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IAEA – Workshop on Steps for Conduction Nuclear Power Plant Technology Assessments

Reactor Design Technology Selection and Decision Making Process

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Problem Statement

Utilities looking to build new Nuclear have a number of reactor technology choices:

- ABWR (Hitachi GE or Toshiba)
- ESBWR (GEH)
- AP1000 (Westinghouse)
- EPR (AREVA)
- APWR (Mitsubishi)

A rigorously defined and applied evaluation process must be followed to ensure that the utility selects the best choice for its particular situation.

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Creating the Process

Identify Needs/Desires

- Quantitative Process to maximum extent
- Weighting scheme to account for utility specific values and goals (e.g. passive versus active)
- Use of subject matter experts
- Formal process for review and challenge

A hand selected, highly qualified team was assembled to create and execute the process

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The Process

The team:

- Used a recognized methodology for the quantitative process
- Identified Key Technical considerations
- Defined the systems and topics for review
- Created summary comparison sheets
- Determined appropriate weighting factors
- Utilized Excel spreadsheets for calculating results.
- Presented final recommendation to senior executives following internal challenge reviews

The Details

Key Technical Considerations

- Safety Margins
- Design Margins
- Operational Margin
- Security Considerations
- Unit Availability Considerations
- Operating Experience
- Materials Assessment
- Maintenance and Refueling Considerations

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The Details (continued)

Systems and Topics for Review

- Nuclear Steam Supply Systems (NSSS)

  This included systems such as Reactor Design, Reactor Coolant System Design and Residual Heat Removal and Shutdown Cooling Design.

- Balance of Plant (BOP)

  This included systems such as Main Feedwater Design; Condensate Design; Main Condenser Design and Circulating Water Design.

The Details (continued)

Systems and Topics for Review (continued)

- Instrumentation & Controls Systems

  This included systems such as Reactor Protection System, Engineered Safeguards Actuation System and Feedwater Control System Design.

- Electrical Systems

  Included were Offsite Power System Design; Onsite Power Distribution System Design and Class 1E DC System Design.

The Details (continued)

Systems and Topics for Review (continued)

- Civil, Security, and Fire Protection

  Areas such as Internal Flooding, External Flooding, Buried Piping and security considerations were reviewed.

- Operational Considerations

  Areas such as Heat Up, Start Up, Power Ascension, Reactor Shutdown and Turbine Trip Response were reviewed.

- Maintenance & Refueling Considerations

  Critical Path Comparison, Fuel Transfer System Design and Major Maintenance Comparison were reviewed.

The outputs: Example of High level Summary pages

Reactor Design

Technology "A" Advantages

- Operating Pressure 1040 PSIA versus 2250 PSIA
- Internal Head Vent Arrangement

Technology "A" Disadvantages

- 345 Penetrations Below The Active Core
- Material Selection and Mitigation Has Not Been Optimized
- MSL 28" Diameter

Technology "B" Advantages

- No Penetrations Below The Active Core
- Has Incorporated Material Lessons Learned.
- 120 Penetrations Above Active Core
- Integrated Top Head Assembly

Technology "B" Disadvantages

- Large Loop Penetrations
- Boric Acid Inspection Requirements

Technology "B" Advantage

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Conclusion and Wrap-up

- The recommended technology was chosen based on the high level summary pages and Excel spreadsheet results.
- Following team challenges and minor adjustments, the results were presented to Exelon Nuclear's senior management team for approval.
- Lessons learned confirmed the criticality of having a rigorous evaluation process and an experienced and diverse team.

Questions?

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