20 May 2010

To: J.N. McKamy, Manager, US DOE NCSP

From: C.M. Hopper, Chair, US DOE NCSP CSSG CMH

In response to Tasking 2011-04, a subgroup of the Criticality Safety Support Group (CSSG) was organized to draft a CSSG Response to DNFSB Staff Member on CSSG Position in Regards to Seismic Design.

The drafting team consisted of the following CSSG members:
James A. Morman (ANL, CSSG member and writing team lead)
Thomas P. McLaughlin (LANL ret., CSSG member)
David Erickson (SRNS, CSSG member)
Michael Salmon (LANL, *ad hoc* CSSG member)

The draft response was reviewed by the members of the CSSG. Comments from that review were considered for the enclosed final version of the response that is attached to this memo. This version represents a consensus position by the entire CSSG.

Cc: CSSG Members
A.N. Ellis
J.R. Felty
L. Scott
G.O. Udenta

Response to CSSG Tasking 2011-04

CSSG Review of the UPF Position on Criticality Safety in Regards to Seismic Design

The Criticality Safety Support Group (CSSG) was directed in Tasking 2011-04 to provide a review of the Y-12 Uranium Processing Facility (UPF) project in regards to the seven topic areas listed below, with particular attention to the interaction of seismic design with criticality safety, including cost-benefit considerations. The entire statement of Tasking 2011-04 is included as Attachment 1.

Review areas:

Priority Group 1

1. Safety Design Strategy (SDS) seismic event tree
2. Design process and representative Criticality Safety Process Studies (CSPSs)
3. Fire initiated criticality accident

Priority Group 2

4. Implementation of DOE-STD-3007 for elevation of controls to the Technical Safety Requirement (TSR) process
5. Design basis criticality accident consequence information

Priority Group 3

6. Need/adequacy of the drain/dike system
7. UPF Non-Destructive Assay (NDA) program and filter barriers (i.e., pre-filters, etc.)

Three permanent CSSG members and one *ad hoc* member were assigned to conduct the review and prepare this response for subsequent review and concurrence by the entire CSSG. The review team members were:

David Erickson (SRNS, CSSG member)
Thomas McLaughlin (LANL ret., CSSG member)
James Morman (ANL, CSSG member)
Michael Salmon (LANL, *ad hoc* CSSG member)

Introduction and Approach to the Review

The CSSG team initiated its review by reading numerous UPF documents including the Safety Design Strategy (SDS), Nuclear Criticality Safety (NCS) design considerations, representative Criticality Safety Process Studies (CSPSs), a draft of the Criticality Control Review (CCR), and the Preliminary Assessment of the Criticality Accident Alarm System (CAAS) and Immediate Evacuation Zone (IEZ) plus other documents dealing with seismic design and criticality safety controls. A complete list of the documents that were reviewed is included in Attachment 2. The document study was followed by on-site discussions and interviews with members of the Y-12 DOE Site Office (DOE-YSO) and the Y-12 facility and criticality safety staff on May 4-6, 2011. The list of persons interviewed is also included in Attachment 2.

The UPF project is following the general guidance presented in DOE-STD-3009, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses,* as part of the overall process to develop the Safety Basis (SB) documents. The UPF has completed many of the preliminary hazards analyses required in support of CD-1, but is not yet in final design. The project is currently progressing in the CD-2/3 phase of the design process. The evaluations presented in the CSPSs and other documents reflect the current best understanding of the processes and NCS controls and this review was performed with an understanding of this design and development status.

The project is designing fissile material bearing equipment and facilities to be seismically resistant to the DBE.

Based on the limited time frame of this tasking, the general approach taken for this review was to assess whether applicable requirements and standards were addressed in the topic areas and whether criticality safety was adequately addressed in each of the topic areas. The review was not meant to be an in-depth audit of the extent to which the project has successfully integrated safety into design following DOE-STD-1189. Rather, this review provides a snapshot as to whether the project is meeting the intent of DOE-STD-1189 with respect to criticality safety, and the adequacy of the programs and documentation to address the specific topics listed above. Many, if not all, of the reviewed documents may be revised as the design matures. Therefore, the opportunity was taken to suggest some areas where additional focus may be appropriate.

The following sections of this report provide the results of the team review of each of the indicated tasking areas.

1. <u>SDS Seismic Event Tree</u>

   Document RP-ET-801768-A0003 Rev.0, *Event Tree Assessment of UPF Design Basis Seismic Event*, January 2010, approved 3/23/2011 (the Assessment), provides an integrated examination of the UPF response to a seismic event. One of the objectives of the Assessment was to identify additional seismic-initiated functional requirements of safety systems, structures, or components (SSCs) for the UPF that were not identified elsewhere. The results of the Assessment are being used to support the ongoing UPF safety basis documentation and design.

   The Assessment uses a success-path approach to identify functional requirements of SSCs needed to arrive at the desired safe-shutdown state following a design basis earthquake (DBE). Although not succinctly stated, the implied top-level safety event is "to safely and orderly evacuate the facility so that seismic-initiated criticality accidents, fires or explosions will not endanger workers." The success path approach, to prevent fires, explosions and criticality accidents, uses event trees and fault trees to flesh out the functional requirements of safety-affecting SSCs needed to enable a safe, prompt evacuation.

   The Assessment (authored by members of the UPF Project Team as part of the UPF safety basis documentation and design basis) is a good tool and the Project Team should be commended for developing it. The use of the tool to draw out additional functional requirements (of SSCs) needed to provide for the prompt, safe evacuation of the facility, and to prevent fires, explosions and criticality accidents, is deemed as going beyond the minimum requirements for seismic safety as promulgated by DOE O 420.1B, DOE-STD-1189, ANS 2.26, ASCE-43 and other natural phenomena hazards (NPH) orders and standards. It is judged by the CSSG that the use of the event tree tool is a noteworthy process improvement in implementing the requirements of DOE-STD-1189.

   Considering the current design stage of the UPF, the Assessment is judged to be adequate in describing the SSCs that are needed to ensure the prompt, safe evacuation of UPF personnel following detection of the DBE. Although the use of the event tree tool to improve the safety of the facility is commendable, its effectiveness will only be realized if recommendations made in it are carried out. Several key actions need to be completed by the project in order to ensure that the success path presented in the Assessment is achieved following the design basis earthquake. These include:

   - Verification and validation of the event trees and fault trees in the Assessment. One method that may be used to verify and validate the event and fault trees in the Assessment is through the use of peer review and/or independent evaluation.
   - Further development and implementation of the design requirements identified in the fault trees by the engineers responsible for those design features (e.g., event branch E2.1N "*one or more process isolation/shutdown components is less than adequate."*)
   - Carrying out additional recommendations presented in Section 6 of the Assessment.

2. <u>Design Process and Representative CSPSs</u>

The Safety Design Strategy (SDS) document, RP-FS-801768-A003, Rev. 3, November 2010, presents a good summary of the project's efforts to integrate safety into design as required by DOE O 420.1B and DOE-STD-1189. The SDS employs best-of-use practices in following the guidance in DOE G 420.1-1 to include minimization of hazardous material, use of engineered controls over administrative controls, selection of passive controls over active controls and preference for preventive controls over mitigative controls. It is judged that the requirements which are needed and the level of analyses, both safety and engineering, that should be completed at this phase of design (after CD-1, before CD-2/3) are appropriate and adequate.

Along with the SDS document, several UPF Criticality Safety Process Studies (CSPSs) were also reviewed (CSPS-EN-801768-BMO-A001, Rev. 1; CSPS-EN-801768-DR-A001, Rev. 0; CSPS-EN-801768-LCH-A001, Rev. 1; CSPS-EN-801768-OXD-A001, Rev. 1; and CSPS-EN-801768-POG-A001, Rev. 1) and, when questions arose, discussed with Y-12 staff. The SDS document is judged to be comprehensive and to appropriately discuss nuclear criticality safety requirements and goals. In particular, the requirement for accident prevention as stated in American National Standard, ANSI/ANS-8.1, section 4.1.2, Process Analysis is emphasized therein:

> *Before a new operation with fissionable material is begun, or before an existing operation is changed, it shall be determined that the entire process will remain subcritical under both normal and credible abnormal conditions.*

Other important design guidance from ANS-8.1 is also incorporated in the SDS, namely, the importance of geometry control and its preference rather than administrative controls. While the above ANS-8.1 requirement is meant to be inclusive of all potential accident initiators, fires and seismic events are specifically called out in the SDS. A review of each of the CSPSs listed above showed that these two potential criticality accident initiators were, indeed, discussed and analyzed in each of them.

It was inquired of the Y-12 criticality safety staff whether or not the transition from DOE Order 420.1B to 420.1C would impact the design from a criticality safety standpoint and the response was that it would not. The CSSG agrees with this assessment. A discussion then ensued as to the facility hazard classification guidance in the SDS. It was noted that the National Nuclear Security Administration (NNSA) has recently asked for and received guidance from the CSSG, published in *NNSA Technical Bulletin 2010-3&4*, dated December 2010, that might suggest a UPF facility classification based on criticality hazards different than currently in the SDS.

A specific over-arching aspect of this review was to assess the reasonableness and cost-effectiveness of the criticality safety strategy as implemented in the process designs to date. Based on the CSPSs that were reviewed during this effort, it is judged that there is significant, but not undue, conservatism in all of the routine criticality safety related specifications such as vessel dimensions and volumes, fissile masses of individual items and cans, etc.

It is noted that the development and updating of the CSPSs is a positive contribution to the implementation of the intent of DOE-STD-1189. There is no requirement or guidance for CSPSs, which are essentially preliminary Criticality Safety Evaluations. Y-12 is to be commended for generating these documents without which this review would also have been significantly impaired.

Regarding criticality accident prevention during a seismic event, the current design strategy is to prevent a criticality accident up to the seismic severity of the DBE. This is currently being accomplished via the specification of seismically qualified vessels, piping and brackets. The cost-benefit considerations leading to this strategy are not well documented but seismic qualification will be expensive and it should be justified as best it can be, realizing that it will involve professional judgment. To support the cost-benefit analysis the CSPSs should look at the specific configurations that are judged credible if the racks and vessels were not designed to full seismic qualification to determine if the changes lead to credible risks for a criticality event.

Given that a disruptive earthquake is one unlikely event, it can almost always be argued that the subsequent loss of one, or even more than one, liquid-holding vessel's integrity in a large geometry exclusion area (LGEA) with a large, flat floor that somehow results in a critical configuration is a second very unlikely event such as the collection of solutions in an unapproved container. Thus the likelihood of the criticality accident might be judged to be incredible and in compliance with ANS-8.1 even without seismic qualification of vessels at the DBE level. As is required by the Process Analysis statement cited above from ANS-8.1, each individual process must be thoroughly reviewed to reach the determination of subcriticality. The cost trade-offs, even if subcriticality is determined to be the appropriate conclusion, would probably include process down-time and equipment replacement as well as some decontamination due to a leak that might not have happened had the seismic integrity of the vessel been more robust.

Similarly, though storage arrays of materials and containers are seismically qualified for the DBE, if process/storage cans and arrays were of a lesser seismic integrity and happened to fall and/or breach during a DBE, it is not a foregone conclusion that a critical configuration could be reached. Again, each process, and its abnormal conditions, must be analyzed thoroughly to reach conclusions about subcriticality during such disruptive events, but often a judgment of subcriticality has been the result of the required Process Analysis. Process tradeoffs, in addition to the cost of the cans, include possible minor contamination and the weight of the cans and their impact on the ease/difficulty of manual operations.

The following general comments are made with regard to the facility strategy for seismic safety.

- It is understood that the facility structure, at this stage in the project, was designed to NPH Seismic Design Category (SDC) 3, Limit State D. The SDS document notes that "*based on the analysis for the facility using the methods defined in Appendix A of DOE-STD-3009-94, the radiological consequences are below 5 rem. Therefore, no safety-class SSCs are required for the facility.*" The design of the structure and the supporting components to NPH SDC-3, Limit State D will generally require the performance of a site-specific seismic hazards assessment and a soil-structure interaction analysis, and the consideration of multiple earthquake input directional components for the qualification of safety-significant components. DOE O 420.1B endorses the use of a graded approach when designing, constructing, and operating facilities. Although it is recognized that in preliminary design phases the use of conservative criteria to govern the design of the facility structure may be prudent due to uncertainties in the risk analysis, there may be cost savings realized during final design by downgrading the facility structure and some components from SDC-3 Limit State D to SDC-2 (or -1) and the limit state that is consistent with the functional requirements of the particular SSC.
- A noteworthy practice adopted by the project to improve communications between the safety analysts, criticality analysts, and designers is the use of the Safety SSC (SSSC) Table. The SSSC Table 2-602 (DE-PE-801768, A007, Rev. 4) summarizes the safety function and functional requirements of equipment important to safety. The use of the Table and its endorsement by members of the Safety-in-Design Integration Team, DOE-YSO, and the Technical Change Control Board through formal Project Change Controls will help to ensure that all affected parties are aware of changes in functional requirements of equipment important to safety.

The CSSG urges the Y-12 staff to include cost-benefit considerations in the criticality safety related seismic design process, and as the design of components is refined, to use a graded approach to reevaluate the seismic qualification characteristics of confinement systems and criticality-related SSCs.

3. Fire Initiated Criticality Accident

Moderation of fissile material from fire-fighting water is unlikely due to a strong combustible control program and the general robustness of the water sprinkler system. While the sprinkler system will be seismically designed to function after a DBE, even if it were to fail or subsequently activate as designed due to fires induced by the DBE, all the CSPSs that were reviewed conclude that fire water would not likely result in the critical state being reached. Thus fires, whether initiated by non-seismic or by seismic events are expected to have essentially the same results and to not lead to a criticality accident occurring.

The current criticality safety design strategy calls for all vessels to retain their integrity as the result of a DBE. Potential fires initiated by the DBE will have essentially the same likelihood of resulting in a criticality accident as those fires initiated independently of a seismic event. It is understood that a disruptive facility fire-caused criticality accident, regardless of likelihood, would not put non-emergency personnel at risk since they would have promptly evacuated the area. Emergency response plans should consider the need for and result of sheltering in place during lesser magnitude fires. In ANS-8.1, it is recognized that the primary function of the ANS-8 criticality safety standards is to provide guidance for the protection of personnel and that when personnel are not at risk from the consequences of a criticality accident requirements may be reduced somewhat. Consequently, immediate evacuation procedures and emergency response actions may be credited. It is also noted in ANS-8.1 that cost must be a consideration, but that the safety of personnel is paramount. When personnel are not at risk due to the inherent shielding of the facility, then ANS-8.10, Criteria for Nuclear Criticality Safety Controls in Operations with Shielding and Confinement, may provide additional guidance.

Should fire fighters be involved in fire fighting actions, administrative controls can further reduce the likelihood of initiating a criticality accident. Therefore, even though this would be an emergency response activity, and not a process operation, the overall likelihood of the criticality accident occurring would be expected to be very unlikely. Furthermore, the distance that firefighters would be expected to be from a criticality accident location (that their fire hoses would be potentially causing) would be sufficient to keep a single fission spike from producing a life-threatening dose. It is understood that in accordance with emergency response procedures, monitoring for high radiation fields will occur prior to response personnel (including fire fighters) entering an area that was suspected to possibly have an ongoing criticality accident.

If process/storage cans and liquid-holding process vessels were not designed to withstand the DBE, it is not apparent that there would be any increased likelihood of a criticality accident associated with fire and fire-fighting scenarios. Certainly they would be expected to release their contents somewhat more readily, but the likelihood of a resulting criticality accident would still be expected to be very remote. That is, both the likelihood of the fire and the likelihood of a potential ensuing criticality accident are in the unlikely range with the resulting overall likelihood of the accident being in compliance with ANS-8.1.

Recent events, such as the March 11, 2011 Tohuku Earthquake, have emphasized the need to consider rare events that could compromise the safety of nuclear and high-hazard facilities. The potential for seismic-initiated fires should be considered in the planning, design, and operation of a nuclear facility. This is a scenario which is credible based on experience in recent earthquakes such as Haiti 2010, Christchurch 2011 and Tohuku 2011. The project is to be commended for completing such a comprehensive investigation on the effects of post-earthquake induced fires.

The report, RP-EF-801768-A003, *Post-Seismic Fire Evaluation Report*, does a good job of identifying the materials at risk and both meets the requirements and is adequate. It documents a conservative approach for estimating the conditional probability (likelihood) of post-earthquake ignitions (0.15 to 0.40) and then uses a conservative approach for estimating the number of sprinkler head activations given the combustible loading, and given the expected number of ignitions. The data in the report are conservative for estimating both the number of post-earthquake induced fires and post-earthquake induced sprinkler head activations. Empirical data suggest that for a modern, well-built facility with relatively low combustible loading the probability of earthquake induced fires is relatively low (<0.05).

4. Implementation of DOE-STD-3007 for Elevation of Controls to the TSR Process

The site Safety Analysis Report (SAR) (Y/FSD-017 Rev. 6) is approved by DOE-YSO. Chapter 6 of the SAR is the site criticality safety program description documentation. Sections 6.4.1 and 6.4.2 discuss the need to evaluate passive/active engineered controls and administrative controls, respectively, for elevation to the TSR level, and the use of the Criticality Control Review (CCR) document to list these controls. It indicates that the criteria of DOE-STD-3007-2007 are utilized to perform the review. Section 6.4.4 discusses the CCR document with additional detail. This document is utilized to summarize all controls and identify the controls that are to be elevated to the TSR level.

Section 4.1 of RP-EN-801768-A008, Rev. 0, DRAFT, discusses a control binning process to identify common types of controls from the applicable CSPSs and then perform a group evaluation for possible elevation. Section 4.2 discusses the criteria from DOE-STD-3007-2007 and how each of these criteria is applied.

The UPF criticality safety design philosophy is to rely on passive engineered features for the majority of the operations. Categorical exclusions are applied for some of the features if the safety function is addressed by a facility program (e.g., nuclear material control and accountability). Due to the priority assigned to the different types of controls (passive/active engineered, administrative) there are fewer active engineered or administrative controls being utilized to protect against a criticality accident. Active engineered controls are also excluded if their safety function is addressed by a facility program (e.g., automated fissile material mass checking).

Some additional criteria are utilized for the remaining passive/active engineered controls. These criteria place increased priority on elevating controls based on the consequence to the operation if the control fails. Finally, administrative controls are evaluated. These controls also use additional criteria similar in function to the criteria utilized for the engineered controls.

It is concluded that the application statement for each of the DOE-STD-3007-2007 criteria appears to be a reasonable interpretation of the criteria as it applies to the UPF process studies and goals associated with the UPF design. In the current draft form, and without detailed knowledge of all of the process studies and associated controls, the binning and categorization appear reasonable. In some cases a more detailed basis may be appropriate. There is no easy tie from the summarized/binned controls to the applicable CSPSs. From the information reviewed it is not clear if the process is only focused on controls that are to be elevated to the TSR level, or if this also includes potential elevation of additional controls to the DSA. This should be clarified in the CCR document.

5. Design Basis Criticality Accident Consequence Information

Assessment of this topic area focused on the postulated design basis criticality accidents for both CAAS placement and IEZ determination. The magnitude and consequences of postulated criticality accidents have been identified in RP-EN-801768-A004, Rev.0, which defines both the minimum accident of concern (MAC) used in the determination of CAAS detector placement and the bounding accident used for immediate evacuation zone (IEZ) definition:

- Considering, the amounts and types of materials planned for operations in the UPF, the default MAC defined in ANSI/ANS-8.3 was selected as the MAC for the UPF.
- Based on data from criticality accident simulation experiments, actual criticality accidents and an estimation of credible volumes of materials that could be involved in a criticality accident, the bounding accident for IEZ determination was deemed to be one in which 10^{18} fissions occur within

the first 10 minutes, the maximum time for emergency response personnel to arrive at the IEZ boundary to provide radiation monitoring and clearing of personnel outside the perimeter of the building (Y/DD-1308, Rev. 0 (draft)).

The CSSG agrees with these design basis accident magnitudes and duration for CAAS and IEZ determinations. It is noted that there is one additional report, Y-12 Generic Threshold Analysis for Use with DOE-STD-1189, DAC-FS-900000-A025, Rev. 4, that contains yet different criticality accident consequence values for various uranium forms. These consequence values were taken from DOE-HDBK-3010-94 and used primarily for purposes of estimating off-site consequences and was not used to evaluate CAAS or IEZ issues.

The CAAS in the UPF will not be seismically qualified; that is, it will not be designed to survive the DBE and cannot be relied on to signal a criticality event following the DBE. However, a seismically qualified seismic detection system will be installed that will trigger an evacuation alarm upon registering a seismic event. In addition, the UPF structure is designed to survive the DBE (Limit State D) and engineered nuclear criticality safety (NCS) controls are also designed to be seismically qualified as stated in the CSPSs. Thus by design, a criticality accident is not considered credible and personnel are unlikely to be exposed to radiation from a potential criticality accident initiated by a beyond design basis seismic event before and during evacuation.

The consequence of the bounding criticality accident, assumed to be located near the outside wall of the UPF, is stated to be a dose of about 3 rad in air at the external surface of the wall. Less shielded locations (e.g., near entry and exit portals) could receive much higher doses and these areas need to be evaluated in more detail using accident locations in the process areas as the facility design continues.

CSPSs for specific operations address seismic events as part of the contingency analysis. Secondary fires with resulting sprinkler activation are also addressed. The CSPSs identify those controls (equipment, piping, etc.) that require seismic qualification to preclude a criticality accident under these contingency scenarios. The conclusions in the CSPSs are consistent with the design basis requirement (RP-ET-801768-A003, Rev. 0) that the seismic detection and alarm system will provide adequate time for evacuation of the UPF before any secondary effects of the DBE could cause a criticality accident. The UPF construction makes it essentially a radiation-shielded facility except near the entry and exit portals, limiting exposure to anyone who was initially, or who has evacuated to, outside the building.

The conclusions of this review are twofold: 1) that the CAAS and IEZ design basis criticality accidents have been adequately justified and that the consequences have been adequately analyzed based on the current preliminary design of the facility and 2) that the IEZ as defined adequately limits doses to personnel at the IEZ boundary during the 10-minute emergency response time. The CAAS recommendation, and CAAS detector locations are appropriately conservative considering the maturity of the facility design and the criticality safety process studies. The determination that the CAAS does not require seismic qualification is appropriate given the supporting documentation.

6. <u>Need/Adequacy of the Drain/Dike System</u>

Typically a dike, curb, or berm in fissile material operating areas would be considered when the consequences of a spill would result in significant decontamination costs. With only uranium operations planned for the UPF and with an impermeable layer planned to be applied over the process floor, it is not clear that contamination cleanup costs would be significantly exacerbated were rooms not bermed, one from the next. Certainly criticality accident prevention is provided if floor flatness is assured and berm heights are limited to 2 inches (i.e., a maximum of 2 in. for criticality safety purposes, but could be reduced to a lower height consistent with other requirements such as chemical separation), as stated in design requirements. However, there are operational issues associated with berms that must be considered. Regardless of the decision on the use of interior berms, it would seem reasonable to have a slight ramp into and out of the UPF to avoid contaminated liquid from escaping from the perimeter of the facility. Project personnel have indicated that the trade-off study has not been completed and no final decision has been made on the use of berms within the facility. The review team agrees that further evaluation is necessary before any design decisions are made.

7. UPF NDA Program and Filter Barriers (i.e., Pre-filters, etc.)

The UPF Non-Destructive Analysis (NDA) program utilizes the current Y-12 Uranium Holdup Survey Program (UHSP) and the Inadvertent Accumulation Prevention Program (IAPP). These programs will be revised as necessary to support any needed detail differences due to UPF specifics. CSPS documents associated with the Process Off-Gas (POG) system (RP-EN-801768-POG-A001, Rev. 1), the Ventilation (VENT) system (RP-EN-801768-VENT-A001, Rev. 0), and the NDA laboratory (RP-EN-801768-NDA-A001, Rev. 1) were reviewed.

All chemical processing off-gas vents that might contain corrosive vapors will be routed through the process off-gas scrubber before being combined with dry process vents and undergoing final high-efficiency particulate air (HEPA) filtration. The POG system primarily utilizes favorable-geometry piping and tanks for the anticipated materials. The volumes of pumps are also controlled for criticality safety. Both the UHSP and IAPP are utilized as needed.

To extend the life of many HEPA filters, pre-filters or sock filters are being considered. For operations where high-temperature operations or highly dispersible powders may result in significant airborne concentrations, sintered metal filters are utilized. As the air flows away from the source, air-cleaning devices, such as cyclones, are utilized. Favorable geometry features are utilized to support the final ductwork branches are utilized prior to the final HEPA filter bank that are not of favorable geometry. The UHSP is utilized in locations where holdup has the potential to accumulate. If/when mass control is required the IAPP is utilized.

For the NDA laboratory, plans are to install equipment similar to that already in use at Y-12: gamma counters, a solution assay system, a density meter, an enrichment measurement system and an active well coincidence counter. Interaction is the primary criticality safety control utilized as there is minimal container opening, containers are verified to be compliant for upstream handling requirements, and spacing is maximized to minimize the radiation background for many of the measurements. Engineered storage racks will be utilized where necessary to assure spacing. Mass is controlled prior to the containers reaching the NDA laboratory, but may be based on conservative estimates, such as for waste containers. Notification limits will be utilized to manage containers that exceed specified uranium mass limits. Volume is controlled for the density meter as that is the only location where fissile material (liquid) may be removed from the received container for measurement purposes.

Overall it appears that the UPF project is utilizing appropriate controls for the POG, VENT and NDA systems. The level of conservatism appears appropriate given the current maturity of the facility/process design.

Conclusions

Overall, the review team judges that criticality safety related requirements are being appropriately applied to the UPF project. In addition, the effects of a seismic-initiated accident sequence and the controls needed to bring the facility to a safe-shutdown condition appear to have been considered in the design phase. This includes the potential for increased criticality concerns due to an earthquake. Design processes in place allow for the efficient flow of design information from the safety basis analysts and the criticality analysts to the design engineers.

There appears to be significant conservatism in the CSPSs that were reviewed as well in most of the other documents. How much of this conservatism is required is difficult to judge. In many cases it is appropriate to err on the conservative side when details are still being developed, and it is recognized that it may be more cost-effective to downgrade equipment after procurement/installation, if appropriate, than it is to upgrade equipment to a higher standard if required later.

The UPF safety strategy endorses the use of passive engineered features over administrative controls for operations. This is recognized as having a higher up-front cost, but could result in significant overall savings over the life of the facility. In many cases the incorporation of the engineered features may simplify the operation thereby improving overall operational efficiency and actual safety.

This review was largely based on a review of interim safety documents and interviews with facility safety personnel. These documents are being utilized to support the design effort and analysis efforts associated with other safety related disciplines. As the design matures the CSPSs will be revised as necessary. Finally, the CSPSs will be rewritten as Criticality Safety Evaluations (CSEs). The CSEs will be utilized to support the creation of the operating procedures. Verifications will be made to ensure that the design requirements identified by the CSPSs/CSEs are incorporated into the as-built facility. The final passive/active engineered controls and administrative controls will all go through a final CCR process to identify which controls will be elevated into the final DSA/TSR.

The safe-shutdown strategy adopted by the UPF project in response to a design basis earthquake is to provide for a safe and orderly evacuation of the facility. This is to be achieved by assigning the appropriate SDC and LS levels to both the facility structure and certain SSCs relied on for criticality safety. Other than to provide for safe facility evacuation, the project does not include post-seismic criticality, fire protection, or explosion protection as part of its safe-shutdown strategy needed to protect workers although the most important systems and controls have been designed to survive the DBE. Once the facility has been evacuated the emergency response process will be utilized to protect all involved personnel against subsequent accidents, including criticality. Radiation monitoring will be utilized to indicate where it is safe to be, and when it is safe to be there. Personnel from many organizations will be providing input, based on the data available, to ensure the safety of responders, and those in the vicinity. It is the judgment of the CSSG that this approach is appropriate, and is compliant with applicable requirements.

Attachment 1

CSSG TASKING 2011-04
Date Issued: April 26, 2011

Task Title: ***CSSG Review of the UPF Facility Position on Criticality Safety in Regards to Seismic Design***

Task Statement:

The CSSG is directed to provide a review of the Y-12 UPF project in regards to the seven topic areas provided below and provide a report on their findings to the NCSP Manager. Due to the limited time available for the tasking, the seven areas of interest are grouped into three priority categories, representing the order in which they are to be addressed by the review team.

Priority Group 1

1. SDS seismic event tree
2. Design process and representative CSPSs
3. Fire initiated criticality accident

Priority Group 2

4. Implementation of DOE-STD-3007 for elevation of controls to the TSR process
5. Design basis criticality accident consequence information

Priority Group 3

6. Need/Adequacy of the drain/dike system
7. UPF NDA program and filter barriers (i.e., pre-filters, etc).

The CSSG Chair will create a small subgroup to work with the Y-12 UPF team to develop the response to this tasking.

Resources:
The CSSG Chair will assign two to three members to support the response development. An ad-hoc member from LANL will supplement the CSSG response team. The entire CSSG will review the draft submitted by the response subgroup and provide comments to the CSSG response team lead. Contractor CSSG members of the team will use their FY11 NCSP CSSG support funding as appropriate; DOE CSSG members of the team will utilize support from their site offices.

Task Deliverables:

1. CSSG subgroup visits Y-12 UPF and develops draft report (week of May 2)
2. CSSG drafting team submits draft of Y-12 UPF position to the CSSG Deputy Chair by May 9, 2011.
3. CSSG Deputy Chair distributes draft response and solicits comments to be provided to the response team lead by May 12th.
4. CSSG response team lead to consolidate comments and obtain CSSG concurrence by May 13, 2011.
5. CSSG Chair briefs the NCSP Manager and Y-12 UPF team on the report by May 13, 2011.
6. CSSG Chair transmits the CSSG response to the NCSP Manager by May 16, 2011.
7. CSSG response team provides on-site (Y-12) brief to Y-12 Team (week of May 16).

Task Due Date: May 20, 2011

Signed: Jerry N McKamy

Jerry N. McKamy, Manager US DOE NCSP

Attachment 2

Documents Reviewed and Personnel Interviewed

Documents Reviewed

CSPS-EN-801768-BMO-A001, Rev. 1, *Nuclear Criticality Safety Process Study of Bulk Metal Oxidation.*

CSPS-EN-801768-DR-A001, Rev. 0, *Nuclear Criticality Safety Process Study of the Facility Liquid Collection System.*

CSPS-EN-801768-LCH-A001, Rev. 1, *Nuclear Criticality Safety Process Study of Leaching.*

CSPS-EN-801768-OXD-A001, Rev. 1, *Nuclear Criticality Safety Process Study of Oxide Dissolution.*

CSPS-EN-801768-POG-A001, Rev. 1, *Nuclear Criticality Safety Study of Process Off-Gas System.*

DE-PE-801768-A007, Rev. 4, *UPF Facility Safety Design Criteria (U), Chapter 2, Section 600, of the UPF Design Criteria*.

DG-EN-801768-A002, Rev. 0, *UPF Process Studies Guide.*

FR-CS-801768-A001, Rev. 0, *Nuclear Criticality Safety Design Considerations for the Uranium Processing Facility*.

RP-EF-801768-A003, *Post-Seismic Fire Evaluation Report*.

RP-EN-801768-A004, Rev. 0, *Preliminary Assessment of Criticality Accident Alarm System and Immediate Evacuation Zone Issues for the Uranium Process Facility.*

RP-EN-801768-A008, Rev. 0, DRAFT, *Criticality Control Review for the UPF*.

RP-EN-801768-VENT-A001, Rev. 0, *Nuclear Criticality Safety Process Study of Process Confinement System Exhaust.*

RP-EN-801768-NDA-A001, Rev. 1, *Nuclear Criticality Safety Process Study of the Non-Destructive Analysis Laboratory.*

RP-ET-801768-A003, Rev. 0, *Event Tree Assessment of UPF Design Basis Seismic Event.*

RP-FS-801768-A003, Rev. 3, *Safety Design Strategy for the Uranium Processing Facility.*

Y/DD-1308, Rev. 0 (draft), Nuclear Criticality Accident Emergency Planning Evaluation Guidance for the Y-12 National Security Complex.

Y/FSD-17 Rev. 6, *Y-12 National Security Complex Safety Analysis Report.*

Y70-150, Rev. 08/05/2009, *Nuclear Criticality Safety Program.*

Y70-68-001 Rev. 04/01/09, *Criticality Safety Approval/Requirements Development, Review, and Approval.*

Personnel Interviewed

Sheena Whaley, Safety-Analysis Engineering Lead
Danny Walker, Safety-Analysis Project Engineer
John Gertsen, Vice President, Y-12 Engineering
Barb Krogfuss, NCS Engineering Lead
Chris Haught, NCS Engineering Manager
Chuck Robinson, NCS Engineer
Mike Swientoniewski, NDA Process Engineer
Jim Goss, DOE-YSO
Harry Peters, DOE-YSO