APR1400 HFE

- Resolution Summary of Acceptance Review Results
- Documents Submitted for Review
- HFE Program Status
- Specific Comments
- Response to NRC Review Comments
- Summary

Resolution Summary of Acceptance Review

- 14th PARM - HFE(Dec 12, 2013)

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Resolution Summary of Acceptance Review

- **15th PARM – HFE (May 29, 2014)**
  - Quality Improvement Plan was presented by KHNP
    - Resolution of 10 significant issues identified during Acceptance Review (Dec, 2013)
      - Required technical information, level of detail, acceptance criteria and measures
      - Document clarity and consistency
    - Staffing and Organization (KHNP, KEPCO E&C, RTS/WEC)
    - Revision Process (3 iteration before submission)
    - Process
      - Single responsible person (champion)
      - NUREG-0711 compliance matrix
      - Communication and integration

Resolution Summary of Acceptance Review

- **NRC Review Plan**

DCD	Section/Chapter/TeR	NRC Review	
		17th PARM	Readiness Assessment
Tier1	Section 2.9	O	O
Tier2	Chapter 18	X	O
IP	HFE Program Plan	O	O
	OER Implementation Plan	O	O
	FRA/FA Implementation Plan	O	O
	TA Implementation Plan	O	O
	S&Q Implementation Plan	O	O
	TIHA Implementation Plan	O	O
	HSI Design Implementation Plan	O	O
	HF V&V Implementation Plan	O	O
	Design Implementation Plan	O	O
TeR	Basic HSI TeR	X	O
	Style Guide TeR	X	O
	HF V&V Scenario TeR	O	O

Resolution Summary (15th PARM - HFE)

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Resolution Summary (14th PARM - HFE)

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Resolution Summary (14th PARM - HFE)

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Resolution Summary (14th PARM - HFE)

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Resolution Summary (14th PARM - HFE)

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Future Plan

- All IPs and TeRs will be revised to incorporate the 17th PARM results
- Tier 1 and Tier 2 of Ch. 18 will be revised to incorporate Acceptance Review result results and 17th PARM results.
- All DCD, IPs, TeRs will be submitted to NRC before Readiness Assessment

Documents Submitted for Review

- **HFE Draft Implementation Plans**
  - Program Plan
  - Operating Experience Review
  - Functional Requirements Analysis & Function Allocation
  - Task Analysis
  - Staffing & Qualifications
  - Treatment of Important Human Actions
  - HSI Design
  - Human Factors Verification & Validation
  - Design Implementation

Documents Submitted- continued

- **Draft Tier 1**
- **Draft Technical Reports**
  - V&V Scenarios

Team Composition

- **HFE Team**
  - R. Hall
  - K. Scarola
  - M. Boggi
  - T. Clouser
  - R. Turk (Westinghouse)
- **HFE Review and Design Team**
  - KHNP
  - KEPCO E&C
  - ENP (OER only)

Tier-1

- **ITAAC for six elements of the HFE program**
  - OER
  - FRA & FA
  - TA
  - S&Q
  - TIHA
  - HSI Design

Design Commitment	Inspection, Test, Analysis	Acceptance Criteria
1. <u>Example:</u> Operating experience review identifies past human factors issues	1. An inspection verifies the operating experience review is conducted in accordance with the Operating Experience Review Implementation Plan.	1. A report exists and concludes that the operating experience review was conducted in accordance with the Operating Experience Review Implementation Plan.

Tier-1 (cont)

- **ITAAC for two elements of the HFE program**
  - V&V
  - Design Implementation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
The Control Room design incorporates human factors engineering principles that minimize the potential for operator error.	An integrated System Validation Test (ISV) will be performed in accordance with the Verification and Validation Implementation Plan.	All pass/fail criteria associated with each test scenario are passed either on initial performance of the Scenarios or following remediation of failures.
The as-built Control Room Human-System Interface is consistent with the final validated design specifications.	An inspection of the as-built Control Room Human- System Interfaces will be performed.	The as-built Control Room Human-System Interface conforms to the validated design with no configuration deviations.

Schedule of Submittals

- Implementation Plans

NUREG 0711	HFE Elements	YEAR 1 3 6 9 12	YEAR 2 3 6 9 12	YEAR 3 3 6 9 12	YEAR 4 3 6 9 12
	Key Activity	DCD (Docket) ◆			
2	HFE Prgoram Plan				
3	OER Implementation Plan				
4	FRA/FA Implementation Plan				
5	TA Implementation Plan (for HSI Design)				
6	S&Q Implementation Plan (for HSI Design)				
7	TIHA Implementation Plan				
8	HSI Design Implementation Plan				
9	HF V&V Implementation Plan				
10	Design Implementation				

Schedule of Submittals (cont)

- **Results Summary Reports**

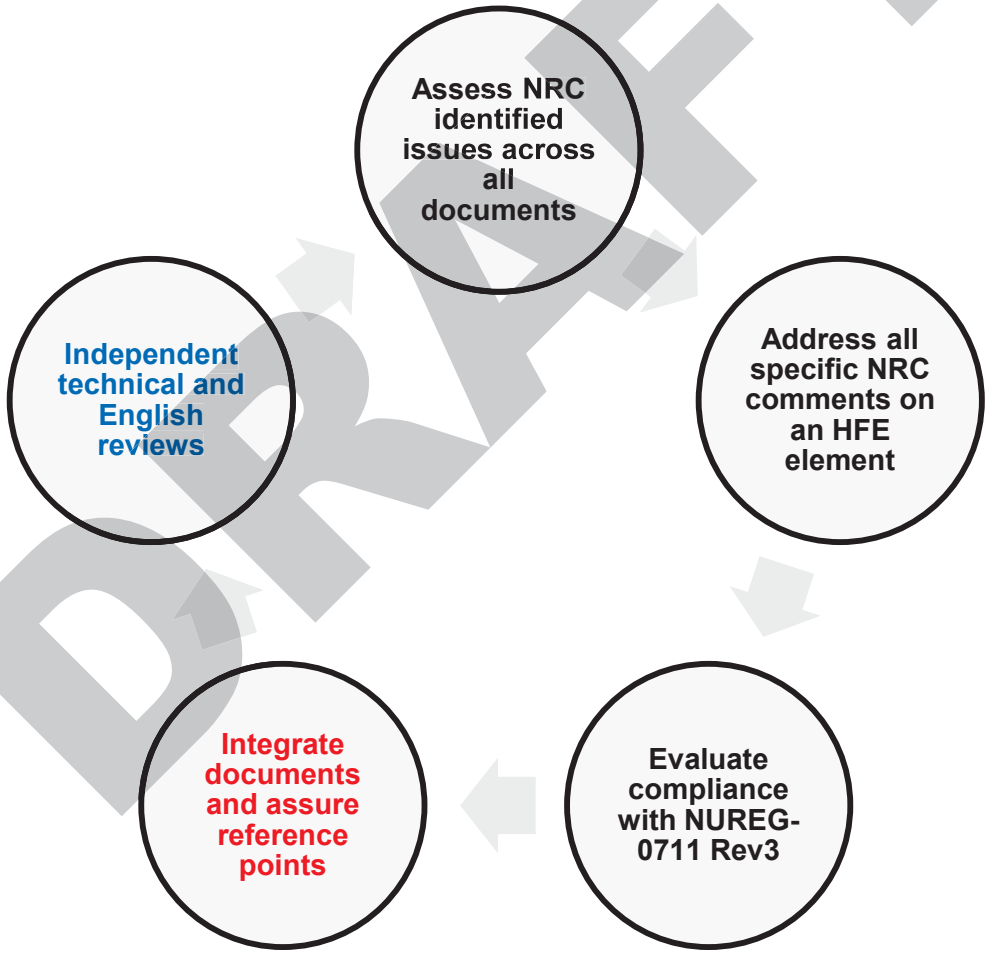
NUREG 0711	HFE Elements	YEAR 1				YEAR 2				YEAR 3				YEAR 4			
		3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
	Key Activity	DCD (Docket) ◆															
2	OER Result Summary Report for DC only																
3	FRA/FA Result Summary Report for DC only																
4	TA Result Summary Report																
5	S&Q Result Summary Report																
6	TIHA Result Summary Report																
7	HSI Design Result Summary Report																
8	HF V&V Result Summary Report																
9	Design Implementation Result Summary Report																

HFE Program Status

- **Review process iterations & change**
  - Reference slide 10
- **All Documents revised**
  - Implementation Plans
  - Technical Reports
    1. Basic HSI Platform
    2. V&V Scenarios
    3. Style Guide
  - DCD Chapter 18 Tier & Tier 2
- **Revision @ 80 % completed**
  - One more review/revision cycle
  - Final documents by September 30

Revision Process

- 3 proposed, revised to 4 iterations before submission



Schedule Presented

	May	June	July	Aug	Sep	Oct	Nov	Dec
2014 1st HFE PARM	♦							
1st Draft of DOCs		♦						
2014 2nd HFE PARM				♦				
2nd Draft of DOCs					♦			
2014 Pre-Audit						♦		
Final HFE DOCs							♦	
DC Submission								♦

Current Schedule

	May	June	July	Aug	Sep	Oct	Nov	Dec
1st Drafts								
2nd Drafts								
3rd & 4th Drafts		▲						
2014 PARM			▲					
Final Draft for Pre Audit				▲				
2014 Pre-Audit					▲		♦	
DC Submission								♦

Works to be Done through Sep. 2014

- **Program integration**
  - Document internal and external referencing
  - Interface reconciliation
- **Editing**
  - Technical
  - Regulatory language
  - English language
  - Format
- **Continuation and completion of independent reviews**
- **Responses to NRC 8/27/2014 PARM comments**
- **Final documents**

Specific Document Comments

- FRA/FA
- TA
- S&Q
- TIHA
- HD
- V&V, including Scenarios TeR

FRA / FA

- **The APR1400 FRA/FA is a complete, stand-alone analysis. It encompasses and builds on the System 80+ predecessor design's evaluation and allocation of functions to account for:**
  - Any changes in critical functions (none are anticipated)
  - Evolutionary design changes resulting modifications to the functional hierarchy (i.e., changes to processes, systems and components resulting in changes to the System 80+ success paths)
  - Increased depth of the functional hierarchy to the level of control actions
  - Operating Experience incurred subsequent to the System 80+ functional evaluation
  - Additional information needed to facilitate review to the criteria of NUREG 0711 revision 3

FRA / FA

- **Predecessor Design – System 80+**
  - NPX80-IC-IC-RR790 Human Factors Evaluation and allocation of System 80+ Functions
- **High Level Functions Expected to be Unchanged**
  - No significant change in functional design of plant
  - Some additions and changes to success paths (processes systems and components)
    - No success paths were deleted
  - High level safety functions for large 2-loop US PWRs* are standardized by PWROG Functional Recovery Guidelines (CEN-152)

* ANO 2, Calvert Cliffs 1&2, Millstone 2, St. Lucie 1&2, Waterford 3, PVNGS 1,2&3, System 80 +

FRA / FA

- Process

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APR1400 Chapter 18

- Allocation Decision Tree

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FRA / FA

- NUREG 0711 Rev 3 Compliance matrix added
- Added robust illustrative tables and figures
- Added detailed narrative of FRA / FA Process with improved traceability to predecessor evaluation and allocation of functions
- Included more completed examples of work product
- Placed illustrative figures and tables with the associated narrative text
- Eliminated use of diverse term for same item
- Aligned narrative text terms and illustrative figure labeling

FRA / FA

- Previous interface issues – confusion over interface with HSI due to wording on slide that implied bottom up approach
- New methods or differences – not new but re use of the allocation decision tree used on System 80+ will probably receive significant RAI scrutiny but shouldn't prevent docketing
- What's left:
  - Acronyms
  - Definitions
  - Consistency Check
  - Independent Review

TA

- **Describes extraction and selection process for tasks to be analyzed**
  - Extraction from previous HFE program elements, predecessor procedures
  - SME judgment for additional tasks, bias control through independent review
- **Describes process for Basic Task Analysis, applicable to all tasks**
- **Describes process to select tasks for Task Timing Analysis (TTA)**
- **Describes process for TTA**
    - Workload analysis
    - Margin Analysis (Time Required – Time Available)
  - Empirical development of Standard Subtask Times
  - Effect of situational factors and secondary tasks on Time Required
- **Describes TA requirements imposed on plant design, potential for HEDs**
- **Describes handling of design changes that impact TA before and after ReSR**
  - Including site-specific changes via DI

TA

- TA Process

TS

S&Q

- **Three sequential activities:**
  - Initial S&Q Assumption
    - Picks a starting point for S&Q analysis based on predecessor designs, staffing constraints, OER and other considerations.
  - S&Q analysis
    - Evaluates task data from TA, aggregated to represent actual plant evolutions, to challenge the Initial S&Q Assumption and modify numbers and/or qualifications as necessary.
    - Identify resulting issues via HEDs.
  - Resolution of S&Q related HEDs
    - Resolves staffing related issues from the S&Q analysis and other HFE program elements to determine the final APR1400 staffing numbers and qualifications.

S&Q

- 3 Step S&Q Process

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S&Q

- Added more detail on process of using TA to assign tasks to positions
- Addressed plant maintenance, plant surveillance, and testing
- Added more detail on consideration of issues related to OER, FRA/FA, TA, IHA
- Rewrote and expanded process description and process diagram
- Clarified relationship with predecessor/reference plants and use of OER
- Add definitions (e.g. Initial S&Q Assumption)
- Consistent terminology (e.g., Shift/Safety Technical Advisor)

S&Q

- **Previous interface issues – non-licensed EO – current IP is now silent on what the initial assumption actually is**
- **New methods or differences – none**
- **What's left:**
  - Expand guidance for conduction the table top talk-through/walk-through
  - Acronyms
  - Definitions
  - Consistency Check
  - Independent Review

APR1400 Chapter`18: TIHA

- **Describes DIHA selection process from TAA and D3CA**
  - Who, how, selection criteria
- **Describes RIHA extraction process from PRA**
- **Describes HFE characteristics extraction process for IHAs, from PRA, TAA and D3CA**
- **Describes documentation of IHAs and HFE characteristics in TIHA ReSR**
- **Describes confirmation of IHAs in other HFE program elements**
  - Describes potential for HEDs
- **Describes treatment of IHAs in other HFE program elements**
- **Describes handling of IHA revisions before and after ReSR**
  - Including site-specific changes via DI

TIHA

- Process

TS

HD

- **Defines APR1400 Basic HSI, APR1400 HSIS and APR1400 Facilities**
  - Methods, HSI inventory and physical configuration of control rooms
- **Overviews development process for predecessor, SKN 3&4 Basic HSI**
  - And transition to conceptual design in APR1400 Basic HSI TeR
- **Describes HD process for taking conceptual design in APR1400 Basic HSI TeR to detailed design**
  - Testing with US operators
- **Describes key components for HSIS and Facilities, and design process**
  - Inputs, outputs, performance tests, independent review and criteria
- **HD output is used to build simulator for V&V**
  - All HEDs must be resolved
- **Describes handling of design changes that impact HD before and after ReSR**
  - Including site-specific changes via DI

HD

- HD Process

TS

HD

- **Clear distinction of terms**
  - Eg. display, IPS, VDU,FPD, operator console
- **Replacement of subjective terms with clear descriptions**
  - Eg. important, sufficient, appropriate, considered, typically
- **Elimination of overlap between HD IP and Basic HSI TeR**
  - APR1400 Basic HSI TeR describes the conceptual design
  - HD IP describes the process to take the conceptual design to the detailed design of the APR1400 Basic HSI
  - HD IP describes the process of designing the HSI inventory within the methods and framework of the Basic HSI, to create the APR1400 HSIS
- **The high level principles in the APR1400 Basic HSI TeR are supplemented with actual design descriptions**
  - To demonstrate compliance to the principles and NUREG-0700

V&V & Scenarios

- **V&V**
  - Added descriptions of specific methods & criteria
  - Removed tutorial material
  - Removed diverse use of terms
  - Addressed NUREG-0711 rev 3 completeness & compliance
  - Aligned the SOC process and the Scenarios
  - Added an iterative process to revision of the Scenarios
  - Integrated the V&V with other program elements
  - Added a V&V HED process
  - Addressed past NRC & internal review comments

V&V & Scenarios

- **V&V- continued**
  - Clearer discussion of use of simulator and style guide in the verification
  - Added a discussion of the Implementation Procedure
  - Made the Electrical Operator a licensed position
  - Added detail to the V&V training programs
  - Redefined pass or fail indicators
  - Describe methodology to assess cross cutting issues
  - Added detail on content of the ReSR
  - Added the use of independent reviews

V&V & Scenarios

- **Human factors V&V scenario TeR**
  - Added plant and personnel details
  - Added test instructions
  - Aligned the Scenarios with the SOC process
  - Changed to US operating terminology
  - Added an iterative design based process to revision of the Scenarios

V&V & Scenarios

- **What's left to do**
  - Review SOC & scenario alignment
  - Fill in the V&V compliance matrix
  - Continue to add plant & procedural information to the Scenarios, as available
  - Check for internal and cross document consistence
  - Final independent review