



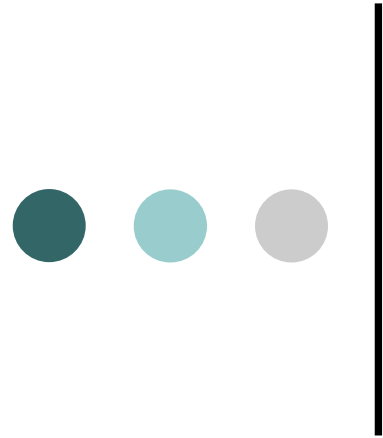
Design Acceptance Criteria (DAC)

NRC-ESBWR DCWG Meeting
April 10, 2008



Meeting Objectives

- Meet Dominion commitment to provide an update on the I&C DAC ITAAC process
- Discuss definition of DAC
- Discuss approach for DAC ITAAC standardization and closure
- Discuss Piping, I&C, and HFE DAC ITAAC
- Discuss responses to NRC Requests for Additional Information on DCD Revision 4 questions
- Propose next steps



Definition of DAC



ESBWR DAC Areas

- ESBWR is currently proposing DAC in the following three areas, based on previous NRC guidance:
 - Piping
 - Digital Instrumentation and Controls (I&C)
 - Human Factors Engineering (HFE)
- These areas relate to issues that require as-built information (piping DAC) or involve areas subject to rapidly evolving technology (digital I&C and HFE).



What is DAC?

- NRC defined DAC in SECY-92-053 (also see RG 1.206 and SRP Section 14.3):
 - *The DAC are a set of prescribed limits, parameters, procedures, and attributes upon which the NRC relies, in a limited number of technical areas, in making a final safety determination to support a design certification. The DAC are to be objective (measurable, testable, or subject to analysis using pre-approved methods), and must be verified as part of the ITAAC performed to demonstrate that the as-built facility conforms to the certified design. That is, the acceptance criteria for DAC become the acceptance criteria for ITAAC, which are part of the design certification.*



Level of Design Detail Necessary in DCD

- NRC identified the level of design detail required for design certification in the 2/15/1991 SRM for SECY-90-377. The same level of detail applies to DAC. That is, the level of design detail that is needed to close DAC is that level that would have been provided in the DCD during the certification process. The NRC explained that applications for design certification should:
 1. Reflect a design which, for all structures, systems, or components that can affect safe operation of the plant, is complete, except to the extent that some further adjustment to the design within established design envelopes may be necessary – during what the staff has referred to as the design reconciliation process – to accommodate actual, as-procured hardware characteristics;
 2. Encompass a depth of detail no less than that in an FSAR at the operating state for a recently licensed plant, except for site-specific, as-procured, and as-built information;
 3. Be sufficient to allow staff to evaluate the resolution of severe accident issues in the design, as well as to incorporate the experience from operating events in current designs which [the NRC staff] want to prevent in the future; and
 4. Provide a sufficient level of detail to ascertain how the risk insights from the design-specific PRA are addressed in the design.



Areas of ITAAC

- A review of C.III.5 indicates there are two distinct areas of ITAAC. They will be called for clarity:
 - Design ITAAC (DAC ITAAC) and
 - Construction ITAAC
- DAC ITAAC
 - Provide acceptance criteria for Construction ITAAC
 - Used to satisfy “one issue, one review, one position”
- Construction ITAAC are used to verify that the design, including DAC ITAAC, has been implemented successfully into the as-built plant.
 - Meet the requirement of Section C.III.5 as-built requirements



Approach for DAC ITAAC Standardization and Closure



Goal - Standardization

NRC supports standardization of information to close DAC ITAAC using design-centered approach:

Although numerous detailed design configurations may satisfy a given set of DAC, the NRC staff expects standardization of the design in keeping with the letter and intent of 10 CFR Part 52. This will also support the NRC's design-centered review approach (DCRA) to licensing [discussed in RIS 2006-06]...Deviations from standard designs or practices used to satisfy DAC may challenge the NRC's goal to implement its "one issue, one review, or one position." RG 1.206, Page C.III.5-1.



Approach to Standardize and Close DAC ITAAC

- **Proposed approach for DAC ITAAC closure would support NRC's goal:**
 - Clearly establish which ITAAC represent DAC ITAAC in Tier 1 - mark {{Design Acceptance Criteria}}
 - Tier 1 will specify that DAC ITAAC will be closed only for first ESBWR Model 1 ("R-COL")
 - Tier 1 will specify that subsequent ESBWR ("S-COL" for Model 1) will use information from DAC ITAAC closure and perform construction ITAAC
 - As time allows and/or when technology evolves, GEH may amend ESBWR design certification rule (e.g., ESBWR Model N) and the process would be repeated



Approach to Standardize and Close DAC ITAAC (cont)

- **R-COL DAC ITAAC closure process**

- NRC issues License
 - R-COL presents DAC ITAAC design information to NRC inspectors and technical reviewers as information is completed (e.g., in phases of the phased process)
 - NRC provides feedback throughout the process
 - Licensee submits notification letter of DAC ITAAC completion
 - NRC informs Licensee if NRC agrees DAC ITAAC is completed
 - Licensee moves into phases for completion of construction ITAAC
 - Detailed design and testing are completed and systems are ready for startup testing and operation once all remaining ITAAC are completed
 - Licensee changes licensing basis as appropriate



Approach to Standardize and Close DAC ITAAC (cont)

○ **S-COL DAC ITAAC closure process**

- S-COLA application submitted
 - If S-COLA seeks to use a different process than the DAC ITAAC as closed by R-COL, S-COLA must seek NRC approval of an exemption from Tier 1
- S-COL receives License
 - S-COL uses DAC design information prepared for DAC ITAAC closure, as closed by R-COL or seeks an exemption to deviate (unless an exemption was sought and approved by NRC during license application review)
 - Licensee moves into phases of completion of construction ITAAC
 - Detailed design and testing are completed and systems are ready for startup testing and operation once all remaining ITAAC are completed
 - Licensee changes licensing basis as appropriate



Approach to Standardize and Close DAC ITAAC (cont)

- **Option to Amend Design Certification**

- GEH may request an amendment to incorporate completed DAC ITAAC design into Design Control Document/ Design Certification Rule
 - For early R-COL and S-COLs, this option may not be available to support schedules
 - While this option may be viable, depending upon schedules, it may not be needed if the DAC ITAAC process supports standardization for each ESBWR Model N
- Later ESBWR Models with no Design Certification Amendment
 - DAC ITAAC closure process by ESBWR Model remains in place
 - Modifications to incorporate evolving technology could be made available to a new ESBWR Model N R-COL
 - DAC ITAAC for ESBWR Model N would be closed by R-COL process for DAC ITAAC



Tracking DAC ITAAC

- GEH is developing tracking process for DAC ITAAC closure
- Once the DAC ITAAC closure process has been completed, changes will be in accordance with configuration management program
 - Should changes be required during plant construction, then the same high quality design process will be followed and the new criteria will be verified in the Construction ITAAC closure process (e.g., reconciliation report for piping)



Discussion of DAC ITAAC Areas



Piping DAC ITAAC

- Scope comprised of safety-related ASME Section III, Class 1, 2 and 3 piping
- ASME design and construction process is well defined and consists of:
 - Design Reports
 - Reconciliation Reports



Piping DAC ITAAC (cont)

- Piping DAC ITAAC consist of:
 - System specific 'Design' ITAAC located throughout Section 2 of Tier 1
 - Generic ITAAC found in Section 3.1 of Tier 1
 - ITAAC identified by {{Design Acceptance Criteria}}
- Piping DAC ITAAC are completed by:
 - ASME NCA-3550 compliant Design Reports
 - HELB analysis
- Reconciliation/Construction ITAAC follow DAC ITAAC



I&C and HFE DAC ITAAC

- I&C DAC ITAAC - split into two areas:
 - Hardware, as outlined in Tier 1 Section 2.15 and 3.7
 - Software, as outlined in Tier 1 Section 3.2
- HFE DAC ITAAC – outlined in Tier 1 Section 3.3



Systems Associated with I&C and HFE DAC ITAAC

- Safety Related Systems Associated with DAC ITAAC
 - Per Tier 1 Table 2.2.15-1 the systems associated with DAC ITAAC are:
 - RPS and related systems – Examples:
 - CMS (safety-related parts)
 - NMS
 - ESF and related systems – Examples:
 - SLC
 - ICS
 - ADS
- Nonsafety-related systems do not have DAC ITAAC but some do have their own associated Construction ITAAC.
 - Example: Feedwater Control System



Hardware DAC ITAAC

- Hardware DAC ITAAC are completed by:
 - Items identified in Tier 1 Table 2.2.15-2
 - Block Level Failure Modes and Effects Analysis (FMEA)
 - Simplified Logic Diagrams (SLD)
 - These will be developed in the initial detailed design (Phases 1 and 2) of the GEH design process.
 - DAC ITAAC for hardware then will be complete.



Software Development

- Software Development Process is an iterative process that consists of eight phases
 - Planning
 - Requirements
 - Design
 - Implementation
 - Test
 - Installation
 - O&M
 - Retirement (beyond scope of ITAAC)
- Cyber Security
 - Currently being developed (also has a hardware aspect)



Software Development

- Software development will be performed per the software development plans. The software development plans align with the requirements of SRP-0800, BTP 7.14, Section B.2.1. These plans are described in Tier 1 Section 3.2 and are used to develop the acceptance criteria for software. Examples:
 - Software Management Plan
 - Software Development Plan
 - Software QA Plan
 - Software Safety Plan
 - Software Verification And Validation Plan
 - Software Configuration Management Plan
- Process plans have been developed by GEH and submitted to the NRC for review.



Software Development

- Requirements Phase:
 - At the end of the Requirements Phase, all safety-related software requirements will be identified and software coding will commence.
 - The definition of the detailed functional requirements and performance requirements, design constraints, and validation criteria is complete. Example:
 - Hardware/Software Specifications - HSS
 - DAC ITAAC for Software then will be complete.



Software: Relationship to ITAAC

- Correlation of ITAAC to the Eight Phases of Software Development
 - DAC ITAAC {{Design Acceptance Criteria}}
 - Planning
 - Requirements (Requirements issued, DAC is complete)
 - Construction ITAAC
 - Design Phase
 - Implementation
 - Test
 - Installation (Verification of DAC, includes FAT/SAT)
 - O&M processes in place, e.g. for revisions of Production Software



Use of HFE

- Why use HFE?
 - HFE analysis of the design is required by NUREG 0711, Revision 2.
- When will it be used?
 - HFE provides the basis for development of all plant operational and safety requirements.
- What will it analyze?
 - HFE analysis shall be directed to the full range of plant operating modes, including:
 - startup
 - normal operations
 - abnormal operations
 - transient conditions
 - low power
 - shutdown conditions
 - The analysis shall also address personnel tasks during periods of maintenance of plant systems and equipment.



HFE and Hardware Design

- HFE Inputs to the Hardware Design Process
 - HFE plays a major role in the development of the hardware (and software) specifications. Early in the development process, HFE analysis is performed on the system requirements and these analyses are fed into the hardware/software design. Primarily, the following four analyses are used to develop detailed design requirements:
 - Operational Experience Reports – OER
 - Functional Requirement Analysis – FRA
 - Allocation of Functions – AOF
 - Task Analysis – TA
 - The HFE process is used for development of all safety-related and nonsafety-related hardware and software specifications and design criteria.



HFE ITAAC

- HFE Consists of 12 Processes Requiring ITAAC
 - HFE {{Design Acceptance Criteria}} are completed by issuing Results Summary Reports for following processes:
 - Operating Experience Review (OER)
 - Functional Requirements Analysis (FRA)
 - Allocation of Functions (AOF)
 - Task Analysis (TA)
 - Construction ITAAC Processes
 - Staffing and Qualifications (SQR)
 - Human Reliability Analysis (HRA)
 - Human System Interface Design (HSI)
 - Procedure Development (PD)
 - Training Development (TD)
 - Human Factors Verification and Validation (HFEV&V)
 - Design Implementation (DI)
 - Human Performance Monitoring (HPM)

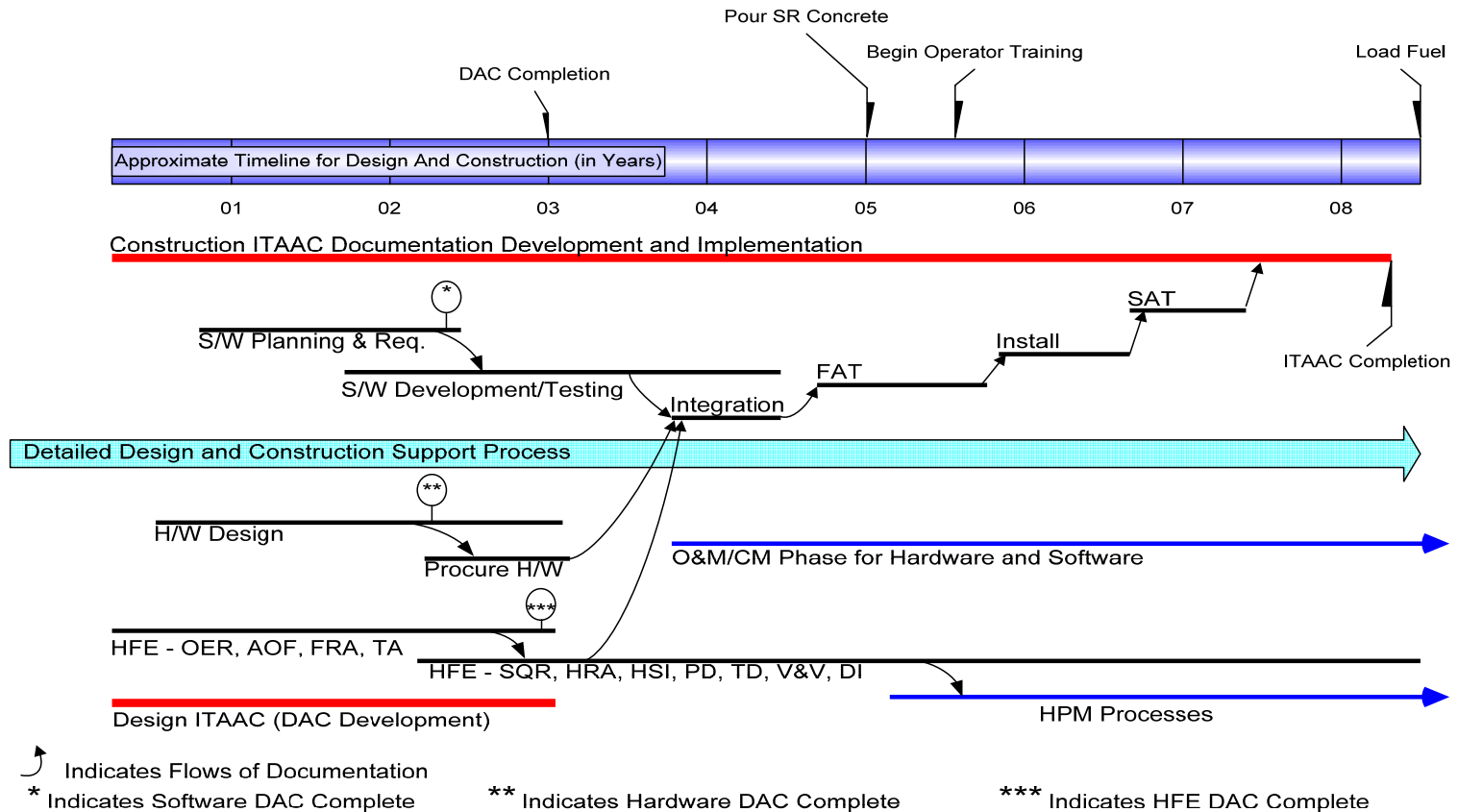


HFE

- The Results Summary Reports for HFE OER, FRA, AOF and TA analyses are used to develop the detailed functional and performance requirements for the SR system hardware and software. Examples of output:
 - Minimum inventory
 - Main Control Room design
- Subsequent HFE activities (SQR, PD, TD, DI, etc.) are used to develop the training systems and HSI interface documents used to operate and maintain the plant.
- The Human Performance Monitoring plan will be used by the utility to maintain the HFE process and programs for the life of the plant.

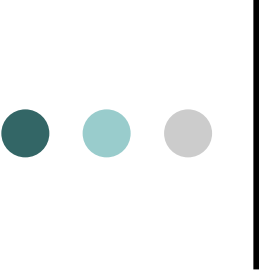
I&C and HFE ITAAC Timeline

Approximate Timeline for SR I&C Systems Design and Construction Including HFE Development





DCD RAIs Related to DAC ITAAC



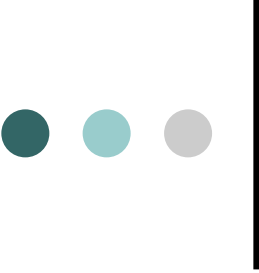
DCD RAI 14.3-75, Software

- *The digital I&C system design development process, as documented in the certified design's DCD should be addressed to the greatest extent possible in the COL application. Some activities can be performed during pre-COL application stage, some activities can only be performed after equipment is purchased and tested. Therefore, the software development ITAAC should clearly identify which activities will be performed before COL license stage, and which activities will be performed after COL license. For those activities to be performed by the COL licensee, the COL action requirements should be specified in the DCD.*
- DAC ITAAC on software under review to ensure appropriate {{Design Acceptance Criteria}} ITAAC are identified
- Assuming that {{Design Acceptance Criteria}} ITAAC will be closed following issuance of COL, ESBWR DCWG working on milestones for closure
- No R-COL action requirements other than closing {{Design Acceptance Criteria}} ITAAC are necessary



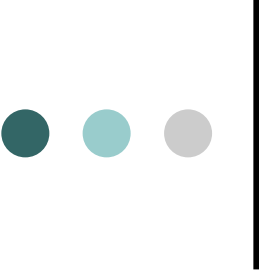
DCD RAI 14.3-170, Software ITAAC

- ***3.2 Software Development is in DAC process, the ITAAC table should be labeled {DAC}.***
- Following development of appropriate Software ITAAC for Revision 5 of DCD, those that are design-related ITAAC will be marked {{Design Acceptance Criteria}} and remaining ITAAC will be considered construction ITAAC
- Coordinated with RAI 7.1-75 concerning the status of the submitted plans



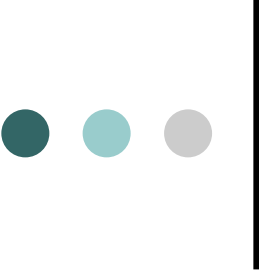
DCD RAI 14.3-171, HFE ITAAC

- ***3.3 Human Factor Engineering is in DAC process, the ITAAC table should be labeled {DAC}.***
- Following development of appropriate HFE ITAAC for Revision 5 of DCD, those that are design-related ITAAC will be marked {{Design Acceptance Criteria}} and remaining ITAAC will be considered construction ITAAC



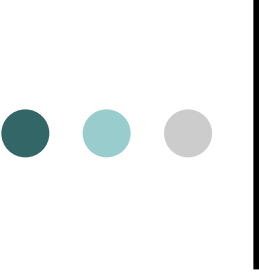
DCD RAI 14.3-210, COL Item for DAC Schedule

- *RG 1.206 Section C.III.5.1, "Detailed Design Information and the Combined License Application," states that "the NRC staff recommends, to the greatest extent practicable, that the COL applicant include detailed design information in the areas where design acceptance criteria (DAC) were used during the design certification. The applicant should submit this information early enough in the process to allow the NRC staff sufficient time to review it and determine compliance with the DAC and associated ITAAC. Early submission of such information should help avoid potential impacts on the licensee's plans and schedules for loading fuel. The COL applicant should identify those design areas where detailed information cannot be provided and should supply the NRC with a schedule for completion of detailed engineering, procurement, fabrication, installation, and testing information. The applicant should similarly do this in a manner to support timely NRC inspection of DAC information." In accordance with RG 1.206 guidance, the staff requests GEH to add a COL information item to the DCD for the applicant to identify those design areas where detailed information cannot be provided and should supply the NRC with a schedule for completion of detailed engineering supporting implementation of the Design Acceptance Criteria (DAC) in the areas that DAC was approved for the ESBWR design certification.*



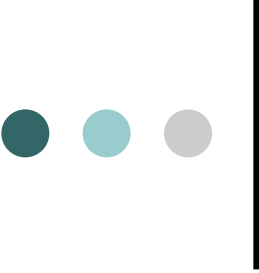
DCD RAI 14.3-210, COL Item for DAC Schedule (cont)

- With proposed DAC ITAAC closure process, the ESBWR DCWG proposes the alternative method to address the NRC's concerns
 - ESBWR DCWG is currently in process of determining what elements of design are DAC ITAAC and what level of design detail is necessary to close DAC ITAAC
 - DCD will be revised (Revision 5) to finalize DAC ITAAC, explain DAC ITAAC closure process, and reflect today's presentation
 - ESBWR DCWG/R-COL will make available milestone/schedule information for DAC ITAAC closure to NRC when developed
 - DAC ITAAC will apply to only R-COL for first of a standard ESBWR Model N



DCD RAI 14.3-211, HFE ITAAC

- ***ITAAC Table 3.3-1 contains 11 items, one for each element of NUREG-0711 and the corresponding ESBWR element implementation plan. However, the Design Commitment column for each element refers to the overall MMIS and HFE Implementation Plan rather than the specific pertinent elements implementation plan. Please update the 11 Design Descriptions to refer to the applicable implementation plans.***
- ITAAC on HFE under review to ensure appropriate DAC ITAAC and construction ITAAC are identified
- Revised ITAAC will reflect the elements of NUREG-0711 and the specific pertinent elements for the implementation plans



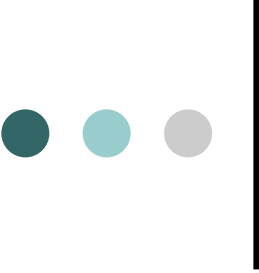
DCD RAI 14.3-271, HFE ITAAC

Update ITAAC Columns 2 and 3 - Tier 1 Table 3.3-1 Column 2 (Inspections, Tests, Analyses) and Column 3 (Acceptance Criteria) should be revised for each Design Commitment to ensure that they accurately reflect the methodology described in the final versions of the implementation plans following revisions to address the staff's RAIs identified in Chapter 18 of the SER. In addition, please review all of the items in the acceptance criteria column to ensure that the text is complete. For example Table 3.3-1 item 1, the Acceptance criteria states:

Summary reports document that:

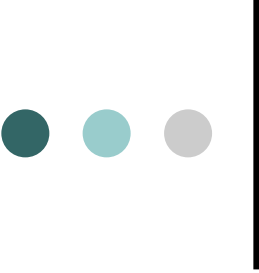
- a. The OER team members and backgrounds.*
- b. The scope of the OER.*
- c. The sources of the operating experience reviewed and documented results.*
- d. The Process for issue analysis, tracking and review."*

This is not complete and does not provide an acceptable acceptance criterion.



DCD RAI 14.3-271, HFE ITAAC (cont)

- HFE ITAAC are being reviewed
- Appropriate Acceptance Criteria will be identified for each HFE ITAAC, including both DAC ITAAC and construction ITAAC



DCD RAI 14.3-389, HFE ITAAC

- ***For ITAAC Table 3.3-1, Item 1, the staff requests that the applicant clarify in the DC that the activities will be performed in accordance with the OER Implementation Plan.***
- HFE ITAAC are being reviewed, as noted above
- For ITAAC 1 (i.e., Item 1), the Design Commitment will be appropriately related to the OER Implementation Plan

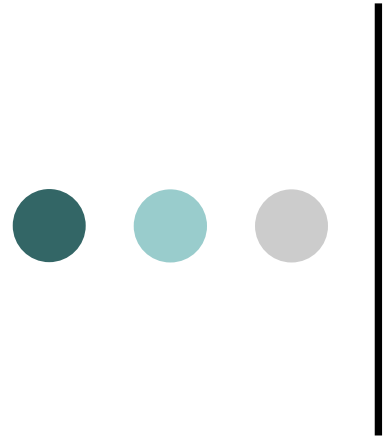


Next Steps



Next Steps

- Revision 5 of ESBWR DCD will reflect positions discussed today
- ESBWR DCWG will continue to work on development of the DAC ITAAC process and schedule
- We anticipate future meetings during 2008
- DCWG will present updated information in late 2008 related to DAC ITAAC closure process and milestones



Questions?