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*B&W mPower™ Software Process/Procedure
Update and Human Factors Engineering
Program Plan Overview*

August 30, 2011



August 30, 2011, Meeting Topics/Schedule

- Introduction
- Overview of Software Process/Procedure Update
- Conclusion
- Lunch
- Introduction
- HFE Program Plan Overview
- Conclusion



B&W mPower Software Process/ Procedure Update



Regulatory Requirements/Software Procedures Review

- Northrop Grumman has a baseline set of software procedures that are part of an overall Engineering Process appraised at CMMI Level 5
- Based on feedback from the staff, Northrop Grumman is conducting a review of these software procedures
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[CCI per Affidavit 4(a)-(d)]

Resulting Baseline SW Process will be documented in a Technical Report



Northrop Grumman Heritage of Process Improvement

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[CCI per Affidavit 4(a)-(d)]



Essential Elements of NGC SW Development Process

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[CCI per Affidavit 4(a)-(d)]



Northrop Grumman SW Integration Procedure

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[CCI per Affidavit 4(a)-(d)]



Relevant Baseline Process Areas

- Overview of pertinent Northrop Grumman baseline procedures

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] [CCI per Affidavit 4(a)-(d)]



Next Steps

- Complete traceability matrix of regulatory requirements to baseline procedures
- Assess any gaps with respect to Regulations
- Provide traceability matrix and associated baseline set of procedures to the staff
- Submit SW Process Technical Report
- Schedule meeting with NRC staff to discuss and review the Technical Report



Conclusion



Human Factors Engineering Program Plan Overview



Meeting Objectives

- Expand NRC understanding of our HFE design team composition, responsibilities, authority, and placement within the organization
- Explain how an effective HFE process is being developed and implemented for the B&W mPower design
- Discuss planned submittal timelines
- Outline design process and consistency with NUREG-0711 review criteria
- Discuss preliminary concepts, design, and a planned assessment process



B&W mPower Engineering Organization

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[CCI per Affidavit 4(a)-(d)]

HFE independence in organization



HFE Program Scope of Responsibility

- Develop and implement an iterative HFE process
- Submit HFE program implementation plans to the NRC, resolve and incorporate RAls for submitted Topical Reports
- Develop “Concept of Operations” and “Human System Interface Concept” (DCS requirements)
- Integrate HFE with other design activities
- Ensure that subcontractor engineering processes include HFE program requirements
- Identify and inform the design for areas that have the potential to improve human performance



HFE Design Team Plant Design Accomplishments

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[CCI per Affidavit 4(a)-(d)]

**Simplification through functional
integration of systems**



Proposed Submittal Timeline

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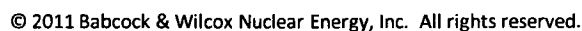
] [CCI per Affidavit 4(a)-(d)]



Design Philosophy

- Optimize the number of components and systems required to operate (not fail) to perform a given plant function
- Capture and integrate user needs in design
- Use a top-down requirements-based design process
- Leverage design team experience to improve HRA critical shaping factors beginning in concept phase
- Maintain an iterative design process
- Consider entire design lifecycle including: development, validation, implementation, testing, operation, maintenance, and obsolescence

Improve human performance by
leveraging operating experience





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Focus on Safety Important SSCs

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mPower Reactor Credited Safety Systems

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mPower Reactor Systems Included in the Initial Scope of HFE Program

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[CCI per Affidavit 4(a)-(d)]

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Systems to be Designed Using HFE Best Practices

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DCS and HSI Architecture

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][CCI per Affidavit 4(a)-(d)]

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[CCI per Affidavit 4(a)-(d)]



Proposed Functional Control Room Layout

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[CCI per Affidavit 4(a)-(d)]



B&W mPower Main Control Room Concept

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[CCI per Affidavit 4(a)-(d)]



Brief Review of Discussions

- Where we are in our schedule timeline
- General discussion and questions
- Quick break



Current Status: Operational Analysis

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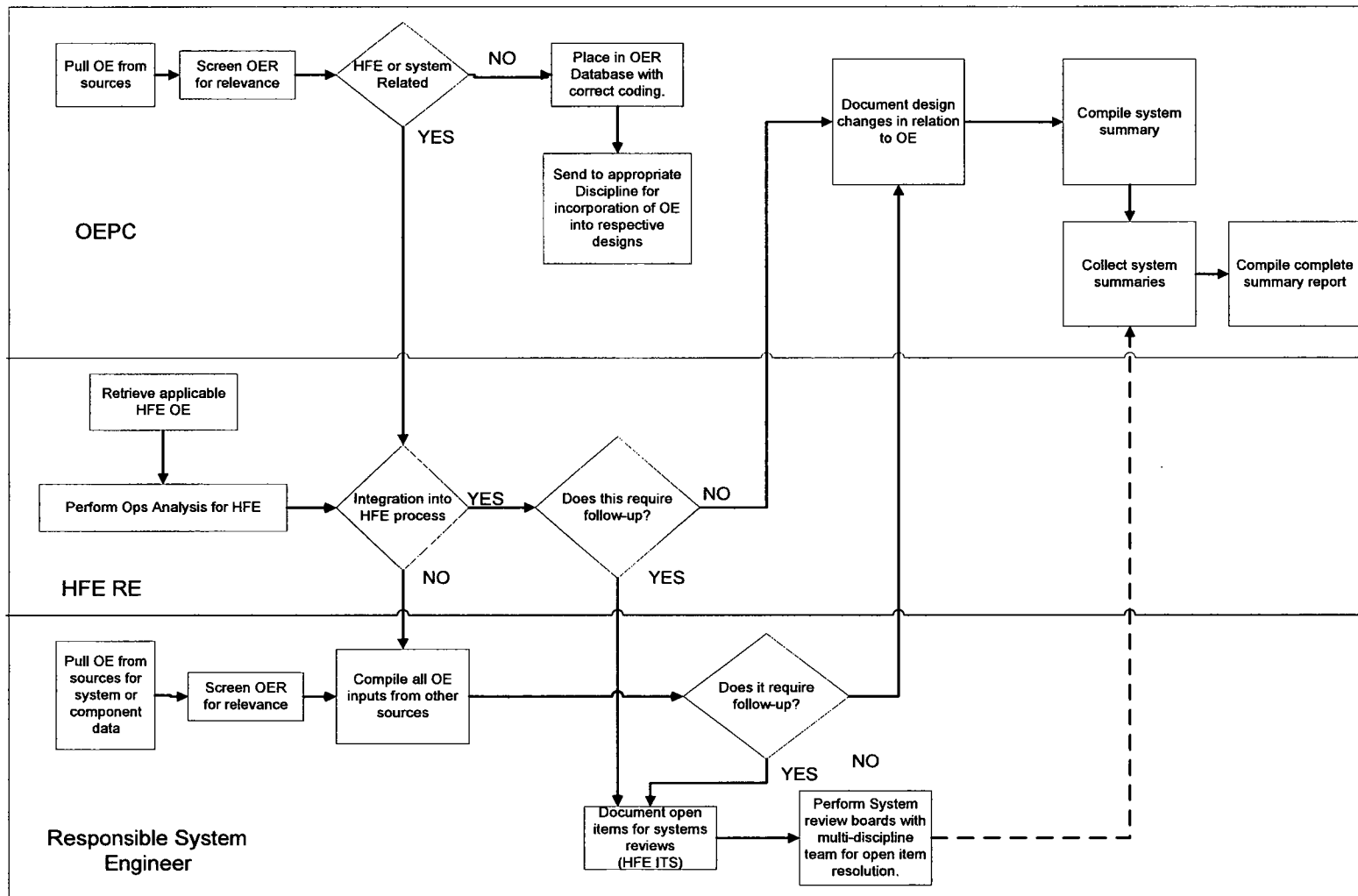
] [CCI per Affidavit 4(a)-(d)]



Discussion of Planned Reviews, Analyses, Approaches

- Operating Experience
- Human Reliability Assessment
- System Functional Requirements Approach
- Design Assessment
- Staffing Approach
- Operational Considerations
- HFE Concept Development
- General Discussions/Questions
- Proposed Future Meeting Topics

Planned Operating Experience Review Process

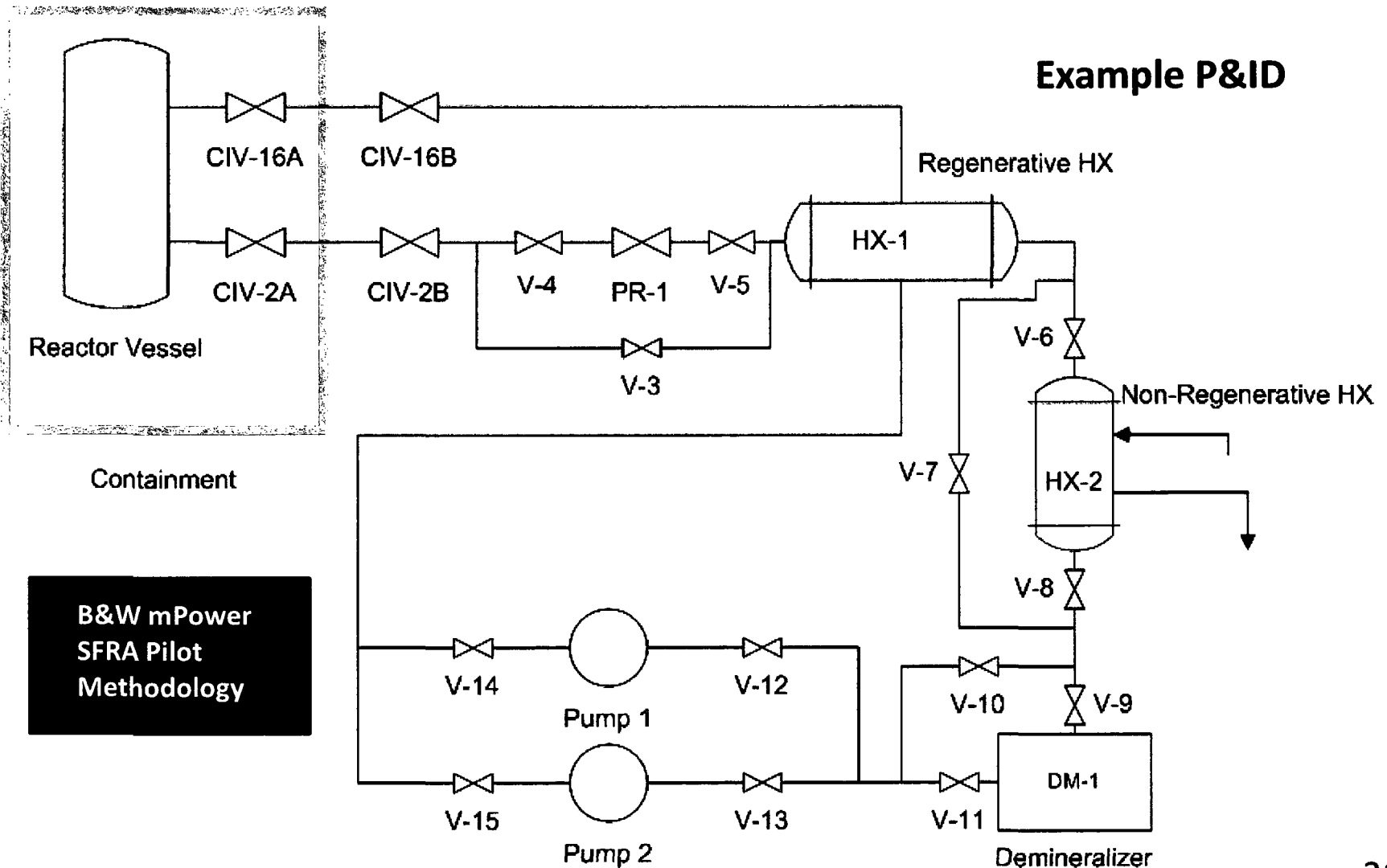




Planned Human Reliability Assessment (HRA)

[CCI per Affidavit 4(a)-(d)]

Planned System Functional Requirements Approach





Example SFRA Function Tree



Example SFRA Fault Tree (Derived from System Function Analysis)

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[CCI per Affidavit 4(a)-(d)]



System Function Versus Plant Mode Table

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[CCI per Affidavit 4(a)-(d)]



Configuration Change Table

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Functional Configuration Change Table

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[CCI per Affidavit 4(a)-(d)]



Component Configuration Change Table []

[CCI per Affidavit 4(a)-(d)]

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[CCI per Affidavit 4(a)-(d)]



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[CCI per Affidavit 4(a)-(d)]

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Additional Task Analysis Fields

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[CCI per Affidavit 4(a)-(d)]



Areas of Design Assessment Focus

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] [CCI per Affidavit 4(a)-(d)]



Design Assessment

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] [CCI per Affidavit 4(a)-(d)]



Critical SMR Staffing Issues

Staffing Issue	B&W mPower Mitigation Strategy
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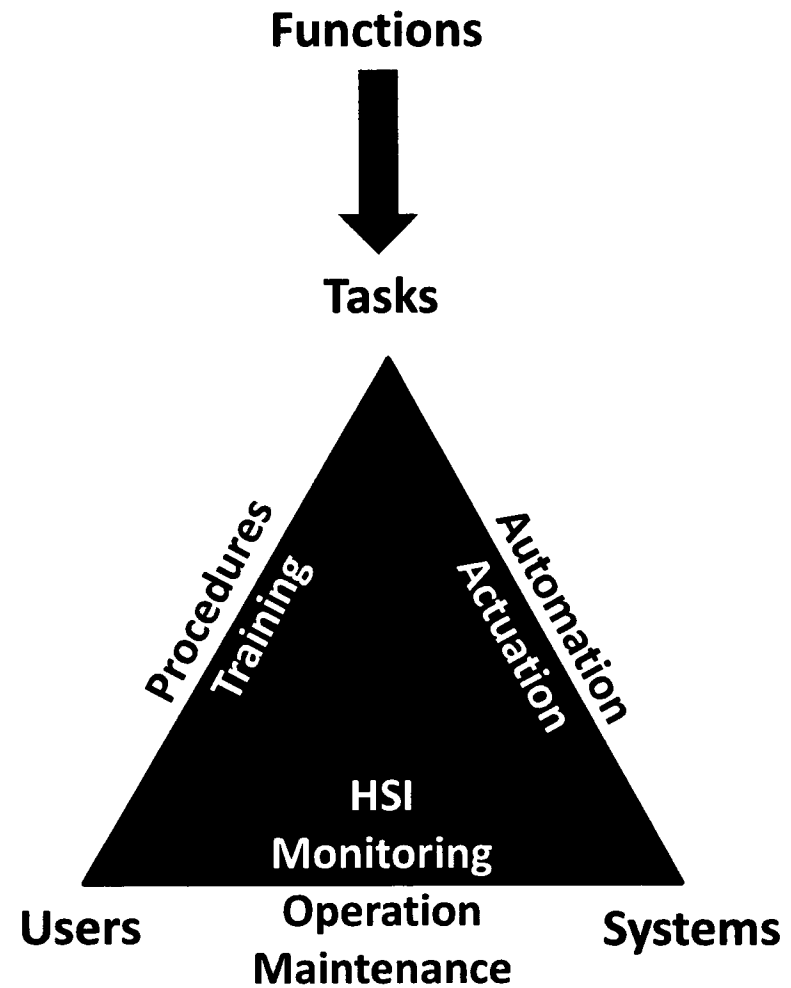
Current Goal : Optimize Number of Licensed Operators per B&W mPower Standard Plant

- Streamlining and simplification of operator workload
- Reduction of actual workload with enhanced situational awareness
- Availability of clear, focused, and appropriate information for operators

Concept of Operation

- Functions are defined
- Tasks are developed to support functional requirements
- Functions/Tasks are allocated to man and/or machine to optimize reliability
- Knowledge and abilities, training objectives, and user guidance is developed for tasks allocated to man
- Prerequisites, interlocks, sequence, and success criteria are provided to control systems
- Guidance provided to user is compatible with requirements provided to control systems

Top-down and Based on Required Functions





Concept of Normal Operation

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[CCI per Affidavit 4(a)-(d)]



Concept of Emergency Operations

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[CCI per Affidavit 4(a)-(d)]

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Concept of Operations –

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[CCI per Affidavit 4(a)-(d)]



Concept of Operations –

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[CCI per Affidavit 4(a)-(d)]



Initial HFE Design Considerations

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[CCI per Affidavit 4(a)-(d)]



Initial HFE Design Considerations (cont.)

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[CCI per Affidavit 4(a)-(d)]



Discussion

- General Discussion/Questions
- Parking Lot Items
- Future Meetings and Potential Topics

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Conclusion