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Spent Nuclear Fuels Project
Cold Vacuum Drying Facility
Human Factors Engineering (HFE) Analysis: Results and Findings

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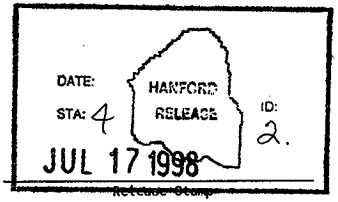

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SPENT NUCLEAR FUELS PROJECT
COLD VACUUM DRYING FACILITY

HUMAN FACTORS ENGINEERING (HFE) ANALYSIS:

Results and Findings

SNF-2825
Rev. 0

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July 17, 1998

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1 Introduction And Summary

1.1 Purpose

This report presents the background, methodology, and findings of a human factors engineering (HFE) analysis performed in May, 1998, of the Spent Nuclear Fuels (SNF) Project Cold Vacuum Drying Facility (CVDF), to support its Preliminary Safety Analysis Report (PSAR), in responding to the requirements of Department of Energy (DOE) Order 5480.23 (DOE 1992a) and drafted to DOE-STD-3009-94 format. This HFE analysis focused on general environment, physical and computer workstations, and handling devices involved in or directly supporting the technical operations of the facility.

This report makes no attempt to interpret or evaluate the safety significance of the HFE analysis findings. The HFE findings presented in this report, along with the results of the CVDF PSAR Chapter 3, Hazards and Accident Analyses, provide the technical basis for preparing the CVDF PSAR Chapter 13, Human Factors Engineering, including interpretation and disposition of findings. The findings presented in this report allow the PSAR Chapter 13 to fully respond to HFE requirements established in DOE Order 5480.23.

DOE 5480.23, Nuclear Safety Analysis Reports, Section 8b(3)(n) and Attachment 1, Section 14, require that HFE be analyzed in the PSAR for the adequacy of the current design and planned construction for internal and external communications, operational aids, instrumentation and controls, environmental factors such as heat, light, and noise; and that an assessment of human performance under abnormal and emergency conditions be performed (DOE 1992a).

1.2 Summary of Results

It is important to note that only 1% of the criteria capable of being reviewed at this time were considered non-compliant. Those criteria were discussed with the designers and resolved. Where appropriate, the designs are being updated to reflect the need for these changes. Where appropriate, administrative features are being implemented to training and procedures to reflect the need to meet these criteria. Therefore, each of these "non-compliant" responses can be considered appropriately resolved at this point. These responses will need to be further evaluated at the FSAR level to ensure they were finally resolved.

An overall 35% of the HFE criteria still need to be resolved in the FSAR. These criteria were discussed with the designers and are to be included in subsequent design considerations. Each of these criteria will need to be evaluated at the FSAR level to ensure adequate inclusion.

1.3 Human Operations at the CVDF

The primary operations at the CVDF are characterized by the following:

- Operators raise the door to allow backing the transporter into a predetermined position. The tractor is driven out of the bay and the bay door is closed, achieving process bay confinement. The security system is activated for the specific bay. Radiation surveys are conducted on the cask/transporter. The quality assurance package is delivered to the CVDF shift operations manager.

- A bridge is installed from the process bay mezzanine to the transporter work platform. The top of the cask is prepared for cask lid removal.

- Cask venting occurs by means of special venting hardware and flex lines connected to a cask lid port and the CVDF process vent system. After venting, the cask lid is removed by the CVDF process bay overhead crane, the process hood/seal ring is installed onto the cask, and the multi-canister overpack (MCO) is prepared for process operations.

- There are minimal manual operator actions in the process sequences other than field operator actions (e.g., connecting the MCO valves, flex lines, and) or control room operator actions (e.g., acknowledging alarms or instructing the monitoring and control system [MCS] to proceed with the next step).

- Control room operators direct the MCS when to initiate a certain sequence based upon status updates from field operators and the MCS, previous sequence completion notification, and operating procedures.

- Following the cold vacuum drying process and MCO testing, the cask–MCO transporter is prepared for shipment to the Container Storage Building (CSB). This operation is basically the reverse of the receipt operation. Through operations controlled at the MCS, the cask–MCO is cooled, the MCO is inerted and pressurized with helium, sealed and leak tested. The cask annulus is drained and dried with an instrument air purge and the cask lid is reinstalled. The bay is isolated from the ventilation systems and the telescoping door is opened. The transporter is reconnected to the tractor and released for shipment to the CSB.

1.4 HFE SAR Analysis Technical Approach

This engineering analysis considers HFE requirements established by Attachment 1, Section 14 of DOE Order 5480.23, commensurate with:

- Planned CVDF mission
- Hazard Category 2 classification
- Low complexity of the CVDF
- Passive nature of the safety-significant structures and components (SSCs) and the cold vacuum drying (CVD) process.

The methodology used to evaluate whether the current level of design and the anticipated design specifications and processes meet established HFE guidelines and standards was a tabletop task analysis, direct interview with design authorities and cognizant engineers, and finally reviewing applicable design documentation.

The results of the task analyses, interviews, and design documentation reviews was analyzed using INEL-95/0117 "Human Factors Engineering Checklists for Application in the SAR Process" (Overlin, Romero, & Ryan, 1995). These checklists result in a determination of whether the reviewed designs currently meet applicable HFE requirements or whether the design specifications account for the HFE requirements, or finally if the HFE requirement is to be a consideration in the ongoing design process.

Finally, the hazards analysis was reviewed to determine whether human operator actions involve using equipment or taking action that must be further analyzed.

This process is consistent with DOE 5480.23. According to Section 3.a.(2).(a), "Preliminary Safety Analysis Reports (PSARs) will define the final commitments governing preliminary design, procurement, construction, and preoperational testing of DOE nuclear facilities and will identify preliminary commitments to its ultimate design and operation." HFE analysis is primarily a paper-based design activity, with assessment of the current prototypes included. As the SAR progresses to a Final Safety Analysis Report (PSAR), a more rigorous analysis is performed of existing human-machine interfaces and actions during abnormal events.

1.4.1 Summary of Compliances and Deviations from Full Compliances

Approximately 10,000 HFE criteria are contained in DOE and DOE referenced HFE standards which were identified as appropriate for analyzing CVDF workstations, building areas, and handling devices, given the facility's mission, life cycle status, and Category 2 classification. These criteria were subsequently divided into 19 checklists corresponding to the communication, operational aid, instrumentation and control, and environmental factors requirements of the DOE order (DOE 1992b).

A total of 2,505 HFE observations were made using the checklists. All criteria did not apply to every workstation, building area, and handling device. Of the total observations (each observation defined an application of a single criterion to a single piece of equipment or human-machine interface feature thereof), 797 were determined to be not applicable. The remaining observations were determined germane to the analysis and led to 21 judged deviations from full compliance with respect to the standards, 797 judged to-be-determined based upon final design, and finally 822 judged fully compliant based upon the current and anticipated designs and design standards.

After factoring out the non-applicable criteria, CVDF was found to be in compliance with relevant HFE standards, and therefore, with DOE HFE requirements, in 48 percent of applicable observations. This is due mostly to the fact that several pertinent human-machine interfaces have yet to be completely realized, i.e., the Multi-Canister overpack

Control System (MCS). Table 3 presents a summary of the results of the HFE analysis. Appendices A and B provide detailed tallies and discussions of non-compliances respectively.

1.4.2 Identification of Human–Machine Interfaces

The intent of this section is to summarize the safety-class and safety-significant SSCs that require human–machine interfaces to function, and the associated human–machine interfaces. The human factors engineering process considered in the CVDF design of safety-class and safety-significant SSCs involves a number of requirements and guideline documents. These include DOE Order 6430.1A, Section 1300-12; MIL-STD-1472E; and UCRL-15673, *Human Factors Design Guidelines for Maintainability of Department of Energy Nuclear Facilities* (NRC 1985). A draft engineering standard, *Human Engineering Design Criteria*, Volume I, was used as a guideline. Human factors engineering analysis techniques are contained in NUREG/CR-3331, *Methodology for Allocating Nuclear Power Plant Control Functions to Human or Automatic Control* (NRC 1983).

A systems requirements analysis using a graded approach was performed as an integral part of the design. A number of human factors considerations were included in the CVDF design, as required by HNF-SD-SNF-DRD-002 (Irwin 1997).

In addition, U.S. Nuclear Regulatory Commission equivalency requires that NUREG-0700, *Human System Interface Design Review Guidelines* (NRC 1996), and NUREG-0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants*, Section 18.1, "Human Factors Engineering, Control Room" (NRC 1987), be reviewed for additional applicable requirements above DOE guidelines. Application of these guidelines to the CVDF for human factors interfaces (human–machine interfaces) are to be documented for the safety-class SSCs. Safety-class SSCs for the CVDF include the following:

- Safety-class instrumentation and control system
- Safety-class helium system
- Safety-class annulus water protection components
- MCO
- Process water vessels
- Water isolation components.

Safety-significant SSCs for the CVDF include the following:

- Heating, ventilating, and air conditioning systems
- CVDF structures
- Cask–MCO vent components.

The following interfaces and activities were reviewed:

- Process bay overhead crane interface
- Process equipment skid
- Multi-canister overpack (MCO), vacuum and purge system, and safety-class helium system interfaces
- Monitoring and control system (MCS) and safety-class instrumentation and control interfaces.

This analysis effort evaluated the human-machine interfaces (HMI) of the safety class systems described in Chapter 4 of the CVDF PSAR. Several of the systems are physically grouped and for purposes of the SAR were grouped during the analysis. The human-machine interfaces of the systems were grouped according to the following matrix:

Table 1: Matrix of Human-Machine Interfaces

Safety Class System	HMI Grouping
Safety-class instrumentation and control system	SCIC
Safety-class helium system	MCO and Equipment, MCS, and SCIC
Safety-class annulus water protection system	MCO and Equipment and MCS, and SCIC
Multi-canister overpack	MCO and Equipment and MCS
Process water vessels	Process Equipment Skid and MCS
Water isolation system	Process Equipment Skid and MCS
Heating, ventilating, and air conditioning systems	No HMI during operations
CVDF structures	No HMI during operations
Cask-multi-canister overpack vent system	No HMI during operations

1.5 Deviation from Full Compliance Equivalences

The results of the HFE analysis also demonstrate that all types of deviations from full compliance are not equal in their implications for CVDF, nor do deviations from full compliance of a single type necessarily have identical implications. Different HFE compliance criteria have different overall impacts on safety, and the same criteria can have different impacts on safety for different pieces of equipment and building areas. In the first instance, deviations from full compliance involving labeling, for example, do not carry the same weight as those involving partial availability or non-availability of public address (PA) system communications. Also, uniformity in labeling might be more important than visibility or contrast factors, both of which are sub-criteria under labeling. The impacts of each deviation from full compliance is not

considered within the body of this HFE analysis report, but provide foundational information for the human reliability analysis supporting the CVDF accident analysis. The results of the CVDF PSAR Chapter 3 hazards and accident analyses were used to characterize the safety significance of individual and grouped deviations from full HFE compliance in Chapter 13 of the CVDF PSAR.

1.6 Conclusion

The overall compliance percentage, and operation by operation compliance percentages, are considered very positive given CVDF's current level of design. It demonstrates that CVDF designers and operations personnel have been considering human factors while the design is being realized.

CVDF HFE designs, with exceptions discussed later in this report, provide workstation, building, and handling device human-machine interfaces directed toward maintaining the safety envelope for workers, collocated workers, and the public.

1.7 Organization of Report

The remainder of this report is organized into four sections and three appendices. Section 2 provides background information on the human factors discipline of which HFE is a part. Section 3 describes the methodology that was used to perform the HFE analysis. Included are:

- the technical approach and related PSAR guidance,
- a listing of the HFE tasks involved,
- CVDF descriptions and major tasks covered in depth by the HFE analysis,
- specific PSAR requirements for HFE established by the DOE and HFE standards used to assess compliance with DOE requirements, and
- considerations of human reliability analyses (HRA) conducted at CVDF.

Section 4 presents HFE analysis findings. Section 5 presents references used to support the HFE analysis. Appendix A provides the results of the HFE analysis in tabulated form. Appendix B provides a complete listing of HFE deviations from full compliance identified during the analysis in the general building areas, by operation, and by piece of equipment. Appendix C provides a complete listing of HFE TBDs identified during the analysis in the general building areas, by operation, and by piece of equipment. Appendix D provides a listing of assumptions that were used to complete this analysis. The complete checklists can be found in INEL-95/0117 "Human Factors Engineering Checklists for Application in the SAR Process" (Overlin, Romero, & Ryan, 1995).

2 Technical Background

Human error is known to be involved in 50% to 90% of all abnormal occurrences in complex, high reliability system settings like CVDF. In the commercial nuclear arena, the U.S. Nuclear Regulatory Commission (USNRC) estimates that human error is involved in about 65% of all abnormal occurrences as a direct, indirect, or contributing cause (Trager 1985). A wide range of person-machine and person-person factors enter the human error equation. Some examples include misallocation of duties and responsibilities, technically inaccurate or incomplete training or operating procedures, poor supervisory or administrative controls, and/or a poorly designed work environment.

Human factors as a scientific discipline dates back to World War II, during which complex socio-technologies in aviation, radar, and weapons control were introduced and advanced. The behavioral and social sciences body of knowledge from which human factors emerged, however, dates back well into the last century. Therefore, as a scientific and engineering support discipline, human factors applies behavioral and social sciences principles developed over the past century to system settings, with the goal of optimizing human--and ultimately--system performance. There are three somewhat overlapping areas within human factors:

1. The first area is HFE or, simply, human engineering (sometimes referred to as ergonomics). HFE primarily addresses person-machine issues such as equipment design (e.g., displays, controls, and their juxtaposition); workspace layout and accessibility; and habitability (e.g., temperature, light, noise, radiation). HFE is the subject of Chapter 13 of the CVDF PSAR.

2. The second area is personnel subsystems analysis. It primarily addresses person-person issues such as allocation of duties and responsibilities, staffing, qualifications, selection, training, operating procedures, technical and administrative management and organizational controls. Personnel subsystems analysis is a subject in Chapters 10, 12, and 17 of the CVDF PSAR. These were briefly reviewed during this analysis

3. The third area is HRA. It addresses both person-machine and person-person issues pertaining to human performance measurement whether qualitative or quantitative, including probabilistic analysis. HRA is covered in Chapters 3 and 5 of the CVDF PSAR.

The HFE analysis and results combined with the results of the PSAR Chapter 3 hazards and accident analyses serve as the technical bases for Chapter 13 of the PSAR.

3 Methodology of PSAR HFE Analysis

3.1 Technical Approach

CVDF has been classified a Hazard Category 2 facility based on criteria established in DOE 1027-92 regarding inventories of radiological and chemical materials (DOE 1992b). The technical approach (i.e., scope and depth of the HFE analysis) was guided, in part, by the following considerations. CVDF technical activities are characterized by:

- an administratively bounded radiation zone surrounding a multi-canister overpack,
- a computer process controller,
- a process water and venting system,
- a process and safety-class helium system, and
- protective clothing, remote handling, shielding, venting, and filtration providing personnel protection.

Most of these operations are passive in nature. During normal operations, the human operator is mostly responsible for connecting and disconnecting the venting and purging systems to the MCO and monitoring its progress.

In summary, the HFE analyses described in this report considers HFE requirements established by Section 1300-12 of DOE 6430.1A and Attachment 1, Section 14 of DOE 5480.23, commensurate with CVDF's:

- planned mission,
- Hazard Category 2 classification,
- moderate complexity, and
- the passive nature of human activity.

3.2 Description of HFE Analysis Tasks

This HFE analysis was performed during May, 1998, by means of three mostly sequential tasks.

Task 1: Conduct Tabletop Task Analyses. -- These task analyses were directed toward person-machine interfaces involving operations in and around the following CVDF work areas and equipment:

- MCO,
- MCS,
- SCIC,
- Process Equipment Skid, and
- Crane.

The results of the task analyses were used for: (1) selecting the HFE checklists in Task 2; (2) providing a context for conducting and reporting the HFE analysis as part of Task 3; (3) providing explanatory information for use in the CVDF PSAR Chapter 13, in instances where structures, work areas and equipment are judged not to fully meet the HFE criteria; and (4) for identifying design principles and guiding standards for human machine interfaces that have yet to be fully realized.

Task 2: Select HFE Checklists. -- HFE requirements were listed from DOE 5480.23, DOE Order 6430.1A, and IEEE 1023-88 (DOE 1992a, 1989; IEEE 1988). Criteria for meeting each of these requirements were identified from HFE standards referenced by DOE. These standards include MIL-STD 1472D, NUREG-0700, UCRL 15763, DOE 1062-93, OSHA 29 CFR 1910.132, 1910.133, 1910.134; and, ANSI Z88.1980 (DOD 1989; USNRC 1981; UCRL 1985; DOE 1993b; OSHA 1992, ANSI 1981).

The resulting series of HFE checklists based on DOE requirements and standards referenced by DOE, address the following human-machine compliance categories established by DOE 5480.23, Attachment 1, Section 14a through 14c (DOE 1992a). The checklist topics are listed here.

- Operational Aids
- Control/Display Integration
- Controls - General
- Hand Operated Controls
- Foot Operated Controls
- Controls for User Computer Interface (UCI)
- Visual Displays
- Transilluminated Displays
- Scale Indicators
- Displays
- Labeling
- Remote Handling
- Environment
- Operation & Maintenance of Ground Vehicles
- Hazards & Safety
- Protective Clothing
- Communications

Task 3: Conduct HFE Analysis. -- A comprehensive HFE analysis was performed on human-machine interfaces in the HFE compliance categories listed above, using the checklists selected in Task 2. Instances of compliance, deviations from full compliance, and compliance to-be-determined are tallied in Table 3 and Appendix A and Appendix B.

3.3 DOE Requirements and HFE Standards

With the publishing of DOE 6430.1A (General Design Criteria), in April 1989, DOE established its first set of HFE requirements (Section 1300-12) for reactor and nonreactor facilities (DOE 1989). In April 1992, DOE 5480.23 (Safety Analysis Reports) established HFE requirements (Attachment 1, Section 14a through 14c) drawing heavily from DOE 6430.1A (DOE 1992a, DOE 1989). Additionally, DOE references, such as IEEE Standard 1023-88, describe requirements for good human factors engineering design (IEEE 1988). Therefore, in establishing a set of HFE requirements for CVDF, the documents, including IEEE 1023-88, listed in Section 7, were considered in addition to DOE 5480.23 in establishing HFE topical areas for the CVDF analysis (IEEE 1988; DOE 1992a).

Each of these DOE and IEEE requirements documents references several HFE compliance standards from DOE and other Federal agencies, professional groups, and the military. These DOE and non-DOE standards contain criteria against which to assess compliance with PSAR requirements.

Several HFE compliance standards promulgated among government, industrial, military, and professional groups are listed in Section 7. These standards were selected to provide HFE criteria for the CVDF analysis since they have been developed or referenced by DOE, and they contain criteria for addressing all of the topic areas required by DOE 5480.23 (DOE 1992a).

- 29 CFR 1910, on Protective Clothing (CFR 1992a, b, and c).
- DOE-STD-3009-94, on SAR Preparation (DOE 1994)
- DOE 5480.23, Attachment 1, Section 14, on Human Factors Engineering (DOE 1992a)
- DOE 6430.1A, Section 1300-12, on Human Factors Engineering (DOE 1989)
- IEEE 1023-88, on Human Factors Engineering of Systems (IEEE 1988).

3.4 HFE Standards

- ANSI Z88.2-1980, on Practices for Respiratory Protection (ANSI 1981)
- DOE 1027-92, Hazard Classification & Accident Analysis (DOE 1992b)
- NUREG-0700, on Guidelines for HFE Design Reviews (USNRC 1981).
- MIL-STD-1472D, on Human Factors Engineering System Design Criteria (DOD 1989).
- UCRL 15673, on guidelines for HFE in maintenance and maintainability (UCRL 1985).
- DOE 1062-93, on HFE design criteria (DOE 1993b).

As indicated in the previous section, DOE Order 5480.23, other DOE orders, and DOE guidance documents reference a number of DOE and other entity HFE compliance standards. The task for the PSAR analysts was to select a set of criteria from these standards appropriate for CVDF.

Table 2: HFE Requirements Matrix

HFE Area	DOE Requirements		HFE Standards	
Operational Aids	5480.23, Attachment 1: 14a	6430.1A, 1300-12.4.8 DOE-STD-3009-94	NUREG-0700: 6.3.1	DOE-STD-1062-93
Control/Display Integration	5480.23, Attachment 1: 14b DOE-STD-3009-94	6430.1A, 1300-12.4.6 IEEE 1023-88: 4.3	NUREG-0700: 6.5, 6.7.1 MIL-STD-1472D: 5.1, 5.2, 5.15.3	DOE-STD-1062-93
Controls - general	5480.23, Attachment 1: 14b DOE-STD-3009-94	6430.1A, 1300-12.4.6 IEEE 1023-88, 4.3	NUREG-0700: 6.4	DOE-STD-1062-93
Hand Operated Controls	5480.23, Attachment 1: 14b DOE-STD-3009-94	6430.1A, 1300-12.4.6 IEEE 1023-88, 4.3	NUREG-0700: 6.4	DOE-STD-1062-93
Foot Operated Controls	5480.23, Attachment 1: 14b DOE-STD-3009-94	6430.1A, 1300-12.4.6 IEEE 1023-88, 4.3	NUREG-0700: 6.4	DOE-STD-1062-93
Controls for UCI	5480.23, Attachment 1: 14b DOE-STD-3009-94	6430.1A, 1300-12.4.6 IEEE 1023-88, 4.3	NUREG-0700: 6.4	DOE-STD-1062-93
Visual Displays	5480.23, Attachment 1: 14b DOE-STD-3009-94	6430.1A, 1300-12.4.6 IEEE 1023-88: 4.3	NUREG-0700: 6.5, 6.7 MIL-STD-1472D: 5.1, 5.2	DOE-STD-1062-93
Transilluminated Displays	5480.23, Attachment 1: 14b DOE-STD-3009-94	6430.1A, 1300-12.4.6 IEEE 1023-88: 4.3	NUREG-0700: 6.5, 6.7 MIL-STD-1472D: 5.1, 5.2	DOE-STD-1062-93
Scale Indicators	5480.23, Attachment 1: 14b DOE-STD-3009-94	6430.1A, 1300-12.4.6 IEEE 1023-88: 4.3	NUREG-0700: 6.5, 6.7 MIL-STD-1472D: 5.1, 5.2	DOE-STD-1062-93
Displays	5480.23, Attachment 1: 14b DOE-STD-3009-94	6430.1A, 1300-12.4.6 IEEE 1023-88: 4.3	NUREG-0700: 6.5, 6.7 MIL-STD-1472D: 5.1, 5.2	DOE-STD-1062-93
labeling	5480.23, Attachment 1: 14b DOE-STD-3009-94	6430.1A: 1300-12.4.11 IEEE 1023-88: 4.3.7	NUREG-0700: 6.6 DOE-STD-1062-93	
Remote Handling	5480.23, Attachment 1: 14b	DOE-STD-3009-94	MIL-STD-1472D: 5.10	DOE-STD-1062-93
Environment	5480.23, Attachment 1: 14c IEEE 1023-88: 4.2.1	6430.1A: 1300-12.4.2 DOE-STD-3009-94	MIL-STD-1472D: 5.8.1, 5.8.2, 5.8.3 DOE-STD-1062-93	
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Protective Clothing	5480.23, Attachment 1: 14c	6430.1A: 1300-12.4.5	OSHA 29 CFR 1910: 132, 133, 134 ANSI-STD-Z88.2-1988: 6.15, 7.2 DOE-STD-1062-93	
Communications	5480.23, Attachment 1: 14a	6430.1A, 1300-12.4.9	NUREG-0700: 6.2.1 DOE-STD-1062-93	

The criteria making up the HFE compliance standards were reviewed for their: (1) responsiveness to the HFE requirements (i.e., communications, operational aids, instrumentation and controls, environmental factors) established by DOE Order 5480.23, Attachment 1, Section 14a through Section 14c, and (2) relevance of the HFE requirements to the CVDF operating configuration. Applying these responsiveness and relevance criteria, along with the considerations stated above, a total of 1008 individual HFE criteria, out of a cumulative total of approximately 10,000 listed in the standards, were selected for the CVDF analysis. These criteria were collapsed into the HFE checklists. Table 3 presents a summary of HFE compliance categories and their associated DOE requirements and HFE standards selected for the CVDF HFE analysis.

4 Results

4.1 Introduction

Of the human factors criteria capable of being evaluated at this time, CVDF was found to be in compliance with 99% of the criteria. This section specifically looks at the deviations from complete compliance and provides a means for accomplishing compliance while the design matures. Also, this section relates HFE judged deviations from CVDF full compliance to safety, as required by DOE Order 5480.23, Attachment 1, Sections 14a through 14d (DOE 1992a).

Section 4.2 presents compliance and deviation results derived directly from the HFE checklists. It responds to requirements established by DOE Order 5480.23, Attachment 1, Section 14a for communications and operational aids (warning systems), and Section 14c for environmental factors. The HFE analysis of work stations and handling devices responds to requirements established by Section 14b regarding controls and instrumentation. Table 3 summarizes HFE compliances and deviations by HFE compliance category for workstations, building areas, and handling devices. Appendix A and Appendix B present a comprehensive discussion of HFE judged deviations for CVDF work areas, workstations, and handling devices.

4.2 HFE Analysis of Human-Machine Interfaces

DOE 5480.23 and DOE-STD-3009-94 both require a systematic inquiry into the human-machine interfaces pertinent to safety, especially focusing on those systems that are defined as SSCs. Those systems were evaluated using HFE checklists especially design for this process (Overlin, Romero, & Ryan, 1995). These checklists are designed to evaluate the human-machine interface of safety class systems according to criteria established by DOE, NRC, and the HFE professional community. These checklists can be applied to both existing equipment and designs. The checklists result in one of four responses: (1) compliance with the criteria, (2) non-compliance with the criteria, (3) the criteria is not applicable, and (4) to-be-determined (TBD) as the design evolves. The fourth category, TBD, is only applicable to a PSAR since the facility is not completely constructed. Once the human-machine interfaces are completed, the TBD responses must be resolved into either compliance, non-compliance, or ultimately non-applicable. At the PSAR level, the non-compliance responses must be grouped into either "to be resolved" or "not appropriate to the design being contemplated" (meaning ultimately non-applicable). The results from the HFE analysis are summarized in the following tables.

Table 3: HFE Analysis Results

	HMI Interfaces																			
	MCS				MCO and Equipment				Process Equipment Skid				SCIC				Crane			
HFE Criterion	Yes	No	NA	TBD	Yes	No	NA	TBD	Yes	No	NA	TBD	Yes	No	NA	TBD	Yes	No	NA	TBD
Operational Aids	7	0	9	2	-	-	-	-	-	-	-	-	7	0	9	2	-	-	-	-
Control/Display Relationship	16	0	30	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Visual Displays	14	0	9	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transilluminated Displays	-	-	-	-	-	-	-	-	-	-	-	-	8	0	10	15	-	-	-	-
Scale Indicators	-	-	-	-	-	-	-	-	27	2	7	1	-	-	-	-	-	-	-	-
Displays	1	0	58	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Audio Displays	13	0	34	28	-	-	-	-	-	-	-	-	13	0	34	28	-	-	-	-
General Controls	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	0	29	3
Hand Operated Controls	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	0	135	1
Foot Operated Controls	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
User-Computer Interface	11	1	201	556	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Labeling	-	-	-	-	127	0	0	1	128	0	0	0	127	0	0	1	127	0	0	1
Remote Handling	-	-	-	-	6	0	9	3	-	-	-	-	-	-	-	-	6	0	9	3
Environment	-	-	-	-	16	0	16	13	-	-	-	-	-	-	-	-	-	-	-	-
Operation & Maintenance: Vehicles	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hazards & Safety	-	-	-	-	33	3	1	16	25	3	11	13	-	-	-	-	-	-	-	-
Physical Access	-	-	-	-	20	5	24	55	20	6	34	43	-	-	-	-	-	-	-	-
Protective Clothing	-	-	-	-	13	0	51	0	-	-	-	-	-	-	-	-	-	-	-	-
Communications	-	-	-	-	23	0	7	6	23	0	7	6	-	-	-	-	-	-	-	-

Table 4: Summary of HFE Analysis

HMI	Yes	No	NA	TBD
MCS	62	1	341	654
MCO and Equipment	265	10	115	95
Process Equipment Skid	196	9	52	62
SCIC	155	0	53	46
Crane	146	0	173	8
MCS	6%	0.1%	32%	62%
MCO and Equipment	55%	2%	24%	20%
Process Equipment Skid	61%	3%	16%	19%
SCIC	61%	0%	21%	18%

As can be seen in the previous tables, an overall 35% of the HFE criteria still need to be resolved in the FSAR. These criteria were discussed with the designers and are to be included in subsequent design considerations. Each of these criteria will need to be evaluated at the FSAR level to ensure adequate inclusion.

It is important to note that only 1% of the criteria capable of being reviewed at this time were considered non-compliant. Those criteria were discussed with the designers and resolved. Where appropriate, the designs are being updated to reflect the need for these changes. Where appropriate, administrative features are being implemented to training and procedures to reflect the need to meet these criteria. Therefore, each of these "non-compliant" responses can be considered appropriately resolved at this point. These responses will need to be further evaluated at the FSAR level to ensure they were finally resolved.

CVDF was found to be in compliance with relevant HFE standards, and therefore, with DOE HFE requirements, in 99% of applicable observations. Of the observations made, there were 21 human-machine interfaces judged as deviations from full compliance with the HFE criteria listed in Appendix B. Table 3 presents a summary of the results of the HFE analysis. HFE findings are listed according to the human machine interface that was reviewed.

The SCIC and Crane have the highest compliance rate with no non-compliances. The MCS currently has only 2 non-compliances. The MCO has the highest non-compliance rate due mostly to the physical access and safety hazard issues related to operating in the MCO area. The process Equipment Skid has the next highest non-compliance rate with 9 non-compliances due to physical access and safety hazard issues related to operating in the area. While these issues may at first appear unrelated to HMI issues with SSCs, it is important to note that when operators are unable to easily access equipment, they are more likely to make errors in connecting hoses, performing maintenance activities, or verifying and validating system status.

4.2.1 Suggested Interpretations and Resolution of Judged Deviations from Full HFE Compliance

The following subsections address two issues confronting the HFE analyst involved in the PSAR process. The first involves safety, that is, judged non-compliances based on their relatedness to radiological, chemical, and/or industrial safety. The second are mechanisms for correcting judged non-compliances especially those of workstations, building areas, and handling devices involved in high likelihood/consequence accident scenarios.

The suggestions presented below for interpreting and resolving judged deviations from full HFE compliance are derived from detailed reviews of existing DOE orders and comments provided by DOE on earlier PSARs, and SAR preparation guidance provided by or referenced by DOE. Nevertheless, these suggestions are not necessarily endorsed by DOE, nor might they represent the only approach for interpreting and resolving HFE deviations. Ostensibly other approaches can be derived from DOE orders and guidance provided or referenced by DOE.

4.2.2 Interpretations of Judged Deviations from Full Compliance with HFE Standards, and Safety

DOE Order 5480.23, Attachment 1, Section 14, establishing HFE requirements, refers to safety without specifically distinguishing among radiological, chemical, and industrial safety (DOE 1992a). Nevertheless, it is necessary for responding to the graded approach, that the results of the HFE analysis be interpreted for their relevance to each of these forms of safety.

Each HFE criterion making up the HFE compliance standards used in this analysis is, without exception, related to safety in that failure to comply raises the likelihood of human error which in turn leads to an increased probability of an unsafe condition. HFE criteria are based on scientific literature developed in the behavioral and social sciences over the past 120 years. Whether or not an unsafe condition, induced by non-compliance with one or more HFE criteria, has the potential for radiological, chemical, and/or industrial consequences is determined by the type of accident sequence in which the workstation, building area, or handling device is involved.

For purposes of the CVDF PSAR, it is suggested that deviations from full HFE compliance be categorized under radiological safety, chemical safety, or industrial safety, using the results of the PSAR Chapter 3 hazards and accident analysis, and other safety analyses done to the support the PSAR. Chapter 3 categorizes accident scenarios according to their likelihood/consequence combinations ranging from dominating to incredible. Deviations from full HFE compliance can be categorized using the same scheme. Chapter 3 data focus on radiological and chemical safety, unless accident scenarios involving the latter are screened out using DOE Standard 1027-92 requirements and standards, in which case the Chapter 3 data are further limited to radiological safety (DOE 1992b). Chapter 3 results are used as one basis for doing this screening. Remaining deviations from full HFE compliance can be categorized as industrial safety issues.

Once deviations from full HFE compliance have been categorized, facility managers and DOE regulators can make safety-based decisions regarding their resolution.

4.2.3 Alternatives for Resolving Deviations from Full Compliance with HFE Standards

CVDF workstation, building area, and handling device human-machine interfaces included in the HFE analysis involve a variety of equipment most of which are not yet completely realized. The four options presented below, for resolving HFE deviations, do two things. First, they provide a methodology for resolution. Second, they help designers to determine the level of design changes required to resolve the issue. Categorization of deviations from full HFE compliance, discussed in the previous section, can help facility managers and DOE regulators in deciding on one of the following interventions discussed in the following paragraphs.

4.2.3.1 Administrative Control Interventions. Administrative controls involve changes in training, written procedures, staffing, and direct oversight, or any combination capable of compensating for HFE deviations. These interventions do not impact the current equipment design and configuration. For example, improper positioning of displays and controls relative to one another that preclude individual workers from operating the equipment can often be overcome by adding a second participating worker. Marginal labeling can often be overcome through additional training of workers or expanded written procedures for operating equipment associated with the marginal labeling.

4.2.3.2 Non-Intrusive Interventions. These interventions involve changes in equipment operating configurations without changing the equipment itself. For example, higher wattage light bulbs can be added without modifying the electrical system or electrical fixture. Individual pieces of equipment and furniture making up a workstation can be physically rearranged to achieve compliance.

4.2.3.3 Intrusive Interventions. These interventions involve actual changes to the equipment designs. They are used where administrative controls and non-intrusive interventions cannot be demonstrated to achieve acceptable performance levels. They may be necessary in all cases of equipment involved in dominating accident sequences.

Appendix B lists the non-compliances that were identified during this review. Appendix B also lists the current deviation resolution philosophy for each non-compliance. Most of the resolutions were left to be determined as the design evolved.

4.3 HFE Compliance To-Be-Determined

Since most of the HMIs have yet to be fully realized, it was not possible to evaluate full compliance with some of the HFE criterion. These criteria were considered as their compliance to-be-determined (TBD). Appendix A lists the criterion that were judged TBD. During this study, the cognizant personnel were interviewed concerning the general disposition of these criterion and it was decided that these would either be included or reviewed for appropriateness.

The MCS had the highest rate of TBD with 654 criteria judged TBD. Most of these were related to User-Computer Interface issues, though several also considered the audio alarms and general display characteristics. The MCO had 95 TBDs and the Process Equipment Skid had 62 TBDs mostly due to physical access. Since the MCO was only in mockup stage and actual physical layout is still undetermined, this was the only option. However, if the mock-up fairly accurately reflects the physical access to be encountered during operations, it is suggested that physical access be more greatly considered. An appropriate course of action may be to simulate the tasks to be performed, including maintenance and abnormal operations, and identify occasions when the physical access is restricted. Finally, the crane had 8 TBDs mostly due to some issues with control mechanism whose design is yet to be determined. Finally,

communications were listed as TBD on the MCO and the Process Equipment Skid. The reason was that cognizant personnel stated communications to the MCS operator would be accomplished through the use of headsets and microphones, though actual design documentation could not be obtained.

4.4 HFE FSAR Analysis

Both the non-compliances and the TBDs need to be reviewed at the time the FSAR analysis is completed. Furthermore, the HFE criterion currently judged to be complied with must also be reviewed to ensure that the compliance was maintained through the design and construction process.

4.5 Conclusions

The CVDF process and equipment designers have currently included human factors considerations in the majority of their activities as evidenced by the low non-compliance rate. CVDF fully intends to maintain this concern for human factors issues throughout the remainder of the design and procurement activities. This continued concern for HFE issues will ensure the TBD responses are appropriately considered and included. For each of these TBDs, it will easier and less costly to appropriately consider them during design and construction phases than after construction is completed.

5 Human Error Performance in Potential Abnormal Environments

DOE Order 5480.23, Attachment 1, Section 14d, requires that the SAR address human error reduction efforts being made by the reporting facility (DOE 1992a). To respond to this requirement, the CVDF HFE analysis for the PSAR examined the facilities hazards analysis completed to support Chapter 3 of the PSAR for human actions or information processing needs. Once these needs were determined, cognizant professionals were interviewed to determine the level of detail available for determining whether human actions or information processing needs had been appropriately considered. The results of the interview is included in Appendix C.

The result of the interview indicated one overall conclusion. Human error has been attributed to a majority of the accident scenarios in the facilities hazards analysis (See Appendix C). However, much of the human actions have yet to be determined. Therefore, this analysis could not be completed at this time.

It is important to note that while human error is attributed to a majority of accident scenarios, the SCIC is a passive system requiring little human intervention. This system is designed to respond to an incident and place the MCO in a fail-safe mode ensuring little opportunity for a release.

Human actions during abnormal operations need to be further analyzed throughout the design process and completed in time to support the FSAR. This table lists the accident scenarios in the accident analysis that involve human error and need further analysis.

Location/Checklist Entry	Cause
Administrative area AA-L-01, AA-L-02, AA-L-06, AA-L-08, AA-L-11, AA-L-16	Human Error
Administrative area AA-P-02	Human Error
Transfer Corridor (and mechanical corridor) TC-L-01, TC-L-02, TC-L-03, TC-L-04, TC-L-05, TC-L-06, TC-L-08, TC-L-10, TC-L-11, TC-L-13, TC-L-14, TC-L-15, TC-L-16	Human Error (e.g., improper storage practices)
Transfer Corridor (and mechanical corridor) TC-P-02	Human Error
Process bays 2-5 PB-B-03b	Human error (heater turned off)

Location/Checklist Entry	Cause
Process bays 2-5 PB-B-13b	Excessive time under vacuum due to human error, or mechanical or software failure
Process bays 2-5 PB-B-13d	Excessive free water remaining in the MCO (due to inadequate pressure rebound test)
Process bays 2-5 PB-B-13f	Excess shipping time beyond established window Improper loading at fuel retrieval
Process bays 2-5 PB-F-01a, PB-F-01b, PB-F-01c, PB-F-02a, PB-F-02b, PB-F-02c, PB-F-02d, PB-F-05a, PB-F-05b, PB-F-05c, PB-F-05d, PB-G-03a, PB-G-03b, PB-G-03c	Human error
Process Bays 2-5 PB-H-06a	Failure to vent the transport cask Exceeding the shipping window Improper loading at fuel retrieval
Process Bays 2-5 PB-H-06b	Human error resulting in a poor connection to the tempered water system
Process Bays 2-5 PB-H-06c	MCO is isolated for process line hook-up and pressure testing, and remains in that configuration too long (human error)
Process Bays 2-5 PB-H-06d	Human error (isolating the MCO by manually closing the process port isolation valve; refer to PB-R-01h)
Process Bays 2-5 PB-H-06i	Isolation of MCO over a long period of time after processing
Process Bays 2-5 PB-H-06k	Wrong gas hooked into helium supply (due to human error at vendor filling the bottles incorrectly)
Process Bays 2-5 PB-H-06l	Incorrect MCO port opened during cask loadout (e.g., long tube)
Process Bays 2-5 PB-H-11c	Human error
Process Bays 2-5 PB-H-11d	Failure to isolate bay ventilation before opening bay door Bay door opens unintentionally, ventilation restarted accidentally, isolation not adequate (human error)

Location/Checklist Entry	Cause
Process Bays 2-5 PB-L-01 through PB-L-10 and PB-L-13 through PB-L-16	Human error
Process Bays 2-5 PB-L-11a	Failure to isolate auxiliary vacuum pump prior to task venting
Process Bays 2-5 PB-N-04a, PB-P-02	Human error
Process Bays 2-5 PB-P-01	Fuel truck accident
Process bay 1 (spare bay) SB-F-01a, SB-F-02a, SB-F-01b, SB-F-02b, SB-F-01c, SB-F-02c	Human error
Process bay 1 (spare bay) SB-F-11	Failure to isolate bay ventilation before opening bay door Bay door opens unintentionally, ventilation restarted accidentally, isolation not adequate (human error)
Process bay 1 SB-L-01 through SB-L-10 and SB-L-13 through SB-L-16	Human error
Process bay 1 SB-N-03, SB-P-02	Human error
Process Water Room PW-L-01 through PW-L-06, PW-L-08, PW-L-10, PW-L-13, PW-L-14, PW-L-16, PW-P-02	Human error
Outside OU-F-01	Human error
Outside OU-N-01b, OU-N-03a	Human error (normal operations step when water is clean)
Outside OU-P-02, OU-Q-01, OU-Q-02, OU-Q-03, OU-Q-04	Human error

6 Limitations of this Study

This study has some limitations imposed by three factors outside the control of these authors. First, the time frame to complete the study was necessarily compressed. Second, this study focused on the current and expected design as it supports a PSAR. Several important human machine interfaces have yet to be fully realized. Several HFE criterion were necessarily left as to-be-determined (TBD) and several important assumptions were used to complete the analysis. Third, human actions during abnormal operations have yet to be fully determined and could not be analyzed. Each of these issues must be further addressed in the FSAR.

Another limitation of this study is that due to DOE 5480.23, this study focuses on human factors engineering versus physical ergonomics. There were several important physical ergonomics issues that need to be considered to ensure that the operations can be completed in a manner that will not result in a large potential for back injuries or cumulative trauma disorders. These are:

1. Placing the gate valve covers on the MCO,
2. Using the quick disconnect tool on the access port at the bottom of the MCO,
3. Removing and tightening bolts around the cask lid,
4. Maintenance activities on the HEPA filters and the process equipment skid, and
5. Placing the mezzanine bridge.

These issues potentially involve handling large forces, awkward postures, or biomechanically difficult tasks. CVDF management has been made aware of these issues and are willing to consider means for addressing them in the continuing design and procurement activities.

7 References

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8 Appendix A: Checklist Results by HMI

This section includes the tables of the checklists completed during this evaluation. This appendix is organized first by the human-machine interface being evaluated and then by the human factors engineering (HFE) criteria. The HFE criteria are not actually listed in this appendix due to space considerations. They can be found in INEL-95/0117 "Human Factors Engineering Checklists for Application in the SAR Process" (Overlin, Romero, & Ryan, 1995). They are referenced in this section by the criterion number. For example, the MCS was analyzed using Checklist 11: User Computer Interface. The checklist table in this document will list a criteria as 11-1. This refers to the first question of Checklist 11 and that criterion number can be found in INEL-95/0117 "Human Factors Engineering Checklists for Application in the SAR Process" (Overlin, Romero, & Ryan, 1995). These tables also list several assumptions that were used in completing these checklists.

8.1 Human-Machine Interface: Crane Operations

Checklist	No.	Yes	No	NA	TBD	Assumptions
8	1	X				
8	2	X				
8	3	X				
8	4				X	
8	5			X		
8	6			X		
8	7			X		
8	8			X		
8	9			X		
8	10			X		
8	11				X	
8	12			X		
8	13	X				
8	14			X		
8	15			X		
8	16			X		
8	17			X		
8	18			X		
8	19			X		
8	20			X		
8	21			X		
8	22			X		
8	23			X		
8	24			X		
8	25			X		
8	26			X		
8	27			X		
8	28			X		
8	29			X		
8	30			X		
8	31			X		

Checklist	No.	Yes	No	NA	TBD	Assumptions
8	32				X	Need to determine the hand protection needed
8	33			X		
8	34	X				
8	35			X		
8	36			X		
8	37	X				
8	38			X		
9	1			X		
9	2			X		
9	3	X				
9	4	X				
9	5	X				
9	6			X		
9	7			X		
9	8			X		
9	9			X		
9	10			X		
9	11			X		
9	12			X		
9	13			X		
9	14			X		
9	15			X		
9	16			X		
9	17			X		
9	18			X		
9	19			X		
9	20			X		
9	21			X		
9	22			X		
9	23			X		
9	24			X		
9	25				X	Will there be any cover guards?
9	26			X		

Checklist	No.	Yes	No	NA	TBD	Assumptions
9	27			X		
9	28			X		
9	29			X		
9	30			X		
9	31			X		
9	32			X		
9	33			X		
9	34			X		
9	35			X		
9	36			X		
9	37			X		
9	38			X		
9	39			X		
9	40			X		
9	41			X		
9	42			X		
9	43			X		
9	44			X		
9	45			X		
9	46			X		
9	47			X		
9	48			X		
9	49			X		
9	50			X		
9	51			X		
9	52			X		
9	53			X		
9	54			X		
9	55			X		
9	56			X		
9	57			X		
9	58			X		
9	59			X		

Checklist	No.	Yes	No	NA	TBD	Assumptions
9	60			X		
9	61			X		
9	62			X		
9	63			X		
9	64			X		
9	65			X		
9	66			X		
9	67			X		
9	68			X		
9	69			X		
9	70			X		
9	71			X		
9	72			X		
9	73			X		
9	74			X		
9	75			X		
9	76			X		
9	77			X		
9	78			X		
9	79			X		
9	80			X		
9	81			X		
9	82			X		
9	83			X		
9	84			X		
9	85			X		
9	86			X		
9	87	X				
9	88			X		
9	89	X				
9	90			X		
9	91	X				Assumes standard box design
9	92			X		

Checklist	No.	Yes	No	NA	TBD	Assumptions
9	93			X		
9	94			X		
9	95			X		
9	96			X		
9	97			X		
9	98			X		
9	99			X		
9	100			X		
9	101			X		
9	102	X				
9	103			X		
9	104			X		
9	105			X		
9	106			X		
9	107			X		
9	108			X		
9	109			X		
9	110			X		
9	111			X		
9	112			X		
9	113			X		
9	114			X		
9	115			X		
9	116			X		
9	117			X		
9	118			X		
9	119			X		
9	120			X		
9	121			X		
9	122			X		
9	123			X		
9	124			X		
9	125			X		

Checklist	No.	Yes	No	NA	TBD	Assumptions
9	126			X		
9	127			X		
9	128			X		
9	129			X		
9	130			X		
9	131			X		
9	132			X		
9	133			X		
9	134			X		
9	135			X		
9	136			X		
9	137			X		
9	138			X		
9	139			X		
9	140			X		
9	141			X		
9	142			X		
9	143			X		
12	1				X	
12	2	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	3	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	4	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	5	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	6	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	7	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	8	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	9	X				Assuming done according to Hanford label standard pending a final FSAR analysis

Checklist	No.	Yes	No	NA	TBD	Assumptions
12	10	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	11	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	12	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	13	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	14	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	15	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	16	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	17	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	18	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	19	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	20	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	21	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	22	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	23	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	24	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	25	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	26	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	27	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	28	X				Assuming done according to Hanford label standard pending a final FSAR analysis

Checklist	No.	Yes	No	NA	TBD	Assumptions
12	29	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	30	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	31	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	32	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	33	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	34	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	35	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	36	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	37	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	38	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	39	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	40	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	41	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	42	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	43	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	44	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	45	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	46	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	47	X				Assuming done according to Hanford label standard pending a final FSAR analysis

Checklist	No	Yes	No	NA	TBD	Assumptions
12	48	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	49	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	50	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	51	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	52	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	53	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	54	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	55	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	56	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	57	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	58	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	59	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	60	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	61	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	62	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	63	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	64	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	65	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	66	X				Assuming done according to Hanford label standard pending a final FSAR analysis

Checklist	No	Yes	No	NA	TBD	Assumptions
12	67	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	68	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	69	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	70	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	71	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	72	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	73	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	74	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	75	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	76	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	77	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	78	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	79	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	80	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	81	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	82	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	83	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	84	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	85	X				Assuming done according to Hanford label standard pending a final FSAR analysis

Checklist	No.	Yes	No	NA	TBD	Assumptions
12	86	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	87	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	88	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	89	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	90	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	91	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	92	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	93	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	94	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	95	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	96	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	97	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	98	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	99	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	100	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	101	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	102	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	103	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	104	X				Assuming done according to Hanford label standard pending a final FSAR analysis

Checklist	No.	Yes	No	NA	TBD	Assumptions
12	105	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	106	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	107	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	108	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	109	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	110	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	111	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	112	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	113	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	114	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	115	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	116	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	117	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	118	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	119	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	120	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	121	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	122	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	123	X				Assuming done according to Hanford label standard pending a final FSAR analysis

Checklist	No.	Yes	No	NA	TBD	Assumptions
12	124	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	125	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	126	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	127	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	128	X				Assuming done according to Hanford label standard pending a final FSAR analysis
13	1	X				
13	2	X				
13	3			X		
13	4	X				
13	5				X	
13	6	X				
13	7			X		
13	8			X		
13	9			X		
13	10	X				
13	11			X		
13	12			X		
13	13	X				
13	14			X		
13	15			X		
13	16			X		
13	17				X	
13	18				X	

8.2 Human Machine Interface: Process Equipment Skid

Checklist	No.	Yes	No	NA	TBD	Assumptions
16	1	X				
16	2	X				
16	3				X	
16	4	X				
16	5	X				
16	6				X	
16	7				X	
16	8	X				
16	9				X	
16	10	X				
16	11	X				
16	12				X	
16	13				X	
16	14	X				
16	15	X				
16	16	X				
16	17	X				
16	18	X				
16	19	X				
16	20	X				
16	21	X				
16	22	X				
16	23	X				
16	24	X				
16	25	X				
16	26			X		
16	27		X			
16	28				X	
16	29			X		
16	30				X	
16	31			X		

Checklist	No.	Yes	No	NA	TBD	Assumptions
16	32			X		
16	33			X		
16	34			X		
16	35			X		
16	36	X				
16	37	X				
16	38	X				
16	39	X				
16	40	X				
16	41			X		
16	42			X		
16	43				X	
16	44				X	
16	45				X	
16	46			X		
16	47				X	
16	48	X				
16	49				X	
16	50		X			
16	51		X			
16	52			X		
16	53	X				
17	1		X			
17	2	X				
17	3				X	
17	4				X	
17	5				X	
17	6	X				
17	7			X		
17	8	X				
17	9	X				According to the Hanford Standard on labeling
17	10	X				
17	11		X			

Checklist	No.	Yes	No	NA	TBD	Assumptions
17	12	X				
17	13		X			
17	14	X				
17	15	X				
17	16	X				
17	17				X	
17	18				X	
17	19				X	
17	20		X			
17	21				X	
17	22		X			
17	23				X	
17	24				X	
17	25				X	
17	26			X		
17	27				X	
17	28			X		
17	29	X				
17	30	X				
17	31				X	
17	32				X	
17	33				X	
17	34		X			
17	35				X	
17	36				X	
17	37				X	
17	38				X	
17	39	X				
17	40				X	
17	41				X	
17	42				X	
17	43				X	
17	44				X	

Checklist	No.	Yes	No	NA	TBD	Assumptions
17	45				X	
17	46				X	
17	47				X	
17	48				X	
17	49				X	
17	50				X	
17	51				X	
17	52				X	
17	53				X	
17	54				X	
17	55				X	
17	56				X	
17	57	X				
17	58	X				
17	59	X				
17	60			X		
17	61			X		
17	62			X		
17	63			X		
17	64			X		
17	65			X		
17	66			X		
17	67			X		
17	68			X		
17	69			X		
17	70	X				
17	71	X				
17	72	X				
17	73				X	Change room
17	74			X		
17	75			X		
17	76				X	
17	77				X	

Checklist	No.	Yes	No	NA	TBD	Assumptions
17	78			X		
17	79				X	
17	80			X		
17	81				X	
17	82			X		
17	83			X		
17	84			X		
17	85			X		
17	86			X		
17	87			X		
17	88			X		
17	89			X		
17	90			X		
17	91				X	
17	92			X		
17	93				X	
17	94				X	
17	95	X				
17	96			X		
17	97			X		
17	98	X				
17	99			X		
17	100			X		
17	101			X		
17	102			X		
17	103			X		
17	104	X				
18	1			X		Assumes no protective clothing required
18	2			X		Assumes no protective clothing required
18	3			X		Assumes no protective clothing required
18	4			X		Assumes no protective clothing required
18	5			X		Assumes no protective clothing required
18	6			X		Assumes no protective clothing required

Checklist	No.	Yes	No	NA	TBD	Assumptions
18	7			X		Assumes no protective clothing required
18	8			X		Assumes no protective clothing required
18	9			X		Assumes no protective clothing required
18	10			X		Assumes no protective clothing required
18	11			X		Assumes no protective clothing required
18	12			X		Assumes no protective clothing required
18	13			X		Assumes no protective clothing required
18	14			X		Assumes no protective clothing required
18	15			X		Assumes no protective clothing required
18	16			X		Assumes no protective clothing required
18	17			X		Assumes no protective clothing required
18	18			X		Assumes no protective clothing required
18	19			X		Assumes no protective clothing required
18	20			X		Assumes no protective clothing required
18	21			X		Assumes no protective clothing required
18	22			X		Assumes no protective clothing required
18	23			X		Assumes no protective clothing required
18	24			X		Assumes no protective clothing required
18	25			X		Assumes no protective clothing required
18	26			X		Assumes no protective clothing required
18	27			X		Assumes no protective clothing required
18	28			X		Assumes no protective clothing required
18	29			X		Assumes no protective clothing required
18	30			X		Assumes no protective clothing required
18	31			X		Assumes no protective clothing required
18	32			X		Assumes no protective clothing required
18	33			X		Assumes no protective clothing required
18	34			X		Assumes no protective clothing required
18	35			X		Assumes no protective clothing required
18	36			X		Assumes no protective clothing required
18	37			X		Assumes no protective clothing required
18	38			X		Assumes no protective clothing required
18	39			X		Assumes no protective clothing required

Checklist	No.	Yes	No	NA	TBD	Assumptions
18	40			X		Assumes no protective clothing required
18	41			X		Assumes no protective clothing required
18	42			X		Assumes no protective clothing required
18	43			X		Assumes no protective clothing required
18	44			X		Assumes no protective clothing required
18	45			X		Assumes no protective clothing required
18	46			X		Assumes no protective clothing required
18	47			X		Assumes no protective clothing required
18	48			X		Assumes no protective clothing required
18	49			X		Assumes no protective clothing required
18	50			X		Assumes no protective clothing required
18	51			X		Assumes no protective clothing required
18	52			X		Assumes no protective clothing required
18	53			X		Assumes no protective clothing required
18	54			X		Assumes no protective clothing required
18	55			X		Assumes no protective clothing required
18	56			X		Assumes no protective clothing required
18	57			X		Assumes no protective clothing required
18	58			X		Assumes no protective clothing required
18	59			X		Assumes no protective clothing required
18	60			X		Assumes no protective clothing required
18	61			X		Assumes no protective clothing required
18	62			X		Assumes no protective clothing required
18	63			X		Assumes no protective clothing required
18	64			X		Assumes no protective clothing required
19	1	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	2	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	3				X	Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	4	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	5				X	Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios

Checklist	No	Yes	No	NA	TBD	Assumptions
19	6				X	Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	7	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	8			X		Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	9	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	10	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	11	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	12	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	13			X		Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	14			X		Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	15	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	16			X		Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	17			X		Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	18				X	Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	19			X		Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	20			X		Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	21	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	22	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	23	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	24	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios

Checklist	No	Yes	No	NA	TBD	Assumptions
19	25	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	26				X	Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	27	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	28	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	29	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	30				X	Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	31	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	32	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	33	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	34	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	35	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	36	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios

8.3 Human Machine Interface: SCIC

Checklist	No.	Yes	No	NA	TBD	Assumptions
1	1	X				
1	2	X				
1	3				X	
1	4			X		
1	5			X		
1	6	X				
1	7			X		
1	8				X	
1	9	X				
1	10			X		
1	11			X		
1	12			X		
1	13			X		
1	14			X		
1	15			X		
1	16	X				
1	17	X				
1	18	X				
4	1	X				
4	2				X	
4	3			X		
4	4	X				
4	5				X	
4	6			X		
4	7			X		
4	8				X	
4	9	X				
4	10				X	
4	11			X		
4	12				X	
4	13				X	

Checklist	No	Yes	No	NA	TBD	Assumptions
4	14				X	
4	15				X	
4	16	X				
4	17				X	
4	18				X	
4	19				X	
4	20			X		
4	21				X	
4	22				X	
4	23			X		
4	24	X				Assuming it meets HNF labeling standard
4	25	X				Assuming it meets HNF labeling standard
4	26			X		
4	27			X		
4	28			X		
4	29	X				
4	30	X				
4	31			X		
4	32				X	
4	33				X	
7	1	X				
7	2			X		
7	3			X		
7	4	X				
7	5	X				
7	6			X		
7	7			X		
7	8			X		
7	9				X	
7	10				X	
7	11	X				
7	12	X				
7	13	X				

Checklist	No.	Yes	No	NA	TBD	Assumptions
7	14			X		
7	15	X				
7	16			X		
7	17			X		
7	18				X	
7	19				X	
7	20	X				
7	21	X				
7	22				X	
7	23	X				
7	24	X				
7	25				X	
7	26				X	
7	27				X	
7	28				X	
7	29				X	
7	30				X	
7	31				X	
7	32				X	
7	33				X	
7	34			X		
7	35			X		
7	36			X		
7	37			X		
7	38			X		
7	39			X		
7	40				X	
7	41			X		
7	42				X	
7	43				X	
7	44			X		
7	45			X		
7	46			X		

Checklist	No.	Yes	No	NA	TBD	Assumptions
7	47				X	
7	48			X		
7	49			X		
7	50			X		
7	51			X		
7	52			X		
7	53			X		
7	54			X		
7	55				X	
7	56			X		
7	57			X		
7	58			X		
7	59				X	
7	60				X	
7	61				X	
7	62			X		
7	63				X	
7	64				X	
7	65			X		
7	66				X	
7	67				X	
7	68	X				
7	69	X				
7	70			X		
7	71			X		
7	72			X		
7	73			X		
7	74				X	
7	75				X	
12	1				X	
12	2	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	3	X				Assuming done according to Hanford label standard pending a final FSAR analysis

Checklist	No.	Yes	No	NA	TBD	Assumptions
12	4	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	5	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	6	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	7	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	8	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	9	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	10	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	11	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	12	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	13	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	14	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	15	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	16	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	17	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	18	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	19	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	20	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	21	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	22	X				Assuming done according to Hanford label standard pending a final FSAR analysis

Checklist	No.	Yes	No	NA	TBD	Assumptions
12	23	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	24	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	25	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	26	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	27	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	28	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	29	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	30	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	31	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	32	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	33	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	34	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	35	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	36	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	37	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	38	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	39	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	40	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	41	X				Assuming done according to Hanford label standard pending a final FSAR analysis

Checklist	No.	Yes	No	NA	TBD	Assumptions
12	42	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	43	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	44	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	45	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	46	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	47	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	48	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	49	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	50	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	51	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	52	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	53	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	54	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	55	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	56	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	57	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	58	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	59	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	60	X				Assuming done according to Hanford label standard pending a final FSAR analysis

Checklist	No.	Yes	No	NA	TBD	Assumptions
12	61	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	62	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	63	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	64	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	65	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	66	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	67	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	68	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	69	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	70	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	71	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	72	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	73	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	74	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	75	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	76	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	77	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	78	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	79	X				Assuming done according to Hanford label standard pending a final FSAR analysis

Checklist	No.	Yes	No	NA	TBD	Assumptions
12	80	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	81	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	82	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	83	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	84	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	85	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	86	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	87	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	88	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	89	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	90	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	91	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	92	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	93	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	94	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	95	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	96	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	97	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	98	X				Assuming done according to Hanford label standard pending a final FSAR analysis

Checklist	No.	Yes	No	NA	TBD	Assumptions
12	99	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	100	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	101	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	102	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	103	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	104	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	105	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	106	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	107	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	108	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	109	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	110	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	111	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	112	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	113	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	114	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	115	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	116	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	117	X				Assuming done according to Hanford label standard pending a final FSAR analysis

Checklist	No.	Yes	No	NA	TBD	Assumptions
12	118	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	119	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	120	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	121	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	122	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	123	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	124	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	125	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	126	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	127	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	128	X				Assuming done according to Hanford label standard pending a final FSAR analysis

8.4 Human Machine Interface: MCO

Checklist	No.	Yes	No	NA	TBD	Comment
5	1	X				Based on mock up
5	2		X			
5	3		X			
5	4			X		
5	5			X		
5	6	X				
5	7	X				
5	8	X				assuming standard gauges are used
5	9	X				assuming standard gauges are used
5	10	X				assuming standard gauges are used
5	11	X				assuming standard gauges are used
5	12	X				assuming standard gauges are used
5	13	X				assuming standard gauges are used
5	14	X				assuming standard gauges are used
5	15	X				assuming standard gauges are used
5	16	X				assuming standard gauges are used
5	17				X	
5	18	X				assuming standard gauges are used
5	19	X				assuming standard gauges are used
5	20	X				assuming standard gauges are used
5	21			X		assuming no negative values
5	22	X				assuming standard gauges are used
5	23	X				assuming standard gauges are used
5	24	X				assuming standard gauges are used
5	25	X				assuming standard gauges are used
5	26	X				assuming standard gauges are used
5	27			X		assuming no negative values
5	28	X				assuming standard gauges are used
5	29	X				assuming standard gauges are used
5	30	X				assuming standard gauges are used
5	31	X				assuming standard gauges are used

Checklist	No.	Yes	No	NA	TBD	Comment
5	32			X		assuming no moving scales
5	33	X				assuming standard gauges are used
5	34			X		
5	35	X				assuming standard gauges are used
5	36			X		
5	37	X				assuming standard gauges are used
12	1				X	
12	2	X				Assuming done according to Hanford label standard pending a final FSAR analysis
12	3	X				
12	4	X				
12	5	X				
12	6	X				
12	7	X				
12	8	X				
12	9	X				
12	10	X				
12	11	X				
12	12	X				
12	13	X				
12	14	X				
12	15	X				
12	16	X				
12	17	X				
12	18	X				
12	19	X				
12	20	X				
12	21	X				
12	22	X				
12	23	X				
12	24	X				
12	25	X				
12	26	X				
12	27	X				

Checklist	No	Yes	No	NA	TBD	Comment
12	28	X				
12	29	X				
12	30	X				
12	31	X				
12	32	X				
12	33	X				
12	34	X				
12	35	X				
12	36	X				
12	37	X				
12	38	X				
12	39	X				
12	40	X				
12	41	X				
12	42	X				
12	43	X				
12	44	X				
12	45	X				
12	46	X				
12	47	X				
12	48	X				
12	49	X				
12	50	X				
12	51	X				
12	52	X				
12	53	X				
12	54	X				
12	55	X				
12	56	X				
12	57	X				
12	58	X				
12	59	X				
12	60	X				

Checklist	No.	Yes	No	NA	TBD	Comment
12	61	X				
12	62	X				
12	63	X				
12	64	X				
12	65	X				
12	66	X				
12	67	X				
12	68	X				
12	69	X				
12	70	X				
12	71	X				
12	72	X				
12	73	X				
12	74	X				
12	75	X				
12	76	X				
12	77	X				
12	78	X				
12	79	X				
12	80	X				
12	81	X				
12	82	X				
12	83	X				
12	84	X				
12	85	X				
12	86	X				
12	87	X				
12	88	X				
12	89	X				
12	90	X				
12	91	X				
12	92	X				
12	93	X				

Checklist	No.	Yes	No	NA	TBD	Comment
12	94	X				
12	95	X				
12	96	X				
12	97	X				
12	98	X				
12	99	X				
12	100	X				
12	101	X				
12	102	X				
12	103	X				
12	104	X				
12	105	X				
12	106	X				
12	107	X				
12	108	X				
12	109	X				
12	110	X				
12	111	X				
12	112	X				
12	113	X				
12	114	X				
12	115	X				
12	116	X				
12	117	X				
12	118	X				
12	119	X				
12	120	X				
12	121	X				
12	122	X				
12	123	X				
12	124	X				
12	125	X				
12	126	X				

Checklist	No.	Yes	No	NA	TBD	Comment
12	127	X				
12	128	X				
13	1	X				
13	2	X				
13	3			X		
13	4	X				
13	5				X	
13	6	X				
13	7			X		
13	8			X		
13	9			X		
13	10	X				
13	11			X		
13	12			X		
13	13	X				
13	14			X		
13	15			X		
13	16			X		
13	18				X	
13	19				X	
14	1			X		
14	2	X				assumes a thermally controlled environment
14	3	X				assumes a thermally controlled environment
14	4				X	
14	5	X				assumes a thermally controlled environment
14	6			X		
14	7				X	
14	8	X				assumes a thermally controlled environment
14	9				X	
14	10				X	
14	11			X		
14	12	X				
14	13	X				assumes a thermally controlled environment

Checklist	No.	Yes	No	NA	TBD	Comment
14	14	X				
14	15				X	
14	16			X		
14	17				X	
14	18				X	
14	19				X	
14	20			X		
14	21	X				
14	22	X				
14	23			X		
14	24			X		
14	25	X				
14	26	X				
14	27	X				
14	28	X				
14	29				X	
14	30	X				
14	31				X	
14	32				X	
14	33				X	
14	34				X	
14	35			X		
14	36	X				
14	37	X				
14	38			X		
14	39			X		
14	40			X		
14	41			X		
14	42			X		
14	43			X		
14	44			X		
14	45			X		
16	1	X				

Checklist	No.	Yes	No	NA	TBD	Comment
16	2	X				
16	3				X	
16	4	X				
16	5	X				
16	6				X	
16	7				X	
16	8	X				
16	9				X	
16	10	X				
16	11	X				
16	12				X	
16	13				X	
16	14	X				
16	15	X				
16	16	X				
16	17	X				
16	18	X				
16	19	X				
16	20	X				
16	21	X				
16	22	X				
16	23	X				
16	24	X				
16	25	X				
16	26	X				
16	27		X			
16	28				X	
16	29				X	
16	30				X	
16	31	X				
16	32	X				
16	33	X				
16	34	X				

Checklist	No.	Yes	No	NA	TBD	Comment
16	35	X				
16	36	X				
16	37	X				
16	38	X				
16	39	X				
16	40	X				
16	41	X				
16	42				X	
16	43				X	
16	44				X	
16	45				X	
16	46				X	
16	47				X	
16	48	X				
16	49				X	
16	50		X			
16	51		X			
16	52			X		
16	53	X				
17	1				X	Are there any access covers?
17	2	X				
17	3				X	Are there any access covers?
17	4				X	Are there any access covers?
17	5				X	Are there any access covers?
17	6				X	Are there any access covers?
17	7				X	Are there any access covers?
17	8				X	Are there any access covers?
17	9				X	Are there any access covers?
17	10				X	Are there any access covers?
17	11		X			
17	12		X			
17	13	X				
17	14	X				

Checklist	No.	Yes	No	NA	TBD	Comment
17	15	X				
17	16	X				
17	17				X	
17	18				X	
17	19				X	
17	20		X			
17	21	X				
17	22		X			
17	23				X	
17	24				X	
17	25				X	
17	26			X		
17	27				X	Is there a maintenance area in CVDF?
17	28			X		
17	29	X				
17	30	X				
17	31				X	
17	32				X	
17	33				X	
17	34		X			No moving aids in bay except overhead crane
17	35				X	
17	36				X	
17	37				X	
17	38				X	
17	39	X				
17	40				X	
17	41				X	
17	42				X	
17	43				X	
17	44				X	
17	45				X	
17	46				X	
17	47				X	

Checklist	No.	Yes	No	NA	TBD	Comment
17	48				X	
17	49				X	
17	50				X	
17	51				X	
17	52				X	
17	53				X	
17	54				X	
17	55				X	
17	56				X	
17	57	X				
17	58	X				
17	59	X				
17	60				X	Bridge from mezzanine to MCO platform
17	61				X	Bridge from mezzanine to MCO platform
17	62	X				
17	63	X				
17	64				X	Bridge from mezzanine to MCO platform
17	65				X	Bridge from mezzanine to MCO platform
17	66				X	Bridge from mezzanine to MCO platform
17	67				X	Bridge from mezzanine to MCO platform
17	68				X	
17	69			X		
17	70	X				
17	71	X				
17	72	X				
17	73				X	Change room
17	74			X		
17	75			X		
17	76				X	
17	77				X	
17	78			X		
17	79				X	
17	80			X		

Checklist	No.	Yes	No	NA	TBD	Comment
17	81				X	
17	82			X		
17	83			X		
17	84			X		
17	85			X		
17	86			X		
17	87			X		
17	88			X		
17	89			X		
17	90			X		
17	91				X	
17	92			X		
17	93				X	
17	94				X	
17	95	X				
17	96			X		
17	97			X		
17	98	X				
17	99			X		
17	100			X		
17	101			X		
17	102			X		
17	103			X		
17	104	X				
18	1	X				
18	2			X		
18	3	X				
18	4	X				
18	5	X				
18	6	X				
18	7	X				
18	8	X				
18	9	X				

Checklist	No.	Yes	No	NA	TBD	Comment
18	10	X				
18	11	X				
18	12			X		
18	13			X		
18	14			X		
18	15			X		
18	16			X		
18	17			X		
18	18			X		
18	19			X		
18	20			X		
18	21			X		
18	22			X		
18	23			X		
18	24			X		
18	25	X				
18	26			X		
18	27			X		
18	28			X		
18	29			X		
18	30			X		
18	31			X		
18	32			X		
18	33			X		
18	34			X		
18	35			X		
18	36			X		
18	37			X		
18	38			X		
18	39			X		
18	40	X				
18	41	X				
18	42			X		

Checklist	No.	Yes	No	NA	TBD	Comment
18	43			X		
18	44			X		
18	45			X		
18	46			X		
18	47			X		
18	48			X		
18	49			X		
18	50			X		
18	51			X		
18	52			X		
18	53			X		
18	54			X		
18	55			X		
18	56			X		
18	57			X		
18	58			X		
18	59			X		
18	60			X		
18	61			X		
18	62			X		
18	63			X		
18	64			X		
19	1	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	2	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	3				X	Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	4	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	5				X	Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	6				X	Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios

Checklist	No.	Yes	No	NA	TBD	Comment
19	7	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	8			X		Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	9	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	10	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	11	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	12	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	13			X		Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	14			X		Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	15	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	16			X		Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	17			X		Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	18				X	Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	19			X		Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	20			X		Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	21	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	22	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	23	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	24	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	25	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios

Checklist	No.	Yes	No	NA	TBD	Comment
19	26				X	Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	27	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	28	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	29	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	30				X	Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	31	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	32	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	33	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	34	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	35	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios
19	36	X				Assuming it meets HNF STD and is accomplished over standard telephone lines versus handheld radios

8.5 Human Machine Interface: MCS

Checklist	No.	Yes	No	NA	TBD
1	1	X			
1	2	X			
1	3				X
1	4			X	
1	5			X	
1	6	X			
1	7			X	
1	8				X
1	9	X			
1	10			X	
1	11			X	
1	12			X	
1	13			X	
1	14			X	
1	15			X	
1	16	X			
1	17	X			
1	18	X			
2	1	X			
2	2	X			
2	3				X
2	4			X	
2	5				X
2	6				X
2	7	X			
2	8	X			
2	9	X			
2	10	X			
2	11			X	
2	12	X			
2	13	X			
2	14	X			
2	15	X			
2	16			X	

Checklist	No.	Yes	No.	NA	TBD
2	17	X			
2	18	X			
2	19	X			
2	20				X
2	21				X
2	22				X
2	23				X
2	24				X
2	25				X
2	26				X
2	27				X
2	28	X			
2	29	X			
2	30	X			
2	31				X
2	32			X	
2	33			X	
2	34			X	
2	35			X	
2	36			X	
2	37			X	
2	38			X	
2	39			X	
2	40			X	
2	41			X	
2	42			X	
2	43			X	
2	44			X	
2	45			X	
2	46			X	
2	47			X	
2	48			X	
2	49			X	
3	1	X			
3	2	X			
3	3	X			
3	4				X

Checklist	No.	Yes	No	NA	TBD
3	5				X
3	6	X			
3	7		X		
3	8				X
3	9	X			
3	10				X
3	11				X
3	12				X
3	13				X
3	14	X			
3	15	X			
3	16				X
3	17				X
3	18			X	
3	19				X
3	20				X
3	21				X
3	22				X
3	23	X			
3	24				X
3	25			X	
3	26			X	
3	27			X	
3	28			X	
3	29			X	
3	30				X
3	31				X
3	32	X			
3	33	X			
3	34				X
3	35			X	
3	36	X			
3	37				X
3	38			X	
3	39				X
3	40				X
3	41	X			

Checklist	No.	Yes	No	NA	TBD
3	42				X
3	43				X
3	44	X			
3	45			X	
3	46				X
3	47				X
3	48				X
6	1	X			
6	2				X
6	3				X
6	4				X
6	5				X
6	6				X
6	7				X
6	8				X
6	9				X
6	10				X
6	11				X
6	12				X
6	13				X
6	14				X
6	15				X
6	16				X
6	17				X
6	18				X
6	19				X
6	20				X
6	21				X
6	22				X
6	23				X
6	24				X
6	25				X
6	26				X
6	27				X
6	28				X
6	29				X
6	30				X

Checklist	No.	Yes	No	NA	TBD
6	31				X
6	32				X
6	33				X
6	34				X
6	35				X
6	36				X
6	37				X
6	38			X	
6	39			X	
6	40			X	
6	41			X	
6	42			X	
6	43			X	
6	44				X
6	45				X
6	46				X
6	47				X
6	48			X	
6	49			X	
6	50			X	
6	51			X	
6	52			X	
6	53			X	
6	54			X	
6	55			X	
6	56			X	
6	57			X	
6	58			X	
6	59			X	
6	60			X	
6	61			X	
6	62			X	
6	63			X	
6	64			X	
6	65			X	
6	66			X	
6	67			X	

Checklist	No.	Yes	No	NA	TBD
6	68			X	
6	69			X	
6	70			X	
6	71			X	
6	72			X	
6	73			X	
6	74			X	
6	75			X	
6	76			X	
6	77			X	
6	78			X	
6	79			X	
6	80			X	
6	81			X	
6	82			X	
6	83			X	
6	84			X	
6	85			X	
6	86			X	
6	87			X	
6	88			X	
6	89			X	
6	90			X	
6	91			X	
6	92			X	
6	93			X	
6	94			X	
6	95			X	
6	96			X	
6	97			X	
6	98			X	
6	99			X	
7	1	X			
7	2			X	
7	3			X	
7	4	X			
7	5	X			

Checklist	No.	Yes	No	NA	TBD
7	6			X	
7	7			X	
7	8			X	
7	9				X
7	10				X
7	11	X			
7	12	X			
7	13	X			
7	14			X	
7	15	X			
7	16			X	
7	17			X	
7	18				X
7	19				X
7	20	X			
7	21	X			
7	22				X
7	23	X			
7	24	X			
7	25				X
7	26				X
7	27				X
7	28				X
7	29				X
7	30				X
7	31				X
7	32				X
7	33				X
7	34			X	
7	35			X	
7	36			X	
7	37			X	
7	38			X	
7	39			X	
7	40				X
7	41			X	
7	42				X

Checklist	No.	Yes	No	NA	TBD
7	43				X
7	44			X	
7	45			X	
7	46			X	
7	47				X
7	48			X	
7	49			X	
7	50			X	
7	51			X	
7	52			X	
7	53			X	
7	54			X	
7	55				X
7	56			X	
7	57			X	
7	58			X	
7	59				X
7	60				X
7	61				X
7	62			X	
7	63				X
7	64				X
7	65			X	
7	66				X
7	67				X
7	68	X			
7	69	X			
7	70			X	
7	71			X	
7	72			X	
7	73			X	
7	74				X
7	75				X
Checklist	No.	Yes	No	NA	TBD
11	1	X			
11	2	X			
11	3				X

Checklist	No.	Yes	No	NA	TBD
11	4				X
11	5				X
11	6				X
11	7				X
11	8				X
11	9				X
11	10				X
11	11				X
11	12				X
11	13				X
11	14				X
11	15				X
11	16				X
11	17				X
11	18				X
11	19				X
11	20				X
11	21				X
11	22				X
11	23				X
11	24				X
11	25				X
11	26				X
11	27				X
11	28				X
11	29				X
11	30				X
11	31				X
11	32				X
11	33	X			
11	34			X	
11	35			X	
11	36			X	
11	37			X	
11	38			X	
11	39			X	
11	40			X	

Checklist	No.	Yes	No	NA	TBD
11	41			X	
11	42			X	
11	43			X	
11	44			X	
11	45			X	
11	46			X	
11	47			X	
11	48			X	
11	49			X	
11	50			X	
11	51			X	
11	52			X	
11	53			X	
11	54			X	
11	55			X	
11	56			X	
11	57			X	
11	58			X	
11	59			X	
11	60			X	
11	61			X	
11	62			X	
11	63			X	
11	64			X	
11	65			X	
11	66			X	
11	67			X	
11	68			X	
11	69			X	
11	70			X	
11	71			X	
11	72			X	
11	73			X	
11	74			X	
11	75			X	
11	76			X	
11	77			X	

Checklist	No.	Yes	No	NA	TBD
11	78			X	
11	79			X	
11	80			X	
11	81			X	
11	82			X	
11	83			X	
11	84			X	
11	85			X	
11	86			X	
11	87			X	
11	88			X	
11	89			X	
11	90			X	
11	91			X	
11	92			X	
11	93			X	
11	94			X	
11	95			X	
11	96			X	
11	97			X	
11	98			X	
11	99			X	
11	100			X	
11	101			X	
11	102			X	
11	103			X	
11	104			X	
11	105			X	
11	106			X	
11	107				X
11	108				X
11	109				X
11	110				X
11	111				X
11	112				X
11	113				X
11	114				X

Checklist	No.	Yes	No	NA	TBD
11	115				X
11	116				X
11	117				X
11	118				X
11	119				X
11	120				X
11	121				X
11	122				X
11	123				X
11	124				X
11	125				X
11	126				X
11	127				X
11	128				X
11	129				X
11	130				X
11	131				X
11	132				X
11	133				X
11	134				X
11	135				X
11	136				X
11	137				X
11	138				X
11	139				X
11	140				X
11	141				X
11	142				X
11	143				X
11	144				X
11	145				X
11	146				X
11	147				X
11	148				X
11	149				X
11	150				X
11	151				X

Checklist	No.	Yes	No	NA	TBD
11	152				X
11	153				X
11	154				X
11	155				X
11	156				X
11	157				X
11	158				X
11	159				X
11	160				X
11	161				X
11	162				X
11	163				X
11	164				X
11	165				X
11	166				X
11	167				X
11	168				X
11	169				X
11	170				X
11	171				X
11	172				X
11	173				X
11	174				X
11	175				X
11	176				X
11	177				X
11	178				X
11	179				X
11	180				X
11	181				X
11	182				X
11	183				X
11	184				X
11	185				X
11	186				X
11	187				X
11	188				X

Checklist	No.	Yes	No	NA	TBD
11	189				X
11	190				X
11	191				X
11	192				X
11	193				X
11	194				X
11	195				X
11	196				X
11	197				X
11	198				X
11	199				X
11	200				X
11	201				X
11	202				X
11	203				X
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11	206				X
11	207				X
11	208				X
11	209				X
11	210				X
11	211				X
11	212				X
11	213				X
11	214				X
11	215				X
11	216				X
11	217				X
11	218				X
11	219				X
11	220				X
11	221				X
11	222				X
11	223				X
11	224				X
11	225				X

Checklist	No.	Yes	No	NA	TBD
11	226				X
11	227				X
11	228				X
11	229				X
11	230				X
11	231				X
11	232				X
11	233				X
11	234				X
11	235				X
11	236				X
11	237				X
11	238				X
11	239				X
11	240				X
11	241				X
11	242				X
11	243				X
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11	246				X
11	247				X
11	248				X
11	249				X
11	250				X
11	251				X
11	252				X
11	253				X
11	254				X
11	255				X
11	256				X
11	257				X
11	258				X
11	259				X
11	260				X
11	261				X
11	262				X

Checklist	No.	Yes	No	NA	TBD
11	263				X
11	264				X
11	265				X
11	266				X
11	267				X
11	268				X
11	269				X
11	270				X
11	271				X
11	272				X
11	273				X
11	274				X
11	275				X
11	276				X
11	277				X
11	278				X
11	279				X
11	280				X
11	281				X
11	282				X
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11	284				X
11	285				X
11	286				X
11	287				X
11	288				X
11	289				X
11	290				X
11	291				X
11	292				X
11	293				X
11	294				X
11	295				X
11	296				X
11	297				X
11	298				X
11	299				X

Checklist	No.	Yes	No	NA	TBD
11	300				X
11	301				X
11	302				X
11	303				X
11	304				X
11	305				X
11	306				X
11	307				X
11	308				X
11	309				X
11	310				X
11	311				X
11	312				X
11	313				X
11	314				X
11	315				X
11	316				X
11	317				X
11	318				X
11	319				X
11	320				X
11	321				X
11	322				X
11	323				X
11	324				X
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11	326				X
11	327				X
11	328				X
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11	330				X
11	331				X
11	332				X
11	333				X
11	334				X
11	335				X
11	336				X

Checklist	No.	Yes	No	NA	TBD
11	337				X
11	338				X
11	339				X
11	340				X
11	341				X
11	342				X
11	343				X
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11	345				X
11	346				X
11	347				X
11	348				X
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11	351				X
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11	357				X
11	358				X
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11	360				X
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11	364				X
11	365				X
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11	367				X
11	368				X
11	369				X
11	370				X
11	371				X
11	372				X
11	373				X

Checklist	No.	Yes	No	NA	TBD
11	374				X
11	375				X
11	376				X
11	377				X
11	378				X
11	379				X
11	380				X
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11	382				X
11	383				X
11	384				X
11	385				X
11	386				X
11	387				X
11	388				X
11	389				X
11	390				X
11	391				X
11	392				X
11	393				X
11	394				X
11	395				X
11	396				X
11	397				X
11	398				X
11	399				X
11	400				X
11	401				X
11	402				X
11	403				X
11	404				X
11	405				X
11	406				X
11	407				X
11	408				X
11	409				X
11	410				X

Checklist	No.	Yes	No	NA	TBD
11	411				X
11	412				X
11	413				X
11	414				X
11	415				X
11	416				X
11	417				X
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11	420				X
11	421				X
11	422				X
11	423				X
11	424				X
11	425				X
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11	431				X
11	432				X
11	433				X
11	434				X
11	435				X
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11	438				X
11	439				X
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11	441				X
11	442				X
11	443				X
11	444				X
11	445				X
11	446				X
11	447				X

Checklist	No.	Yes	No	NA	TBD
11	448				X
11	449				X
11	450				X
11	451				X
11	452				X
11	453				X
11	454				X
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11	462				X
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11	470				X
11	471				X
11	472				X
11	473				X
11	474				X
11	475				X
11	476				X
11	477				X
11	478				X
11	479				X
11	480				X
11	481				X
11	482				X
11	483				X
11	484				X

Checklist	No.	Yes	No	NA	TBD
11	485	X			
11	486	X			
11	487	X			
11	488				X
11	489			X	
11	490				X
11	491	X			
11	492	X			
11	493				X
11	494				X
11	495				X
11	496				X
11	497				X
11	498				X
11	499				X
11	500				X
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11	502				X
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11	504			X	
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11	507			X	
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11	511			X	
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11	514			X	
11	515			X	
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11	517			X	
11	518			X	
11	519			X	
11	520			X	
11	521			X	

Checklist	No	Yes	No	NA	TBD
11	522			X	
11	523			X	
11	524			X	
11	525			X	
11	526			X	
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11	540			X	
11	541			X	
11	542			X	
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11	544			X	
11	545	X			
11	546	X			
11	547			X	
11	548			X	
11	549			X	
11	550			X	
11	551			X	
11	552	X			
11	553			X	
11	554			X	
11	555			X	
11	556			X	
11	557			X	
11	558			X	

Checklist	No.	Yes	No	NA	TBD
11	559			X	
11	560			X	
11	561			X	
11	562			X	
11	563			X	
11	564			X	
11	565			X	
11	566			X	
11	567			X	
11	568			X	
11	569			X	
11	570			X	
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11	572			X	
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11	585			X	
11	586			X	
11	587			X	
11	588			X	
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11	590			X	
11	591			X	
11	592			X	
11	593			X	
11	594			X	
11	595			X	

Checklist	No.	Yes	No	NA	TBD
11	596			X	
11	597			X	
11	598			X	
11	599			X	
11	600			X	
11	601			X	
11	602			X	
11	603			X	
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11	614			X	
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11	622				X
11	623				X
11	624				X
11	625				X
11	626				X
11	627				X
11	628				X
11	629				X
11	630				X
11	631				X
11	632				X

Checklist	No.	Yes	No	NA	TBD
11	633				X
11	634				X
11	635				X
11	636				X
11	637				X
11	638				X
11	639				X
11	640				X
11	641				X
11	642			X	
11	643			X	
11	644			X	
11	645			X	
11	646			X	
11	647			X	
11	648			X	
11	649			X	
11	650			X	
11	651			X	
11	652			X	
11	653			X	
11	654			X	
11	655			X	
11	656			X	
11	657			X	
11	658			X	
11	659			X	
11	660				X
11	661				X
11	662				X
11	663				X
11	664				X
11	665				X
11	666				X
11	667				X
11	668				X
11	669				X

Checklist	No.	Yes	No	NA	TBD
11	670				X
11	671				X
11	672				X
11	673				X
11	674				X
11	675				X
11	676				X
11	677				X
11	678				X
11	679				X
11	680				X
11	681				X
11	682				X
11	683				X
11	684				X
11	685				X
11	686				X
11	687				X
11	688				X
11	689				X
11	690				X
11	691				X
11	692				X
11	693				X
11	694				X
11	695				X
11	696				X
11	697				X
11	698				X
11	699				X
11	700				X
11	701				X
11	702				X
11	703				X
11	704				X
11	705				X
11	706				X

Checklist	No.	Yes	No	NA	TBD
11	707				X
11	708				X
11	709		X		
11	710				X
11	711				X
11	712				X
11	713				X
11	714				X
11	715				X
11	716				X
11	717				X
11	718				X
11	719				X
11	720				X
11	721				X
11	722				X
11	723				X
11	724				X
11	725				X
11	726				X
11	727				X
11	728				X
11	729				X
11	730				X
11	731				X
11	732				X
11	733				X
11	734				X
11	735				X
11	736				X
11	737				X
11	738				X
11	739				X
11	740				X
11	741				X
11	742				X
11	743				X

Checklist	No.	Yes	No	NA	TBD
11	744				X
11	745				X
11	746				X
11	747				X
11	748				X
11	749				X
11	750				X
11	751				X
11	752				X
11	753				X
11	754				X
11	755				X
11	756				X
11	757				X
11	758				X
11	759				X
11	760				X
11	761				X
11	762				X
11	763				X
11	764				X
11	765				X
11	766				X
11	767				X
11	768				X
11	769				X

9 Appendix B: HFE Non-Compliances

This appendix lists the actual criteria that were judged as being non-compliant based upon a review of the current design. The resolution lists the responses from the cognizant person when interviewed about the non-compliance. No attempt was made at this point to judge whether the resolution was sufficient to allow for compliance with the HFE criteria listed.

Human Machine Interface	Criteria	Resolution
MCS	Are physical key locks provided? (User-Computer Interface in Process Control (1989))	Not needed because physical access is restricted.
MCO	Is the workspace around areas where maintenance is performed free of obstructions which could cause injury to personnel? (DOE-STD-1062-DFT Obstructions: 10.4.4)	Housekeeping administratively controlled
MCO Process Equipment Skid	Where applicable are all exposed edges and corners rounded to a minimum of 0.03 in. (0.75 mm) radius? (DOE-STD-1062-DFT Edge Rounding: 10.7.4)	To be determined
MCO Process Equipment Skid	Are sharp edges and corners that present a personal safety hazard or that may damage equipment during usage are protected or rounded to a minimum radius of 0.5 in. (13 mm)?(DOE-STD-1062-DFT Edge Rounding: 10.7.4)	To be determined
Process Equipment Skid	Is the workspace around areas where maintenance is performed free of obstructions which could cause injury to personnel? (DOE-STD-1062-DFT Obstructions: 10.4.4)	Housekeeping administratively controlled
MCO	Is the size of accesses determined by what the maintenance technician will have to do and should depend on factors such as: (1) Size and shape of the part, component, or assembly to which access is desired; (2) Whether or not the object must be removed and replaced through the openings; (3) Movement of the human body member or members required once access is gained (turning, pulling, pushing, etc.); (4) The size of the body member or members required to enter through the access? (UCRL 15673 1.4.4.1.a)	To be determined

Human Machine Interface	Criteria	Resolution
MCO	Are the edges of accesses that might injure the technician's hand or arms protected with internal fillers or other protection? (UCRL 15673 1.4.4.1.a)	To be determined
MCO Process Equipment Skid	Does the workspace allow the technician to change posture if the maintenance task being performed requires prolonged kneeling, crawling, or crouching? (UCRL 15673 2.1.3.1)	To be determined
MCO Process Equipment Skid	Whenever possible, does workspace design allow routine, frequent, and/or short-term maintenance to be performed from a standing position? (UCRL 15673 2.1.4.1)	To be determined
MCO Process Equipment Skid	Are appropriate cranes, monorails, forklifts, carts, and other movement aids available within the workshop to allow for moving of heavy equipment and hardware? (UCRL 15673 2.1.4.1h)	To be determined
Process Equipment Skid	Are accesses designed so that the removal of any replaceable unit requires opening of only one access, unless the accesses are of the latched or hinged door type? (UCRL 15673 1.4.3.6)	To be determined
Process Equipment Skid	Is the size of accesses determined by what the maintenance technician will have to do and should depend on factors such as: (1) Size and shape of the part, component, or assembly to which access is desired; (2) Whether or not the object must be removed and replaced through the openings; (3) Movement of the human body member or members required once access is gained (turning, pulling, pushing, etc.); (4) The size of the body member or members required to enter through the access? (UCRL 15673 1.4.4.1.a)	To be determined
Process Equipment Skid	Do the handles have rounded corners and edges to minimize the possibility of injuries and equipment damage, access covers, cases? (UCRL 15673 1.4.4.4b)	To be determined
MCS	Do the panel faces display only functional or operational markings? (DOE-STD-1062-DFT Unrelated Markings: 3.1.1.7)	No longer in noncompliance due to improved system description.

Human Machine Interface	Criteria	Resolution
MCO	Is the scale indicator coding used to convey information such as desirable operating range, caution, undesirable condition, inefficient operation, or dangerous operating level? (DOE-STD-1062-DFT Use: 3.3.1.3.1)	To be determined
MCO	Are standard or usual operating ranges identified by means of pattern or color coding applied to the face of the instrument? (DOE-STD-1062-DFT Pattern or Color Coding: 3.3.1.3.2)	To be determined.

10 Appendix C: Human Actions Requiring Further Analysis

This section reflects the results of interviewing the cognizant personnel regarding human actions and human-machine interface issues in normal and abnormal events that require further analysis to ensure human factors have been appropriately considered.

Interview Question	Answer
What is the mitigation response to high fuel temperature?	Since internal MCO temperature is not directly monitored a temperature interlock based on Tempered Water Cask inlet temperature is provided as part of the SCIC system. The MCS will also monitor and control this value to less than the SCIC trip point. Another potential source for a high fuel temperature is a runaway accident scenario. This Safety Class event has been identified in the PSAR. Prevention of this accident is provided by the SCIC in conjunction with operator actions. These operator actions need to be further analyzed.
Is cask transport time critical? If so, how is it monitored? How is fuel temperature monitored prior to hookup?	Yes, cask transport is time critical, a 24 hour time span is allowed. The temperature and pressure of the cask is not monitored prior to CVDF operations but is controlled by limiting the transport time. Maintaining this TSR during shift changes and other interruptions have been considered. Recovery actions for unexpected delays is still being reviewed.
If time critical and the mezzanine is struck and damaged, what happens?	Recovery actions need to be determined if something happens to the bay prior to connecting the MCO.
Where do the following alarms sound? Low pressure helium Low pressure air High level in water drain tank	Each of these alarms at the MCS. Further analysis of appropriate operator actions upon receipt of the alarms is needed.
What prevents multiple MCO drain lines, condensate drain lines, or tempered water lines from being opened at the same time?	The lines are interlocked at the MCS and TSRs will be generated to preclude these actions.
What is the mitigator if cask tips over since overhead crane has insufficient lifting capacity?	The engineering design team stated that they do not anticipate this event happening. However, recovery actions in this event are yet to be determined.
How do shift changing personnel know of cask status, i.e., MCO isolation time, vacuum drying time, etc?	Plant status will be provided on the MCS Main screen. Time remaining for the specific step in the sequence are individually displayed for each active bay. In addition, there will be a logbook for the new shift to review identifying the cask status. Detail procedures for shift turnover have not been determined at this time.

Interview Question	Answer
How is bay isolation status verified?	The verification of bay isolation status is performed manually and by the security system. Per TSR and operating procedures the bay confinement and access is re-initiated after the MCO is delivered.
How is the second pressure test verified completed?	The operator will verify if the pressure rebound tests has passed and the completion of the procedure. The probability of appropriate human actions and associated performance shaping factors need to be determined.
Where is auxiliary vacuum pump isolation displayed?	To be determined.
How is the mezzanine bridge installed? What is the design of the bridge?	To be determined.
Where does MCS interface with contaminated water sampling and radiological effluent handling and transport systems?	The MCS interfaces are shown on H-1-82164 and H-1-82223 for these two systems. In essence the MCS controls the sampling of the water to sample collection bottles. The MCS will also provide control of pumps and valves to the main process water storage tank. The actual transfer or off-load is done manually by Operations.
What is illumination level in bay?	To be determined.
Do all SCIC and MCS alarms have equal value?	There are only two types of alarms on the SCIC annunciator, Purge Initiated and Low TW Level. These two Safety Class events have equal valve. The MCS monitors and alarms many parameters. The alarms are presented equally as red flashing boxes for the individual item and an audible alarm. The MCS has the ability to indicate alarm priority but this is still under development. In any case, the operating procedures, i.e. alarm response procedures, will be developed that will mandate the required response.
What are the design specifications for the headphones and microphones?	To be determined.
What is the status of the CVDF HFE program plan?	To be determined.
What if operators do not place the SCIC in correct mode?	The operation of the SCIC switch will be controlled by administrative procedures with the required oversight. In addition to the SCIC switch position, other prerequisites are verified automatically by the MCS to proceed with the planned sequence.
What if the SCIC and MCS systems are not reset appropriately after an alarm condition?	Resets only clear interlocks once the value that tripped has gone below the trip setpoint. The only way to "inappropriately" reset an alarm/interlock is to do so outside a written procedure.

Interview Question	Answer
Can each operator control all four bays from their MCS station?	Yes, any of the three MCS stations in the control room can control all four process bays equipment and support equipment in the Mechanical Room and the PWC room. The expected control is two bays per station, maximum.
What are the procedures for shift briefings at change over?	To be determined.