analysis Report* (Site SAR), Rocky Flats Environmental Technology Site, Golden, CO, Revision 3

3-2 RFPE-DOE-5480 7-EX-001, *Fire Dampers Within HVAC Ductwork*, DOE-RFFO approved 05/31/1991

3-3 10 CFR 830, *Nuclear Safety Management, Final Rule* January 10, 2001

3-4 *Building 776/777 Closure Project Decommissioning Operations Plan*, Revision 0, November 3, 1999

3-5 MAN-19-FPPM, *Fire Protection Program Manual*, Rocky Flats Environmental Technology Site, Golden, CO, Revision 0

Table 5-4. BUILDING 776/777 COMPLEX HAZARD DESCRIPTION (continued)

Hazard /Energy Source	Description	Evaluation	Preventive/Mitigative Equipment and Programs
11 High Temperature and Pressure (continued)			
K Elevators	Pressurized hydraulic system and lines Standard industrial hazard	Worker concerns • ~~Chemical Exposure~~ • Missile impact Offsite concerns • None Potential Scenarios • Spill ♦	SSCs • None Programs • Conduct of Operations (e g , approved procedure, LO/TO), • Training,
L Temporary Heaters	Used to provide temporary heat for personal comfort and freeze protection Standard industrial hazard	Worker concerns • Burns Offsite concerns • None Potential Scenarios • Fire ♦	SSCs • UL Listed Equipment Programs • Fire Protection (e g , combustible control)
12 Kinetic Energy			
A Rotating Equipment Scenarios that require further analysis are annotated with a "♦"	Various types of fans, pumps air movers, compressors, electric motors Standard industrial hazard	Worker concerns • Hit/impact Offsite concerns • None Potential Scenarios • None	SSCs • None Programs • Conduct of Operations (e g , LO/TO), • OS&IH (e g , PPE)
B Moving Vehicles	Forklifts loaders, cranes, trucks, excavators, backhoes, trucks Standard industrial hazard	Worker concerns • Hit/impact Offsite concerns • None Potential Scenarios • Spill ♦	SSCs • None Programs • Conduct of Operations (e g , approved procedure), • Training (e g , qualified worker), • OS&IH (e g , PPE, area control, escorts)

Table 5-4. BUILDING 776/777 COMPLEX HAZARD DESCRIPTION (continued)

Hazard /Energy Source	Description	Evaluation	Preventive/Mitigative Equipment and Programs
13 Potential Energy (continued)			
D Rollup Doors	Heavy doors held by springs or chains Standard Industrial hazard	Worker concerns • Falling objects, • Hit/impact Offsite concerns • None Potential Scenarios • Spill •	SSCs • None Programs • Conduct of Operations (e g , approved procedure), Training (e g , qualified operator)
E Torqued Bolts	Equipment held together by bolts under high torque	Worker concerns • ~~Falling objects~~ • ~~Missile impact~~ • Hit/impact Offsite concerns • None Potential Scenarios • Spill ♦	SSCs • None Programs • Conduct of Operations (e g , approved procedure), Training (e g , qualified operator)
14 Non-Ionizing Radiation Sources			
A Plasma Arc	Plasma arc cutters are used to cut up tanks, gloveboxes, plenums, etc	Worker concerns • Sight impairment Offsite concerns • None Potential Scenarios • None	SSCs • None Programs • Conduct of Operations (e g , approved procedure), • Training (e g , qualified worker), • OS&IH (e g , PPE)
15. High Intensity Magnetic Fields			
None	None	N/A	N/A

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6.2.1.3 Large Fire, Engulfing Pool

Scenario Description

This scenario considers a large engulfing pool fire (5 MW to 10 MW) involving packages of nuclear material such as 55-gallon drums of TRU waste or LLW, TRUPACT-II SWBs, or IP-2 boxes of LLW The large engulfing pool fire could result from breaching a 55-gallon "bung" drum containing combustible liquids with a resulting pool forming in and around two waste drums coincident with any of the previously identified fires inside Building 776/777 This scenario may occur in any location (i e , outside the building, on a dock, or inside the building)

The dominant cause or initiator for this scenario is size reduction activities or other ignition sources such as transportation equipment (e g , forklift fuel/oil fire), maintenance, or closure activities However, other possible initiators include external fires, exothermic chemical reactions from incompatible container contents, improper hot work, equipment malfunction (e g , electrical short, overheat) or improperly operated or degraded electrical equipment, power supplies, and electrical power cords

Activities

A large room fire could be initiated by any of the following primary activities

1) Radioactive Waste Generation and Handling,

2) Decommissioning-Decontaminate, Dismantle, and Demolish

Hazardous Material Handling is a secondary activity that could also be an initiator

Assumptions

In addition to the generic assumptions listed at the beginning of Section 6 2, the following additional assumptions were also applied to this accident scenario

- Using RADIDOSE, the scenario was modeled as a large, non-lofted fire involving confined materials
- Per SARAH, a large fire is a 10-MW fire large enough to breach some structures, and actuate the suppression system
- ~~Per SARAH the~~ This large fire burns for ~~30~~ 60 minutes

- The MAR is assumed to be two TRU drums (one overpacked to 250 grams, 450 grams total) plus [illegible]-gallons of contaminated oil at 0 001 grams per liter
- One of the TRU drums will lose its lid and eject 33% of the contents with an ARF of 0 01 The 67% remaining material is evaluated as confined material at an ARF of 5E-4
- The second drum is evaluated as confined material with a DR of 1 0 representing seal failure with a high DR due to the drum being engulfed
- The oil will be treated as volatile liquid with a DR of 1 0 The oil drum has secondary containment, which allows detection of leaking drums

Accident Frequency

Large engulfing pool fires are *UNLIKELY* without prevention because of the use of new drums (low likelihood of failing), the configuration of two adjacent drums is not expected in this facility, limited quantities of oil expected, facility oils are expected to be difficult to ignite rather than being flammable, the facility expects to ship drums as soon as they are filled, and the fire precursor is a drum failure along with the ignition source

Accident Consequences and Risk

Without crediting mitigative controls, the consequence to the Public is *LOW* and the Worker is *MODERATE* These consequences, when combined with an *UNLIKELY* frequency, result in a *RISK CLASS III* scenario to the Public and *RISK CLASS II* scenario to the Worker

Broadness

This scenario, including selected controls, encompasses other engulfing pool fires of several analyzed configurations involving drums and crates

Immediate Worker

The unmitigated dose consequences are qualitatively assessed as *MODERATE* because the facility is not expecting large quantities of oil, and the model is conservative in MAR availability for the accident When evaluated at an *UNLIKELY* frequency, the event represents a *RISK CLASS II* scenario The same controls credited for the Worker also reduce risk to the immediate worker The potential for serious injury or significant radiological exposure can be further reduced by evacuating the immediate area of the fire Various aspects of the SMPs such as training and fire protection ensure that workers in the immediate vicinity of the fire evacuate and that other workers in the facility are notified via fire alarms or voice notification As these are all governed by SMPs, no additional controls to protect the immediate workers require elevation to the TSR level With the immediate worker protection afforded by the SMPs, the mitigated consequences are qualitatively assessed as *LOW* When assessed at an *EXTREMELY UNLIKELY* frequency, the event represents a *RISK CLASS*

6.2.2 Spills

The hazard analysis process identified numerous scenarios involving spills of radioactive materials This subsection presents analyses of one scenario within the Building 776/777 Complex

6.2.2.1 Large Spill, Package

Scenario Description

This scenario considers a large spill involving packages of nuclear material such as 55-gallon drums of TRU waste or LLW, TRUPACT-II SWBs, or IP-2 boxes of LLW This spill could be caused by dropping four packages (e g , from a pallet) or otherwise damaging four packages and resulting in a damage ratio of 0 1 (10%) Other potential initiators include (1) kinetic energy sources such as operational, maintenance, or closure activity equipment (e g , drills, grinders, saws, nibblers), handling equipment (e g , fork trucks, lift-tables, dollies), and internally generated missiles (e g , a bullet from a weapon, a damaged compressed gas cylinder, or shrapnel

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evaluated at an *UNLIKELY* frequency, the event represents a *RISK CLASS III* The potential for serious injury or significant radiological exposure can be reduced by evacuating the immediate area of the event Various aspects of the SMPs such as training to evacuate the immediate vicinity of the event and emergency response protect the immediate worker With the immediate worker protection afforded by the SMPs, the mitigated consequences are qualitatively assessed as *LOW* When evaluated at an *EXTREMELY UNLIKELY* frequency, the event represents a *RISK CLASS IV* Since the programs governed by the SMPs provide adequate protection for the immediate worker, no additional controls to specifically protect the immediate workers require elevation to the TSR level

6.2.3.2 Explosion

Scenario Description

Hot work will be conducted for closure activities in Building 776/777 In order to perform such tasks, flammable/explosive gas (e g , acetylene) cylinders will be required If the contents of these cylinders are accidentally released, there is a potential for a flammable vapor cloud, or vapor-jet explosion An explosion would initiate a pressure pulse in the room and could potentially breach containers or equipment containing holdup In addition, depending on the location of the explosion, there may be sufficient force to impact the ventilation system ducting/plenum There are a variety of locations where this scenario could occur

The dominant cause or initiator for this scenario is a leak (e g , cylinder/tank regulator nozzle/valve failure) of a flammable explosive gas cylinder that generates a vapor cloud that is ignited to create an explosion

Activities

An explosion could be initiated by any of the following primary activities

1) Radiological Waste Generation and Handling,

2) Decommissioning-Decontaminate, Dismantle and Demolish

Secondary activities involving Hazardous Material Handling could also be initiators

Assumptions

In addition to the generic assumptions listed at the beginning of Section 6 2, the following additional assumptions were also applied to this accident scenario

6.2.4 NATURAL PHENOMENA AND EXTERNAL EVENTS

In addition to the analysis of operational hazards and accidents, an analysis of accidents resulting from Natural Phenomena Hazards (NPHs) and EEs was also conducted for this DSA The evaluation-basis events analyzed relate to the facility's designed capability and the analysis is based on definable and defensible MARs

6.2.4.1 CRANE DROP – EXTERNAL EVENT

Scenario Description

This scenario considers a crane loading operation that drops a cargo container on TRU/TRM drums in an outdoor staging area awaiting shipment The cargo container is not breached but a portion of the staged TRU/TRM containers is spilled

Activities

A crane drop could be initiated by any of the following primary activities

1) Radiological Waste Generation and Handling,

2) Decommissioning-Decontaminate, Dismantle and Demolish

Secondary activities involving Hazardous Material Handling could also be initiators

Assumptions

In addition to the generic assumptions listed at the beginning of Section 6 2, the following additional assumptions were also applied to this accident scenario

- Using RADIDOSE, the scenario was modeled as a spill of unconfined non-combustible materials
- MAR is assumed to be 30 waste drums containing 900 grams aged WG Pu TRU/TRM waste
- Release duration is 10 minutes, based on SARAH
- The DR is assumed to be 1.0% ~~based on the 707 DBIO model for this type of accident~~.

Accident Frequency

Crane drops in Building 776/777 are judged to be *UNLIKELY* without prevention, based on SARAH

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Accident Consequences and Risk

Without crediting mitigative controls, the consequence to the Public is *LOW* and to the Worker is *LOW* These consequences, when combined with an *UNLIKELY* frequency, result in a *RISK CLASS III* scenario to the Public and the Worker

TABLE 6-15. CRANE DROP

HAZARD/MAR	Crane drop causing a release of radioactive materials MAR = 30 drums of TRU/LLRM waste [illegible] grams							
ACCIDENT TYPE	Spill of Radioactive Materials							
DOMINANT INITIATOR	Release of radioactive material during crane transfer activities							
VULNERABLE DSA ACTIVITIES	**Primary** Radioactive Waste Generation and Handling and Decommissioning-Decontaminate, Dismantle, and Demolish **Secondary** Hazardous Material Handling							
RECEPTOR	**SCENARIO FREQUENCY**		**CONSEQUENCES**		**RISK CLASS**		**CONTROLS**	
	Without Prevention	**With Prevention**	**Without Mitigation**	**With Mitigation**	**Without Prevention or Mitigation**	**With Prevention & Mitigation**	**Credited Controls**	**Defense-In-Depth Controls**
PUBLIC	Unlikely	N/A	Low 3.0E-[illegible] rem	N/A	III	N/A	NOT WARRANTED	NOT WARRANTED
WORKER	Unlikely	N/A	Low 3 [illegible] rem	N/A	III	N/A	NOT WARRANTED	NOT WARRANTED

Control Set

No other specific controls or restrictions are credited for this scenario beyond what are assumed in the analysis or the Site SMPs provide

Defense-In-Depth

While there are no defense-in-depth controls, other controls are provided and available through the Safety Management Programs, but are not credited for frequency, nor consequence, reduction

Broadness

This scenario, and its credited control, represents the bounding external event (unlikely frequency) analyzed The following events are bounded by this scenario

TABLE 6-16. ACCIDENTS BOUNDED BY SCENARIO 6.2.4.1

HAZARD/MAR	EXTERNAL EVENT 1 (EE-1) Station Blackout MAR – [illegible] duct and plenum holdup							
ACCIDENT TYPE	External Event/Natural Phenomena							
DOMINANT INITIATOR	Various							
VULNERABLE DSA ACTIVITIES	**Primary** Radioactive Waste Generation and Handling and Decommissioning-Decontaminate, Dismantle and Demolish **Secondary** Hazardous Material Handling							
RECEPTOR	**SCENARIO FREQUENCY**		**CONSEQUENCES**		**RISK CLASS**		**CONTROLS**	
	Without Prevention	With Prevention	Without Mitigation	With Mitigation	Without Prevention or Mitigation	With Prevention & Mitigation	Specific Credited Controls	Defense-In-Depth Controls
PUBLIC								
EE-1	Unlikely	N/A	Low 2 8L-4 rem	N/A	III	N/A	NOT WARRANTED	NOT WARRANTED
WORKER								
EE-1	Unlikely	N/A	Low 1 3L-2 rem	N/A	III	N/A	NOT WARRANTED	NOT WARRANTED

Immediate Worker

The unmitigated dose consequences are qualitatively assessed as *LOW* When evaluated at an *UNLIKELY* frequency, the event represents a *RISK CLASS III* scenario No additional controls to specifically protect the immediate workers require elevation to the TSR level for this event

6.2.4.2 AIRCRAFT CRASH – EXTERNAL EVENT

Scenario Description

This scenario considers a building breach, major structural damage, and possible major fire resulting from the crash of an aircraft into Building 776/777 The consequences of an airplane crashing into the building depend on the size of the aircraft, the speed of the aircraft, the location and direction of the impact, the amount of fuel onboard, and other factors The aircraft could fail to penetrate the building, could penetrate in a localized area, could penetrate and cause a partial or total collapse of the building In addition, there could be an ensuing fire caused by ignition of the aircraft fuel Rather than analyze this scenario in detail, it is reasonable to assume that the consequences are the same as those calculated for the earthquake plus large engulfing pool fire

Activities

An aircraft crash could occur during the conduct of and affect the evolution of any activity in the facility at the time of the event

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Assumptions

The assumptions used in this analysis are detailed in the generic assumptions listed at the beginning of Section 6 2 and/or in this text The Earthquake-induces a total building collapse

Accident Frequency

The Earthquake scenario was postulated to result from a 0 1-g seismic event that impacts Building 776/777 Based on the estimated return periods for these events, a 0 1-g seismic event is *UNLIKELY*

Accident Consequences and Risk

Without crediting mitigative controls, the consequence to the Public and the Worker is *LOW* These consequences, when combined with an *UNLIKELY* frequency, result in a *RISK CLASS III* scenario to the Public and to the Worker

The frequency, consequences, Risk Class and controls for an ~~aircraft crash~~earthquake are presented in Table 6--- below

TABLE 6-18. EARTHQUAKE

HAZARD/MAR	A seismic collapse of the building MAR = 1 500 grams (750 holdup 750 drums SWBs)							
ACCIDENT TYPE	Natural Phenomena							
DOMINANT INITIATOR	Earthquake							
VULNERABLE DSA ACTIVITIES	Not activity specific							
RECEPTOR	SCENARIO FREQUENCY		CONSEQUENCES		RISK CLASS		CONTROLS	
	Without Prevention	With Prevention	Without Mitigation	With Mitigation	Without Prevention or Mitigation	With Prevention & Mitigation	Credited Controls	Defense-In-Depth Controls
PUBLIC	Unlikely	N/A	Low 1 'F 2 rem	N/A	III	N/A	NOT WARRANTED	NOT WARRANTED
WORKER	Unlikely	N/A	Low 1.2 rem	N/A	III	N/A	NOT WARRANTED	NOT WARRANTED

Control Set

The analysis shows that an earthquake is a *RISK CLASS III* scenario to the Public and to Workers without prevention or mitigation No other specific controls or restrictions are credited for this scenario beyond what the Site SMPs provide

Defense-In-Depth

While there are no defense-in-depth controls, other controls are provided and available through the Safety Management Programs, but are not credited for frequency, nor consequence, reduction

Broadness

This scenario, and its credited control, represents the bounding external event (unlikely frequency) analyzed The following events are bounded by this scenario

TABLE 6-19. ACCIDENTS BOUNDED BY SCENARIO 6.2.4.3

HAZARD/MAR	NATURAL PHENOMENA 2 (NP-2) High Winds/Tornado/Wind Generated Missiles MAR = one TRU waste drum (250 grams) NATURAL PHENOMENA 3 (NP-3) Heavy Snow MAR = 4 TRU waste drums (850 gr[illegible])							
ACCIDENT TYPE	External Event/Natural Phenomena							
DOMINANT INITIATOR	Various							
VULNERABLE DSA ACTIVITIES	**Primary** Radioactive Waste Generation and Handling and Decommissioning-Decontaminate, Dismantle, and Demolish **Secondary** Hazardous Material Handling							
RECEPTOR	SCENARIO FREQUENCY		CONSEQUENCES		RISK CLASS		CONTROLS	
	Without Prevention	With Prevention	Without Mitigation	With Mitigation	Without Prevention or Mitigation	With Prevention & Mitigation	Specific Credited Controls	Defense-In Depth Controls
PUBLIC								
NP-2	Unlikely	N/A	Low [illegible] rem	N/A	III	N/A	NOT WARRANTED	NOT WARRANTED
NP 3	Unlikely	N A	Low 2 8E-3 rem	N A	III	N A	NOT WARRANTED	NOT WARRANTED
WORKER								
NP 2	Unlikely	N A	Low [illegible] rem	N/A	III	N A	NOT WARRANTED	NOT WARRANTED
NP-3	Unlikely	N/A	Low 2 9E-1 rem	N/A	III	N/A	NOT WARRANTED	NOT WARRANTED

Immediate Worker

The unmitigated dose consequences are qualitatively assessed as *HIGH* since the unmitigated event has the potential to cause a significant radiological exposure or prompt death When evaluated at the *UNLIKELY* frequency, the event represents a *RISK CLASS I* The potential for serious injury or significant radiological exposure can be reduced by evacuating the immediate area of the event Various aspects of the SMPs such as training to evacuate the immediate area of the event and emergency response protect the immediate worker With the immediate worker protection afforded by the SMPs, the mitigated consequences are qualitatively assessed as *MODERATE* since even the mitigated event results in a spill with a moderate to large release When evaluated at an *UNLIKELY* frequency, the event represents a *RISK CLASS II* This dominant scenario is further discussed in section 6 3

6.2.5 SUMMARY OF ACCIDENT ANALYSIS

A summary of the frequencies, consequences, and risk classes for the preceding bounding accident scenarios are presented in Table 6-18 below

TABLE 6-20. SUMMARY OF ACCIDENT ANALYSIS

SCENARIO CASE	SCENARIO FREQUENCY		PUBLIC CONSEQUENCES		PUBLIC RISK CLASS		WORKER CONSEQUENCES		WORKER RISK CLASS	
	Without Prevention	With Prevention	Without Mitigation	With Mitigation	Without Prevention or Mitigation	With Prevention & Mitigation	Without Mitigation	With Mitigation	Without Prevention or Mitigation	With Prevention & Mitigation
Small Fire, Package										
	Anticipated	N/A	Low 3.0E-2 rem	N/A	III	N/A	Low 3.1 rem	N/A	III	N/A
Medium Fire, Adjacent Pool										
	Anticipated	Unlikely	Low 8.2E-2 rem	N/A	III	N/A	Moderate 8.6 rem	Moderate 8.6 rem	I	II
Large Fire, Engulfing Pool										
	Unlikely	Extremely Unlikely	Low 2.4E-1 rem	N/A	III	N/A	Moderate 24.8 rem	N/A	II	III
Large Spill, Package										
	Anticipated	N/A	Low 2.8E-2 rem	N/A	III	N/A	Low 2.9 rem	N/A	III	N/A
Overpressurization/Deflagration, Hydrogen										
	Unlikely	Extremely Unlikely	Low 1.2E-1 rem	N/A	III	N/A	Moderate 12 rem	N/A	II	III
Explosion										
	Unlikely	N/A	Low 5.6E-3 rem	N/A	III	N/A	Low 5.9E-1 rem	N/A	III	N/A
Aircraft Crash										
	Extremely Unlikely	N/A	Low 2.5E-1 rem	N/A	IV	N/A	High 26 rem	N/A	II	N/A II
Crane Drop										
	Unlikely	N/A	Low 3.0E- rem	N/A	III	N/A	Low 3.[illegible]-1 rem	N/A	III	N/A
Earthquake										
	Unlikely	N/A	Low 1.2E-2 rem	N/A	III	N/A	Low 1.2 rem	N/A	III	N/A

6.3 HIGH-RISK SCENARIOS

The scenarios identified in the accident analyses include Fires, Spills, Explosions, External Events, and Natural Phenomena This section discusses those scenarios where the risk could not be reduced to a *RISK CLASS III* or *IV*

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Medium Adjacent Pool Fire

This scenario considers a medium fire (1 MW to 5 MW) involving packages of nuclear material such as 55-gallon drums of TRU waste or LLW, TRUPACT-II SWBs, or IP-2 boxes of LLW. It is conservatively modeled to involve 900 grams of TRU/TRM waste.

By minimizing combustible loading, the Combustible Control Program reduces the probability that a small fire propagates into a larger one. This control does not reduce dose to the Worker and the scenario is risk dominant at *RISK CLASS II*. There are no additional controls that are available that would be cost effective in reducing the risk.

Aircraft Crash

This scenario considers a building breach, major structural damage, and possible major fire resulting from the crash of an aircraft into Building 776/777. The consequences of an airplane crashing into the building depend on the size of the aircraft, the speed of the aircraft, the location and direction of the impact, the amount of fuel onboard, and other factors. The aircraft could fail to penetrate the building, could penetrate in a localized area, could penetrate and cause a partial collapse of the building, or could penetrate and cause a total collapse of the building. In addition, there could be an ensuing fire caused by ignition of the aircraft fuel. There are no controls to reduce dose to the Worker and the scenario is risk dominant at *RISK CLASS II*.

The potential for serious injury or significant radiological exposure can be reduced by evacuating the immediate area of the event. Various aspects of the SMPs such as training to evacuate the immediate area of the event and emergency response protect the immediate worker. With the immediate worker protection afforded by the SMPs, the mitigated consequences are qualitatively assessed as *MODERATE* since even the mitigated event results in a spill with a moderate to large release. When evaluated at an *UNLIKELY* frequency, the event represents a *RISK CLASS*. There are no additional controls that are available that would be cost effective in reducing the risk.

Earthquake

This scenario is postulated to occur because of a seismic-induced failure of Building 776/777. The earthquake is assumed to impact all support systems (e.g., electrical power, ventilation, fire suppression) and cause damage to internal components (e.g., piping, ducting, drums, containers). Therefore, active mitigative controls are considered unavailable.