Industry Perspectives on GSI-191 Closure

September 29, 2010

Ed Halpin
President and CEO
STP Nuclear Operating Company

Mutual Agreement

- NRC Staff and Industry have done substantial work to drive this issue to closure
- Significant progress has been made in addressing GSI 191
- More probable small LOCA events should be addressed in the short-term
- Application of a risk informed approach for large LOCAs is appropriate based on extremely low risk

Proposed Small LOCA Resolution

- Target completion of testing by the end of 2011
- Licensees evaluate test results and commit to a resolution path by mid-year 2012
- Base any needed modifications on NRC accepted test results and acceptance criteria

Proposed Large LOCA Resolution

- Maintain all risk informed options available including an enhanced GDC 4
- Develop risk-informed methods and guidance specific to and appropriate for GSI-191
- Close the issue with commitments by mid-year 2012 for any additional actions, necessary modifications, and timelines on a plant specific basis

Timeline Basis

Why is this timeline appropriate?

- Extremely low risk
- Industry has made significant progress in addressing GSI 191
- Allows completion of testing for small LOCA and application of PRA tools for large LOCA
- Test results may affect scope of additional modifications
- Adequate planning time minimizes radiological dose impacts
- Allows planning for aggregate impact of other regulatory issues

Why is a Holistic Risk Informed Approach Appropriate for Large LOCAs?

- Absolute versus reasonable certainty. What is needed to meet the adequate protection standard?
- Holistic risk informed approach is consistent with NRC principles
- All risk informed approaches remain available to licensees including 50.46(a), RG 1.174, and an enhanced GDC 4

GSI 191 Closure Interactive Resolution

September 29, 2010

Peter P. Sena III
Senior Vice-President, FENOC Operations

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Beaver Valley is Substantially Complete

Item	Beaver Valley Unit 1	Beaver Valley Unit 2
Strainer	20 fold increase	20 fold increase
Piping Insulation	700 lineal feet	1700 lineal feet
SG Insulation	RMI (installed concurrent with RSG in 2006)	Replaced with RMI in 2009
Buffer Replacement	Not required	Sodium Tetraborate

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Beaver Valley is Substantially Complete

Impact	Beaver Valley Unit 1	Beaver Valley Unit 2
Cost	$25 M	$36 M
Dose	37 Rem	76 Rem
Outage duration (insulation replacement)	Did not impact critical path	Extended 2009 scheduled outage duration by 7 days

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Remaining Items for GSI-191 Closure

- Obtain final NRC approval of formal RAI responses
- Implement remaining outage modifications
- Resolve in-vessel effects

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FENOC Made Conservative Decisions Based on Deterministic Approach

- Our decisions were based on circumstances specific to our situation

- Risk-informed opportunity
  - Unit 2 SG insulation replacement (22 Rem)

- General Design Criteria 4 opportunity
  - Unit 2 SG insulation replacement (22 Rem)
  - Unit 1 Rx Nozzle insulation (12 Rem)
  - Unit 1 & 2 Piping insulation (10 Rem)
  - Unit 1 RCS primary piping insulation (6 Rem)

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Deterministic Approach - Leaves Limited Operational Margin

- Bounding analysis, levels of conservatism applied leave limited operating margin
- Strainer head loss results do not easily support extrapolation to higher debris loads
- Application of risk informed guidance could benefit operating margin

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Unresolved In-Vessel Effects Cause Ongoing Uncertainty

- Fuel may become limiting
- Potential for additional modifications or reduction in operating margin
- Application of risk informed guidance could benefit margin

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Summary

- Beaver Valley is substantially complete
- Our decisions were conservative, based on a deterministic approach and were specific to Beaver Valley
- Risk informed guidance could benefit operating margin
- Unresolved in-vessel effects causes ongoing uncertainty

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GSI –191
PWROG Resolution Efforts

September 29, 2010

Amir Shahkarami
Chairman PWROG Executive Committee
Senior VP Exelon, Site VP Braidwood Exelon Nuclear

Summary of Remaining PWROG Actions

- Zone of Influence Testing
- Long Term Core Cooling
- Method of Closure

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Zone of Influence Testing

- **Provided for both**
  - Deterministic approach (<12 inch breaks) and
  - Holistic risk approach (≥12 inch breaks) including GDC 4 and other potential mitigations
- **Staff was in agreement with the previous work on all but two issues**:
  - Scaling
    - Pipe break
    - Large components
  - Determination of Zone of Influence
    - Calculation of isobars
- **Schedule to complete testing and report: 12/2011**

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Long-Term Core Cooling Status

- **Cross test**
  - Conducted cross-test 9-09-10
  - Path forward - Options being evaluated:
    - Evaluating existing test results for applicability
    - Potential for further testing to support evaluation
    - Potential quantification of conservatisms in the testing process
    - Choose path forward with detailed resolution schedule by 10/4/10
- **Single train flow – dP**
  - Conducted tests at various participate-to-fiber (p:f) ratios
    - A 5:1 (p:f) test remains to be executed.

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Method of Closure

- **Two approaches should be used**
  - Closure for breaks smaller than the 12 inch pipe
  - Closure for breaks greater than or equal to 12 inch pipe

- **Timing of closure**
  - Smaller breaks (< 12 inch) addressed on shorter term schedule
  - Larger breaks ($\geq$ 12 inch) addressed in manner that risk-informs schedule, methods and actions

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Closure Method for Larger Breaks

- **Strong technical basis for application of GDC-4**
  - **Rigor in determination of lines and inspections**
    - Methodology typically used for 12-inch diameter and larger piping
    - Break probability is low, based on material properties
  - **PWSCC - inspection /mitigation**
    - Limited susceptible weld locations
    - Material Reliability Program (MRP) 139 –Primary System Piping Butt Weld Inspection and Evaluation Guidelines
    - Issued under NEI 03-08 and mandatory Implementation Schedule, Examination Requirements and Examination schedule
  - **Leak Monitoring**
    - LBB critical flaw size is a factor of 20 smaller on leakage vs. actual flaw size
    - PWROG Issued recommendation for implementation of RCS leak rate program guidelines under NEI 03-08 for any RCS leakage
      - Provides up to ~10x better leak detection than required for LBB

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Capability to Maintain Defense-in-Depth

- **Safety Margins and Defense in Depth**
  - Significant safety margins are maintained in leakage detection for LBB critical flaw size vs. actual
  - Defense in Depth is maintained by combining LBB and ISI; application to GSI-191 does not decrease defense in depth
  - Double ended break of loop piping is much less probable than reactor vessel failure
  - EOP changes in response to NRC Bulletin 2003-01 provide additional defense in depth
  - Additional defense-in-depth measures and design modifications can be considered on plant specific basis
- **Changes in overall plant risk (CDF and LERF) are very small when LBB is applied to break $\geq$ 12 inch diameter**

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Summary

- Agree with addressing small LOCA in short term
- Large LOCA resolution includes available holistic risk informed methods
- Proposed resolution timeline takes into account both risk and dose
- Complete analysis and testing prior to modifications
- Consider aggregate of NRC rulemaking

STP GSI 191 Cost and Dose

Previous SG insulation replacement experience

1RE09 43.8 REM
2RE09 73.0 REM
Total 116.8 REM

Dose to date (Rem)	Spent to date (Millions)	Estimated cost (Millions)	Estimated dose (Rem)
9.6	6.8	20 - 30	36 - 162

Acronyms

EOP	Emergency Operating Procedures
GDC-4	Appendix A to 10 CFR Part 50, General Design Criteria, Criterion 4, Environmental and dynamic effects design basis
ISI	In-service Inspection
LBB	Leak-Before-Break
LOCA	Loss-of-Coolant Accident
PWROG	Pressurized Water Reactor Owners Group
PWSCC	Pressurized Water Stress Corrosion Cracking
RCS	Reactor Coolant System
RMI	Reflective Metal Insulation
Rx	Reactor
SG	Steam Generator