Physical Security Position Paper

NRC SMR Licensing Workshop
August 10, 2011

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Physical Security for SMRs

- Current security performance objectives will be met
- Security-informed design is key
- Appropriate approach for SMR designs must be identified through detailed technical analysis

Technical Considerations Affecting SMR Physical Security

- Reactor Coolant Boundary contained entirely within the RPV
- More passive physical barriers
  - Underground
  - Underwater
  - Sealed vault
- Greater simplicity in systems required for safe shutdown means fewer targets

Technical Considerations Affecting SMR Physical Security

- Smaller source terms
- Relatively larger passive heat sinks
- Longer time constants before any fuel thermal limits are approached
- Smaller total plant footprint

SMR-Specific Considerations

- Pre-application meetings with NRC
  - Identify security related regulatory requirements in context of specific SMR designs
  - Establish clear approach to meeting performance objectives
- Design Centered Working Groups
  - Used to drive standardization
  - Facilitates integration of operational security considerations into design

SMR-Specific Considerations

- Technology neutral framework
- Performance-based licensing process
- Physical protection capabilities integrated into design
- Scope of security issues (e.g.)
  - Security staffing
  - Insider threat
  - Cyber security
  - Beyond design basis events

SMR-Specific Considerations

- Current regulations can be adapted to reflect design features
- SMR design features simplify security operations
- Integration of security at early design stage improves efficiency of the licensing process
- Security staffing needs to be appropriate for specific designs

Conclusions

- SMRs will meet performance-based outcomes consistent with current regulations
- Identify security related regulatory requirements in context of specific SMR designs early on
- Guidance developed from technology specific NRC and Design Centered Working Group engagements
- Anticipate completion of paper by end of 2011
- Look forward to further engagement with NRC at future public workshops

Industry Control Room Staffing Position Paper

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Control Room Staffing

- Getting it right is essential to safe and reliable performance during normal operations and accident management
  - Evaluating approaches to determine appropriate control room staff complement for SMRs
  - Analysis of operator workload indicates that appropriate control room staff complement will be different from that of operating fleet
- Engaging with the NRC staff to achieve alignment on approach

Position Paper Objectives

- To review the process for assessing crew complements for licensed operating personnel
- To identify lessons learned for ensuring appropriate control room staffing is achieved in timeframes that support SMR design, construction and startup
- To identify whether new regulations or regulatory policy changes are needed to support licensing SMRs

Evaluation of Current Regulatory Framework

- First-of-a-kind deployment will follow existing regulations using one of two options below
  - Staffing requirements will either reflect the numbers identified in 10 CFR §50.54(m) table or exemption requests may be pursued as allowed by current regulations
  - Staffing requirements exemption guidance in NUREG-1791 informs the SMR optimized staffing
    - Nine review areas provide a template

Important to Determine Appropriate Control Room Staffing Complement

- Exemption Process (first plants)
  - Address design-specific control room staffing complement and number of reactors controlled from one control room
  - NUREG-1791 appears reasonable
    - Benefits from the products developed from a robust Human Factors Engineering Program
  - Process applicable to both Part 50 and 52 applications
  - Per NUREG 0800, applications will address:
    - Chapter 13: procedures and training
    - Chapter 16: staffing complement
    - Chapter 18: human factors program
    - Chapter 19: human reliability analysis

Important to Determine Appropriate Control Room Staffing Complement

- Petition for Rulemaking
  - Subsequent SMR deployments may petition for rulemaking
  - An HFE process that conforms to the guidance in NUREG-0711 and evaluates issues identified in NUREG-1791
  - Could cover all SMRs with a process approach versus a prescriptive approach to staffing
    - Focus on a proven process that can consistently be used to identify the right staffing complement

Applying HFE Program Process to Control Room Staffing

- HFE program review model described in NUREG-0711
- Iterative process used to determine basis and level of staffing:
  - Analysis
  - Design
  - Verification and Validation
  - Implementation

Applying HFE Program Process to Control Room Staffing

- Analysis Phase
  - Operating Experience Review
    - Experience from existing nuclear facilities and other industries
    - Use of engineering simulator and mock up in an iterative design process
    - Provide basis for incorporation of feedback into plant design at the beginning of the design process
  - Functional Requirements Analysis and Function Allocation
    - Evaluate new and different functions associated with SMR designs (e.g. passive features, design simplicity, increased response time)
    - Capitalize on human strengths and avoid allocating functions that would be negatively affected by human limitations

Applying HFE Program Process to Control Room Staffing

- Analysis Phase (continued)
  - Task Analysis
    - Address design-specific considerations
    - Similar to process for existing reactors
  - Staffing Qualifications
    - Design-specific considerations for number and qualifications of personnel
    - Develop specific job definitions and staffing plan
  - Human Reliability Analysis
    - Evaluate the potential for human error that may affect plant safety
    - Minimize personnel errors, allow their detection, and provide recovery capability

Applying HFE Program Process to Control Room Staffing

- Design Phase
  - Human-System Interface (HSI) Design
    - Translate functional and task requirements to the detailed design of displays, alarms, controls and other aspects of the HSI
  - Procedure Development
    - Develop procedures from the same design process and analyses as the HSI and training
  - Training Program Development
    - Based on the systematic analysis of job and task requirements
      - Establish an approach for developing personnel training
      - Evaluate the knowledge and skill-requirements
      - Coordinate the development of the training program
      - Implement training consistent with human factors principles and practices

Applying HFE Program Process to Control Room Staffing

- Verification Phase
  - Human Factors Verification and Validation
    - Comprehensively confirm that the final design conforms to the HFE design principles
      - Verify that the HSI supports personnel task requirements as defined by task analysis
      - Verify that the HSI is designed to accommodate human capabilities and limitations
      - Validate the integrated system design acceptably supports safe plant operation

Applying HFE Program Process to Control Room Staffing

- Implementation Phase
  - HFE Design Implementation
    - Well-defined and carefully monitored during startup procedures and testing
  - Human Performance Monitoring
    - Verify the confidence developed by the completion of the integrated system validation is maintained over time
    - Submit a human performance monitoring strategy to ensure that no safety degradation occurs due to plant changes and to verify that the conclusions remain valid over time

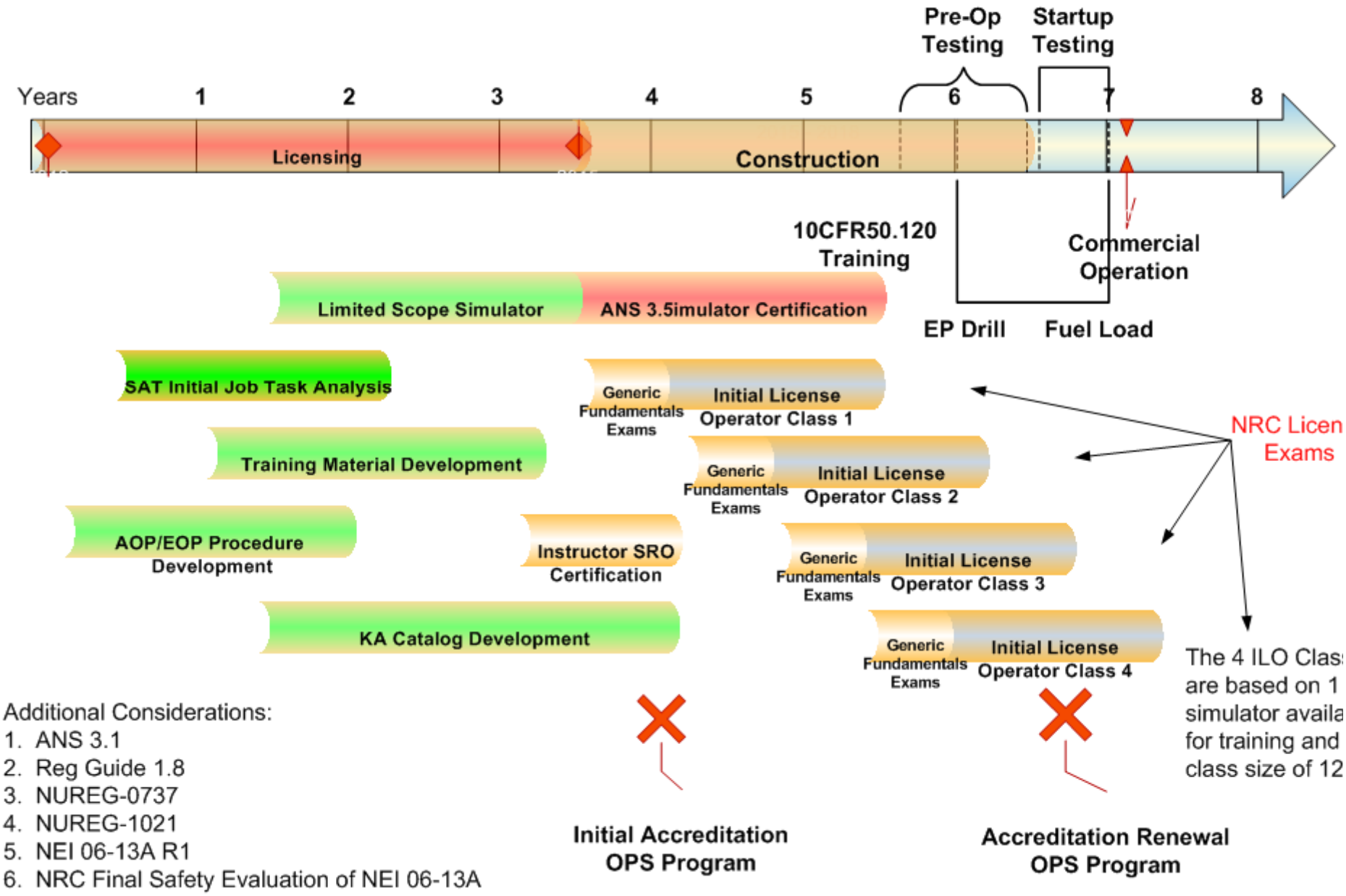
Near-Term ALWR Lessons Learned

- Standardization is key
- Knowledge and Ability Catalog needs to be developed in parallel or immediately following job/task analysis
- The initial accreditation process for new training programs can be used to identify and correct training deficiencies before training of first students
- Training task analysis must be comprehensive and complete prior to starting training design phase
- A close relationship must exist between the utility training material developers and the vendor design organizations

Near-Term ALWR Lessons Learned

- Early use of simulator
  - Supports iterative design process
  - Allows for human factors evaluation and for development of training materials
  - Validates normal, abnormal, and emergency procedures
- Simulator development is important to instructor certification
- Careful consideration of class size, simulator availability, staffing lead times, initial class duration, must be factored in to the planning and scheduling

Representative Timeline for License Operator Training



Additional Considerations:

1. ANS 3.1
2. Reg Guide 1.8
3. NUREG-0737
4. NUREG-1021
5. NEI 06-13A R1
6. NRC Final Safety Evaluation of NEI 06-13A

Conclusions

- Getting it right is essential to safe and reliable performance during normal operations and accident management
- Standardization throughout is key
- The human factors engineering program review model described in NUREG-0711 provides a reasonable basis for analysis, design, verification and validation, and implementation of the process
- Iterative design process supports identification of appropriate control room staffing complement
- Near term SMRs can be licensed using existing regulations including the exemption process
  - The exemption process outlined in NUREG-1791 appears reasonable
- For follow-on SMRs, rulemaking may be petitioned using a process similar to that outlined in relevant NUREGs

Position Paper Schedule

- Draft position paper in progress
- Feedback to be incorporated from today's meeting and recently-issued SECY-11-0098
- Task Force review in August
- Paper completion expected 3rd quarter