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# **NRC Meeting:** Human Factors Engineering



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# Meeting Agenda

- Introductions
- Purpose & Outcome
- Overview of HFE Program
- OER Summary
- FRA/FA Summary
- TA Summary
- S&Q Summary
- Simulator Configuration Control
- Open Forum

# Introductions



- NRC Staff

- Holtec Staff

# Purpose and Outcome

## ■ Purpose

To provide a high-level overview of the SMR-160 Human Factors Engineering (HFE) milestones and discuss the HFE Implementation Plans.

## ■ Outcome

To obtain feedback from the NRC staff on the HFE implementation plans and examples of OER, FRA/FA and TA elements.

# Overview of HFE Program



- The Human Factors Engineering (HFE) program is being implemented according to NUREG-0711 and related regulatory requirements.
- The first element is the Program Plan which is HOLTEC procedure HPP-160-1014.
- The schedule is proprietary and will be discussed during the closed session.

## Overview of HFE Program (cont'd)



- This procedure contains 11 Appendices – one for each of the other elements of the HFE program.
- Each Appendix represents the Implementation Plan for one of the HFE program elements.
  
- Question: How do we submit the Implementation Plans (procedure HPP-160-1014) for NRC review and feedback?

# HFE Schedule

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# HFE Issues Tracking

- HFE issues are identified and tracked in the HFE Issue Tracking System (HITS), which is a web-based database. HFE issues include:
  - known industry issues (typically identified in the OER)
  - issues identified in one of the HFE program elements
  - human engineering discrepancies (HED) identified during the HFE design (typically during the V&V process)
  - issues identified during HSI design
  - issues identified via simulator modeling

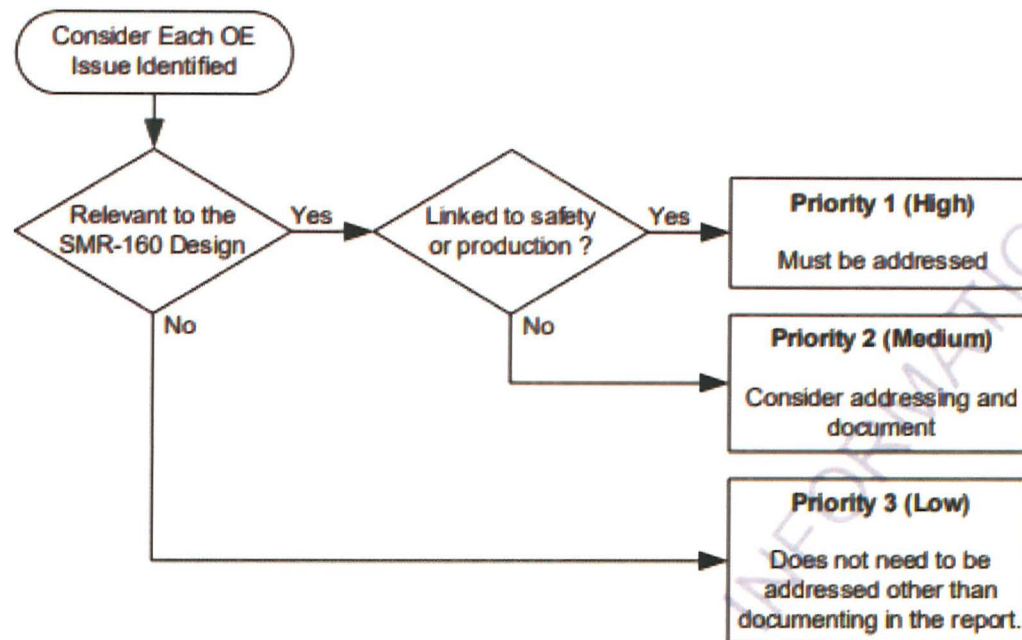


## OER Scope

- The OER scope includes reviews of the following inputs:
  - predecessor and related plants and systems
  - recognized industry HFE issues
  - related HSI technology
  - issues identified by plant personnel
  - important human actions (IHAs)

# OER Screening and Prioritization

- OE is reviewed by a team to screen according to the following:



# OER Priorities

- The three priorities are defined as:
  - Priority 1 issues are high priority and need to be addressed. These must have a documented way it is addressed. If it has not been addressed yet, it must be in the HITS database with a high priority.
  - Priority 2 issues are moderate priority and should be assessed to determine if they should be addressed. If the issue has not been addressed yet, it should be in the HITS Database.
  - Priority 3 issues are low priority and normally not considered. These issues are documented in the OER report but not entered into the HITS Database.

# OER Documentation

- The OER report includes:
  - The sources of information and methodology used to perform the OER
  - Description of how the OER was conducted
  - A list of the OER-identified issues that have been or will be incorporated including any open issues from the HITS

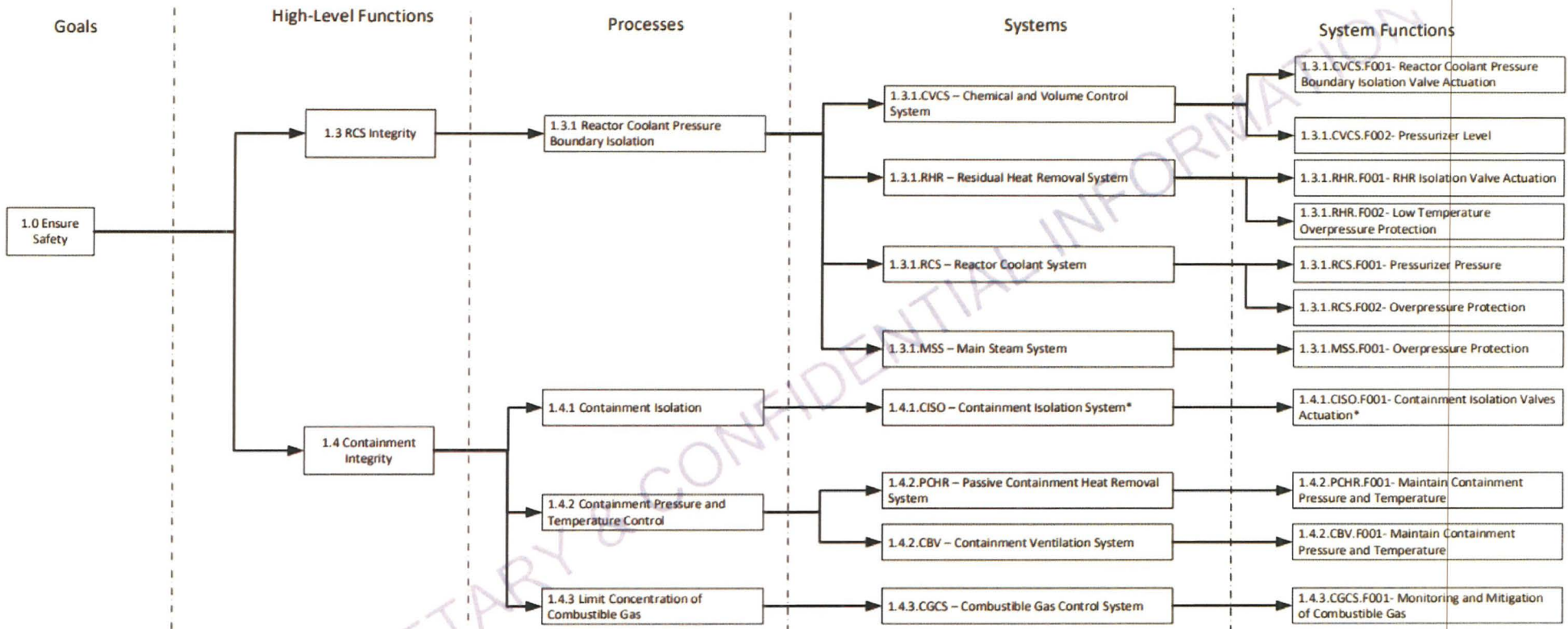
# FRA/FA

- The Functional Requirements Analysis and Function Allocation (FRA/FA) defines the plant's high-level functions of safety and power production and allocates the actions to human and system resources:
  - Establish a description of the plant functions that are required to operate the plant
  - Establish the inter-relationships between plant functions
  - Describe the allocation assignment of functions
  - Assess the adequacy of functions against operational and human needs

## FRA/FA Process

- Step 1: Plant Function Identification and Decomposition is performed for overall plant design to identify all the plant functions required to accomplish plant goals.
- Step 2: Functional Requirements Analysis is done for each high-level function associated with the system, the requirements are identified, and the results are captured in the Function Description Form.
- Step 3: Function Allocation divides the system functions identified in the previous steps into actions, evaluated, and allocated as automatic, manual, or shared control.

# FRA/FA Plant Function Identification example



## TA Process

- The Task Analysis (TA) takes Human Actions (HA) identified in the FRA/FA and other HFE program elements and further analyzes them to identify the tasks that personnel must perform to accomplish the HA.
- Task analysis encompasses a range of plant operating conditions, including startup, normal operations, abnormal operations, transient conditions, low power, shutdown, and refueling conditions.



## TA Process (cont'd)

- The task analysis includes four major steps:
  - 1) Identify and Define Tasks - gathers the HAs to be analyzed and defines tasks that encompass all the HAs.
  - 2) Develop Task Descriptions – develops task descriptions, which include attributes about the task
  - 3) Analyze Tasks – refines the Task Descriptions to include enough detail to allow requirements to be developed
  - 4) Identify Requirements - identifies task requirements such as: information, controls, alarms or other support needed to perform the task; K&A required; workload estimates; and constraints

## TA Process (cont'd)

- Each task contains 3 elements:
  - 1) Task Description Form documenting the HAs and task attributes
  - 2) Task Analysis identifying specific tasks, subtasks and actions to perform the function containing HAs
  - 3) Operational Sequence Diagram (OSD) to graphically shows the relationship between personnel and automated actions

# S&Q



- The Staffing & Qualification (S&Q) is applicable licensed operators as defined in 10CFR55 or optimized for SMR-160.
- The SMR-160 intends to seek an exemption to the staffing guidance in 10 CFR 50.54(m) based on results of the HFE V&V and validation testing of the staffing plan. Currently no operator actions are credited for DBAs with a digital control system containing defense-in-depth monitoring, tiered alarm system and computerized procedures.
- Question: How is the workload scenario(s) for the unaffected unit determined?

## OER, FRA/FA, TA examples

- Some OERs have been prioritized with examples for each priority (1, 2, and 3).
- The initial FRA/FA for major systems are complete.
- Some TAs for completed FRA/FAs have been prepared.
  
- Question: How do we submit examples of completed OERs, FRA/FAs and TAs for NRC review and feedback?

## TA V&V



- Once the desktop simulator is ready, the HFE Verification & Validation (V&V) will begin.
- The HFE V&V will be used as part of the plant referenced simulator (PRS) testing and qualification.
- HOLTEC will use qualified Subject Matter Experts (SMEs) for simulator testing, including HFE V&V.

## Simulator Testing per ANSI/ANS-3.5



- ANSI/ANS-3.5-2018 will be used to perform simulator testing.
- Section 5.1 provides details for initial construction.
  
- Question: Reg Guide 1.149 endorses the 2009 version, can we use the 2018 version?
- Question: Section 5.1 implies that an SME can verify the simulator configuration. What training documentation is required for an SME?

# Simulator Configuration Control



- HOLTEC will have a configuration control program in place to track plant (design) and simulator changes following declaration of a PRS.
  
- Question: Will the NRC want to see a configuration control program during simulator development? How about after HFE V&V but prior to declaring a PRS?

# Open Forum

