THE NATION'S URANIUM PROCESSING FACILITY

Preparer: 11/28/22

Roger W. Bartholomay
UPF Nuclear Criticality Safety Technical Advisor

Date

Approval: 11/28/22

Kevin H. Reynolds
UPF Nuclear Safety Director

Date

11/29/22

Effective Date

# REVISION LOG

**Revision 5** ☒ Intent ☐ Non-Intent

- Guidance contained in this document aligns with requirements flowed down from Y70-68-001, *Criticality Safety Approval/Requirements Development, Review, and Approval*
- No forms have been edited as part of this revision
- Other changes include:
  - Added guidance for addressing the Facility Monitoring and Control System within CSEs (Appendix K, *FMCS Guidance*)
  - Updated Attachment 2, *Criticality Control Review (CCR) Table Template*, to remove the ability to flow up a design feature that does not meet criteria (deletion failed in Revision 4 contrary to log entry)
  - Updated Attachment 2 to add another option for why an administrative limit may elevate
  - Added risk-significant structures, systems, and components to scope of Initial Testing and In-Service Surveillance discussion in Appendix D, *Plant Programs Credited by NCS*
  - Added more items to consider in determining water use category, including Table 5, within Section 2.15, *CSE Section 6.5, Fire Protection Guidance*
  - Added further guidance concerning cranes and hoists in Attachment 1, *Seismic Contingency Template*
  - Updated references
  - Updated acronyms
  - Editorial changes

**Revision 4** ☒ Intent ☐ Non-Intent

- Guidance contained in this document aligns with requirements flowed down from Y70-68-001, *Criticality Safety Approval/Requirements Development, Review, and Approval*
- No forms have been edited as part of this revision
- Changed Major Fire Event to Design Basis Fire Event to match terminology in RP-EN-801768-B003, *Application of Defense-in-Depth Control Strategy for NCS Regarding Design Basis Fire Events*
- Reworded "shall" statements as appropriate (i.e., statements which match procedural requirements remained as "shall" statements, others turned to "should" statements)
- Added guidance for addressing installed equipment (fissile and non-fissile) near CSE's scope, which included additions to Appendix I, *CSE Interaction* Analysis
- Removed outdated Evaluation Example (including obsoleted references) in the Seismic Contingency Template
- Replaced Large Geometry Exclusion Area (LGEA) Program with Uranium Solution Control Program
- Updated Attachment 2 Criticality Control Review (CCR) Table to remove the ability to flow up a design feature that does not meet criteria
- Other changes include:
  - Updated references
  - Updated acronyms
  - Editorial changes

**Previous revisions on record**

# CONTENTS

# 1.0 INTRODUCTION

## 1.1 Purpose

This Design Guide (DG) provides guidance for preparing or revising Criticality Safety Evaluations (CSEs) for the Uranium Processing Facility (UPF). It is a compilation of items intended to serve as a guide for Nuclear Criticality Safety (NCS) analysts and peer reviewers to help produce a quality analysis, a complete control set, and a document that is written to an appropriate level of detail. The goal is to produce an analysis that is comprehensive and supports derivation of the complete control set needed to ensure safe operations. The objective is to create a CSE written clearly enough for others in the NCS organization and customer organizations to understand the rationale for safety and the basis for controls. Achieving such a standard will allow other personnel who did not write the CSE to draw the same conclusions on safety and adequacy of controls as the original analyst and reviewer.

In accordance with Y70-68-001, *Criticality Safety Approval/Requirements Development, Review, and Approval*, Document Change Notices (DCNs) may be used to revise portions of a CSE without issuing an entire new revision. A DCN is limited to those sections of the CSE being changed. The applicable guidance in this DG also applies to preparing DCNs used to modify CSEs.

## 1.2 Scope

This DG is applicable to all CSEs being prepared or revised to support the development, issuance, and maintenance of the Documented Safety Analysis for the UPF Project. This DG is a living document that will evolve with more specific guidance on the content of the analysis and the types of controls. The guidance topics in **Section 2.0, *CSE Content Guidance***, are organized according to the format required for upgraded CSEs (refer to U.S. Department of Energy (DOE)-STD-3007-2017, *Preparing Criticality Safety Evaluations at Department of Energy Nonreactor Nuclear Facilities,* and the format in Y70-68-001).

Guidance and information on various topics are provided in several appendices and attachments as part of this DG. The following topics are covered:

- Appendix A, *Acronyms and Definitions*
- Appendix B, *Seismic Contingency Guidance*
- Appendix C, *Design Basis Fire Contingency Guidance*
- Appendix D, *Plant Programs Credited by NCS*
- Appendix E, *NCS Control Generation*
- Appendix F, *Analyses Requiring Special Authorization*
- Appendix G, *Standard Assumption Wording*
- Appendix H, *Criticality Control Review (CCR) Table Guidance*
- Appendix I, *CSE Interaction Analysis*
- Appendix J, *CSE Analysis of Gradual Uranium Accumulations*
- Appendix K*, FMCS Guidance*
- Attachment 1, *Seismic Contingency Template*
- Attachment 2, *Criticality Control Review (CCR) Table Template*

- Attachment 3, *Design Basis Fire Contingency Template*
- Attachment 4, *CSE Cover Page and Approval Page Formatting*

# 2.0 CSE CONTENT GUIDANCE

The intent of the discussion in the following sections is to describe, in detail, the content expected in each CSE section so consistency among all CSEs developed for the UPF Project is maintained.

**NOTE:** *Additional guidance is provided in GU-PM-801768-A009,* UPF Style Guide*.*

The following content structure is based on the information presented in Appendix B of Y70-68-001 and is required for CSEs produced in support of the UPF Project.

## 2.1 CSE Content Structure

The CSE includes the following sections:

- Signature/Cover Page
- Record of Revisions
- Table of Contents
- Table of Tables
- Table of Figures
- List of Acronyms, Abbreviations, and Initialisms
- 1.0, *Introduction*
- 2.0, *Description*
- 3.0, *Unique or Special Requirements*
- 4.0, *Methodology and Validation*
- 5.0, *Process Analysis*
- 5.1, *Parameters*
- 5.2, *Normal Conditions*
- 5.3, *Unlikely Events (Contingencies)*
- 5.4, *Conclusion*
- 6.0, *Credited Controls and Assumptions*
- 6.1, *Passive Design Features*
- 6.2, *Active Design Features*
- 6.3, *Administratively Controlled Limits and Requirements*
- 6.4, *Operational Good Practice Recommendations*
- 6.5, *Fire Protection Guidance*
- 6.6, *CAAS Coverage and Immediate Evacuation Zone*
- 6.7, *Assumptions*
- 6.8, *Criticality Control Review*
- 6.9, *Requirements from Other Criticality Safety Evaluations*
- 7.0, *References*
- 7.1, *Referenced Documents*

- 7.2, *Source Documents*
- Appendices (as needed)
- Addenda (as needed)

**NOTE:** *The section titles listed in* ***Section 2.1,*** **CSE Content Structure***, must be copied verbatim. Major section numbering may be "1.0" or "1." at the discretion of the NCS analyst, but must be consistent throughout the CSE.*

### 2.1.1 Text and Formatting Guidance

**Sections 2.1.2, *Cross-Referencing***, through **2.1.14, *Equipment Names and Unique Identifications***, contain a collection of technical editing guidance on the proper formatting and wording to use when authoring a CSE.

### 2.1.2 Cross-Referencing

**Table 1** describes the proper language for cross-referencing items in a CSE when followed by a cross-reference number. Never use the word "see" before a cross-reference.

**Table 1. Cross-Referencing**

| ITEM | CROSS-REFERENCE |
|---|---|
| Section | Sect. |
| Table | Table |
| Figure | Fig. |
| Assumption | Assumption |
| Passive Design Feature | Control |
| Active Design Feature | Control |
| Performance Criteria | Control |
| Administratively Controlled Limits and Requirements | Control |

**Exception**: If using the cross-reference as the first word of a sentence, write out the entire word (e.g., Section, Figure).

**Plural**: Abbreviations may be made plural (e.g., Sects., Figs.).

### 2.1.3 Use of Referenced Revisions

When a reference is discussed in the body of the CSE, the revision is only added if multiple revisions of that reference are specifically used in the CSE. Never include the date of the reference in the body text.

### 2.1.4 Acronyms

The first time an acronym appears in the CSE, spell it out, with each prominent word in most acronym definitions being capitalized, and add the acronym in parentheses after. An acronym must be found more than once in the body text in order to be used (unless it is generally only known as the acronym rather than the words it stands for).

### 2.1.5 References

The first time a reference is discussed in the body of the CSE, use the following format:

“<document number>, <title>,” (title is italicized)

For example:

LA-12808, *Nuclear Criticality Safety Guide*

For all subsequent times the same reference is discussed, using just the document number without including the title is appropriate.

Exception: If a document has the text “(U)” in its title, those three characters are not italicized.

### 2.1.6 Tables

Table captions are placed above the table, page centered, with the following format:

Table X-n. <Table descriptive name>

Where:

“X” is the main section number

“n” starts at 1 and increments in ascending order

There is no period at the end of the descriptive name.

Repeat table captions and the header row across each page that the table spans.

Use sentence case (i.e., capitalize the first letter of the first word and any proper names).

For example:

**Table 2-1. Boundary summary table**

### 2.1.7 Figures

Figure captions are placed below the figure, page centered, with the following format:

Fig. X-n. <Figure descriptive name>.

Where:

“X” is the main section number.

“n” starts at 1 and increments in ascending order.

There is a period at the end of the descriptive name.

Use sentence case (capitalize the first letter of the first word and any proper names).

For example:

**Fig. 2-1. General process flow**.

### 2.1.8 Table of Contents

The table of contents should not display beyond three levels.

Only sections or subsections should be displayed. For example:

- Assumptions are third-level depth (6.7.X), but should not be displayed because there is no subsection title associated with them
- Controls are third-level depth (6.X.Y), and should only be displayed if they have a subsection title
- Performance Criteria are fourth-level depth (6.1.X.Y) and, therefore, should not be displayed

### 2.1.9 Units

Spell out units when using the word in a sentence ambiguously (with no number assigned to it). Limit the use of commingling different standards of units within bodies of documents wherever possible. Pay attention to which standards of units were used in source and reference documents and ensure units appearing in the CSE are always labeled correctly.

If a unit has a number assigned to it, abbreviate it.

Examples include:

- The equipment is a few meters away from the nearest wall
- The equipment is approximately 3.5 m away from the nearest wall

Abbreviations include:

- in. (inch)
- ft. (foot)
- cm (centimeter)
- m (meter)
- L (liter)
- ga (gauge)
- Use "$g/cm^3$" – not "g/cc"

### 2.1.10 Formatting

Do not add tabs to the beginning lines of paragraphs.

Staggered indention of subsections is not necessary.

### 2.1.11 Discipline-Specific Information

"Subcriticality" is a valid word.

"Calculational" is a valid word.

"$k_{eff}$" is written as a lowercase "k" followed by subscript "eff" (no italics).

Use symbols where possible, such as "σ" instead of "sigma."

#### 2.1.12 Cover Page and Approval Page Information

Each CSE cover page and approval page will be formatted in accordance with the template provided in **Attachment 4**, and will include the following:

- CSE Title (i.e., "Criticality Safety Evaluation for <Process/System Name>")
- CSE Document Number and Revision Number
- Consolidated Nuclear Security (CNS) Logo (**Figure 1**)
- Reference the "Uranium Processing Facility Project"
- Date of CSE issuance in the form "Month Year" (e.g., June 2019)

**Figure 1. CNS Logo**

#### 2.1.13 Revision Log Information

The revision log format is presented in **Figure 2**. The revision log includes the current revision information, as well as data from previous revisions. The description of change needs to include the Engineering Change Proposal (ECP) number for the ECP approving the revision, as well as ECP numbers for those which changed information incorporated into the revision.

| Revision Number | Date | Description of Change | Affected Pages | Total Pages |
|---|---|---|---|---|
| 1 | August 2021 | Revised to address increased mass allowed in process.<br>ECP-EG-801768-C222 is incorporated into the CSE.<br>Approval by ECP-EG-801768-C333. | All | Total:206 i–xviii, 1-188 |
| 0 | January 2021 | Initial issue of the CSE. Incorporated all comments in the Safety Analysis Engineering (SAE) Database and updated in accordance with DG-EN-801768-A004.<br>Approval by ECP-EG-801768-C111. | All | Total:200 i–xvi, 1-184 |

**Figure 2. Example Revision Log**

#### 2.1.14 Equipment Names and Unique Identifications

If equipment names and Unique Identifications (UNIDs) are listed in Section 6 of the CSE, they should match the equipment name and UNIDs as depicted in referenced Project documents (e.g., Piping and Instrumentation Diagrams [P&IDs]). In general, leading zeros used for equipment UNIDs, as they appear in Quality Level Determinations (QLDs), are not used on P&IDs and should be not used in the CSE.

Examples:

- Calciner Scrubber Solution Cooler (9226-01-CAL-C-3020)
- Low Equity Calciner Rotary Tube (9226-01-CAL-B-2000)

If piping UNIDs are listed in Section 6 of the CSE, they should match the UNIDs as depicted in referenced Project documents (e.g., P&IDs). In general, leading zeros used for piping UNIDs, as they appear in QLDs, are not used on P&IDs and should not be used in CSEs.

Examples:

- 9226-FRN-POG-50020-8”-400513.20-ET-2 3/8”
- 9226-SMP-PCWR-736-1/2”-400513.19

In the CSE, where controls are listed verbatim, the full UNID needs to be used to match the Section 6 wording (see **Section 2.9.4, *Related Features***, for additional information).

Within other sections of the CSE (except when performance criteria, assumptions, or administrative controls need to be listed verbatim), if specific equipment or pipe UNIDs are used, enough information should be provided to adequately identify the equipment or pipe. This may not necessitate using the full UNID as it would show on a P&ID.

Examples:

- Cooler (C-3020)
- Rotary Tube (B-2000)

This example assumes there is a note somewhere in the CSE to state that all UNIDs begin with “9226-01-CAL unless stated otherwise.”

## 2.2 CSE Section 1, Introduction

This section should provide a brief statement of the fissile material processes or activities being analyzed and the scope of the evaluation with respect to those processes or activities. Utilities supporting the process are not expected to be discussed in the Introduction section. Proper system or process titles should be used, along with any unique system identifiers associated with the process/activity being evaluated. Relevant background information necessary to orient the reader to special circumstances associated with the process/activity should be included (e.g., something in the process has changed since the last revision of the CSE). The specific reasons for the changes in the CSE may be listed in the Record of Revisions at the beginning of the CSE as opposed to outlining them in the Introduction.

When a CSE is revised, it is acceptable to analyze and review only certain portions of the CSE. When a full analysis is not performed, the Introduction should clearly identify what portions of the CSE were revised. When this option is exercised, care should be taken to ensure the relevant parts of each section in the CSE are evaluated. As an example, if the analysis of one workstation or one item of equipment is being revised, the relevant sections of the Description, Normal Conditions, Unlikely Events, Credited Controls and Assumptions, etc., must be reviewed to ensure proper consideration of the limited-scope changes. All changes must be identified via revision bars unless the changes in the CSE are so numerous as to represent a total revision of the document, which should be documented in the revision log (NCS Management agreement is necessary).

## 2.3 CSE Section 2, Description

The Description section of a CSE is intended to enable a basic understanding of the process/activity being evaluated. The Description is not expected to contain elements of system design and operating characteristics that have no bearing on NCS, but it should contain sufficient descriptive detail (e.g., fissile material forms, containers, equipment, fissile material activities, fissile control areas) to support the evaluation. All equipment (e.g., gloveboxes, glovebox equipment, modules, Facility Monitoring and Control System [FMCS]) and operational activities that will be analyzed for criticality safety concerns must be described in this section. Other documents (e.g., drawings, engineering flow calculations) contain the more detailed information necessary to support the validity of the CSE and are managed through the Configuration Management (CM) Program. References to the other descriptive documents should be present so the reviewer can determine the potential impact of those aspects of process/activity operation that are important to NCS.

A System Design Description (SDD) should exist for all fissile material processes or activities and should contain sufficient detail to be used as a source of information for the Description section in a CSE. The SDDs relevant to the systems or activities within the scope of the CSE should be referenced in the Description section, unless they exist only as a letter revision document. If an SDD only exists in letter revision form, then the original number revision references in the SDD should be used as process description references for the CSE. If an SDD does not exist, then one will need to be generated, or permission from the UPF NCS Management Approver must be obtained to proceed with CSE development using best available information.

Process system diagrams are very useful in presenting the flow of piped systems and, therefore, should be referenced when describing pertinent aspects of system design and operation. It is not intended that every drawing associated with the process/activity be referenced in the CSE. In addition, some CSEs address activities that are only administrative and, therefore, have no drawings that provide meaningful information to support development of the CSEs. Detail drawings may provide useful descriptive information, but they are usually more important to NCS by serving to document the implementation of design feature requirements derived from the CSE. Electrical features relied upon for Active Design Features (ADFs) are usually sufficiently shown on process system diagrams. Equipment layout drawings can be useful in orienting the reviewer to the location of process/activity features within a particular building, but these drawings can also be used to capture NCS requirements generated by the CSE as they relate to interaction or reflection concerns.

Illustrations or block diagrams should be provided for more complex process systems to demonstrate interactions with other systems or to depict analysis boundaries. "Complex" process systems include:

- Hard-piped solution systems with several tanks or other equipment
- Glovebox systems that involve multiple activities among multiple gloveboxes or workstations
- Systems that require multiple process system and utility interfaces
- Process systems that are highly segmented

Some processes may not lend themselves to illustration or diagramming. For example, an evaluation that addresses the loading and handling of portable containers throughout the facility can be very complex to diagram because of the applicability at many locations in many processes. Conversely, many other processes/activities involve few interfaces and/or few components, and illustrations or diagrams are unnecessary. Whether or not a diagram is used is left to the judgment of the analyst and the reviewers; however, the process boundary must be clearly defined. Sufficient information should be included to enable a technically knowledgeable individual to review and understand the Description.

An essential element of the Description contained in the CSE is to provide an understanding of the boundary of the analysis. This boundary encompasses those locations and activities that will be evaluated for criticality safety of a given process. The CSEs must explain in some detail where the process boundaries that define the scope of the evaluation are located. This detailed explanation ensures that fissile material process/activity boundaries are not drawn in a way that leaves analysis gaps that could result in unanalyzed operations. Specific attention should be placed on the interface points with other processes/activities and other CSEs and utilities. The boundary discussion contains three key elements, and documentation of each element creates a complete boundary discussion. These three elements are:

- Identification of the interfacing system(s) and process(es)
- Description of the nature of the interface
- Description of the analytical boundary

The boundary discussion subsection should be presented in tabular format with the four column headers as conveyed in **Table 2**.

**Table 2. Boundary Table Headers**

| Interfacing | | Nature of Interface | Analytical Boundary |
|---|---|---|---|
| **CSE** | **System or Process** | | |

The "Interfacing System or Process" column should simply identify the system(s) and process(es) that interface with the processes or activities being analyzed in the CSE. If a system or process acronym is used in this column for the first time in the CSE, remember to define the acronym.

The "Nature of Interface" column should describe what flows or moves across, or touches, the boundary between the previously described interfacing system or process and the process or activity being analyzed in the CSE. It should provide an explanation of how the systems or processes interact at that boundary under normal conditions. Note that the interaction may take place at the boundary without necessarily crossing the boundary. An example is a process that transports fissile material through a facility that may potentially move past, and interact with, fissile material within another fixed process.

The "Analytical Boundary" column should describe what will be analyzed within the subject CSE and what will be analyzed within the interfacing CSE. This boundary may not necessarily be a clearly defined geographical location in the facility or a clearly defined system boundary on a drawing. The Analytical Boundary is the point at which the ownership and authority end for one CSE and begin for another. The boundary description between the CSEs need not be verbatim, but needs to match in intent so it is clear that all of the equipment/process analysis is contained within one of the two CSEs.

The intent of describing this analytical boundary is to ensure the normal and abnormal conditions that are clearly within each CSE are properly identified and that all aspects of the interface are covered, including all potential interface upset conditions. These interface upset conditions may include equipment failures that allow fissile material to cross the boundary, environmental changes within one process that produce changes in moderation or reflection for the other process, or operational upsets that move fissile material within one process close to, or to mix with, fissile material, moderators, or reflectors in the other process. It should be noted that identification of this interface can be iterative, as additional aspects of the interface will likely develop during the hazard analysis of the process.

As an example of the boundary discussion for two interfacing CSEs, consider CSE #1 (the subject of the current CSE development work) and interfacing CSE #2. CSE #1 is applicable to a single glovebox with a single machine that makes solid lumps of fissile material out of two liquid materials that are mixed in the machine. CSE #2 is a transport CSE applicable to a robust cart that receives the lumps from the CSE #1 process and transports them to another process. It should be noted that the CSE #2 cart also transports other fissile materials for other “non-CSE #1” processes. The boundary discussion for these two CSEs is described in **Table 3**.

**Table 3. Boundary Table Example**

| Interfacing | | Nature of Interface | Analytical Boundary |
|---|---|---|---|
| **CSE** | **System or Process** | | |
| CSE #2 | Fissile Material Transport | The CSE #2 cart is moved adjacent to the CSE #1 glovebox and receives fissile material lumps that are produced within the glovebox. The CSE #2 cart also moves past the CSE #1 glovebox on a daily basis transporting fissile material from other processes. | CSE #1 evaluates the production of fissile material lumps in the lump-making machine. This evaluation includes interaction of fissile lumps with the liquid input material. CSE #1 also evaluates the impact of reflecting and moderating materials within the glovebox (including sprinklers), over-batch scenarios, interaction of fissile materials with the clean-up vacuum in the glovebox, and the impact of fire and seismic events on the contents of the glovebox.<br>CSE #2 evaluates the criticality safety of having fissile material within the cart under normal and credible abnormal conditions, including fire and seismic scenarios. CSE #2 also evaluates the interaction of fissile material in the cart with other fissile materials being transported or stored along the path of the cart.<br>The analytical boundary between CSE #1 and CSE #2 has been determined to be the wall of the glovebox. |

When determining the interface with other CSE(s), consideration should be made regarding the following:

- Processes that physically connect to the CSE process
- Processes that provide an input to the CSE process
- Processes that receive a product from the CSE process
- Processes that receive waste/scrap from the CSE process
- Processes with potential operational upsets that could result in an interaction with the CSE process
- Processes with potential equipment upsets that could impact the CSE process
- Processes that provide an off-gas or ventilation service to the CSE process
- Processes that provide a utility service to the CSE process
- Processes that provide a transport or transfer service to the CSE process

It is not necessary to identify in the boundary table all potential mobile fissile items that may pass by and thus interact with the equipment within the scope of the subject CSE. Also, it is not necessary to identify in the boundary table installed equipment nearby the subject CSE's equipment. However, all such items and the neutron interaction or reflection they may provide to the subject CSE's equipment will be discussed in the normal conditions section and appropriate contingency sections of the subject CSE.

The Description section may be split into as many subsections as necessary to facilitate an orderly description of the processes or activities being analyzed; however, the final subsection should always contain the boundary discussion.

## 2.4 CSE Section 3, Unique or Special Requirements

This section describes any unique requirements not normally associated with CSEs. If guidance or requirements outside of those normally expected for CSEs apply to any given evaluation, then it would be reasonable to find this type of information in this section. An example of such special requirements might be criteria from American National Standards Institute (ANSI)/American Nuclear Society (ANS)-8.21-1995 (R2011), *Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors*. There is no need to document Rules, DOE Orders, or ANSI/ANS standards that are routinely applicable.

Where there are no unique or special requirements, the following standard language should be used in this section:

> "There are no unique or special requirements applicable to the <process/activity>."

## 2.5 CSE Section 4, Methodology and Validation

This section is intended to identify the analysis and computational methods used in the evaluation. When computer codes are used, this section is intended to document that the code is validated and the use of the code is within the area of applicability of the code. Use of any of the following approaches is considered acceptable for the determination of subcritical limits:

- Reference to national consensus standards

- Reference to accepted handbook data
- Reference to experiments with the data adjusted appropriately to account for uncertainties
- Use of validated calculations (including hand calculations)

Appendix C of Y70-68-001 presents requirements for the use of critical data from handbooks or guides, and requires use of a safety margin on the most sensitive parameter(s) to derive a subcritical limit. Any use of such safety margins should be identified in this section of the CSE.

When referencing national consensus standards, handbooks, or experiments in this section of the CSE, only cite the reference document. Additional details regarding the specific information used will be discussed in **Section 2.6, *CSE Section 5, Process Analysis***. In addition, any limitations on the use of these types of information must be considered and other confirmatory references applied where appropriate.

When the methodology employed for a CSE includes criticality code calculations, the following must also be identified either in the referenced calculation or in this section of the CSE (if the referenced calculation does not contain all of the information listed here, the missing information should be identified in the CSE):

- Computational code used
- Cross-section data used along with any cross-section data processing codes
- Documented validation and determination of the Upper Subcritical Limit (USL)
- Hardware platform used

The USL itself shall be documented in this section of the CSE to provide a direct link between calculation results documented in the CSE and the corresponding calculational limit.

In addition, referenced calculation reports must be reviewed to determine if adequate information is presented with regard to uncertainties, simplifications, and area of applicability to allow use in the CSE. If this information is not discussed in the referenced calculation document, Section 4 of the CSE should describe any uncertainties and include a discussion of using the code within the area of applicability. Summarizing the uncertainty and area of applicability information in Section 4 of the CSE is only necessary when calculations are documented directly in the analysis in Section 5 of the CSE, or when the referenced calculation reports do not provide sufficient information about the validation and area of applicability.

If no benchmark experiments exist within the area of applicability of the system being evaluated, it may be possible to interpolate or extrapolate from existing benchmark data to the area of applicability of interest. Consult with the Chief NCS Engineer to assess the use of wide interpolation or long extrapolation of benchmark results.

## 2.6 CSE Section 5, Process Analysis

The Process Analysis section of a CSE should be a short summary that details the information contained in the subsequent subsections. It is recommended the following standard language be used:

> "The NCS parameters controlled in this CSE are presented in Sect. 5.1. Parameter limits are established during the evaluation of normal and

contingent conditions, presented in Sects. 5.2 and 5.3, respectively. Specific references for these limits are cited therein and include the basis for applicability and acceptability of each assigned limit."

## 2.7 CSE Section 5.1, Parameters

The parameters section of the CSE should list the following NCS parameters and evaluate their applicability to the processes or activities being analyzed:

- Mass
- Neutron absorption/poison
- Geometry
- Interaction (within a process/activity and with adjacent processes/activities)
- Concentration/density
- Moderation
- Enrichment
- Reflection
- Volume
- Other/Multiple Parameters

This section is intended to provide only summary-level information on parameters with respect to whether or not they are controlled or process-limited in some way. This section also identifies abnormal events and presents each under the appropriate parameter. Events that meet the definition of "unlikely" are identified as "contingencies." All other events are considered normal conditions. It is not expected that analysis be provided in this section. Analysis is to be included in Sections 5.2 and 5.3. Supporting documentation, such as Process Descriptions, SDDs, Hazard Analysis Reports, Accident Analyses, and the Documented Safety Analysis, should be reviewed as sources of events that may have an impact on NCS. Any such events that may impact NCS should be identified and analyzed. If available references do not sufficiently identify potential conditions abnormal to NCS, then UCN-23408, *UPF CSE Hazard Evaluation Checklist,* may be used to identify potential abnormal conditions for a process or activity. UCN-23408 provides a Hazard Evaluation table specifically for CSE development. UCN-23408 should be used in conjunction with personnel from other organizations, such as Facility Safety, Operations, and Engineering, who are familiar with the process/activity being evaluated. The items in the Hazard Evaluation table are generally applicable to a wide range of fissile material activities, although a specific item may be more applicable to a metal activity than to a solution activity or vice versa. There may be additional considerations for a specific fissile material activity that can be identified and assessed as part of the disciplined review for determination of abnormal conditions for the process/activity.

Parameters that are controlled for the process/activity must be explicitly identified as requiring control. When a parameter is not applicable to the process, it must be clearly identified. Bounding assumptions about the state of a parameter (e.g., 100% enrichment or optimum moderation), must also be clearly identified.

Events that impact multiple parameters (i.e., natural phenomena events or other design basis events) are to be summarized under "Multiple Parameters." Additionally, other parameters may be included if applicable to the processes or activities being analyzed (e.g., Heterogeneity, Chemical Form). Note that every CSE is required to include a Design Basis Fire (DBF) Event and a Seismic Event contingency.

The Parameters section should be presented in tabular format with the three-column headers as conveyed in **Table 4**.

**Table 4. Controlled Parameters**

| Parameter | Controlled (Y/N) | Contingent Conditions |
|---|---|---|

If additional information is needed that does not fit the scope of this table, then the information may be presented in paragraph format following the table.

## 2.8 CSE Section 5.2, Normal Conditions

The evaluation in this section demonstrates that the process/activity is subcritical under normal conditions. This section should include specific analysis of all normal conditions (e.g., fissile material forms, fissile material equipment, fissile material containers, interfacing fissile material processes including mobile fissile items, which can pass by, and nearby installed equipment that is outside the scope of the CSE) and explicitly provide the basis for subcriticality of normal conditions. A statement that normal conditions are bounded by the analysis for abnormal conditions is not sufficient.

The evaluation in this section may also present features that are credited to prevent abnormal conditions that are not otherwise evaluated in this CSE. When crediting a feature for preventing abnormal conditions that are not otherwise evaluated, the analyst must ensure the feature reliably performs the preventative function and that this function is intuitively obvious to those who may read the CSE. As an example, the presence of an air gap on a liquid utility line can be discussed as a normal condition that prevents backflow of process solution into the utility supply line. There would be no need to evaluate backflow of solution into the utility supply line as an abnormal condition. All features and associated controls that are credited with maintaining subcriticality of normal operations must be identified in this section of the CSE.

When assumptions are made, the basis for validity of the assumption must be presented. The definition of an assumption in Y70-68-001 reflects the intent of DOE standards. Assumptions may or may not be associated with controls, but for those cases in which controls depend upon assumptions, the dependence must be clearly documented. For Rev. 0 UPF CSEs (i.e., CSEs that will not be declared effective for UPF facility operations), identify and discuss any assumptions that need confirmation. As CSEs are revised, assumptions shall be confirmed to the extent possible. All assumptions shall be confirmed, and the confirmation documented, prior to declaration of the UPF CSE as effective.

The evaluation of normal conditions must include an explicit statement that all normal conditions are shown to be subcritical. The documented basis supporting this conclusion must be included in this section.

## 2.9 CSE Section 5.3, Unlikely Events (Contingencies)

The evaluation in this section demonstrates that the process/activity is subcritical under unlikely (contingent) conditions. The purpose of this section is to derive the conditions and limitations necessary to maintain subcriticality when a contingency occurs, or establish that a nuclear criticality accident as a result of the contingency is not credible. CSEs must show entire processes involving fissionable materials remain subcritical under normal and credible abnormal events, including those initiated by design basis events (including fire and Natural Phenomena Hazard [NPH] events). With the exception of seismic events, NPH events are mitigated by the UPF building structure. Additional guidance for evaluating seismic events and DBF events is located in **Appendix B** and **Appendix C**, respectively.

Each contingency must be dispositioned in one of the following two ways:

1. Determination that the contingency is credible and its occurrence is demonstrated to be subcritical
2. Determination that the occurrence of the contingency is not credible

There is no obligation to document non-credible upsets. The analyst has the option of including events that are not credible simply to document the rationale for concluding the occurrence is not credible. This option might be necessary if another safety analysis document, such as a Hazard Assessment, presents such an event as one that might impact NCS. As a general rule, if the event appears plausible, the analyst should describe why it is not credible. For contingencies considered to be not credible (category 2), ensure the discussion demonstrates "not credible" by reliance upon multiple factors, including NCS controls, as well as the nature of the operation. The Description section of the contingency should present the rationale for the event not being credible to occur, and the Evaluation sub-section is not applicable to this type of contingency analysis.

Certain NCS analyses require special authorization, which is concurrence from the Chief NCS Engineer on the rationale used in these analyses. Concurrence is indicated by the Chief's signature on the Approval page of the CSE. The two types of analyses requiring special authorization are summarized below, with greater detail presented in **Appendix F**:

1. Establishing an acceptably low or "trivial risk" of a criticality accident to support the determination that Criticality Accident Alarm System (CAAS) coverage is not warranted for operations within a facility with a credible risk of a criticality
2. Establishing that a criticality is "not credible" for the release of process material(s) from a facility with a credible risk of a criticality

Judgments are within analysts' expertise when they are related to process conditions or nuclear science. Analysts are encouraged to consult with process engineers, system engineers, and other process experts to provide guidance in forming defensible judgments on process conditions. As necessary, a reference document should be obtained for establishing the bounding condition(s) for judgments that are outside analysts' area of expertise. Consult with the Chief NCS Engineer for additional guidance in this area as needed.

If an event in an interfacing process could affect the subcritical state of the process being evaluated, including general processes (e.g., trash handling, utilities, waste water), then that event must be addressed in the evaluation of the process affected by the event. The analyst should review evaluations of interfacing systems for potential effects on the process being evaluated.

In evaluations of contingent conditions, the failure of design features as a result of procurement or installation failures is typically judged to be not credible, based on UPF Project and Y-12 National Security Complex (Y-12) Programs that protect and verify such features. The NCS analyst may choose to evaluate a design feature failure of this type, but the description of the event must discuss the programmatic failures required to allow the event to occur. If the NCS analyst chooses to utilize the judgment of "not credible", the CSE should include the following standard paragraph prior to contingency discussions in Section 5.3:

> "The failure of design features (as a result of procurement or installation failures) that are relied upon in the evaluation of the following contingent conditions is judged to be not credible based on UPF Project and Y-12 Programs designed specifically to protect and verify the integrity of such design features. The Conduct of Engineering Program ensures robust design of all design features. The CM Program maintains the design basis for UPF and ensures that it is maintained. The Quality Programs ensure that design features comply with requirements and do so with a high degree of precision and control. The Nuclear Maintenance Management Program (NMMP) and the Initial Testing and In-Service Surveillance (ITISS) Program work together to ensure that:
>
> - Design features are initially in place
> - The function of design features does not degrade over time
> - Credited features perform reliably and as intended when called upon
>
> All of these programs, combined with the validation and implementation efforts that are ultimately part of declaring a CSE effective, ensure that NCS-related design features are available when needed and are effective."

Controls credited with maintaining subcriticality of contingent conditions must be identified in the Section 5.3 discussion of that contingency. Each control should be referenced by the control's number (e.g., Control 6.1.1.1). Controls in other CSEs credited with maintaining subcriticality of contingent conditions must also be identified in this section of the CSE. Each control should be referenced by the CSE document number and the control's number in the other CSE (e.g., CSE-EN-801768-XXX-A001, Control 6.1.1.1). If another CSE to be relied upon has not yet been issued, then the control should be referenced by an assumption in the current CSE (e.g., Assumption 6.7.X). The assumption should include the identification of the CSE to be relied upon and typical wording of the control to be relied upon. The only exception to this direction for credited control identification applies to engineered controls discussed in CSE-EN-801768-FLM-A001, *Criticality Safety Evaluation of the Facility Liquid Management System*. These controls have been evaluated for the entire UPF Project and will be implemented on a facility-wide basis. Reliance on Facility Liquid Management (FLM) controls for subcriticality—such as those for piping integrity, those that protect against fissile liquid accumulation on components in Large Geometry Exclusion Areas (LGEAs), and those that ensure limited liquid accumulation on facility floors—should be identified by referencing the FLM CSE and not the Uranium Solution Control Program (as discussed in **Appendix D**). It should be noted the LGEA Program no longer exists, and CSEs should ensure they do not refer to such a program. Specific control numbers from the FLM CSE do not have to be credited and documented in a non-FLM CSE.

Each contingent condition in Section 5.3 should be discussed in a separate subsection for clarity. For each contingency identified, the following information shall be presented using the following format:

5.3.X <Parameter> Contingency: <Descriptive Title>
- 5.3.X.1 Description of Contingent Configuration
- 5.3.X.2 Evaluation
- 5.3.X.3 Related Features
    - 5.3.X.3.1 Controls in This CSE
    - 5.3.X.3.2 Controls in Other CSEs
    - 5.3.X.3.3 Programs/Procedures
    - 5.3.X.3.4 Nature of the Operation
    - 5.3.X.3.5 Assumptions

Guidance for each element is provided in **Sections 2.9.1, *Contingency Title***, through **2.9.4**.

### 2.9.1 Contingency Title

Provide a title for the contingency that includes the parameter that has been changed followed by a brief descriptive statement. It is important to identify the parameter that is affected and not describe the event simply as a loss of a control. A contingency titled as a missed surveillance or a plugged drain hole is not acceptable because such conditions alone do not impact a parameter important to NCS. Examples of properly titled contingencies are:

- Moderation Contingency: Ingress of Water in the Loaded Glovebox
- Geometry Contingency: Overflow of Concentrated Uranium Solution onto the Floor

The intention of the title is to uniquely identify the contingency in terms of the affected parameter(s). There is no expectation that the title fully describes a contingent event. For contingencies that involve the change of more than one parameter (e.g., a fire that could distort equipment and introduce water from the fire sprinklers), present the title as a multiple parameters contingency, for example:

- Multiple Parameters Contingency: DBF Event

### 2.9.2 Description of Contingent Condition

Provide a description of the contingent event in terms of the change to the affected parameter(s) and describe the magnitude of the event. It is important to describe the contingency to the full extent at which it is evaluated to give the reader an appreciation for the severity of the event being evaluated. Do not discuss the contingency in terms of failed controls but rather in terms of a system that has achieved a more reactive state. As an example, two cans each loaded with 20 kilogram (kg) of pure uranium dioxide ($UO_2$) in contact inside a glovebox clearly conveys the event is well beyond the simple presence of an extra container in the glovebox (which might not be considered unlikely). The discussion should provide enough detail and clarity to demonstrate the condition evaluated is independent of other abnormal conditions evaluated.

In addition to the description, include a detailed basis for why the contingency is unlikely. It is not expected that quantitative means will be used to justify the designation of unlikely; qualitative discussion using commonly accepted engineering judgment is acceptable. Present several factors that make the event unlikely (it is acceptable to credit Nature of the Operation considerations along with the presence of an NCS control). If the event is a failure that one operator can cause by a single mistake and reach the postulated magnitude, then it should not be considered unlikely. There should be several factors in place to justify that it is unlikely for the event to occur and reach the postulated magnitude. If a reasonable argument for unlikely cannot be made with any factors other than a single administrative control, then additional NCS controls should be considered or categorizing the conditions as normal (Section 5.2 of a CSE) should be considered.

For contingencies considered to be not credible, the discussion should demonstrate "not credible" by reliance upon multiple factors, including NCS controls, as well as the nature of the operation. The Description section will present the rationale for event occurrence being not credible, and the Evaluation sub-section is not applicable.

### 2.9.3 Evaluation

The evaluation constitutes the technical defense of subcriticality for the contingent state and derives the limits for applied controls. This section does not apply to a postulated contingency that has been justified as being not credible to occur. The evaluation should include, where known, a qualitative or quantitative discussion of the margin between the contingent state and the point where criticality could occur.

The CSE must ensure any conservatism in the evaluation is appropriate to ensure an adequate margin of safety. The discussion developed in the evaluation should be realistic and consistent with the description in the CSE, as well as the design descriptions. Excess conservatism can lead to overly restrictive controls that may prove to be unreliable. Just as excessive conservatism should be avoided, so should ambiguity. A simplified analytical model that bounds normal or abnormal conditions may be appropriate, but without adequate explanation of how it bounds the conditions being analyzed, other personnel (e.g., other NCS engineers, system engineers, design engineers, or process engineers) could misunderstand the analysis basis and consequently misapply the controls. In the evaluation discussion, all material forms and containers should be considered and discussed, including:

- Physical and chemical conversion of material forms
- Material movement completely through, or interacting with, the process
- All equipment and containers from boundary to boundary, including product withdrawal and waste or by-product collection

Again, the discussion may be presented in terms of a very simple analytical model, but the analyst should provide discussion on how the model bounds the various material forms and containers that could be present. When analyzing process equipment, there will most certainly be other process equipment in the vicinity that should be considered for interaction. Thus, the analyst must also consider interaction with adjacent equipment and provide appropriate discussion in the analysis for why interaction is or is not an NCS concern (in other words, why interaction should or should not be controlled). Where interaction must be controlled, the analyst must impose design features or administrative controls to limit interaction or present assumptions related to interaction that are valid and can be verified.

When the evaluation discussion for a given contingency in a CSE references an evaluation documented in a different CSE, an appropriately detailed summary of the evaluation must be included in the CSE being developed. It is not acceptable to simply document a reference to the other CSE. The summary must include a description of the process model or configuration considered in the other CSE, any calculational documents referenced in the evaluation, controls credited in the other CSE, and the basis for subcriticality of the contingency documented in the other CSE.

Reports of computational results are developed as separate documents that can be referenced. When referenced, the CSE must contain summary-level information sufficient to judge the thoroughness and applicability of the results referenced. The summary must be descriptive enough to allow determination of what is being modeled and the values or ranges of the parameters important to NCS, and it must include a justification for why these modeled values are sufficiently conservative when related to the process being evaluated. When such references are made, it is not necessary to repeat the analysis documented in the reference.

When national consensus standards, handbooks, or experiments are referenced, the reference should include those sections, tables, or figures in the cited document. A brief summary of the referenced information that provides the basis for applicability to the evaluation should also be included.

Controls should be selected based on their implementation simplicity, the ability to readily recognize their failure, and their reliability. When there are solely multiple controls on a single parameter, the analyst should ensure those controls are independent. All controls (including those from other CSEs), assumptions, and programs relied upon for ensuring subcriticality should be explicitly identified. Refer to **Appendix E** for additional discussion on the establishment of NCS controls. The evaluation statement shall conclude with an explicit statement that the contingency is subcritical for each contingency not shown to be incredible.

### 2.9.4 Related Features

Provide a list of related features that support the unlikelihood of the contingency, support the argument that it is not credible the contingency could lead to a criticality accident, or are factors in maintaining the contingent condition as subcritical. Only features that are credited or discussed in some way in the contingency analysis (either the Description or the Evaluation) should be presented here. This section is only intended to list related features and is not intended to provide detailed discussion or analysis. The contents presented in the related features subsections should be listed in a bulleted format. Controls listed that are from the CSE being developed/revised should include the verbatim content of the control, with some exceptions. Controls that include a long list of UNIDs, a long list of approved items that may be present, or a long list of approved contents may omit those lists (acknowledging the missing content). In addition, it is not necessary to include information from notes or exceptions in this section, unless relevant to that particular contingency.

Controls from other CSEs do not have to be listed verbatim, but the intent of the control from the other CSE should be captured. This is allowed as it is acknowledged that wording changes may occur to the other CSEs control language.

For controls and assumptions, a parenthetical statement at the end of the line should point to the numbered control, CSE, and/or assumption, such as (Control 6.X.X), (CSE-EN-801768-XXX-A001, Control 6.X.X), or (Assumption 6.7.X). The term "features" as used here is intended to mean any of the following:

- Controls in this CSE
- Controls in other CSEs
- Programs/Procedures
  - **Appendix D** provides a list of potential programs/procedures that may be cited
- Nature of the Operation
  - Nature of the Operation includes features or characteristics credited in the analysis that encompass two basic types of considerations: (1) "Nature of the Process," which is reliance on known operational processes, the actual form of fissile material, and the predicted behavior of the system according to known laws of nature (Y70-160, *Criticality Safety Approval System*); and (2) hardware features or procedurally controlled activities that constitute the way a process is designed to be operated in order to perform its intended function regardless of NCS considerations
  - The analyst must ensure factors cited as the nature of the operation will remain valid even though they are not imposed as NCS requirements. Operational or design restrictions necessary for NCS must be promulgated through NCS requirements or NCS-related programs. Nature of Operation arguments are appropriate for justifying the unlikelihood of conditions or as one of several barriers presented in justifying the safety of an activity or operation. Nature of Operation arguments shall not be the only justification for the safety of an abnormal condition
- Assumptions
  - An assumption is defined as "a property or characteristic that is accepted as being valid and that may not be directly controlled in the CSE"
  - "Bounding" assumptions that are made for the purposes of developing a conservative representation of the process/activity being analyzed are not to be listed here (e.g., 100% enrichment or optimum moderation)

## 2.10 CSE Section 5.4, Conclusion

The Conclusion is only intended to state the processes or activities being evaluated are safe from the perspective of NCS. A summary statement (see the following examples) should be provided as applicable:

- Process/activity will remain subcritical under normal and credible abnormal conditions
- A criticality accident is not credible in a particular area as part of a particular process/activity

- The risk of a criticality is trivial in a particular area as part of a particular process/activity. Therefore, CAAS coverage is not required

## 2.11 CSE Section 6, Credited Controls and Assumptions

### 2.11.1 General Guidance

This section summarizes the limits and controls derived by NCS evaluation as necessary to ensure NCS in the subject process or activity. The section includes requirements from the CSE being developed and from other CSEs. This section also summarizes good practice recommendations, fire-fighting guidance, CAAS coverage, Criticality Control Review (CCR) information, and assumptions.

The entire process analysis in Sections 5.1, 5.2, and 5.3 must be thoroughly reviewed to ensure all Passive Design Features (PDFs), ADFs, and administrative controls required are presented in this section. If a credited control is not listed, then the safety envelope upon which the analysis is based cannot be maintained in the field. When control limits are specified, ensure control limits are measurable or auditable. All NCS requirements must be reviewed to ensure they are not subject to common mode failure and any credible failure would be self-evident (i.e., not a hidden issue). **Appendix E** provides additional guidelines for writing NCS controls.

**NOTE:** *Controls are applied to equipment or the process handling fissile material. A control worded such as "The tank shall be designed to facilitate draining" is not concise, as the requirement applies to the tank and not to the process designing the tank. Also, listing a reason for the feature (e.g., "to facilitate draining," is not necessary). Instead, it is recommended the control be structured as "The tank shall have a sloped bottom with a drain at the low point."*

To ensure an operation is as safe as possible, the controls should be easy for Operations personnel to understand, convenient to follow, and readily recognizable if the control fails. If these attributes cannot be achieved, controls could be rendered unreliable and, worse yet, hidden failures could produce a more severe situation by slowly progressing as they remain hidden or combined with other failures that might occur in the same area. The potential controls should be discussed with affected Project organizations as early in the process as possible to help ensure a reliable and easy-to-follow control set.

Controls for periodic monitoring in accordance with the Uranium Holdup Survey Program (UHSP) should be established based on a safety limit most preferably in terms of $^{235}$U mass. The limit must be chosen with a reasonable safety margin from a critical state, but must also include sufficient allowance to permit implementation of UHSP count rate notification levels or mass notification levels that are well below the safety limit. The goal is to choose a subcritical limit that is far enough above what may be measured in the field to allow time for mitigation of the uranium accumulation without having to disrupt operations or handle the condition as a noncompliance with NCS requirements. More information on how to establish zones and masses is provided in **Appendix J**.

To the extent practicable, other evaluations should be reviewed for controls that are similar to ones required in the process/activity being evaluated. Controls that are similar should be presented as consistently as possible.

Sometimes requirements are given in one CSE that protect downstream processes. As an example, the shape of buttons is controlled in the process where they are produced and credited in storage analyses. When this is the case, the fact that the requirement is imposed in a process to protect conditions in other processes needs to be clearly presented in the requirement basis.

## 2.12 CSE Sections 6.1 and 6.2, Passive and Active Design Features

The PDFs and ADFs sections of a CSE (Sections 6.1 and 6.2, respectively) shall identify all PDFs/ADFs required by NCS for the processes or activities being analyzed. Each design feature presented in these sections must have been referenced as a control in one or more of the subsections of Section 5.0. If NCS requires no PDFs and/or ADFs for the processes or activities being analyzed, the CSE must state that fact explicitly.

The subsection format for each PDF listed is:

6.1.X <PDF Title>

Safety Function

Functional Requirement

Performance Criteria

6.1.X.1 <Individual Control>

<u>Exception</u> (for individual performance criterion)

Note:

6.1.X.n (Continue as needed)

<u>Exceptions</u> (for entire safety function or functional requirement)

Note:

The safety function is a statement that identifies the feature (e.g., maintain geometry control) that is being controlled to prevent a nuclear criticality accident. The functional requirements give additional detail about the capabilities of the equipment being credited without giving specific numeric values. The performance criteria are the collection of detailed limits that are being credited to prevent a nuclear criticality accident. These criteria document the actual controls that are applied to equipment via QLDs (Y15-95-200, *UPF Graded Approach to Quality*), and flowed into Technical Evaluations of Critical Attributes and Mitigations, and specifications. If applicable implementation strategies for a requirement already exist, the CSE author should familiarize themselves with the strategy for the requirement, and ensure it meets the intent/needs of the CSE, as written.

Exceptions that pertain to a specific performance criterion are to be presented directly following the applicable performance criterion. If the exception pertains to multiple performance criteria, they may be presented following the last performance criterion they are applicable to or following the last performance criterion in the section, as long as the performance criteria to which the exception applies to is included in the exception language.

Notes may be included for clarification of performance criteria. They must not be a source of hidden requirements, but should provide explanations, clarifications, or options.

The subsection format for each ADF listed is identical to the PDF format (other than numbering) and is:

6.2.X <ADF Title>

Safety Function

Functional Requirement

Performance Criteria

6.2.X.1 <Individual Control>

Exception (for individual performance criterion)

Note:

6.2.X.n (Continue as needed)

Exceptions (for entire safety function or functional requirement)

Note:

PDFs and ADFs are stated using "shall" statements. It is unnecessary to restate design features that are controlled in other CSEs, such as container CSEs, because any controls from other CSEs relied upon will be documented in Section 6.9.

A design feature may be stated as either a functional design requirement or as the design feature itself.

In cases where engineering analysis is needed to ensure the design feature can perform the intended function to limit a parameter to a subcritical value, the design feature must be presented in terms of the parameter being controlled and the maximum or minimum limit. As an example, rather than stating a requirement for the presence of a drain pipe, the drainage requirement is stated in terms of the function to limit collection of liquid to no greater than a specified depth. This clearly conveys the intent of the requirement to the engineers performing the analysis and provides the flexibility for the engineering discipline(s) to develop a design solution without unintended constraints.

Where PDF requirements are intended to specify equipment that is not capable of retaining liquids, the requirement must be written in such a way as to acknowledge that liquids have the capability to adhere to surfaces. In such cases, the requirement shall be written to specify a minimum depth or volume that accounts for liquid adhesion or the requirement language needs to acknowledge the acceptability of liquid adhesion. Examples include:

- The holding fixture shall have drainage features to limit liquid accumulation to no more than 0.5 in.

OR

- The holding fixture shall not be capable of retaining liquid beyond that expected from liquid adhesion to the surfaces of the fixture

Dimensional limits must be specified with enough margin to account for tolerances on dimensions and measurement uncertainty. In most cases, a maximum or minimum dimension can be specified to account for tolerance and uncertainty. If there are competing effects on the maximum and minimum side of the nominal dimension, a tolerance should be specified and justified in the NCS analysis.

A list of equipment to which a particular PDF or ADF is applicable may be included (following guidance provided in **Section 2.1.14, *Equipment Names and Unique Identifiers***) as part of the control documentation in this section. If the PDF or ADF is applicable to a small number (e.g., less than 10) of items or interconnected groups of equipment (such as multiple tanks or pumps on a single module), it is acceptable to include that equipment information in the control wording. A detailed list of equipment should not be included in the control documentation if the list is appreciably long to cause the control language to become unwieldy.

## 2.13 CSE Section 6.3, Administratively Controlled Limits and Requirements

The Administrative Control Limits (ACLs) and Requirements section of a CSE (Section 6.3) must identify all ACLs required by NCS for the processes or activities being evaluated. Each ACL in this section must have been referenced as a control in one or more of the subsections of Section 5. If NCS requires no ACLs for the processes or activities being evaluated, the CSE must state that fact explicitly.

The subsection format for each ACL listed should be as follows:

6.3.X <ACL Title>

6.3.X.1 <Individual Limit>

Basis

All administrative controls are stated using "shall" statements. The administrative controls must also be reviewed for consideration of design features that can accomplish the same function in a practicable manner. If this is possible, a new design feature is specified and the ACL revised or deleted. The basis statement for each ACL identifies the characteristic (parameter) being controlled. Ensure all PDFs/ADFs discussed in ACLs are listed in Sections 6.1 and 6.2, respectively, and that all ACLs required to support PDFs/ADFs are listed in Section 6.3. In addition, PDFs/ADFs must be reviewed for hidden ACLs.

In some cases, administrative requirements for the loading of fissile material in hoods, gloveboxes, or other workstations may contain multiple provisions (e.g., numerous containers, numerous forms, and mass limits depending on those forms). In those cases, the multiple provisions, if not properly worded, may allow unintended accumulations of fissile material. Therefore, all normal and abnormal condition evaluations for those areas must be carefully reviewed and verified so the full allowance provided under the limits is adequately evaluated.

## 2.14 CSE Section 6.4, Operational Good Practice Recommendations

List any operational good practice recommendations that are appropriate to the processes or activities being evaluated. An operational good practice recommendation, or "good practice" as defined in Y70-68-001, is a recommendation that provides additional control for criticality safety, but is not credited anywhere in the analysis. These are typically administrative actions and not physical features. Implementation of good practice recommendations is left to the discretion of the operating organization, and, therefore, cannot be credited in the NCS analysis. Because operational good practices are only recommendations and not credited in the analysis, they are denoted by the use of the word "should." Each operational good practice should be identified with a unique number (e.g., 6.4.X). Include a brief basis statement beneath each good practice recommendation. If there are no operational good practice recommendations, indicate such by explicitly stating, "There are no operational good practice recommendations identified for this CSE."

## 2.15 CSE Section 6.5, Fire Protection Guidance

The Fire Protection Guidance section of a CSE must document any relevant information that could be used to inform fire-fighting personnel of any NCS conditions or limitations. Because the UPF will be a new facility, UPF CSEs must develop and document these NCS conditions and limitations so they may be included, if necessary, in a future revision to Y/DD-708, *Nuclear Criticality Safety Guidelines for Firefighting in Y-12*. Table 1 of Y/DD-708 (recreated below as Table 5) identifies four different water use categories for firefighting response: Unrestricted, Water-Caution, Water-Sensitive, and Water Exclusion. This section of the CSE should identify which category the process is binned, but at the very least, the CSE will identify if a system or portion of the system (for example, a glovebox) falls into the Water-Sensitive or the Water-Exclusion categories.

**Table 5. Water Use Categories and Firefighting Response**

| Category | Nuclear Criticality Safety Characteristics | Firefighting Response |
|---|---|---|
| Unrestricted | No likelihood of criticality if water is used for firefighting. Quantity of fissile material is too small. | No restrictions on the use of water for firefighting. |
| Water-Caution (usually sprinklered) | Minimal likelihood of criticality if water is used for firefighting. Total fissile mass in area exceeds critical mass, but materials are usually distributed or in dilute solutions such that accidental criticality is unlikely. Criticality controls such as geometry, volume, or concentration controls exist in these areas. | If feasible, use gaseous or dry chemical extinguishing agents to fight fires in Water-Caution Areas. If water must be used in Water-Caution Areas, then follow the guidelines given in Sect. 2.5.5 of Y/DD-708, "General Guidelines If Water Must Be Used." |
| Water-Sensitive | Under credible conditions, the addition of firefighting water could cause criticality. For example, firefighting with water could result in rearrangement of material, which in the presence of firefighting water might cause criticality. Moderation, reflection, and/or interaction control exists as one leg of double contingency in these areas. | If feasible, use gaseous or dry chemical extinguishing agents to fight fires in Water-Sensitive Areas. Use of water in Water-Sensitive Areas should be limited to pre-planned use or as a last resort to prevent a more severe consequence. If water must be used, then follow the guidelines given in Sect. 2.5.3 of Y/DD-708, "Water-Sensitive Areas." |
| Water-Exclusion (no water) | Fissile materials are present under moderation control to prevent criticality. | Water should not be used. Gaseous (such as carbon dioxide) or dry |

| Category | Nuclear Criticality Safety Characteristics | Firefighting Response |
|---|---|---|
| | Addition of water might be expected to remove all nuclear criticality safety controls. Examples are the inside of Enriched Uranium Operations (EUO) gloveboxes or hoods and both the inside and outside of process exhaust filter houses and baghouses. | chemical extinguishers and coke powder are acceptable. See Sect. 2.5.4 of Y/DD-708, "Water-Exclusion (No Water) Areas," for additional guidance. |

Additionally, any clarifications or guidance that may be useful to fire protection personnel is provided in this section. The CSE should explicitly state any fire-fighting or fire system guidance differing from the general guidelines if water must be used as stated in Y/DD-708, and provide a rationale for the differing guidance. Specialized manual fire-fighting guidance (i.e., any differing from those stated in Y/DD-708) should be minimized.

**NOTE:** *In the determination of process category designation, the CSE analyst should consider the following:*

- *The water density of a fire hose stream may be much higher than that expected from a sprinkler*
- *Additionally, the force behind a fire hose stream might move loose uranium, unrestrained #3, #4, and #5 cans, shipping containers, and carts with wheels*
- *How close to the USL are Design Analysis and Calculation (DAC) calculation models involving sprinkler effects, how fast are keff values changing with interstitial water addition to the model of the equipment/room*
- *Do the calculation models used in the fire contingency evaluation have a wealth of other conservative modeling techniques employed (more tanks, inline components, piping, mobile items, than really exist)*
- *Airlocks and hoods may have less fissile items allowed than attached glovebox, and thus not warrant as high a category as the glovebox*
- *Does the CSE scope encompass an entire room, or does the CSE share boundaries with other CSEs within the room*

The following are examples of process category designations:

- 6.5.X The interior of the Process XXX Glovebox Assembly (9226-XX-R-6000, 9226-XX-R-7000, and 9226-XX-R-8000) is a Water Exclusion area
- Basis: The DAC that supports these areas did not account for the increased water density associated with firefighting water hoses, and the glovebox has kg quantities of loose uranium
- 6.5.X The Room XXX Floor Storage Array (9226-XX-R-6000, 9226-XX-R-7000, and 9226-XX-R-8000) is a Water Sensitive area
- Basis: The containers/items in the array are administratively spaced from other fissile material within this room. The DAC supporting these arrays has been shown to remain subcritical through a full range of interstitial water moderation via sprinklers but does not consider simultaneous interaction/spacing reduction
- 6.5.X The Room XXX/Process XXX Hazardous Liquid Process Room (HLPR) is a Water-Caution area

- Basis: Fissile material within this room is in secure safe geometry pipes, safe geometry tanks, and safe volume inline components. The DAC supporting these modules has been shown to remain subcritical through a full range of interstitial water moderation via sprinklers

## 2.16 CSE Section 6.6, CAAS Coverage and Immediate Evacuation Zone

The CAAS Coverage and Immediate Evacuation Zone section of a CSE must document the status of CAAS coverage for the processes or activities being analyzed. This documentation must also include any conditions that could create potential CAAS coverage issues (e.g., use of temporary equipment in an area) or any conditions that could affect the immediate evacuation zone (e.g., construction activities in a neighboring facility). Finally, this section should identify the processes or activities where CAAS coverage is not required because the risk of criticality has been established as "not credible" in the Contingencies section, or because of a judgment that the risk of criticality in an area is sufficiently low that it presents a "trivial risk." Approval from the Chief NCS Engineer is required if establishing a "trivial risk" justification or if CAAS coverage is required but non-existent. Approval is indicated by the Chief's signature on the Approval Page of the CSE. If CAAS coverage is required but non-existent, the creation of appropriate UPF design change documentation is required.

One of the following standardized statements should be used as the basis of CAAS coverage:

1. For activities within the UPF, the typical statement is: "For the <process/activity/equipment> evaluated in this CSE, CAAS coverage is required due to the expected or potential presence of uranium material in excess of the limit defined in ANSI/ANS-8.3-1997 (R2012), *Criticality Accident Alarm System*, Sect. 4.2.1, '… in which the inventory of fissionable materials in individual unrelated areas exceeds 700 g of U-235, 500 g of U-233, 450 g of Pu-239, or 450 g of any combination of these three isotopes.' There are no exceptions to coverage requirements within the scope of this CSE. RP-EN-801768-A034, *UPF Criticality Accident Alarm System (CAAS) Technical Basis*, provides the technical basis to demonstrate adequate CAAS coverage for all areas associated with the <process/activity/equipment>. RP-EN-801768-A034 also provides analyses to establish areas including (and extending beyond) the <process/activity/equipment> process areas that require immediate action to protect personnel in the event of CAAS actuation."
2. When a "trivial risk" or "not credible" argument has been presented in Section 5 of the CSE to demonstrate that CAAS coverage is not warranted for a specific area or activity, identify the area/activity and include a summary of the rationale in this section. This is discussed further in **Appendix F**

## 2.17 CSE Section 6.7, Assumptions

The Assumptions section of a CSE summarizes the assumptions used to support the evaluation of the process or activities. The assumptions section includes, at minimum:

- Assumptions created in the CSE
- Relevant assumptions from any referenced calculations that support the CSE

The subsection format for each Assumption is:

6.7.X

Description

Justification

Recommended Confirmation Method

The Description must be a clear and concise statement of the Assumption. The Justification must document why the assumption is conservative and why it is appropriate for use in the CSE. If confirmation of an assumption is necessary, the Recommended Confirmation Method describes the expected deliverable that will allow verification of the Assumption (such as a calculation or datasheet), but a specific document number does not need to be mentioned. For those assumptions that do not require confirmation, it is acceptable to enter "No confirmation required" in this section. Assumptions from committed DACs may be referenced without repeating the justification and confirmation method, provided that the specific reference to the DAC is made.

See **Appendix G** for standard wording recommended for some assumptions that are applicable to most UPF CSEs.

When revising a CSE, or when developing a DCN to update a CSE (at NCS management's discretion), effort should be taken to close as many assumptions requiring confirmation as possible.

## 2.18 CSE Section 6.8, Criticality Control Review

The CCR section of a CSE contains the CCR Table applicable to the CSE. Guidance for creating a CCR Table is provided in **Appendix H**. A CCR Table template is provided in **Attachment 2**.

## 2.19 CSE Section 6.9, Requirements from Other Criticality Safety Evaluations

This section of a CSE contains a table that identifies all external CSE requirements that are relied upon to ensure the processes or activities being evaluated will remain subcritical under normal and credible abnormal conditions. This "External Requirements Summary Table" should have three or four column headers as conveyed in **Table 6**. The fourth column ("Additional Information") is included only if needed.

**Table 6. Other Requirements**

| CSE Referenced | Control Number in Referenced CSE or Assumption Number Pointing to an Expected Future Control | Requirement Wording | Additional Information |
|---|---|---|---|

If the system contains some equipment, piping, etc., for which another CSE requirement is not being utilized, that information needs to be provided in the table as an exception. For example, if all pipes in your system except two utilize a spacing requirement from CSE-EN-801768-GEND-A001, *Criticality Safety Evaluation of UPF*

*General Design Requirements*, then specifically state those two pipes as an exception to that requirement in the "Additional Information" column. Do not add this information to the "Requirement Wording" column.

**NOTE:** *The requirement wording from other CSEs may not match the control language from the CSE verbatim, but needs to capture the intent, as stated in* ***Section 2.9.4,*** **Related Features***. Applicable DCNs must be reviewed to ensure the latest control information is included.*

## 2.20 CSE Section 7, References

A list of all references, including any technical data, reports, or documents referenced for evaluation, must be included. It is important that all references be readily retrievable. For UPF or Y-12 generated documents, the company name should be omitted from the reference, and "Y-12 National Security Complex, Oak Ridge, TN" is sufficient. Where reference is made to a document that is not a nationally recognized standard or report, the reference must be filed as a Quality Record. References must have their repository location identified in square brackets at the end of each reference entry. Examples of repository locations include, but are not limited to, the following:

- InfoWorks
- ProjectLink
- NCS Computer Archives
- SAP Document Management System
- Oak Ridge National Laboratory (ORNL) Research Library
- Y-12 Document Management Center

References are divided into two parts: Referenced Documents (Section 7.1) and Source Documents (Section 7.2). Referenced Documents for a CSE include all references that cannot be categorized as a Source Document. Source Documents for a CSE include the following types of references:

- SDDs
- Process Flow Diagrams
- P&IDs
- Material Handling Diagrams
- Equipment Location Drawings
- General Arrangement Drawings
- Other Drawings

Private communications are not acceptable references. Also, "daisy chained" references, where the document being referenced cites one or more documents in a reference chain for the relevant information, must be avoided. In these situations, the analyst must reference each document that presents the relevant information directly.

The references must include other CSEs whose controls are credited in the process analysis and whose evaluation is referenced in the process analysis. This will ensure the NCS Reference Database is updated and will ensure when a CSE is revised, the analyst can properly identify the CSEs that might be impacted by the change to that particular CSE.

When using a DAC as a reference, its status (e.g., confirmed, committed) needs to be identified as part of the reference. Preliminary DACs and other preliminary design input documents are not acceptable references for a CSE.

Regarding the documentation of revision numbers and dates for references, if a reference document has a revision number, it is adequate to document that revision number; no date is necessary. If a reference document does not have a specific revision number, then the date typically serves as the version identification, so the date must be included in the reference documentation.

Drawing change notices that impact the analysis of the CSE must be included with the referenced drawing. It is not necessary to include drawing change notices that have no NCS-related impacts.

### 2.21 CSE Appendices and Addenda

Appendices and addenda may be included at the end of the CSE, as applicable. Appendices generally contain supplemental information and are designated by letter (e.g., Appendix A, B, C). Addenda are generally designated by number (e.g., Addendum 1, 2, 3). The Criticality Safety Process Study (CSPS)/NCS DC-to-CSE Requirements Matrix, which was necessary for the initial version of all UPF CSEs with a predecessor CSPS, is not necessary for subsequent revisions of CSEs.

## 3.0 RECORDS

None

## 4.0 REFERENCES

### 4.1 Source References

None

### 4.2 Interfacing References

ANSI/ANS-2.26-2004 (R2010), *Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design*

ANSI/ANS-8.1-2014, *Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors*

ANSI/ANS-8.21-1995 (R2011), *Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors*

ANSI/ANS-8.3-1997 (R2012), *Criticality Accident Alarm System*

CCG-425, *The Criticality Safety of Water-Moderated, Water-Reflected Uranium Metal of Various Shapes and Sizes*

CSE-EN-801768-FLM-A001, *Criticality Safety Evaluation for the Facility Liquid Management System*

CSE-EN-801768-GEND-A001, *Criticality Safety Evaluation of UPF General Design Requirements*

CSE-EN-801768-LTC-A001, *Criticality Safety Evaluation for the Liquid Transfer Cart Use*

CSE-EN-922600-BASS-A001, *Criticality Safety Evaluation for Break & Shear Sampling*

CSE-EN-922600-EXT-A001, *Criticality Safety Evaluation for Solvent Extraction Operations*

DAC-EZ-922600-F060, *Water Density in Air Resulting from Fire Suppression System Actuation*

DE-PE-801768-A002, *UPF Building and Fire Code Design Criteria, Chapter 2, Section 100 of the UPF Design Criteria*

DE-PE-801768-A007, *UPF Facility Safety Design Criteria, Chapter 2, Section 600 of the UPF Design Criteria*

DE-PE-801768-A025, *UPF Fire Protection Design Criteria, Chapter 3, Section 400 of the UPF Design Criteria*

DE-PE-801768-A036, *UPF Fire Protection Services Design Criteria, Chapter 4, Section 400 of the UPF Design Criteria*

DOE O 420.1C, *Facility Safety*

DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*

DOE-STD-1066-2012, *Fire Protection*

DOE-STD-3007-2017, *Preparing Criticality Safety Evaluations at Department of Energy Nonreactor Nuclear Facilities*

DSA-EF-801768-A001, *Documented Safety Analysis for the Uranium Processing Facility*

ECP-EG-801768-D391, *Addition of NCS Admin Controls to FMCS Software Requirements Specification*

E-PROC-3056, *Initial Testing and In-Service Surveillance*

E-PROC-0012, *Enterprise Conduct of Operations*

E-SD-0001, *Conduct of Engineering Program*

E-SD-0003, *Configuration Management Program*

E-SD-2008, *CNS Nuclear Maintenance Management Program*

FH-EF-801768-A003, *Fire Hazards Analysis of the Uranium Processing Facility*

GU-PM-801768-A009, *UPF Style Guide*

RP-EG-801768-A136, *LIFT System Cranes and Zones of Influence*

RP-EN-801768-A034, *UPF Criticality Accident Alarm System (CAAS) Technical Basis*

RP-EN-801768-B003, *Application of Defense-in-Depth Control Strategy for NCS Regarding Design Basis Fire Events*

UCN-23408, *UPF CSE Hazard Evaluation Checklist*

Y/DD-708, *Nuclear Criticality Safety Guidelines for Firefighting in Y-12*

Y14-001, *Conduct of Operations Manual*

Y15-014, *Uranium Holdup Survey Program*

Y15-232, *Technical Procedure Process*

Y15-95-200, *UPF Graded Approach to Quality*

Y20-NM-010, *Manual for the Control and Accountability of Nuclear Material (U)*

Y60-95-102PD, *UPF Quality Assurance Program Description*

Y70-150, *Nuclear Criticality Safety Program*

Y70-160, *Criticality Safety Approval System*

Y70-162, *Inadvertent Accumulation Prevention Program*

Y70-68-001, *Criticality Safety Approval/Requirements Development, Review, and Approval*

Y79-001, *Y-12 Fire Protection Program Manual*

Y79-002, *Welding, Burning, and Hotwork Operations*

# 5.0 SUPPLEMENTAL INFORMATION

Appendix A, *Acronyms and Definitions*

Appendix B, *Seismic Contingency Guidance*

Appendix C, *Design Basis Fire Contingency Guidance*

Appendix D, *Plant Programs Credited by NCS*

Appendix E, *NCS Control Generation*

Appendix F, *Analyses Requiring Special Authorization*

Appendix G, *Standard Assumption Wording*

Appendix H, *Criticality Control Review (CCR) Table Guidance*

Appendix I, *CSE Interaction Analysis*

Appendix J, *CSE Analysis of Gradual Uranium Accumulations*

Appendix K, *FMCS Guidance*

Attachment 1, *Seismic Contingency Template*

Attachment 2, *Criticality Control Review (CCR) Table Template*

Attachment 3, Design Basis *Fire Contingency Template*

Attachment 4, *CSE Cover Page and Approval Page Formatting*

# APPENDIX A
# Acronyms and Definitions
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## Acronyms

| | |
|---|---|
| **ACL** | Administrative Control Limit |
| **ADF** | Active Design Feature |
| **ANS** | American Nuclear Society |
| **ANSI** | American National Standards Institute |
| **BAS** | Break & Shear |
| **BMO** | Bulk Metal Oxidation |
| **CAAS** | Criticality Accident Alarm System |
| **CCR** | Criticality Control Review |
| **CM** | Configuration Management |
| **CNS** | Consolidated Nuclear Security |
| **CONOPS** | Conduct of Operations |
| **CSE** | Criticality Safety Evaluation |
| **CSPS** | Criticality Safety Process Study |
| **DAC** | Design Analysis and Calculation |
| **DBF** | Design Basis Fire |
| **DC** | Design Criteria |
| **DCN** | Document Change Notice |
| **DG** | Design Guide |
| **DOE** | U.S. Department of Energy |
| **ECP** | Engineering Change Proposal |
| **FHA** | Fire Hazards Analysis |
| **FLM** | Facility Liquid Management |
| **FM** | Factory Mutual |
| **FMCS** | Facility Monitoring and Control System |
| **FPP** | Fire Protection Program |
| **FS** | Filter and Separate |
| **GEND** | General Design Requirements |
| **HCON** | Highly Enriched Uranium Materials Facility Connector |
| **H/U** | Hydrogen-to-Uranium |
| **HEPA** | High-Efficiency Particulate Air |
| **HLPR** | Hazardous Liquid Process Room |
| **HSVAC** | Housekeeping Vacuum |
| **IAPP** | Inadvertent Accumulation Prevention Program |
| **IOI** | Item of Interest |
| **ITISS** | Initial Testing and In-Service Surveillance (program) |
| **kg** | kilogram |
| **LGEA** | Large Geometry Exclusion Area |
| **MPB** | Main Process Building |

# APPENDIX A
# Acronyms and Definitions
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| | |
|---|---|
| **NCS** | Nuclear Criticality Safety |
| **NDA** | Non-Destructive Analysis |
| **NMC&A** | Nuclear Materials Control and Accountability |
| **NMMP** | Nuclear Maintenance Management Program |
| **NPE** | Natural Phenomena Event |
| **NPH** | Natural Phenomena Hazard |
| **ORNL** | Oak Ridge National Laboratory |
| **P&ID** | Piping and Instrumentation Diagram |
| **PDF** | Passive Design Feature |
| **PSB** | Personnel and Support Building |
| **QA** | Quality Assurance |
| **QLD** | Quality Level Determination |
| **SAB** | Salvage and Accountability Building |
| **SAE** | Safety Analysis Engineering |
| **SDD** | System Design Description |
| **SMP** | Special Material Production |
| **SOX** | Special Oxide |
| **UHSP** | Uranium Holdup Survey Program |
| **UNID** | Unique Identification |
| **$UO_2$** | Uranium Dioxide |
| **UPF** | Uranium Processing Facility |
| **USL** | Upper Subcritical Limit |
| **Y-12** | Y-12 National Security Complex |

## Definitions

**NOTE:** *With the exception of the Double Contingency Principle, all definitions originate from Y70-68-001, Y70-160, or Y70-150,* Nuclear Criticality Safety Program.

| | |
|---|---|
| **Active Design Feature (ADF)** | A design feature that relies on external mechanical and/or electrical power, signals, or forces to cause a change from normal to safety state of the design feature; any design feature that is not passive is active. |
| **Assumption** | A property or characteristic that is accepted as being valid and that may not be directly controlled in the CSE. |
| **Barrier** | Any control, feature, or operational practice that impedes the progression of an event that could have a negative impact on criticality safety. |
| **Contingency** | A credible but unlikely change in process conditions important to the NCS of a fissionable material. |
| **Depleted Uranium** | Uranium containing less $^{235}U$ than the concentration found in natural uranium. |

# APPENDIX A
# Acronyms and Definitions
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| | |
|---|---|
| **Double Contingency Principle** | In accordance with ANSI/ANS-8.1, *Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors*, Section 4.2.2, "Process designs should incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible." |
| **Enriched Uranium** | The strict technical definition of enriched uranium is any uranium containing more $^{235}U$ than the naturally occurring distribution of uranium isotopes (natural uranium). For the purpose of the Y-12 NCS Program, enriched uranium is regarded as any uranium containing more than 0.93 weight percent $^{235}U$. |
| **Fire** | For the purpose of this DG, a fire is an event that may result in the activation of fire suppression sprinklers or may require the use of local agents (e.g., extinguisher) to control, but that would not evolve to the point where immediate response from fire department personnel using specialized equipment is necessary to extinguish the fire. As such, it is incumbent on the NCS analyst to consider in the CSE the conditions that could result from a fire. Such conditions may include ingress of water, presence of carbon intermixed with uranium, oxidation of uranium, and limited dispersion of uranium powder. |
| **Fissile Control Area** | A designated area within which fissile material activities are conducted. |
| **Fissile Material** | Any material capable of supporting a self-sustaining neutron chain reaction. The term "fissile" has a strict technical definition related to the energy of a neutron causing fission, and this definition is met by $^{233}U$, enriched uranium, $^{239}Pu$, $^{241}Pu$, $^{242m}Am$, $^{243}Cm$, $^{245}Cm$, $^{247}Cm$, $^{249}Cf$, and $^{251}Cf$. Although they do not meet the strict technical definition of fissile, $^{237}Np$, $^{238}Pu$, $^{240}Pu$, $^{242}Pu$, $^{241}Am$, $^{243}Am$, and $^{244}Cm$ are considered fissile materials for the purpose of the Y-12 NCS Program. |
| **Fissile Material Operation** | Any activity involving the receipt, handling, possession, storage, processing, or transport of fissile material. |
| **Good Practice** | A recommendation that provides additional control for criticality safety but is not credited in the analysis. Implementation of good practice recommendations is left to the discretion of the operating organization responsible for the activity and, therefore, cannot be credited in the NCS analysis. Good practice recommendations are presented as "should" statements. |
| **Natural Uranium** | The naturally occurring distribution of uranium isotopes of approximately 0.711 weight percent $^{235}U$, with the remainder essentially $^{238}U$. |
| **Nature of the Operation** | Features or characteristics credited in an analysis that encompasses two basic types of considerations:<br>1. "Nature of the Process" (as defined here)<br>2. Hardware features or procedurally controlled activities that constitute the way a process is designed to be operated in order to perform its intended function, regardless of NCS considerations |
| **Nature of the Process** | The reliance on known operational processes, the actual form of fissile material, and the predicted behavior of the system according to known laws of nature. |

# APPENDIX A
# Acronyms and Definitions

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| | |
|---|---|
| **Not Credible** | Reliance on commonly accepted engineering judgment that there are no realistic combinations of abnormal conditions that could lead to a critical configuration; or, in the case of a contingency analysis in a CSE, reliance on commonly accepted engineering judgment that it is not believable that the postulated contingent condition could occur. Application of "not credible" is subjective. In the case of applying "not credible" to the release of process materials from a building with a credible potential for a criticality accident, the Chief NCS Engineer must approve the rationale. When used in an NCS context, "incredible" is synonymous with "not credible." |
| **Parameter** | A physical property that affects the nuclear reactivity of a system. |
| **Process Analysis Requirement** | From ANSI/ANS-8.1, Section 4.1.2, "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 be subcritical under both normal and credible abnormal conditions." |
| **Robust** | As used in the context of design feature requirements, a "robust" design feature is one under configuration control that is graded according to the function it performs for NCS. |
| **Trivial Risk** | Reliance on commonly accepted engineering judgment that the risk of a criticality accident in an area is sufficiently low that coverage by the CAAS is not warranted. Such determination must consider realistic combinations of abnormal conditions and conclude that it is not reasonable to expect that the factors preventing a criticality accident could be compromised to such an extent that a critical configuration would be possible. Application of "trivial risk" is subjective; the Chief NCS Engineer must concur with the rationale for trivial risk. |
| **Unlikely** | The attribute of being improbable on the basis of commonly acceptable engineering judgment. |

# APPENDIX B
# Seismic Contingency Guidance

(Page 1 of 2)

The following discussion is meant to provide the analyst with guidance on addressing the evaluation of a seismic event.

**Seismic Event Consequences**

As an initiating event, a seismic event is likely to cause loss of controls associated with geometry (containment), interaction, reflection, and possibly moderation parameters. Controls associated with mass and concentration are not likely to be compromised by a seismic event. Depending on the system configuration, consequences that need to be considered for inclusion as an abnormal event resulting from a seismic event include the following:

- Loss of integrity (either container or system) resulting in exposure to atmosphere, with potential subsequent exposure to sprinkler(s)
- Loss of structural integrity, resulting in a spill of material (e.g., spill of material from a storage tank)
- Loss of containment, resulting in a spill of material (e.g., container of material falls over)
- Loss of structural integrity, resulting in decreased spacing:
  - Between containers of Special Nuclear Material (e.g., in a rack)
  - Between system components (e.g., in an array of tanks)
- Loss of system integrity that results in accidental sprinkler activation
- Loss of system integrity that results in a DBF (e.g., electrical panel failure near combustible waste)

**Seismic Event Evaluation**

With the exception of nearby maintenance cranes and hoists, evaluation of the consequences of a seismic event is limited to direct involvement of the system being evaluated. Thus, the potential impact of a nearby piece of equipment, with the exception of the cranes and hoists, is not evaluated (e.g., overhead equipment falling onto a glovebox being evaluated), while the impact from equipment within the system being evaluated is (e.g., one tank of a storage array leaning against another tank within the array). The only additional exception to this is the introduction of moderator from a failed sprinkler system.

**<u>NOTE:</u>** *For information concerning maintenance cranes and hoists, consult RP-EG-801768-A136,* LIFT System Cranes and Zones of Influence*, for identification of items that do not meet seismic requirements, and therefore have the potential to fail during a seismic event potentially impacting items identified in the zone of influence.*

# APPENDIX B
# Seismic Contingency Guidance
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Each safety function listed in Sections 6.1 and 6.2 of the CSE needs to be evaluated to determine if it is possible for the seismic event to cause loss of that safety function. If the safety function is credited to maintain subcriticality under normal conditions, and the seismic event has the potential to cause loss of that safety function, the safety function should be seismically qualified. If the safety function is only credited to maintain subcriticality under a contingent condition that is not expected to occur because of a seismic event, the safety function should not be seismically qualified. Some safety functions cannot be seismically qualified (e.g., geometry control on glass tanks). The safety function of containing and limiting the diameter of material in glass tanks will not survive a seismic event. Therefore, the seismic contingency must evaluate the complete loss of this safety function and show that the operation remains subcritical.

The following outline summarizes the guidance for addressing the seismic event in the CSE. Note that suggested wording is provided in the CSE Seismic Template.

1. Determine possible consequences of a seismic event on subcriticality
2. Consider the ways a seismic event might affect parameters of interest to the CSE, specifically considering ways that a seismic event might adversely affect multiple parameters concurrently (e.g., moderation and interaction)
3. Determine seismic qualification of design features
4. Require controls to be seismically qualified if both of the following conditions are met:
   A. They are credited to maintain subcriticality under normal conditions
   B. The seismic event has the potential to cause loss of that safety function

**NOTE:** *It is not common for a seismic event to result in new design features.*

5. Identify related features
6. Any item in the list of related features must have been previously cited in the description or evaluation subsections:
   A. Specific controls cited in the CSE
   B. Specific controls cited in other CSEs
   C. Programs/procedures that provide control of certain feature(s)
   D. Factors associated with the nature of the operation
   E. Assumptions

Refer to **Attachment 1** to view the template that corresponds with this guidance.

# APPENDIX C
# Design Basis Fire Contingency Guidance

(Page 1 of 3)

NCS analyses must evaluate the potential for a fire event (ranging from small, incipient fires, up to and including the DBF for each process) as a credible abnormal process condition. Y70-150 requires that "Fissile material activities shall be evaluated to demonstrate that they are subcritical under both normal and credible abnormal conditions." RP-EN-801768-B003, *Application of Defense-in-Depth Control Strategy for NCS Regarding Design Basis Fire Events*, provides the approach for NCS evaluation of fire events at the UPF (from small fires to design basis fires) by application of a defense-in-depth control structure that satisfies the requirements of Y70-150.

The following discussion is meant to provide the analyst with a logical progression of steps to be taken for evaluation of fire as an abnormal event.

**Description of the Contingent Configuration**

The discussion starts with a recognition that small (incipient) fires can occur, but they are not a credible threat to damage fissile operations and do not challenge subcriticality. Fires that progress beyond the incipient stage are considered credible events that might damage NCS-credited process equipment. A fire that could grow unmitigated to a size sufficiently large to result in damage to process equipment is considered a credible event that is unlikely to occur (i.e., a contingency). The inner and middle layers of defense-in-depth provides the basis for considering it unlikely for an unmitigated fire to develop and grow to the point that could result in failure of process equipment important to NCS.

The inner layer of defense-in-depth provides the basis for considering it unlikely for an unmitigated fire to develop and grow to the point that could result in failure of process equipment important to NCS. The inner layer of defense-in-depth consists of the fundamental aspects of design, construction, and operations that minimize the potential for an incipient fire, which could grow to a DBF that is capable of challenging fissile material equipment integrity.

The middle layer of defense-in-depth includes UPF-wide operational requirements identified in the Fire Hazards Analysis (FHA). These requirements address vulnerabilities that potentially exist even if the inner layer of defense-in-depth requirements are satisfied. These requirements are presented in Section 4.3 of FH-EF-801768-A003, *Fire Hazards Analysis of the Uranium Processing Facility*, and are independent of NCS considerations. These requirements are slated to be implemented by Y79-95-001, *UPF Fire Protection Program*, including:

- Combustible loading controlled
- Restrictions on forklifts
- Allowance for only metal, non-combustible pallets

Violation of a particular Fire Protection Program (FPP) requirement does not necessarily result in a fire, nor loss of Item of Interest (IOI); instead, this layer of defense-in-depth is degraded but still capable of providing general protection against significant fire events.

The CSE Fire Template (**Attachment 3**) contains suggested wording to establish the unlikeliness in a consistent manner.

# APPENDIX C
# Design Basis Fire Contingency Guidance
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**Evaluation**

The first aspect for evaluating the impact of a DBF for NCS is to determine the possible consequences of a fire on subcriticality. This is accomplished by considering the ways a large fire might affect the parameters of interest as identified in the CSE, particularly the ways that a fire might adversely affect multiple parameters concurrently (e.g., moderation and interaction). To evaluate the impact, the basis for unprotected features must be established. This is accomplished by identifying the basis for subcriticality for all aspects of the system that are subcritical based on independent controls, regardless of the extent of local damage (e.g., systems independently controlled to < 700 g). Once this has been accomplished, then the NCS IOIs that require protection from potential damage in a DBF can be identified. IOIs are those physical attributes of a system structure or component (e.g., glovebox structure maintaining spacing to the floor) whose applied performance criteria must function during and after the contingent fire, thus maintaining a subcritical configuration under abnormal conditions. Some fissile operations are controlled independently of fire considerations so the system remains subcritical regardless of the extent or type of damage that might be incurred in a fire.

Thus, if the scenario involving a particular feature can be evaluated and shown to be subcritical and requires a second unlikely event to occur before criticality is possible, then the item in question is not an IOI. This applies most commonly to operations that are under mass control to ensure safe mass values with optimal moderation and full reflection.

Once the IOIs have been established, the next portion of the CSE involves developing the basis for IOI failure being unlikely because of defense-in-depth attributes. This is accomplished by identifying the inner and middle layers of the defense-in-depth control structure, identified in RP-EN-801768-B003, that demonstrate IOIs maintain their functionality given the contingent event and the size of any fire that may occur is mitigated, respectively.

The final credited layer of protection is known as the outer layer of defense-in-depth. The outer layer provides controls specifically related to NCS IOIs with area wet pipe sprinklers that are credited as part of the mitigation and suppression layer of defense-in-depth. Sprinkler activation removes heat and prevents damage in most areas and minimizes the chance of damage even in cases where sprinkler effectiveness may be reduced. For those areas or scenarios where sprinkler protection may not provide reliable suppression, additional specific controls may be required that will ensure robust protection of NCS IOIs. The controls may include both design features that are unique to a specific operation and additional administrative controls.

The following outline summarizes the guidance provided for addressing the evaluation of a fire event in the CSE. Note that suggested wording is provided in the CSE Fire Template (**Attachment 3**).

1. Identify ways a DBF can result in process condition changes in one or more NCS parameter(s)
2. Consider the ways a DBF might affect parameters of interest to the CSE, specifically considering ways that a fire might adversely affect multiple parameters concurrently (e.g., moderation and interaction)

# APPENDIX C
# Design Basis Fire Contingency Guidance

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3. Identify basis for unprotected features
4. Identify and document the basis for subcriticality for any aspects of the system that are subcritical based on independent controls, regardless of the extent of local damage (e.g., systems independently controlled to < 700 grams 235U)
5. Identify NCS IOIs that must satisfy their performance criteria during and after the DBF
6. Identify aspects of the system whose performance criteria must maintain functionality during and after the postulated fire to ensure subcriticality
7. Develop the basis for IOI failure being unlikely because of defense-in-depth attributes
8. Identify the Inner and Middle Layers of the NCS defense-in-depth control structure (e.g., combustible loading limits) that demonstrates IOIs maintain their functionality given the contingent event and the size of any fire that may occur is mitigated, respectively. Additionally, identify the Outer Layer attribute(s) that ensures IOI performance criteria functionality failure is unlikely even with failure of the Inner and Middle Layers, including:
    A. Specific controls (Engineered Design Features implemented as either Specific PDFs or as broadly applicable NCS Design Criteria [DC]/General Design Requirements [GEND]) that limit the fire and prevent damage in areas where sprinkler effectiveness may be reduced
    B. Sprinkler activation that removes heat and prevents damage in most areas, and minimizes the chance of damage even in cases, such as those in Item A
    C. Added layers of mitigation provided by emergency response that are present but not part of the NCS defense-in-depth controls structure

With Steps 1 through 4 completed, the IOIs are identified along with the control structure necessary to protect the IOIs and ensure subcriticality during and after a DBF event. The loss of an IOI due to a DBF is shown to be unlikely.

Refer to **Attachment 3** to view the template that corresponds with this guidance.

# APPENDIX D
# Plant Programs Credited by NCS

(Page 1 of 4)

This appendix contains a list of plant programs that may be credited in a CSE. Before a program is referenced in a CSE for ensuring a condition relevant to NCS is being met, the NCS analyst must verify that the program does impose requirements that protect the condition being discussed in the CSE.

**NOTE:** *The initial revision of many CSEs credit the Technical Procedure Program described within this section. Not all procedures that may implement controls from CSEs fall under this program. Administrative controls may also be implemented in surveillance procedures, administrative procedures, or other operating organization documents. These documents are reviewed by NCS to confirm that controls are properly implemented before being made effective. When discussing the failure of an administrative control, it is recommended that credit for the Conduct of Operations (CONOPS) Program be discussed to supplement the reason procedural failures are minimized.*

**Conduct of Engineering Program**

The engineering process is relied upon to provide design features that are robust from an NCS perspective. The Conduct of Engineering Program works along with the CM Program to ensure PDFs and ADFs are designed properly and implemented in a manner that ensures they remain functional for the lifetime of the process. Conduct of Engineering addresses engineering design work and deliverables to ensure appropriate design inputs, such as requirements for PDFs and ADFs designated in CSEs, are adequately incorporated into design, verified, tested, and documented. Additionally, the program ensures design change control and the incorporation of safety, quality, and operability/functionality into the design. Features relied upon for the engineering process include:

- Design of robust piping systems that have properly designed and located fittings, flanges, and welds such that the constructed features are free of leaks or that joints that are potential leak points are located in an LGEA
- Design of anchorage and supports for fissile-material-bearing equipment to meet seismic DC requirements
- Material compatibility such that the likelihood of leaks or failure is low

Details of the Conduct of Engineering Program can be found in E-SD-0001, *Conduct of Engineering Program*.

**Conduct of Operations Program**

The CONOPS Program is an overall methodology for achieving safety, security, and efficiency in operation of DOE facilities using the guidance provided by DOE orders. It is credited with providing well-trained and skilled operators and operating procedures that can be followed without error. CONOPS provides for highly reliable performance with respect to the application of administrative controls that are specified in CSE documents. In addition, the process of revising operating procedures includes validation activities and review by the NCS staff for potential implications to CSEs. The program uses the Integrated Safety Management principles to ensure:

# APPENDIX D
# Plant Programs Credited by NCS

(Page 2 of 4)

- Operators are attentive and responsive to operating parameters
- The operating condition of essential equipment is appropriately monitored and maintained
- Communications regarding operational activities are conducted in a clear, concise, understandable, and professional manner
- Procedures and security plans are used to ensure proper safety limits or conditions are established for all operating conditions and to ensure proper equipment status
- Personnel are effectively trained to use the procedures that govern operations

Details of the CONOPS Program can be found in Y14-001, *Conduct of Operations Manual*.

**Technical Procedure Process**

The technical procedure process is credited for ensuring operating personnel have available procedures that adequately implement NCS requirements. The technical procedure process ensures that intent changes to operating procedures are reviewed by key personnel before the changes are put into effect. The process of revising operating procedures includes review by the NCS staff for potential implications to the governing CSEs. When those changes are made to implement new or revised NCS requirements, the NCS program requires validation activities to ensure the requirements are understood and can be followed. Details of the technical procedure process can be found in Y15-232, *Technical Procedure Process*.

**Fire Protection Program**

NCS documents (e.g., CSPSs, CSEs) credit the FPP to minimize the probability of occurrence of fires and ensure the timely response to any fire that does occur. Specific attributes of the FPP that are credited include combustible control and the presence of fire suppression systems designed and installed in accordance with applicable codes. Because they are designed to the applicable codes, the systems are considered reliable and not prone to spurious actuation, which could result in the moderation or reflection of fissile material operations. Details of the FPP can be found in Y79-001, *Y-12 Fire Protection Program Manual*.

**Uranium Solution Control Program**

This program is not relied upon and will not be initiated at the UPF. Instead, the UPF has the equivalent of this program in the form of CSE-EN-801768-FLM-A001, which ensures that fissile liquids do not collect in unfavorable geometry. CSE-EN-801768-FLM-A001 provides design features and administrative controls that provide protection for the inadvertent accumulation of material in unapproved locations, and thus has been established as an equivalent to Y-12's Uranium Solution Control Program.

**Nuclear Maintenance Management Program/Initial Testing and In-Service Surveillance Program**

Maintenance is credited by NCS for two programs: the NMMP and ITISS Program. The Y-12 NMMP is a uniform, systematic method of administering maintenance activities using a graded approach. The NMMP includes the maintenance program, as well as maintenance functionality of the infrastructure organization. The ITISS Program specifies requirements for ITISS of safety-class, safety-significant, and risk-significant structures, systems, and components, as identified in the Safety Basis and NCS requirements, to ensure they operate when

# APPENDIX D
# Plant Programs Credited by NCS

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needed to prevent or mitigate accidents. This program ensures PDFs and ADFs are initially in place and that their function does not degrade with time, and it ensures the reliability of credited features to perform as intended when called upon.

Details of these programs can be found in E-SD-2008, *CNS Nuclear Maintenance Management Program*, and E-PROC-3056, *Initial Testing and In-Service Surveillance*.

**Inadvertent Accumulation Prevention Program/Uranium Holdup Survey Program**

These programs work together to prevent the inadvertent accumulation of enriched uranium in unexpected locations. The Inadvertent Accumulation Prevention Program (IAPP) involves a team review of fissile material processes to (1) examine the potential for fissile material accumulation, (2) identify design changes that could preclude such accumulations, and (3) specify the need for monitoring various locations where fissile material could accumulate. The UHSP provides Non-Destructive Analysis (NDA) monitoring of potential accumulation locations such as ductwork or housings. The need and locations for UHSP monitoring are identified by the IAPP. Details of these programs can be found in Y70-162, *Inadvertent Accumulation Prevention Program*, and Y15-014, *Uranium Holdup Survey Program*.

**Configuration Management Program**

The CM Program establishes and maintains the design basis for the UPF. This design basis is depicted on configuration-managed drawings and in supporting documentation and is maintained through change control. NCS relies on the CM Program for the development of accurate facility drawings, appropriate technical basis support documentation, and maintenance of the plant configuration through change control consistent with the design basis. NCS also relies on CM for the proper procurement, installation, testing, and maintenance of features that support criticality safety. Details of the CM Program can be found in E-SD-0003, *Configuration Management Program*.

**Quality Assurance Program**

The Quality Assurance (QA) Program is credited by the NCS program for ensuring components with NCS design feature requirements are verified to comply with requirements. The QA process ensures material and service requisitions for components to be procured from vendors include the necessary details on NCS requirements and these requirements are communicated to vendors. The QA process also ensures inspection of components received from vendors to verify that the NCS requirements are fulfilled before such components are released to be put into service. Details of the QA Program can be found in Y60-95-102PD, *UPF Quality Assurance Program Description*.

**Nuclear Materials Control and Accountability Program**

The Nuclear Materials Control and Accountability (NMC&A) Program specifies requirements to develop, implement, and maintain internal systems for the control and accountability of nuclear materials at Y-12. It provides for programmatic control of fissile material scales. This program is relied upon to ensure calibration, testing, and maintenance are periodically performed for scales

# APPENDIX D
# Plant Programs Credited by NCS
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such that credited mass limits are reliably maintained. Details of the NMC&A Program can be found in Y20-NM-010, *Manual for the Control and Accountability of Nuclear Material (U)*.

**Emergency Preparedness Program**

Emergency Preparedness is credited by NCS to ensure appropriate planning for, and response to, emergencies in nuclear facilities at Y-12. Emergency Preparedness ensures the potential for events, such as criticality accidents, fires, or any other emergencies in nuclear facilities that could involve fissile material are evaluated for emergency response. Emergency Preparedness ensures plans are developed for such events and the plans include support from NCS Subject Matter Experts to minimize the risk to personnel from the hazards associated with the event and to minimize the risk associated with protective actions taken by emergency response personnel. Part of that emergency planning includes provisions for prompt evacuation and accountability to ensure the staff of the affected facility is located a safe distance from the hazards. The Y-12 Emergency Management Program is described by E-SD-2028, *Consolidated Nuclear Security Emergency Management Program*, and is implemented by the Emergency Management Program Organization.

**Non-Destructive Analysis Measurements**

NDA measurements of items containing low quantities of enriched uranium are performed by NDA Engineering and the Analytical Chemistry (Quality) organizations. Where NCS evaluations establish mass limits to allow items containing low quantities of enriched uranium to be released from fissile control areas, NDA measurements may be used to determine items are within those limits. The NDA measurements are used when there is no other practical method to measure the $^{235}U$ content in items or to collect a representative sample for laboratory analysis. In addition, NDA measurements may be the best method to use even when destructive testing is possible.

# APPENDIX E
# NCS Control Generation

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An important step in generating the CSE is to establish well-formed requirements. Requirement descriptions should state the subject of the requirement and what should be done to meet the requirement. Each requirement should possess the following characteristics:

- **Necessary** – The requirement defines an essential capability, characteristic, or constraint necessary to ensure subcriticality of the system or process being evaluated in the CSE. If it is removed or deleted, a deficiency will exist
- **Practicable** – The requirement is technically achievable, does not require major technology advances, and fits within the CSE framework with acceptable risk
- **Concise** – Requirements should state "what" is needed, not "how," unless necessary to establish the unlikelihood of the requirement to fail
- **Unambiguous** – The requirement is stated such that it can be interpreted in only one way. The requirement is stated simply and is easy to understand. Vague and general terms should be avoided because they result in requirements that are often difficult/impossible to verify and may allow for multiple interpretations
- **Consistent** – The requirement is free of conflicts with other requirements. As applicable, the same term is used for the same item in all requirements
- **Complete** – The stated requirement needs no further explanation because it is measurable and sufficiently describes the capability and characteristics to ensure it has been met
- **Singular** – The requirement statement includes only one requirement with no use of conjunctions unless dictated by the nature of the process or operation being evaluated
- **Verifiable** – The requirement description includes specific criteria that enable verification that the requirement has been met—evidence may be collected that proves that the requirement is satisfied. Verifiability is enhanced when the requirement is measurable/quantifiable

**Requirements with Multiple Provisions or Locations**

Some requirements may contain lists of numerous allowances and limits. A common grammatical form of presentation is to write these in sentence form where the items are separated by punctuation marks (i.e., commas, semicolons, slashes) and conjunctions. NCS requirements must be presented in such a way to eliminate misinterpretation of the requirements. The following is guidance on how to present requirements with multiple allowances and limits in a clear and consistent manner.

Where the number of items in a list exceeds two, the preferred method of presentation is a bulleted list with a conjunction between each bullet.

Example:

The work station shall be limited to one of the following:

- One enriched uranium metal part

OR

- One NCS-approved process container loaded with uranium metal

OR

- Up to 20 kg of uranium metal items

# APPENDIX E
# NCS Control Generation

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Where requirements contain nested lists, the preferred method of presentation is a bulleted list with indentations used to distinguish the embedded lists.

Example:

The work station shall be limited to the following:

- Maximum 20 kg of dry uranium compounds

AND

- Maximum of two of the following items in any combination:
    - Process containers with volumes ≤ 6 L each

OR

    - Crucible

OR

    - Rod mill can

AND

- Up to 1 L of liquid for cleaning

Where a list of allowances (such as allowable containers or allowable forms) is presented, the language leading to the list must be clear on whether combinations of separate items in the list are allowed together. See the second bullet in the previous example.

Where a mass limit (or item count limit) is applied to multiple locations, the language must be clear whether the limit applies to each location or the total among all locations. If the limit applies to each location without concern for the total mass (or item count) among all locations, then present the limit as a separate requirement for each location where it applies. If the limit applies to the sum of all locations, present it as a single requirement with a list of allowable locations.

Example:

The mass of dry uranium powder shall not exceed a total of 20 kg among the following locations:

- Workstation

AND

- Scale

AND

- Portable Table

Avoid terms that are separated by a slash (/) because the slash could be interpreted as an "and" or as an "or."

# APPENDIX F
# Analyses Requiring Special Authorization

Establishing an acceptably low or "trivial risk" of a criticality accident is done in CSEs to support the determination that CAAS coverage is not warranted for low-risk operations in facilities where the risk of a criticality accident is otherwise credible (i.e., the facility requires CSEs for its processes/activities). This consideration may credit NCS requirements that are established in the CSE for the process/activity, as well as other process conditions. To demonstrate an acceptably low risk, the analysis must go beyond what is normally required and consider realistic combinations of abnormal conditions. The analysis must conclude that it is not reasonable to expect that the factors preventing a criticality accident could be compromised to such an extent that a critical configuration would be possible. Application of "trivial risk" is subjective; the Chief NCS Engineer must concur with the rationale for trivial risk.

In the case of applying "not credible" to the release of process materials from a facility with a credible potential for a criticality accident (i.e., from a facility that requires CSEs for its processes/activities), the analysis must demonstrate more than what is normally required to establish that an abnormal condition is subcritical. The analysis must demonstrate that there are no realistic combinations of abnormal conditions that could lead to a critical configuration, and the analysis may take credit for NCS controls established within the facility, as well as the nature of operations for the processes generating the materials being released. The analyst must also exercise caution when developing NCS limits (i.e., release limits) and ensure such limits do not conflict with assumptions in NCS documents applicable to the handling and processing of these materials in non-nuclear facilities at Y-12. The Chief NCS Engineer must concur with the rationale for "not credible."

# APPENDIX G
# Standard Assumption Wording

(Page 1 of 2)

During the development of UPF Project CSEs, there may be technical information relied upon for which the associated DACs are only issued in "Committed" status, rather than final "Confirmed" status. Until Confirmed DAC status is achieved for a given technical topic, any such information used in a CSE must include an assumption that the technical information will be issued later under Confirmed status. There are multiple such assumptions that will be used in UPF CSEs and, thus, are viewed as "standard assumptions" for UPF CSE development. Suggested wording for these standard assumptions, to be included in Section 6.7 of a CSE, will be documented in this Appendix. While it is recommended that NCS analysts use the words provided for their CSEs, the words may be modified as necessary to meet any special needs in a given CSE.

6.7.X Assumption: Sprinkler Water Density

Description: The maximum sprinkler water density resulting from actuation of the overhead sprinklers at the UPF is less than 0.01 g/cm$^3$.

Justification: DAC-EZ-922600-F060, *Water Density in Air Resulting from Fire Suppression System Actuation*, calculates the maximum sprinkler water density resulting from actuation of the overhead sprinklers at the UPF to be 0.0067 g/cm$^3$. The DAC is currently in "committed" status.

Recommended Confirmation Method: Issuance of DAC-EZ-922600-F060 as "confirmed," with a calculated maximum sprinkler water density of less than 0.01 g/cm$^3$.

6.7.X Assumption: Packing Fraction for Broken U Metal

Description: Broken and sheared uranium metal has a bulk density of no more than 75% of full-density uranium metal, and no less than 20% of full-density uranium metal.

Justification: According to CCG-425, *The Criticality Safety of Water-Moderated, Water-Reflected Uranium Metal of Various Shapes and Sizes*, dry bulk U metal has a typical packing fraction of ~0.30 to 0.75. CCG-425 provides measured results for packing fractions of various Y-12 metal forms, as well as for ordered spheres, mixed aggregates, and other materials. The highest packing fractions for single material forms cited are from perfectly ordered packing of identical spheres, which is 0.7405. Higher packing fractions are possible with mixtures of particle sizes (e.g., gravel and sand), with the smaller particles filling the gaps between larger items. In the case of the #4 and #5 Inner Cans, the smaller particles would be in the form of fines or turnings, which are not permitted in the #4 and #5 Inner Cans, except as incidental content.

When moderated, reducing uranium metal packing fractions may increase $k_{eff}$. According to CCG-425, containers with pieces generated from repeated pressing exhibited packing fractions between 0.30 and 0.37, while pieces that were further sheared exhibited packing fractions between 0.32 and 0.38.

Additional measurements on beakers with metal scrap reported a packing fraction of 0.31. CCG-425 does note one campaign involving shearing scrap metal plates with thicknesses on the order of a fraction of an inch resulted in a packing fraction as low as 0.15. Additional measurements for similar sheared scrap metal had packing fractions ranging from 0.24 to 0.34. These lower packing fractions occur due to the metal becoming deformed in such a manner that

# APPENDIX G
# Standard Assumption Wording

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allows contours to form that introduce void regions between the metal during packing. While a limited amount of broken metal may have a packing fraction below 0.2, a packing fraction of 0.2 is considered to be conservative based on the conclusions of CCG-425.

Recommended Confirmation Method: No confirmation is needed.

# APPENDIX H
# Criticality Control Review (CCR) Table Guidance

(Page 1 of 2)

The CCR table in Section 6.8 of the CSE provides a consolidated listing of the process-specific controls applicable to the CSE. The following guidance for completing this table is provided:

1. Use the CCR table template provided in **Attachment 2**, and document this table and its contents in Section 6.8 of the CSE
2. On the first row, start with PDF 6.1.1. Insert the Control Title, Safety Function, Functional Requirement, Performance Criteria number, and Performance Criteria information from the appropriate sections of that PDF documentation. Except for very special cases, PDFs do not elevate to the safety basis, so the answer in the "Elevate" column is "No." For those cases, choose from the template the applicable basis statement associated with the Control 6.1.1 Performance Criteria. If the design feature relies on neutron poisons, or for some other reason needs to elevate, put "Yes" and choose from the template the applicable basis statement associated with the Control 6.1.2 Performance Criteria
3. If the PDF has more than one performance criterion, use a separate line for each. For these additional performance criteria, the first four columns of the table shall be filled with "N/A." Each additional performance criterion shall have the last two columns filled as discussed previously
4. If the control/safety function includes exceptions, the text of the exception shall be included along with each performance criterion to which it applies. This may mean that the text of the exception is included with all performance criteria under that safety function. This is done so each performance criterion in the table stands alone. While it may not be important to the question of elevation to the safety basis, the CCR table information is used in other ways where it is important for each performance criterion to be complete and clear with regards to how it is to be applied
5. Continue with PDFs 6.1.2, 6.1.3, etc., as needed
6. If there are no ADFs in the CSE, skip to the steps for administrative controls
7. If there are ADFs included in the CSE, fill out the rows in the same manner as was done for PDFs. At this time, any ADFs in a CSE will elevate to the safety basis. The basis for elevation is generally as shown in the template for Performance Criterion 6.2.1.1. If this basis does not apply to the ADF, seek management guidance on the content of the basis statement and/or on the wording of the ADF
8. If the ADF has more than one performance criterion, use a separate line for each. For these additional performance criteria, the first four columns of the table shall be filled with "N/A." Each additional performance criterion shall have the last two columns filled as discussed previously
9. If the control/safety function includes exceptions, the text of the exception shall be included, along with each performance criterion to which it applies. This may mean that the text of the exception is included with all performance criteria under that safety function. This is done so each performance criterion in the table stands alone. As discussed previously, the CCR table information is used in other ways where it is important for each performance criterion to be complete and clear with regards to how it is to be applied

# APPENDIX H
# Criticality Control Review (CCR) Table Guidance

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10. For administrative controls, put the control number (e.g., 6.3.1) and the administrative control title in the first two columns. The columns for safety function and functional requirement are filled with "N/A." Put the fourth level number (e.g., 6.3.1.1) in the column for performance criteria number, and then the administrative control in the column for performance criteria text. It is unusual for an administrative control to be elevated to the safety basis. For non-elevated controls, use the basis as shown in the template for performance criterion 6.3.1.1. For elevated controls select the appropriate basis from the examples provided in **Attachment 2**. If none of the bases shown in the template are applicable to the administrative control, seek management guidance on the content of the basis statement

11. The last row of the table is a footnote that goes with the "Elevate?" column, and tells the revision of Y70-68-001 used for the elevation basis. The procedure has been revised over time, and criteria for elevation have been added or revised, so it is important to know what version of the procedure was in effect at the time the CCR table was developed

12. The headers of the table should not be changed from that shown in the template, and rows/columns should not be merged. The CCR tables from each CSE will eventually be combined into one large table for the CCR report

Refer to **Attachment 2** to view the template that corresponds with this guidance.

# APPENDIX I
# CSE Interaction Analysis

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**CSE Interaction Strategy for Interaction between Moving Fissile Item and Installed Fissile Equipment**

The strategy for evaluation of interaction between installed fissile equipment and mobile fissile material can be summarized in four unique scenarios. These scenarios are identified below, along with identification of the CSE responsible for performing the evaluation. The scenarios identified below are derived based upon the normal or credible abnormal state of three components: 1) the moving fissile item, 2) the interaction between the moving fissile item and installed fissile equipment, and 3) the installed fissile equipment. For these interaction scenarios a moving fissile item is considered to be any fissile item in transit either via manual handling (e.g., #3 Can, seal pot) or conveyance device (e.g., cart, drum dolly).

1. Normal Conditions – In this scenario, the moving fissile item, interaction between the moving fissile item and the installed fissile equipment are all in the normal condition state. The CSE addressing the fissile item movement is responsible for addressing this scenario
2. Normal Equipment Conditions & Interaction Upset – In this scenario, the moving fissile item is evaluated interacting with any installed fissile equipment that it should not normally interact with, hence an upset condition. The moving fissile item and the installed fissile equipment are evaluated at normal conditions. The CSE addressing the fissile item movement is responsible for addressing this scenario
3. Moving Fissile Item Upset – In this scenario, interaction is evaluated with the moving fissile item under credible upset conditions. The installed fissile equipment is evaluated at normal conditions, and this scenario is only evaluated at normal interaction conditions (moving fissile item and fixed fissile equipment normally interact). The CSE addressing the fissile item movement is responsible for addressing this scenario
4. Installed Fissile Equipment Upset – In this scenario, interaction is evaluated with the installed fissile equipment under credible upset conditions. The moving fissile item is evaluated at normal conditions, and this scenario is only evaluated at normal interaction conditions. The CSE addressing the installed fissile equipment is responsible for addressing this scenario

The CSE for the installed fissile equipment will be able to reference the movable item CSE, which will demonstrate that interaction with a movable item at normal conditions and the installed fissile equipment at normal conditions remains subcritical.

**CSE Interaction Strategy for Interaction between Installed Fissile Equipment**

A CSE must also consider interaction between installed fissile equipment within its Analytical Boundary and installed equipment outside that scope, which may neutronically interact with the equipment of the CSE's scope in a significant manner. In accordance with Section 5.1, the CSE is required to provide "summary-level information on parameters with respect to whether or not they are controlled or process-limited in some way." This must include information addressing both categories of interactions: 1) those interactions where all involved equipment is within the Analytical Boundary of the CSE, and 2) those interactions between installed fissile equipment within the CSE scope and installed equipment outside the CSE scope that is close enough to warrant discussion with respect to the parameter of interaction.

# APPENDIX I
# CSE Interaction Analysis

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The CSE must also address interactions with mobile items that may enter its defined 'interaction footprint' as has already been discussed. The 'interaction footprint' is a volume around the installed fissile equipment that extends in all three directions three feet from the physical boundaries of each of the CSE's installed fissile equipment. This interaction footprint extends as necessary through UPF interior walls; however, it does not extend through UPF floors (with the noted exception of toaster slots), if applicable.

A similar strategy will be employed for the evaluation of interactions between installed fissile equipment within the scope of a particular CSE and installed equipment not within its scope, yet within its interaction footprint. The strategy for evaluation of interaction between installed fissile equipment within the scope of one CSE with installed equipment of another CSE can be summarized in three unique scenarios:

1. Normal Conditions – In this situation, both the installed fissile equipment within the scope of the CSE and the installed fissile equipment outside the scope of the CSE are in the normal condition state. Each CSE must address this situation for each of its installed fissile equipment within its Analytical Boundary interacting with the installed fissile equipment from other CSEs that are within its interaction footprint.

   Example: CSE-EN-801768-SAMP-A001, identifies a PCS Duct within the interaction footprint of one of its Universal Sample Bottle Racks. Both CSE-EN-801768-SAMP-A001 and CSE-EN-801768-PCS-A001 have to acknowledge this presence in Sect. 5.2.X, and show subcriticality. If CSE-EN-801768-SAMP-A001 has already performed the analysis, a simple reference to that CSE's Section within CSE-EN-801768-PCS-A001 is sufficient.

2. Upset affects installed equipment within the CSE Analytical Boundary – If the nature of the contingency is such that it only affects equipment within the CSE's Analytical Boundary, then the interaction is evaluated with the equipment outside the scope of the CSE being in its normal condition state.

   Example: The contingency of double batched bottles in Universal Sample Bottle Racks in CSE-EN-801768-SAMP-A001 includes the PCS Duct at its normal conditions within its evaluation of subcriticality. CSE-EN-801768-PCS-A001 would not discuss this contingency.

   However, if the nature of the contingency is such that it affects all involved equipment (e.g., seismic event), then the interaction is evaluated with the equipment outside the scope of the CSE being in the state associated with that contingency. This contingency is addressed in the CSE who owns the installed equipment in a contingent condition.

   Example: The contingency of damage to a Universal Sample Bottle Rack from a forklift could simultaneously impact the PCS ductwork within the interaction footprint of the Universal Sample Bottle Rack, and the resulting configuration is addressed in CSE-EN-801768-SAMP-A001. As with normal conditions above, if the contingency is say a seismic event that impacts both the Universal Sample Bottle Rack and the PCS ductwork, both CSE contingencies should acknowledge the potential configuration,

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and show subcriticality, with the later CSE being allowed to reference a preceding CSE's analysis, as applicable.

3. Upset only affects installed equipment outside the CSE Analytical Boundary – This situation involves the installed fissile equipment within the scope of the CSE being in the normal condition while the installed equipment outside the scope is in a contingent condition. By definition of above, this contingency is only addressed in the other CSE who owns the installed equipment that is in a contingent condition.

   Example: The mass upset contingency for PCS ductwork within CSE-EN-801768-PCS-A001 would have to be analyzed and shown to remain subcritical with the Universal Sample Bottle Rack at normal conditions being within the PCS Ductwork's interaction footprint.

Note this discussion has been very deliberate with calling something installed fissile equipment and calling out something as just installed equipment. An example of what is meant by the two different terms is FLM Downspout and associated Duckbill. During normal conditions, this is just installed equipment; however, in a seismic event it becomes installed fissile equipment. So while it may not be necessary to discuss FLM Downspout and associated Duckbill equipment located in your interaction footprint for normal conditions, it is necessary to include it in the discussion during certain upset conditions.

**Equipment to be addressed if within your installed equipment interaction footprint**

**Table I-1** lists some of the more common equipment that a NCS analyst should be looking for within each of their installed equipment interaction footprint. The table identifies the equipment/item, and a basis for why it may be a concern if within another CSE's equipment interaction footprint. This table should be utilized during facility walkdowns for CSE development to identify all installed equipment near enough to the CSE's installed equipment to warrant discussion and/or evaluation with respect to interaction. Identified fissile equipment within the interaction footprint should be verified to exist on existing equipment location drawings, isometric drawings, or other design output documents. Such documents should be referenced by the CSE, if information such as the quantity of the items or its distance from the CSE's equipment is utilized by the CSE. Please note the table is not intended to be all inclusive of everything within UPF that might be of potential concern.

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**Table I-1. Installed Equipment of Potential Concern**

| Item | CSE | Basis |
|---|---|---|
| Universal Storage Rack | RACK | Stores numerous #3 and #5 Outer Cans as a normal condition. |
| Universal Sample Bottle Rack | SAMP | Stores numerous Sample Carriers of Sample Bottles as a normal condition. |
| Retain Sample Rack | SAMP | Stores numerous Sample Carriers of Sample Bottles as a normal condition. |
| Floor Storage Array | ARAY | Stores numerous fissile containers as a normal condition. |
| Material Transfer Vestibule | ARAY | May stage more than one fissile container at a time as a normal condition and includes the Vestibule Sample Bottle Rack. |
| Glovebox | Many CSEs | May contain multiple fissile items as a normal condition. |
| Airlock/Hood | Many CSEs | May contain multiple fissile items as a normal condition. |
| Waste Preparation Walk In Enclosure (WIE) | WP | May contain multiple fissile items as a normal condition. |
| Calciner WIEs | CAL & HCAL | May contain multiple fissile items as a normal condition. |
| TPS WIE | TPS | May contain multiple fissile items as a normal condition. |
| NDA Work Table | NDA | May contain up to 4.5 L of fissile solution in variety of containers at any location on Table. |
| Furnaces out in Open | VA, CAST, BMO, OXP | Normal condition contains fissile material. |
| Furnaces in own Room | FRN, ARC | Normal condition contains fissile material. |
| Furnace Exhaust Lines | BMO | Normal condition contains fissile material. |
| Recovery Furnace offgas equipment and piping | FRN | CSE presently requires spacing. |
| Recovery Evaporator Piping Larger than 2 in. | REV | CSE presently requires spacing. |
| POG Scrub Solution piping Larger than 2 in. | POG | CSE presently requires spacing. |

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| Item | CSE | Basis |
|---|---|---|
| Large diameter (>2) SMP and CAL calciner scrubber exhaust lines | CAL, HCAL | CSE presently requires spacing. |
| 3 in. PCWS, PCWR, and MW of Reqs. 6.1.7.X of CSE-EN-801768-UTIL-A001. | UTIL | CSE presently requires spacing. |
| Service Code pipes identified in Req. 6.1.1.1 of CSE-EN-801768-GEND-A001 | GEND | As defined by the requirement, either normally contain fissile solution, or could contain fissile solution under credible abnormal conditions. |
| PNS work area | PNS | Both staged fissile items and moving fissile items may exist within the defined area. |
| PCS Duct | PCS | Normal condition contains low quantities of fissile material in a spread out configuration. |
| HEPA Filter Bank | PCS | Normal condition contains low quantities of fissile material in a spread out configuration. |
| DEC Module | DEC | Low fissile concentration in normal condition; however, upset condition may exist. |
| NFC Module | FCL | Low fissile concentration in normal condition; however, upset condition may exist. |
| NFC Autoscrubber Parking Station | FCL | Low fissile concentration in normal condition; however, upset condition may exist. |
| Negative Air Machine Parking Area | NAM | Low fissile mass in normal condition; however, upset condition may exist. |
| Housekeeping Vacuum (HSVAC) components | HSVAC | Above certain gloveboxes, but probably within the interaction footprint. |
| FLM Downspout and associated Duckbill | FLM | During design basis seismic or fire events may contain fissile solution. |
| FLM under-wall and discharge drain piping | FLM | During design basis seismic or fire events may contain fissile solution. |
| FLM trench drains | FLM | During design basis seismic or fire events may contain fissile solution. |
| LGEA Equipment | Various | During fissile leaks, any equipment may become fissile within an LGEA. |
| Favorable Geometry Process Waste Collector | TRASH | Collects low levels of fissile material, but during upset conditions could receive fissile solution. |
| LGEA Modules | Various | Normal conditions contain fissile solution. |

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**Table I-2** lists installed equipment that are equivalent to a single mobile fissile item. Therefore, analysis within a CSE of interaction between installed fissile equipment and mobile fissile items is sufficient to address interaction between installed fissile equipment and these pieces of equipment. Where there is an item from **Table I-2** within your interaction footprint, consider it to be a normal condition of your installed fissile equipment and a mobile fissile item. However, note that another mobile fissile item can also be passing through the interaction footprint, such that now the fixed item has to consider two mobile fissile items within its interaction footprint as a normal condition. Keep in mind however that in certain situations, the item from **Table I-2** might not actually contain fissile material as a normal condition. For example, it takes an unlikely significant water entry event into the PCS ductwork for the seal pot that drains said ductwork to contain sufficient fissile material to warrant addressing it within the CSE as a mobile fissile item.

**Table I-2. Installed Equipment Equivalent to a Single Mobile Fissile Item**

| Item | CSE | Basis |
|---|---|---|
| VRC | VRC | Typically empty. When being used, the VRC is by definition limited to a single fissile item or pallet/wire mesh basket of fissile items that are treated as a single mobile fissile item. |
| Freight Elevator | VRC | Typically empty. When being used, the freight elevator is by definition limited to a single fissile item or pallet/wire mesh basket of fissile items that are treated as a single mobile fissile item. |
| Seal Pot | GEND, PCS | Even when installed, since a single item, is equivalent to a single mobile fissile item. |
| Tables (other than those associated with NDA equipment) | Various | Even though may be fixed in place, are administratively controlled to a single fissile can, or sample bottles acting as a single item; therefore, equivalent to a single mobile fissile item. |
| NDA Equipment | NDA | Non-Table top equipment is limited to a single mobile fissile item when used. Therefore, it may be treated as a single mobile fissile item. |
| Floor Scales | WP, PNS | Typically empty. When being used, the floor scale is by definition limited to a single fissile item or pallet of fissile items that are treated as a single mobile fissile item. |
| Process Waste Collection Drum | TRASH | Is equivalent to a single mobile fissile item. |
| Chemical Pour-Up Hoods (for non-fissile activities) | PRCP | During unlikely upset conditions a 4 L beaker or Sample Bottles could be poured into such hoods. As such, each hood is equivalent to a single mobile fissile item. |

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| Item | CSE | Basis |
|---|---|---|
| RTP Cart parking area | RTP | Administratively controlled to a single cart, and thus equivalent to a single mobile fissile item. |
| 3-Position Can Cart, 1-Position Cart, TOAD, parking areas | 1CART, 3CART, PART | Normal condition each cart type is empty while unattended in its parking area. Under an administrative upset condition of the cart containing fissile material, it is still only a single cart, and thus equivalent to a single mobile fissile item. |

**CSE Requirement Review Guidance**

Carefully review each passive design feature within the CSE involving spacing and avoid using terms like 'other fixed fissile equipment', 'other fissile items', 'other fissile material', 'other fissile lines'. Is the spacing requirement still necessary? Are the items that the CSE's installed fissile equipment needs to be spaced from based on existing design, explicitly spelled out, or is no spacing to the equipment necessary?

Carefully review each administrative requirement within the CSE and avoid terms like 'other fixed fissile equipment', 'fissile equipment', 'all other uranium bearing units' and 'other fissile bearing containers and equipment'. Do other items not specifically mentioned in the requirement also need the spacing specified by the requirement? Ensure the basis actually covers 'and other fissile items' if that is included in the requirement language. In other words, did the calculations actually include or bound all other fissile items? Consider a generic (yet all inclusive) term like 'other fissile item' that operators will understand within the administrative requirement.

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# CSE Analysis of Gradual Uranium Accumulations
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**Overall Strategy**

This guidance is provided for developing analysis and controls when routine measurements done under the UHSP program are utilized to limit uranium accumulation expected to occur at a slow rate in large geometry equipment. Most applications of this guidance will be for ventilation systems, but elements may also be useful for vacuum systems or other equipment where the uranium mass is expected to be low but the interior of the equipment cannot be easily accessed for visual observation and cleanout. This guidance is not applicable when appreciable accumulation can occur over a short period of time. Uranium mass tracking on a per run basis should be utilized to control systems where unacceptable accumulations can occur in a period of a few months or less.

In order to demonstrate subcriticality with water ingress into ductwork, "zones" of ductwork need to be considered. Actual zone identification is part of the IAPP and is not included within the CSE. The zones represent potential flow pathways for water that could mobilize fissile material and extend from high points to the low regions where water/fissile material can collect. An individual zone would include a high point down to the lowest region where water/fissile material may collect in an event involving water ingress. The zone typically includes sections between the high and low points where the centerline is level but water can collect because of a change in diameter along the level section. Lower regions of the ductwork will most likely be included in multiple zones with different high points because of the branching configuration of ventilation systems. In this case, the mass in the lower region needs to be combined with the upper regions from each associated zone independently to address each credible scenario involving uranium material washing to the lowest point.

**Evaluating Zones**

Review the design of the system and identify the criteria to be used for zone establishment. Establish a mass limit of $^{235}$U for each zone that can be demonstrated subcritical at worst-case conditions in the low region(s) of each zone.

Evaluate the entire mass of uranium in a low-leakage pile at an optimal Hydrogen-to-Uranium (H/U) ratio to simulate consolidated material washed to the low region by water. Credit may be taken for reduced reflection because of the proximity of the region away from walls, the floor, or other building structures. The analysis must include water inside the ductwork up to a level limited by drainage features.

The analysis should include a parametric study with the total mass allowed in the zone concentrated in the features, and incrementally distributed along the length/area of the low section to determine the optimum distribution of the mass within the ductwork geometry. The cross-sectional area takes the shape of the ductwork, and the uranium may be assumed to be uniformly distributed across the area.

The following notes are intended to provide clarity and flexibility in the evaluation of each zone:

A. The form of uranium used in the analysis is to conservatively bound what may be present in the ductwork (e.g., oxides if the duct is connected to oxide processes)

B. The depth of water limited by drainage features should be based on flow calculations documented in a DAC

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# CSE Analysis of Gradual Uranium Accumulations

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C. Portions of ductwork might have dimensions small enough to be demonstrated subcritical without requiring drainage; it is acceptable not to require drainage in these sections

D. An alternative that may be utilized to avoid mass optimization is evaluation of the entire region filled with an optimally-moderated U metal/water mixture or U oxide/water mixture, up to the level limited by drainage

E. If $k_{eff}$ is appreciably below the USL, consideration should be given to increasing the mass limit to avoid the need for reanalysis in the future

**Normal Conditions**

If information is available, discuss the expected form of uranium in the ductwork. Provide the rationale for why accumulation is slow. This discussion should credit the presence of roughing filtration or demisters and the fact that only airborne particles or vapors created by the connected operations are introduced into the ventilation system.

Establish that because the nature of accumulation is slow, significant mass upsets over a short period of time (i.e., a few months) are not credible. This discussion provides the rationale for why a mass contingency is not evaluated. Also discuss the ductwork system ventilates numerous locations and consists of headers and branches that are functionally divided into multiple zones to facilitate NCS evaluation of the system.

Specify the mass limit for each zone and demonstrate subcriticality based on limited mass accumulation and the distribution of the accumulation. Comparison of the mass limit for each zone to the subcritical mass limit for unmoderated fissile material in Table 4 of ANSI/ANS-8.1 is most likely adequate to demonstrate subcriticality of the normal condition. If necessary for systems that ventilate solution processes, comparison of the areal density indicated by NDA measurements to the subcritical areal density limit in Table 1 of ANSI/ANS-8.1 is most likely adequate to demonstrate subcriticality of the normal condition for uranium deposits that could be in the form of hydrates.

**Credible Abnormal Condition: Uranium-water Mixture Collected in the Low Region(s) of the Ductwork**

Evaluate the contingency of water entering the ductwork at a high point and draining to the low region(s). Describe the evaluated conditions being based on the assumption that all uranium material mixes with the water and drains with the water to the low region(s). Describe the collection of uranium and water in the low region as an optimal configuration limited only by the required drainage features. Where drainage is required, discuss the presence of the drains and the maximum depth limited by the drains. Credit the conservatism in these assumptions and the conservative assumption that the physical integrity of the ductwork is maintained, supporting the unlikelihood of the evaluated condition instead of the ductwork failing from the additional weight, allowing contents to spill out.

Demonstrate subcriticality based on the depth of the low point and analysis of the optimum distribution following guidance in "Evaluating Zones" above. If the low point is a work area (e.g., a hood or glovebox) used to process or handle enriched uranium and is within the process

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under evaluation, the analysis of an optimized uranium-water mixture also needs to include the normal loading allowed at the work area. Where it is assumed that a uranium-water slurry cannot be sustained in a consolidated pile, the following justification may be used in the analysis: "The collection of [uranium mass limit] in a low leakage pile in an unfavorable geometry low point with water is only possible if the majority of the uranium can be entrained in water and collocated in the same region. In this scenario, the uranium must be in the form of small particles capable of being entrained. A consolidated pile of such material is maintained by the compaction of particles from the weight of the material. Therefore, it is assumed that mixtures of uranium and water above this H/U ratio cannot exist as a consolidated pile."

Be aware that there may be equipment in interfacing processes that present low points where the uranium-water mixture from the ventilation system under evaluation could collect. It is possible that the analysis of the interfacing process did not consider the optimized conditions for the collection of uranium and water at low points within the scope of that evaluation. The CSEs for the interfacing active processes should be reviewed, and if the analysis of the low point(s) in these processes does not consider the normal loading in addition to the collection of an optimized uranium-water mixture from the ventilation system, then notify the NCS Manager that the need to upgrade the analysis of the low point(s) needs to be added to the SAE Tracking Database.

**Credible Abnormal Condition: Flooding the HEPA Filter House**

Evaluate the contingency for water entering a high point in the High-Efficiency Particulate Air (HEPA) filter house or connected ductwork resulting in the filters becoming fully saturated with water. If the entire mass of uranium in the filter house is limited to no more than 700 grams, then demonstrate subcriticality based on the quantity of enriched uranium not exceeding the subcritical mass limit in Section 5.2 of ANSI/ANS-8.1.

If more than 700 grams of enriched uranium could be present, establish a mass limit for each filter and for any areas, depending on the design of the filter house, where uranium can accumulate. Drainage for low points in the housing should be established unless the low point is connected ductwork (in which case the ductwork should have drainage as necessitated by the analysis of uranium collecting in the ductwork low point).

When evaluating uranium loaded on HEPA filters, the distribution of uranium within the filter medium and the composition of the medium are important considerations. DOE-HDBK-1169, *Nuclear Air Cleaning Handbook,* Chapter 3, "Filters for the Nuclear Industry," is a good source for the construction of HEPA filters and the nature of particle filtration. Because of the mechanisms of particle capture and the pleated design of HEPA filers, the uranium loading within the filter medium may be considered uniformly distributed in the volume occupied by the medium by the nature of the process.

Filter media are typically made from glass fibers, but might also have some plastic fibers incorporated into the medium and might also be treated with chemicals. The composition is typically proprietary, and therefore requires the analyst to make assumptions on the makeup of the filter medium. An acceptably conservative assumption for the filter medium material of construction is cellulose ($C_6H_{10}O_5$) at a density determined by the filter weight and size.

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# CSE Analysis of Gradual Uranium Accumulations



When evaluating the flooded condition, perform a parametric study that considers water uniformly mixed with the filter medium (including maximum uranium loading) and incrementally increase the density of water up to a maximum determined by the volumetric capacity of the voids in the filter medium. If the section of connected ductwork from which the water drains into the filter house has uranium holdup, add the maximum allowed amount to a single or multiple filters in close proximity to the connection. If there are sections in the housing with the potential for accumulation, that uranium holdup mixed with water also needs to be considered.

**Credible Abnormal Condition: Uranium-water Mixture Collected in Seal Pots and Berms in the Process Area**

Seal pots, if present, need to be considered in the analysis of uranium-water slurry flowing through the drainage. Because the ability of a seal pot to capture entrained uranium is not well characterized, two extremes must be considered. One involves the entire mass of uranium in the seal pot, moderated and distributed through the entire volume and reflection representing hands and an operator's body. The other is with a uniform distribution of uranium in the seal pot and a slab of water collected on the floor around/under the seal pot. The concentration of uranium and the total volume of the slurry are varied to determine the optimum concentration.

Also ensure any uncredited drains that could allow uranium-water mixtures to drain from the system do not present the possibility of an unsafe mass of uranium in water to wash into an area where large, open volumes might be present (e.g., bermed areas on the floor). If the potential does exist, then the design feature requirements on floor integrity and drain terminations (within 6 in. of the floor or in a seal pot on the floor) may need to be invoked.

**NCS Requirements** – The following items may apply depending upon the analysis of gradual uranium accumulation locations:

- Identify the administrative mass limit for zones
- Identify the administrative mass limit for the filter house, preferably as a mass limit per filter and a limit for any area (e.g., plenums) where uranium could accumulate
- Establish a PDF requirement for drains (if any) in terms of the maximum depth permitted
- Establish a PDF requirement for drains to terminate close to the floor (if no seal pot is used), provide an alternate basis if not required, or terminate in a seal pot
- Establish a PDF requirement for the integrity of the ductwork to limit the rate of liquid ingress in the event of liquid impingement upon the ductwork exterior, if necessary. Consider the following language to ensure alignment with a related assumption discussed in the following section:
  - [System] ductwork shall have sufficient integrity to ensure only a minor ingress of liquid from external sources
  - Basis: Provides moderation control by providing a robust barrier to water ingress into the ductwork. Limits liquid ingress from external sources through breaches such as leaks in gaskets, at flanges, and/or holes due to gradual degradation of the ductwork. Assumption 6.7.x relies on the integrity of the ductwork to justify a maximum water inflow rate to the [system] ductwork

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- Reference PDF requirement (established within the FLM CSE for non-bermed areas) for the integrity of the floor to contain slurry in a slab geometry in the vicinity of the drain terminations

**NOTE:** *Calling out the IAPP or UHSP in Section 6.3 of the CSE is not necessary. As long as mass limits have been established for zones, and the IAPP/UHSP are listed in the Programs/Procedures section of the applicable contingency, then these programs will define the zones, inspection frequencies, and action limits necessary. NCS personnel participate in the development of these IAPP plans.*

**Assumptions (Section 6.7)**

The following assumptions that are applicable to the process being evaluated should be included in Section 6.7. The language in the assumptions below needs to be carefully considered and tailored as necessary to the specific process being evaluated.

6.7.X Assumption: Configuration of Well-Moderated Uranium Solid/Water Mixture

Description: Accumulations of uranium solids and water above an H/U ratio of 20 cannot exist as a consolidated pile.

Justification: The collection of a pile of uranium with water in an unfavorable geometry ductwork low point is only possible if the majority of the uranium can be entrained in water and transported to a region where the particles are subsequently deposited into a consolidated pile (e.g., by settling). In this scenario, the uranium must be in the form of small particles capable of being entrained. A consolidated pile of such material is maintained by the compaction of particles formed by the weight of the material. At this low density, the collection of material is more representative of a mixture of water and suspended uranium metal or uranium oxide particles and not a compacted mass of particles saturated with water. Therefore, it is assumed that consolidated mixtures of uranium metal or uranium oxide and water below this bulk density cannot exist and would be dispersed in the flowing water.

Recommended Confirmation Method: No confirmation necessary.

6.7.X Assumption: Accumulation Rate of Uranium Holdup in Ductwork

Description: The accumulation of uranium within the [system] ventilation ductwork is slow enough that UHSP monitoring will identify an increasing trend before the $^{235}U$ mass limits imposed in Section 6.3 are challenged. There are no credible process anomalies that would result in an immediate introduction of a significant amount of uranium into the ventilation ductwork.

Justification: UHSP monitoring is part of the NCS control strategy for the [system] due to the slow nature of uranium buildup in the ventilation system. The dry uranium processes that the [system] ductwork currently serves are limited to [gloveboxes and enclosures where uranium powders are handled, etc.]. These sources of uranium material into the ductwork are limited to a relatively small fraction of uranium in the form of airborne dust created by pouring or draining powders from one vessel to another. Connected vacuum systems and other dry processes that generate large quantities of airborne material are equipped with features to protect ventilation. Vapors and aerosols from wet uranium processes that the [system] ductwork serves are

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# CSE Analysis of Gradual Uranium Accumulations



removed by [mist eliminators and traps] and therefore ductwork is limited to slow accumulations from the small fraction of vapors and aerosols that pass beyond the removal features. Mass limits are imposed on specified sections of ductwork and are implemented with operational margins to prevent exceeding the safety limits.

Recommended Confirmation Method: No confirmation necessary.

6.7.X Assumption: Water Inflow Rate

Description: The inflow rate of water into the (system) ductwork will not exceed xx gpm [approximately 10 gpm is reasonable; needs to align with flow rates established in a DAC].

Justification: Requirement 6.1.X requires [system] ductwork to have sufficient integrity to ensure only a minor ingress of liquid from external sources. Ductwork is inspected through surveillances looking for degradation of the ductwork and will identify small breaches for repair before they become larger issues. DAC xxxxxx evaluates the outflow rate of drains connected to the [system] and the minimum flow rate calculated is xx gpm. This flow rate is greater than the anticipated water ingress rate from breaches such as leaks in gaskets, at flanges, and/or minor holes due to gradual degradation. Large, sudden breaches in the ductwork would be noticed by an imbalance in airflow in operations connected to the [system] and investigated promptly.

Recommended Confirmation Method: No confirmation necessary.

# APPENDIX K
# FMCS Guidance

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If the CSE has one or more of the administrative requirements identified in ECP-EG-801768-D391, *Addition of NCS Admin Controls to FMCS Software Requirements Specification*, this means all or portions of the administrative control(s) may not be implemented within a procedure, but rather may be implemented via flowdown to the FMCS software requirements specification. Therefore, it is prudent to have some generic description of this tool that Operations will use within Sect. 2 of the CSE.

For each of the sixteen CSEs identified in ECP-EG-801768-D391, the NCS analyst should add a paragraph to Sect. 2 describing the FMCS. The paragraph should be consistent with the following, and be placed where ever it fits best within the flow of the CSE:

**2.X.X Facility Monitoring and Control System**

The Facility Monitoring and Control System (FMCS) is integral to select UPF systems and is composed of logic and hardware that is operated via human-machine interface locations that are either local or centralized. The FMCS responds to input signals from the process, its associated equipment, other programmable systems and/or an operator including actions associated with NCS Administrative Controls (e.g., movement of motorized material transfer carts, and/or isolated door openings for glovebox activities, or valve alignment and/or representative sampling circulation times for solution systems). Furthermore, the FMCS generates output signals (feedback) thus causing the process and its associated equipment to operate in the desired manner and providing system-state data to Operations. The FMCS does not perform any credited safety instrumented functions but, from the perspective of NCS, is considered an extension of the operator.

The NCS analyst will also need to pay attention throughout the CSE to where one of those administrative requirements that may be implemented into FMCS is discussed, specifically, if the administrative control is discussed in the contingency section. For example, a contingency section (5.3.X.1) may have a discussion such as this:

Administrative controls are implemented through operating procedures, to which operators are trained. Requirements implemented through procedures are not expected to be routinely violated based on a culture of adherence to the Conduct of Operations Program principles (including personnel training) and rigorous control of operating procedures. This program is credited as described in Appendix D of DG-EN-801768-A004.

Such a discussion should be revised for accuracy, if any portion of the administrative requirements discussed within the contingency is implemented into FMCS. The following paragraph, which includes some discussion of FMCS, may be used to replace the above paragraph when a contingency discussion includes both types of administrative controls.

Portions of administrative controls discussed in this contingency are implemented through operating procedures, to which operators are trained. Requirements implemented through procedures are not expected to be routinely violated based on a culture of adherence to the Conduct of Operations

# APPENDIX K
# FMCS Guidance

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> Program principles (including personnel training) and rigorous control of operating procedures. This program is credited as described in Appendix D of DG-EN-801768-A004. Other portions of administrative controls discussed in this contingency are implemented into the FMCS logic. Due to these specific NCS-related attributes, the applicable portions of the FMCS system logic are Risk Significant (RS) from a software quality perspective, and thus the applicable portions of FMCS are subject to the Configuration Management Program and the Software Quality Assurance requirements of the Quality Assurance Program. This makes the performance of the administrative control implemented through FMCS just as reliable (if not more) than an administrative requirement implemented through an operating procedure.

Adjustments to the paragraph are necessary to flow into the existing structure and flow of discussion within the CSE contingency. For example, if a contingency contains only administrative controls that are flowed into FMCS, then only the last portion of the paragraph is applicable.

While reviewing a CSE for this aspect of an administrative control flowed into FMCS, whether in combination with it being flowed into an operating procedure or not, the NCS analyst should **ENSURE** that a single failure of the administrative control does not lead to a contingent configuration. Just like it is **NOT** unlikely for a single administrative control flowed into an operating procedure to fail, it also is **NOT** unlikely for a single administrative control flowed only into FMCS to fail. The unlikely configuration (contingency) must involve more upsets, and/or go against the well documented nature of the operation, to occur, than just the failure of a single administrative control as outlined in Sect. 2.9.2.The preceding guidance is outlined in a step-wise format for the NCS analyst, as follows:

**Step 1** Review ECP-EG-801768-D391 to see if it impacts your CSE.

**Step 2** If no, exit this guidance. If yes, include generic FMCS description paragraph in Sect. 2 of CSE.

**Step 3** For an administrative control identified in ECP-EG-801768-D391, track down its use in your CSE, and cross reference it with the operating procedure, and applicable steps and sequence of steps. Ask yourself if the operator pushes the wrong button on the human-machine interface pad what happens next? (samples wrong tank, transfers solution to wrong location). Ask yourself and/or Operations, is it simply pushing one wrong button to sample wrong tank, or send solution to wrong location? How does pushing the wrong button impact the operating procedure? How does it impact the NCS contingency discussion? Modify CSE accordingly.

**Step 4** Repeat Step 3 for each administrative control associated with the CSE identified in ECP-EG-801768-D391.

# ATTACHMENT 1
# Seismic Contingency Template
(Page 1 of 4)

**NOTE:** *Black text is appropriate for use in all CSEs. Red text must be tailored to fit individual CSEs.*

## 5. PROCESS ANALYSIS

### 5.3 UNLIKELY EVENTS (CONTINGENCIES)

### 5.3.1 Multiple Parameters Contingency: Seismic Event

#### 5.3.1.1 Description of Contingent Configuration

DOE O 420.1C, *Facility Safety*, requires that Criticality Safety Evaluations show that entire processes involving fissionable materials remain subcritical under normal and credible abnormal events, including those initiated by design basis NPH events, including seismic events. This contingency postulates that a design basis (or equivalent) seismic event occurs and causes damage to equipment and/or changes in the process status for the XXX process. Consequences that need to be considered include the following:

- A loss of integrity for equipment and/or containers that leads to a spill
- A loss of integrity for equipment and/or containers that results in exposure of the contents to atmosphere
- A loss of structural integrity for equipment and/or containers that results in items coming closer together
- Loss of sprinkler system integrity that results in accidental sprinkler activation
- Loss of system integrity that results in a design basis fire (if applicable)
- Other consequences applicable to a given process

EXAMPLE FOR A SYSTEM WITH AN INTERNAL LIQUID SOURCE (SPRINKLER): For the Bulk Metal Oxidation (BMO) process, dry uranium material is spilled during a seismic event. The initial location of this material could be in a variety of places depending on the stage of the oxidation process (e.g., the feed material can, in the HSVAC system, in/on the oxidation collection trays). During normal operations, internal sources of moderation are limited (Control 6.1.X). However, sprinklers are present within the BMO airlock and glovebox, and it is credible that they could fail in a limited fashion as the result of a seismic event. Therefore, the concurrent introduction of liquid (water) in/on the spilled material due to potential leak(s) from the internal sprinkler system is evaluated with the spill of material. The potential introduction of liquid into the furnace, even from a seismic event, is evaluated in Sect. XXX.

EXAMPLE FOR A SYSTEM WITH NO INTERNAL LIQUID SOURCE (SPRINKLER), BUT NEARBY/OVERHEAD SPRINKLERS ARE PRESENT: For the BMO process, dry uranium material is spilled during a seismic event. The initial location of this material could be in a variety of places depending on the stage of the oxidation process (e.g., the feed material can, in the HSVAC system, in/on the oxidation collection trays). During normal operations, internal sources of moderation are limited (Control XXX). The gloveboxes and airlocks are designed to limit the ingress of water from external leaks and fire suppression systems (Control 6.1.X). However, it is credible that the glovebox would suffer some form of integrity damage such that liquid from a nearby/overhead sprinkler system or other overhead liquid source could enter in limited amounts. Therefore, the concurrent introduction of liquid (water) in/on the spilled material due to potential leak(s) from the external sprinkler system is evaluated with the spill of material. The

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potential introduction of liquid into the furnace, even from a seismic event, is evaluated in Sect. XXX.

A design basis earthquake has been determined to be an unlikely event, in accordance with DSA-EF-801768-A001, *Documented Safety Analysis for the Uranium Processing Facility*. In the event that an earthquake does occur, it is possible that equipment and/or system conditions can be affected in the XXX process.

**5.3.1.2 Evaluation**

EXAMPLE PARAMETER DISCUSSION: For the BMO process, the geometry parameter is challenged when dry uranium material is spilled, and the moderation parameter is challenged when sprinkler water moderates the spilled material. The mass parameter remains unchanged.

During a seismic event, objects attached either to the building structure or to process systems that are not explicitly seismically qualified but could potentially cause damage or unanalyzed conditions to the fissile material operations (as described in this evaluation) are protected or evaluated in accordance with CSE-EN-801768-GEND-A001, Control 6.1.20.3. This requires that the effects of system interaction (referred to as the "two-over-one phenomenon") be addressed in accordance with the requirements of Sect. 6.3.2.4 of ANSI/ANS-2.26-2004 (R2010), *Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design*. Compliance with this standard requires that the fissile operation withstand the imposed loading; therefore, it is not credible for the seismic event to result in a critical configuration from non-seismically credited items in UPF, with the exception of maintenance cranes and hoists (if present).

[Consult RP-EG-801768-A136 to determine whether there are cranes or hoists present that could impact the equipment being evaluated, in other words whether RP-EG-801768-A136 lists equipment within the scope of your CSE within the zone of influence of a crane/hoist. Those cranes and/or hoists identified are potential objects which could impact equipment and must be evaluated, and controlled if necessary, to prevent potential configurations which could result in a criticality. Maintenance activities performed with the crane are not within the scope of the CSE. RP-EG-801768-A136 has the following statement for many cranes, which are not seismically qualified: 'This crane location has been identified as a crane that shall be removed when not in use by maintenance'. However, RP-EG-801768-A136 is not a document that creates requirements. Therefore, if your CSE has such a crane, and cannot or does not show subcriticality should the crane fall, then the CSE must create the requirement that the crane is removed prior to and after maintenance activities. An example of such a requirement is provided as follows:

6.3.x.1 9226-LIFT-HOI-12160 shall not be installed during fissile material operations within 9226-MEXLO-R-6000 or 9226-MEXHI-R-6000.]

[Evaluate postulated seismic scenarios, including any post-seismic fire scenarios from Sect. 13.1 of FH-EF-801768-A003. If there are no post-seismic fire scenarios for your CSE, then state: "There are no seismically-induced fire scenarios identified for the XXX process in FH-EF-801768-A003. Therefore, no additional consequences from a nearby fire (e.g., full sprinkler activation) are evaluated for this scenario." Do not evaluate aftershocks or concurrent upsets, except moderator in a single container/piece of equipment.]

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# Seismic Contingency Template
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Sprinklers are installed and maintained to high standards, as required by applicable DOE orders and standards. It is anticipated that sprinkler system components—sprinkler heads, distribution piping, control valves, and water supply—will have a high level of performance in terms of on-line availability and operational reliability, even after a seismic event. In particular, DSA-EF-801768-A001, classifies the fire protection system as Seismic Design Category-2, Limit State (LS)-B. This classification (i.e., LS-B) means that it is able to perform its safety function even if it develops small leaks as a result of moderate permanent distortion caused by the earthquake. This provides confidence that the sprinkler system will not fail catastrophically in a design basis seismic event. Furthermore, periodic tests, maintenance, and inspections of the fire suppression systems are required to ensure the sprinkler systems are maintained in good working order.

FH-EF-801768-A003 analyzes and reports on the design adequacy of the fire suppression system, and its ability to meet applicable codes and standards. Because of this high standard of construction and maintenance, inadvertent actuation or the development of significant leaks in the sprinkler system is unlikely, even as the result of a seismic event. Given the expected minor leakage from the sprinkler system, it is not considered credible that water would be introduced to more than a single container/piece of equipment. [A similar argument should be established for other liquid moderator sources, such as water lines. As necessary, credit should be taken for the glovebox providing a barrier against external liquid sources.]

EXAMPLE EVALUATION: Refer to existing approved CSEs for examples of how to evaluate and examples for the seismic contingency.

**5.3.1.3 Related Features**

**5.3.1.3.1 Controls in This CSE**

- List relevant controls from this CSE

**NOTE:** *If spacing must be maintained during a seismic event, the requirement must explicitly state the spacing requirement during the event. Where sufficient technical basis currently exists, the difference between the spacing requirement before the seismic event and during the seismic event should be at least 1 in.*

**5.3.1.3.2 Controls in Other CSEs**

- List relevant controls from other CSEs

**5.3.1.3.3 Programs/Procedures**

- Fire Protection Program
- List any other relevant programs

**5.3.1.3.4 Nature of the Operation**

- List relevant nature of operations

**5.3.1.3.5 Assumptions**

- List relevant assumptions

## 6. CREDITED CONTROLS AND ASSUMPTIONS

# ATTACHMENT 1
# Seismic Contingency Template

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## 7. REFERENCES

### 7.1 REFERENCED DOCUMENTS

ANSI/ANS-2.26-2004 (R2010), *Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design*, American National Standards Institute/American Nuclear Society, La Grange Park, IL, 2010. [ORNL Library]

CSE-EN-801768-GEND-A001, Rev. 1, *Criticality Safety Evaluation of UPF General Design Requirements*, Consolidated Nuclear Security, LLC, Y-12 National Security Complex. [InfoWorks]

DOE O 420.1C, *Facility Safety*, U.S. Department of Energy, Washington, DC, December 2012. [UPF Design Code of Record]

RP-EG-801768-A136, Rev. 2, *LIFT System Cranes and Zones of Influence* Consolidated Nuclear Security, LLC, Y-12 National Security Complex. [InfoWorks]

# ATTACHMENT 2
# Criticality Control Review (CCR) Table Template
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## CCR Table

| Control Number | Control Title | Safety Function | Functional Requirement | Performance Criteria | | | |
|---|---|---|---|---|---|---|---|
| | | | | Number | Text | †Elevate? | Basis |
| 6.1.1 | Passive Design Feature Title | Passive Design Feature Safety Function | Passive Design Feature Functional Requirement | 6.1.1.1 | Performance Criterion 1 | No | The design feature is credited as only one of multiple barriers necessary to prevent a criticality accident. |
| N/A | N/A | N/A | N/A | 6.1.1.2 | Performance Criterion 2 | No | The design feature is a non-safety to safety interface ("2 over 1") control for Natural Phenomena Events (NPEs). |
| N/A | N/A | N/A | N/A | 6.1.1.3 | Performance Criterion 3 | No | The design feature is designed to perform its credited safety function for a Natural Phenomenon Hazard (NPH) facility evaluation basis event. |
| N/A | N/A | N/A | N/A | 6.1.1.4 | Performance Criterion 4 | No | The design feature is related to neutron absorption properties of a standard material of construction (e.g., steel or nitrogen). |
| 6.1.2 | Passive Design Feature Title | Passive Design Feature Safety Function | Passive Design Feature Functional Requirement | 6.1.2.1 | Performance Criterion 1 | Yes | The design feature provides a single barrier to protect a process condition that could credibly be affected in such a way that a criticality accident is possible (i.e., a single contingency condition). |
| N/A | N/A | N/A | N/A | 6.1.2.2 | Performance Criterion 2 | Yes | The design feature supports an argument for a criticality accident not being credible that is not supplemented with other defense-in-depth controls. |

# ATTACHMENT 2
# Criticality Control Review (CCR) Table Template
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| Control Number | Control Title | Safety Function | Functional Requirement | Performance Criteria | | | |
|---|---|---|---|---|---|---|---|
| | | | | Number | Text | †Elevate ? | Basis |
| N/A | N/A | N/A | N/A | 6.1.2.3 | Performance Criterion 3 | Yes | The design feature control is related to the composition of materials credited as neutron poisons (e.g., boron or cadmium). |
| N/A | N/A | N/A | N/A | 6.1.2.4 | Performance Criterion 4 | Yes | The design feature ensures the validity of a trivial risk analysis. |
| N/A | N/A | N/A | N/A | 6.1.X.X | (Add rows as necessary for additional performance criteria associated with this safety function.) | | |
| 6.2.1 | Active Design Feature Title | Active Design Feature Safety Function | Active Design Feature Functional Requirement | 6.2.1.1 | Performance Criterion 1 | Yes | This feature is an NCS active design feature control which is an instrumented system to detect a change in a monitored condition and performs an automatic action to ensure a safe condition. |
| N/A | N/A | N/A | N/A | 6.2.X.X | (Add rows as necessary for additional performance criteria associated with this safety function.) | | |

# ATTACHMENT 2
# Criticality Control Review (CCR) Table Template
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| Control Number | Control Title | Safety Function | Functional Requirement | Performance Criteria | | | |
|---|---|---|---|---|---|---|---|
| | | | | Number | Text | †Elevate ? | Basis |
| 6.3.1 | Admin Control Title | N/A | N/A | 6.3.1.1 | Administrative control | No | The administrative control is not a control with a safety function equivalent to an elevated design feature. |
| 6.3.2 | Admin Control Title | N/A | N/A | 6.3.2.1 | Administrative control | Yes | This administrative control is a specific administrative fissile material form limit or mass limit that applies to an entire facility with a credible risk of a criticality accident. |
| 6.3.3 | Admin Control Title | N/A | N/A | 6.3.3.1 | Administrative control | Yes | The administrative control has a safety function equivalent to an elevated NCS design feature and is used in lieu of an elevated NCS design feature. |
| 6.3.4 | Admin Control Title | N/A | N/A | 6.3.4.1 | Administrative control | Yes | The administrative control is related to the composition of materials credited as neutron poisons (e.g., boron or cadmium). |
| 6.3.5 | Admin Control Title | N/A | N/A | 6.3.5.1 | Administrative control | Yes | The administrative limit ensures the validity of a trivial risk analysis. |
| N/A | N/A | N/A | N/A | 6.3.X.X | (Add rows as necessary for additional administrative controls) | | |

†Elevation Criteria from Y70-68-001, *Criticality Safety Approval/Requirements Development, Review, and Approval*, Appendix E, Rev. 10/26/2021

# ATTACHMENT 3
# Design Basis Fire Contingency Template
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The following steps provide a template for revising information in CSE documents related to the multiple parameters DBF scenario. The template is divided into steps that start with Section 5.3 to identify what is important for the fire scenario. Once the multiple parameters DBF contingency is in final draft and controls are identified, then relevant acronyms, definitions, process description changes, and parameter table changes are made.

The red text represents the basic action steps required to update the CSE (not text to be copied into a CSE).

The text in black represents text that can be copied directly into the CSE by relevant section.

The text in blue represents guidance and explanation that is not intended for copying into the CSE.

**Step 1. Review the following information:**

- **5.3.X (title)**
- **5.3.X.1 (Description and Basis for Unlikely)**

**Copy the black-text related to the bullets listed below into the CSE for the Multiple Parameters: Design Basis Fire Event:**

- **Contingency Title**
- **Description**
- **Basis for Unlikely**
- **"5.3.X.2 Evaluation" subheading**

(Ensure update format is in accordance with Section 2.9 of DG-EN-801768-A004, *UPF Criticality Safety Evaluation [CSE] Writer's Guide*.)

## 5.3.X Multiple Parameters Contingency: Design Basis Fire Event

### 5.3.X.1 Description of Contingent Configuration

This contingent event involves a postulated fire that unless mitigated could initiate, grow, and cause an adverse change in process conditions relied on to ensure subcriticality. A DBF can result in fissile material exposure to external water (from sprinkler activation or emergency response). The heat from a DBF can also result in damage to an item in some way that changes system $k_{eff}$. The possible changes in fissile material configuration include, but are not limited to:

- Deformation of equipment
- Loss of equipment integrity
- Loss of structural integrity
- Chemical changes in material
- Physical changes in material

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# Design Basis Fire Contingency Template
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Basis for Unlikely:
As with any operating facility there is potential for incipient fires. Incipient fires are those fires that are of a magnitude that poses no credible challenge to process equipment. Incipient stage fires are rare but anticipated events. However, until a fire develops beyond the incipient stage, it poses no credible threat of damaging process equipment.

A fire that progresses beyond the incipient stage is considered a credible event that might pose a threat to breach, deform, or otherwise damage unprotected process equipment. Furthermore, a DBF is considered an unlikely event as presented in RP-EN-801768-B003, Section 5.1.1, and is based on detailed analyses presented in the following RP-EN-801768-B003 sections, which construct the Inner Layer of the defense-in-depth methodology employed at UPF:

- Section 4.1.1 for fires involving the fixed building structure
- Section 4.1.2 for fires initiated in equipment within the facility
- Section 4.1.3 for fires initiated as a result of human error

These sections demonstrate that UPF is designed, constructed, and operated in a rigorous manner and in compliance with a suite of regulations, public laws, codes, standards, and operation requirements that ensure a diverse and overlapping system of controls are in place to minimize the potential for an incipient fire to grow and challenge fissile material equipment integrity.

Chapter 7 of FH-EF-801768-A003, *Fire Hazards Analysis of the Uranium Processing Facility*, provides detailed fire analyses of each processing area in Main Process Building (MPB)-East, MPB-West Excluding Special Oxide (SOX), MPB-West SOX, Salvage and Accountability Building (SAB) East, and SAB West. These sections of Chapter 7 identify and evaluate the following fire hazards:

- Flammable liquids
- Combustible liquids
- Flammable gases
- Combustible metals
- Water-reactive materials
- Strong oxidizers
- Combustible dusts or powders
- Gloveboxes and attached hoods
- Chemical hoods
- Enclosures
- Furnaces and ovens
- Forklift and battery charging
- Electrical
- Other significant fire hazards (e.g., molten metal spill, loss of chilled water, process steam, beaker leaching hot plates, molten material, process offgas)

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## Design Basis Fire Contingency Template
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The Middle Layer of defense-in-depth also includes specific controls that are identified to ensure the consequences of particular fire events is minimized to the extent necessary to meet the fire safety requirements required by DOE O 420.1C, *Facility Safety*. Fire hazards are evaluated assuming that controls included in the Middle Layer of the defense-in-depth methodology is in place. The Middle Layer includes UPF-wide operational requirements identified in Section 4.3 of the FHA and are implemented by Y79-95-001, *UPF Fire Protection Program* (Assumption 6.7.X). Examples of these requirements include forklift characteristics, combustible loadings, and structural material of pallets. Furthermore, these requirements address vulnerabilities that potentially exist even if the Inner Layer of defense-in-depth requirements is satisfied. However, violation of a particular Middle Layer requirement does not necessarily result in a fire nor loss of an NCS Item of Interest (IOI), instead this layer of defense-in-depth is degraded yet still capable of providing general protection against a DBF. When coupled, the Inner and Middle Layers foster an environment where it is unlikely for a fire to begin and grow to a size capable of disabling the functionality of an IOI's performance criteria.

### 5.3.X.2 Evaluation

**Step 2. Develop basis for subcriticality and identify any IOIs that may be needed.**

Section 5.3.X.2, "Evaluation," has one objective: Establish the basis for subcriticality in the unlikely event that a significant fire becomes possible due to the failure of the Inner and Middle Layers. The basis for subcriticality includes either:

1. Non-IOIs: Items whose assigned performance criteria are NOT required to be maintained during and after a DBF to ensure subcriticality:

   This case involves an NCS control that is unaffected by fire damage. The Non-IOI control must remain in place regardless of unmitigated fire damage AND any automatic mitigating response (e.g., sprinklers) to ensure subcriticality. The most common example of this case would be systems that control total uranium mass to less than a subcritical limit, such as less than 700 g $^{235}$U.

2. IOIs: Items whose performance criteria must maintain functionality during and after the postulated fire to ensure subcriticality.

   This case involves an item identified as an NCS controlled feature that must remain in place and whose failure must be prevented throughout a fire event in order to ensure subcriticality.

# ATTACHMENT 3
# Design Basis Fire Contingency Template
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**Step 2a. Identify performance criteria that ensure subcriticality regardless of fire damage.**

Points of Emphasis:

- The CSE author MUST consider each pathway a fire could adversely change one or more nuclear parameters as a result of fire-related damage.
- Whenever possible, the author should identify applicable controls
  - o that are not adversely affected by the fire event (e.g., mass limits)
  - o that ensure subcriticality with unmitigated fire damage, thus not requiring identification as an IOI.

NOTE: If the analysis documents subcriticality without depending on any IOIs, then the Process Analysis is satisfied and the CSE author should skip to Step 3, Section 5.3.X.3, *Related Features*.

**Step 2b: Identify IOIs (items whose performance criteria must maintain functionality during and after the postulated fire to ensure subcriticality).**

The CSE author must identify results of fire-related damage that could conceivably result in loss of one or more controls that otherwise provide the basis for subcriticality. This case involves an IOI(s) whose performance criteria must maintain functionality during and after the postulated fire to ensure subcriticality.

**Points of Emphasis:**

- identify the IOI directly as a requirement with associated performance criteria in Section 6.1;
- explicitly document that the fire contingency is subcritical if the identified IOI(s) is maintained.

# ATTACHMENT 3
# Design Basis Fire Contingency Template
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**Step 3 Ensure each IOI is clearly identified as an IOI in the "5.3.X.2 Evaluation" section.**

If no IOIs are relied upon for subcriticality;
- o Perform and document typical evaluation

If IOIs are relied upon for subcriticality;
- o The CSE author should ensure each IOI is clearly identified as an IOI in Section 5.3. For example, as a list preceding each by IOI1, IOI2, IOI3. Note, numbering IOIs is not required but is a good practice.
- o Ensure the following information is provided after each IOI in the list:
  - For an IOI that is a passive design feature, ensure it is explicitly presented in Section 6.1 and include a reference to the associated Performance Criteria (by number).
  - For an IOI that is an active design feature, ensure it is explicitly presented in Section 6.2 and include a reference to the associated Performance Criteria (by number).
  - Describe briefly the type of damage from fire (e.g., deformation) that is being controlled and the associated NCS parameter limit (e.g., tank diameter) that is being maintained by the design feature.
  - Employing FHA Chapter 19.3 or Chapter 19.4, verify and document how/why it is unlikely for the loss of IOI functionality due to a fire.
    - Identify equipment associated with the IOI by UNID or other identifier if UNID is unavailable. Submit list at the direction of NCS Management for tally.

⚠ If an IOI is determined to NOT be bounded by FHA Chapter 19.3 nor Chapter 19.4 content, thus posing a threat to the system remaining subcritical in a DBF event, verify with EF staff that required content is undocumented/unanalyzed.
- If undocumented/unanalyzed, contact NCS Management.

⚠ For Active Design Feature IOIs, ensure the NCS feature and applicable scope/description/purpose is correctly presented in Facility Safety documentation including the applicable Hazard Analysis, Technical Safety Report, and Documented Safety Analysis.

**Step 4 IF IOIs are identified, review the following text (shown in black) and copy as the remainder of Section 5.3.X.2, "Evaluation"**

This section of text provides the basis for subcriticality in the unlikely event that a DBF is possible due to systematic failure of the Inner and Middle Layers.

The Inner and Middle Layers of defense-in-depth mitigate the initiation and growth of fire in proximity to the IOI thus rendering the DBF unlikely. The Outer Layer provides protection/mitigation measures such that the loss of an IOI's performance criteria functionality is unlikely.

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# Design Basis Fire Contingency Template

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In order to ensure subcriticality, fire contingencies must be evaluated, including the identification of IOIs with associated performance criteria that must maintain functionality during and after a fire; therefore, an analysis of an IOI's environment during a fire is performed to ensure the Threshold Damage Limit is not exceeded. The analysis provided in Chapter 19 of the FHA demonstrates it is unlikely for any IOI to lose performance criteria functionality. The potential for a fire large enough to cause damage to IOIs is considered in Sect. 5.3.X.1, "Description of Contingent Configuration," of this contingency. Section 5.3.X.1 concludes that compliance with the various building codes applicable to the UPF facility, equipment that is of a robust industrial quality, and competent operators working to minimize risk of personal injury would provide an Inner and Middle Layer of defense-in-depth that make significant fires unlikely. In the unlikely event that such a fire could develop if otherwise left unmitigated, an additional layer of defense-in-depth is established that greatly reduce the ability of a fire to grow unmitigated until an IOI could be damaged and/or compromised thus challenging subcriticality. Development of additional layers of defense-in-depth involves identification and evaluation of fire sources and fire contingencies, which have been completed and documented in FH-EF-801768-A003.

Chapter 19, "Fire Prevention/Protection Controls for NCS Items of Interest," of FH-EF-801768-A003 provides the Outer Layer of defense-in-depth for fire contingencies and are instituted to protect NCS IOIs. These Outer Layer controls are based on a conservative assumption that Inner Layer and Middle Layer credited controls have failed thus exposing an IOI(s) to potential failure due to fire. Given the loss of the Inner and Middle Layers and worst-credible fire that might occur in proximity of an IOI, Chapter 19.3 demonstrates that fire suppression controls mitigate IOI failure and it also presents controls specifically related to NCS IOIs with area wet-piped sprinklers credited as part of the Outer Layer of defense-in-depth. The design of the sprinkler systems is performed in accordance with the following Design Criteria:

- DE-PE-801768-A002, *UPF Building and Fire Code Design Criteria*
- DE-PE-801768-A007, *UPF Facility Safety Design Criteria*
- DE-PE-801768-A025, *UPF Fire Protection Design Criteria*
- DE-PE-801768-A036, *UPF Fire Protection Services Design Criteria*

Separate sprinkler systems are installed to cover the MPB, SAB, Personnel and Support Building (PSB), and Highly Enriched Uranium Materials Facility Connector (HCON). The capability of the sprinkler system is assessed in FH-EF-801768-A003 and it is specifically considered in the context of NCS IOI protection in Chapter 19.3. The analysis concludes the sprinkler system reliably actuates and mitigates fire events that might occur in fissile material handling areas, with the possible exception of fires in Break & Shear (BAS), Filter and Separate (FS), and Special Material Production (SMP). However, the noted areas greatly benefit from sprinkler activation even though the effectiveness of the sprinkler activation may be degraded for events such as torch fires (which are explicitly controlled independent of sprinkler credit by Chap. 19.4). The adequacy of the Outer Layer (suppression) is dependent on reliable sprinkler system design and operation.

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# Design Basis Fire Contingency Template
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Additional Outer Layer controls include design features, which are presented in Chap. 19.4 of the FHA. The design features include passive design features that are either unique to a specific operation (e.g., the aforementioned organic fires in FS and SMP) that are implemented through specific CSEs and/or broad design controls that are implemented through CSE-EN-801768-GEND-A001.

Finally, administrative controls are higher level programmatic requirements whose failure does not significantly degrade the Outer Layer. The Chap. 19 administrative controls are implemented by Y79-95-001, *UPF Fire Protection Program* (Assumption 6.7.X).

UPF processes include several additional protective features that are not credited for maintaining NCS items requiring protection (e.g., Vortex glovebox fire suppression systems in specific gloveboxes, use of inert gas environments in specific processes). Non-credited defense-in-depth structure at UPF includes activation of emergency response resources (e.g., Fire Department deployment).

Based on the NCS defense-in-depth control structure, a DBF that causes a loss of IOI functionality is considered unlikely. The Inner Layer of the control structure provides fire resistant construction, equipment that is of a robust industrial quality, and competent personnel to ensure the fire event remains unlikely. Additionally, the Middle Layer controls combustible material thus limiting the credible size of a fire. When coupled, the Inner and Middle Layers are expected to reliably ensure a DBF is unlikely. Furthermore, Chapter 19 of the FHA provides analysis demonstrating the functional failure of an IOI is unlikely during a fire due to either sprinkler actuation and/or other explicit barriers that mitigate the loss of an IOI's functionality. Therefore, the NCS control structure combined with the analysis detailed in Chapter 19 of the FHA provides the basis for fissile material activities remaining subcritical in the event of a fire.

Table 5-X provides a listing of each performance criterion (control) associated with the IOIs identified in this section plus specific design features required to ensure protection of those IOIs in a DBF.

**Step 5 Review Sect. 6.1 of this template and copy any applicable passive design feature into Sect. 6.1 of the CSE.**

These controls are associated with design features identified in FHA Table 19-2 that are applicable to only a single system (e.g., BAS). All other Table 19-2 design features are implemented as Performance Criteria in CSE-EN-801768-GEND-A001, 6.1.19.

NOTE: The numbering of each PDF control must be adjusted to the next available number in the CSE.

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# Design Basis Fire Contingency Template
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**Step 6 Copy Table 5-X into the CSE and fill in the table.**

**Left column:** Performance Criteria associated with an IOI feature.

**Middle and Right columns:** Provide the GEND or subject-CSE passive Performance Criterion, respectively, associated with each FHA Table 19-2 design feature that is identified to protect the IOI.

**Middle column:** The Performance Criteria number for each applicable criterion from CSE-EN-801768-GEND-A001, 6.1.19.#.

**Right column:** Performance Criteria for each passive design feature added in Step 5. These are features identified for specific systems in Table 19-2 in the FHA (e.g. BAS controls).

**Table 5-X NCS IOI Control Summary**

| NCS IOI (Control) | Design Features that Protect NCS IOIs | |
|---|---|---|
| | **CSE-EN-801768-GEND-A001 Controls** | **Performance Criterion** |
| 6.1.#.# | 6.1.19.#<br>… | 6.1.#.#,<br>… |
| 6.1.#.# | 6.1.19.#<br>… | 6.1.#.#,<br>… |

**Step 7 Complete Sect. 5.3.X.3, "Related Features," using controls identified above and other required information associated with the subject CSE.**

Points of Emphasis:

- For existing IOIs
  - Only include bulleted lines that are applicable to the CSE
  - IF the CSE identifies IOIs, copy the applicable item(s) into the CSE from the bullet list following "Design Features" without the CSE document number in brackets. Numbering varies with each CSE based on passive design features (i.e., 6.1.#.#, where #.# identifies the specific Performance Criterion defined in the governing CSE)
- For newly developed DBF contingencies (new CSEs only) or newly identified IOIs
  - Recreate/Revise Section 5.3.X.3 ensuring to identify and document all applicable Controls, Design Features, Programs, Nature of Operation characteristics, and Assumptions
- *Y79-95-001, UPF Fire Protection Program* is in draft. Therefore, until this document has been published and made available to the UPF Project, CSEs referencing this document shall provide an Assumption that the content relied upon for NCS purposes will be contained within *Y79-95-001*
- For Controls In Other CSEs, ensure the proper document number – specifically 801768/922600/922601 identifier is provided. Delete all unnecessary template examples

## ATTACHMENT 3
## Design Basis Fire Contingency Template
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### 5.3.X.3 Related Features

5.3.X.3.1 Controls in this CSE

Non-IOI controls (as applicable)
IOI 1 (Control 6.1.A, as applicable)
IOI 2 (Control 6.1.B, as applicable)
…

Design Features:

Liquid transfer cart pressure relief [CSE-EN-801768-LTC-A001, Control 6.1.3.1, *Criticality Safety Evaluation for the Liquid Transfer Cart Use*]
BAS requirement to use FM Approved low fire hazard hydraulic oil [CSE-EN-922600-BASS-A001, Control 6.1.16.1, *Criticality Safety Evaluation for Break & Shear Sampling*]
BAS requirement for hydraulic line encapsulation [CSE-EN-922600-BASS-A001, Control 6.1.16.2]
BAS requirement to provide secondary containment [CSE-EN-922600-BASS-A001, Control 6.1.16.3]
SMP-F-2200, SMP-J-2210, SMP-F-2250, and pump skid secondary containment [CSE-EN-922600-EXT-A001, Control 6.1.5.1, *Criticality Safety Evaluation for Solvent Extraction Operations*]
SMP-J-2210 and SMP F-2250 area spray shield requirement for organic liquid transfer pumps [CSE-EN-922600-EXT-A001, Control 6.1.5.2]
Tanks FS-F-1100, FS-F-2200, FS-F-2300, FS-F-3300 (with associated pumps) and columns FS-E-1500, FS-E-1600 secondary spill containment [CSE-EN-922601-FS-A001, Control 6.1.7.1]
FS-R-7000 secondary containment [CSE-EN-922601-FS-A001, Control 6.1.7.2]
Spray/safety shields for organic liquid transfer pumps for FS-J-1110, -1120, -2220 and -3320 [CSE-EN-922601-FS-A001, Control 6.1.7.3]

5.3.X.3.2 Controls in Other CSEs

Summary of aspect(s) being credited (CSE-EN-801768-XXXX-A001)
Summary of aspect(s) being credited (CSE-EN-922600-YYYY-A001)
Summary of aspect(s) being credited (CSE-EN-922601-YYYY-A001)

5.3.X.3.3 Programs/Procedures

Fire Protection Program, including implementation of:

Combustible control and housekeeping program as implemented through Y79-95-001, *UPF Fire Protection Program* (Assumption 6.7.X).
Hot work control program as implemented through Y79-002, *Welding, Burning, and Hotwork Operations*, or equivalent program.

5.3.X.3.4 Nature of the Operation

None (or include if any are relevant).

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5.3.X.3.5 Assumptions

Requirements associated with NCS IOI controls are implemented in Y79-95-001, *UPF Fire Protection Program*.
[Assumption 6.7.X]

**Step 8 Regarding the controls identified for the Right-hand column of Table 5-X in Step 6, ensure each credited Passive Design feature is accurately presented in Sect. 6 of the CSE.**

The passive design features listed in this section are NOT the IOIs themselves. Instead, these Performance Criterion represent system-specific design features (e.g. for BAS or CART) that are listed in Table 19-2 of the FHA and that are not otherwise implemented as an NCS IOI by CSE-EN-801768-GEND-A001.

NOTE: There should be **no** active engineered features (Sect. 6.2) nor explicit NCS administrative controls (Sect. 6.3) protecting IOIs.

**Step 9 IF IOIs are newly identified AND CSE-EN-801768-GEND-A001 does not explicitly address the characteristics of said IOI, add the following assumption to Sect. 6.7.**

**NOTE: Assumption formatting should be consistent with the current CSE content.**

6.7 ASSUMPTIONS

**6.7.X** **<u>Description</u>**: Y79-95-001, *UPF Fire Protection Program* documents UPF programmatic requirements to minimize the likelihood of occurrence of a fire-related event, and minimize the consequences of a fire-related event affecting the public, workers, environment, property, and mission.

<u>Justification</u>: This document is currently in draft and integral to the fundamental approach to fire safety at the UPF, specifically how the occurrence and consequence of fire is managed through standard operations and programs within UPF buildings.
<u>Recommended Confirmation Method:</u> No recommended confirmation method is necessary for this assumption.

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## Design Basis Fire Contingency Template
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**Step 10 Ensure the following acronyms are included in the acronym list, if applicable. NOTE: This list may not be all inclusive therefore, the CSE author must be diligent in properly capturing all acronyms.**

DBF .................... Design Basis Fire
FM ...................... Factory Mutual
IOI ....................... Items of Interest

**Step 11 Update Sect. 5.1, "Parameters." Fire-related upsets are most commonly associated with changes in geometry, interaction, moderation, and/or reflection although other parameters could be affected.**

Points of Emphasis:

Edit the parameters table required by DG-EN-801768-A004 for Sect. 5.1.

- If the DBF contingency results in a change beyond subcritical limits for a single parameter then add DBF as a "Contingent Condition" for the affected parameter.
- If the DBF contingency results in a change beyond subcritical limits for more than one parameter then add DBF and the affected parameters to the "Contingent Condition" column of the "Multiple Parameters" row.

**Step 12 IF CSE includes NCS IOIs, add the following to Sect. 7.1, "Referenced Documents."**

NOTE: At the time this report was published the reference list is current; however, always ensure the applicable reference is contained within the content of Sect. 7.1.

DE-PE-801768-A002, Rev. 8, *UPF Building and Fire Code Design Criteria*, Consolidated Nuclear Security, LLC, Y-12 National Security Complex. [InfoWorks]

DE-PE-801768-A007, Rev. 13, *UPF Facility Safety Design Criteria*, Consolidated Nuclear Security, LLC, Y-12 National Security Complex. [InfoWorks]

DE-PE-801768-A025, Rev. 9, *UPF Fire Protection Design Criteria*, Consolidated Nuclear Security, LLC, Y-12 National Security Complex. [InfoWorks]

DE-PE-801768-A036, Rev. 12, *UPF Fire Protection Services Design Criteria*, Consolidated Nuclear Security, LLC, Y-12 National Security Complex. [InfoWorks]

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DOE-STD-1066-2012, *Fire Protection*, U.S. Department of Energy, Washington DC, December 2012. [*UPF Design Code of Record*, http://energy.gov/sites/prod/files/2016/06/f32/DOE-STD-1066-2012.pdf]

FH-EF-801768-A003, Rev. A, *Fire Hazards Analysis of the Uranium Processing Facility*. [InfoWorks]

Y79-002, Rev. 2/07/2022, *Welding, Burning, and Hotwork Operations*, Consolidated Nuclear Security, LLC, Y-12 National Security Complex. [SAP-DMS]

**ATTACHMENT 4**
**CSE Cover Page and Approval Page Formatting**
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CSE-EN-801768-TRASH-A001,
Rev. 0

consolidated nuclear security, llc
PANTEX PLANT | Y-12 NATIONAL SECURITY COMPLEX

# Criticality Safety Evaluation for Generation, Handling, and Disposal of Fissile-Contaminated Trash

Uranium Processing Facility Project
March 2019

# ATTACHMENT 4
# CSE Cover Page and Approval Page Formatting
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**NOTE:** *Adjust names in accordance with personnel filling the specified roles. Include approvals for co-analyst, co-reviewer, and NCS Chief Engineer, as applicable.*

## APPROVALS

| | |
|---|---|
| Your Name<br>NCS Analyst | Date |
| Peer Reviewer's Name<br>NCS Peer Reviewer | Date |
| R. W. Bartholomay<br>NCS Management Approver | Date |
| T. T. Richey<br>Design Authority | Date |
| J. J. McDonald<br>UPF Operations | Date |
| K. H. Reynolds<br>Project Engineering Manager, Nuclear Safety Engineering | Date |