State-of-the-Art Reactor Consequence Analyses (SOARCA)

Quarterly Briefing for Michael Weber, DEDMRT

November 29, 2010

Pre-decisional Information-
Official Use Only

Brief SRM History

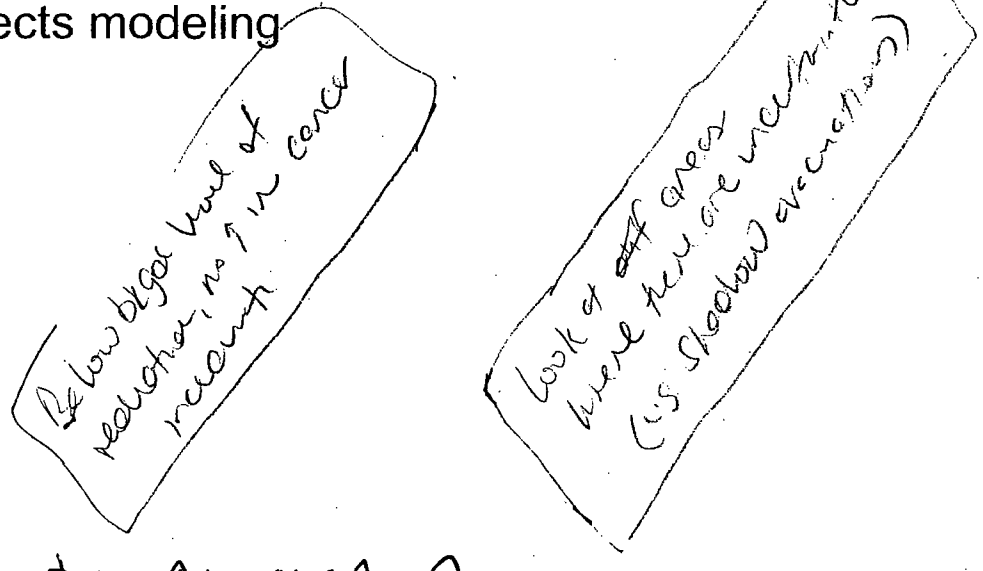
- In 2005 timeframe Commission expressed interest in updating earlier published studies of offsite consequences of nuclear plant accidents based on insights from RES security assessments
  - Older reactor studies such as NUREG/CR-2239 (aka 1982 Sandia Siting Study)
  - More recent but out of date spent fuel pool studies such as NUREG/CR-6451 (1997) and NUREG-1738 (2001)
  - In general, earlier studies were believed to be excessively conservative
  - Earlier studies were used/misused by others to suggest risk associated with severe accidents was extremely large
- Commission
  - SRM-SECY-05-0233, April 14, 2006, approving plan
  - SRM-COMSECY-06-0064, April 2, 2007, limiting scope (to not more than 8 plants) and providing additional guidance

Background

- Objective: To develop a body of knowledge on the realistic outcomes of severe reactor accidents for 2 pilot plants
  - Incorporate plant improvements not reflected in earlier assessments (hardware, procedures, security related enhancements, emergency planning)
  - Incorporate state-of-the-art modeling
  - Evaluate the benefits of recent improvements (10 CFR50.54hh)
  - Update the quantification of offsite consequences found in earlier publications such as NUREG/CR-2239 (1982 Siting Study)
  - Enable the NRC to communicate severe accident aspects of nuclear safety to diverse stakeholders

Background (cont)

- New approaches in many areas:
  - Focus on "important" scenarios (CDF>10^{-6} /RY, 10^{-7} for bypass)
  - Realistic, integrated assessments and detailed analyses versus simplified and conservative treatments used in past PRA
  - Incorporated recent severe accident phenomenological research
  - Treatment of seismic impacts on emergency planning
  - Range of health effects modeling



Conclusions

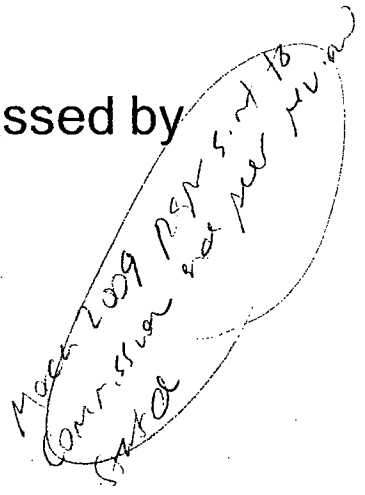
- Mitigation is likely. Implementation of mitigation measures (e.g., B.5.b) will either prevent core damage, or delay or reduce radiation release.

- For cases assumed to proceed to radiological release; accidents progress more slowly and result in smaller and delayed radiological releases than previously assumed/predicted
  - Individual latent cancer fatality risk within the EPZ is very low (thousands of times lower than the NRC safety goal and millions of times lower than other cancer risks-assuming LNT)
  - Individual early fatality risk is essentially zero; No LERF Contributors
  - Individual latent cancer fatality risk generally dominated by long term exposure to small annual doses (return criteria)
  - Insight on EALs revealed (e.g., timing)

- External events dominate the risk-suggests potential need for PRA focus and seismic research

Peer Review

- Assess SOARCA approach, methods, results, and conclusions to ensure study is best estimate and technically sound
- Major areas of uncertainty for peer review have been addressed by sensitivity studies and/or text
  - Severe accident modeling
  - Emergency planning
  - Health effects due to low doses
- Individual draft peer reviewer letter reports received May
- In general, the findings of the peer reviewers (with one exception) were quite positive with respect to the project meeting its stated objectives.
  - E.g., "*The SOARCA has evaluated the scenarios which are the major contributors to risk.*", "*…SOARCA accident progression analysis represents an advancement of the state-of-the-art in severe accident analyses.*"



BWR Issues

- Safety Relief Valve Failure Mode
  - BWR offsite consequence analyses being revised to address new (more realistic) SRV failure model

- RCIC Blackstart for STSBO
  - BWR offsite consequence analyses being added to address 1 hr RCIC blackstart for STSBO (more realistic, confirmed by fact check)

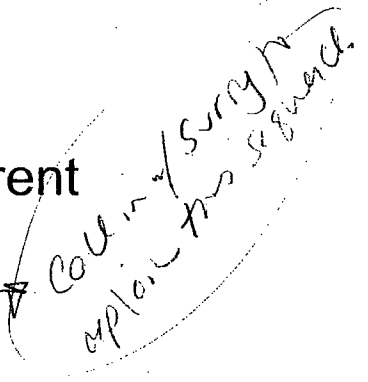
PWR Issues

- Plant fact check issue: Fact check revealed 2 issues
  - Recent site specific seismic study for Surry indicated vulnerability of ECST for 0.4 g earthquake, (currently credited in LTSBO)
  - Pathway of radiation release for ISLOCA has been altered by the use of fire barrier foam (blocking passageway between Safeguards bldg and Auxiliary bldg). Confirmed during recent walkdown.

- Hydrogen Issue: Mitigation by the use of PWR containment sprays during a severe accident has been a longstanding concern in SAMGs, particularly for SBO events - caution because of increased potential for sprays to create a highly combustible mixture
  - In examining sensitivity cases of mitigated STSBO run to address peer review comments, error in the calculations was discovered. Further analysis performed; radiological releases not increased.

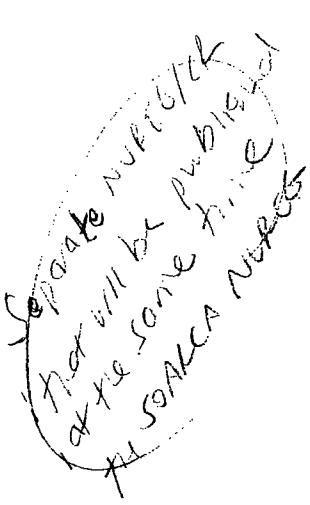
PWR Issues (cont)

- New Surry seismic PRA (EPRI pilot study) identified a different dominant sequence (loss of service water)



- Staff is evaluating options for addressing, such as:
  - Qualitative discussion of loss of service water (LOSW) vs. SBO
  - Perform additional analyses of LOSW using SOARCA methods

Uncertainty Study



- Why: Proper emphasis on more realistic analyses also draws attention to the need to characterize uncertainty.
  - Peer Review Committee and ACRS emphasize the value of the uncertainty study
  - Staff met with Peer Review Committee on 10/26

- What: Detailed, integrated consideration of uncertainty in modeling of integrated accident progression, source term and offsite consequence analyses.

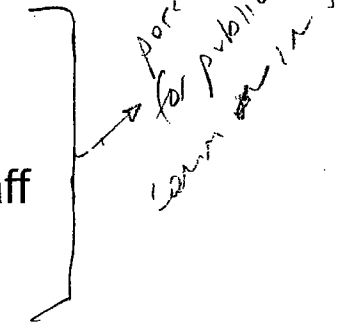
- How: Demonstration of integrated uncertainty study to be performed for a suitable candidate scenario. Methodology, parameter list and distributions were peer reviewed. Primary focus on confirmation of relationship of "best estimate" to the mean value of uncertainty study.

Status

- Update analyses to address BWR/PWR issues from
  - Plant fact check
  - Peer review
- Large effort devoted to resolving internal staff comments and revising/updating documentation
  - Likelihood of mitigation
  - Comparison with and characterization of past studies
  - Characterization of SOARCA findings
- Developing uncertainty analysis plan and approach

Schedule

- Original Plan:
  - Final NUREG to Commission, ready for publication, including input from public by 10/29/2010
- Current Plan:
  - NUREG to Commission prior to public review and comment period by 10/29/2010
  - Final NUREG to Commission, ready for publication, including input from public in July 2011
  - Uncertainty Quantification NUREG/CR also ready for publication in July 2011
- Challenges:
  - Completion of additional technical analysis
  - Review and resolution of greater than anticipated number of staff comments
  - Addressing "substantial" public comments



Project Communication

Element of project reflecting Commission interest

Communication Tools:

- Communication Plan, Rev.5 is available at: ML102720005
- SOARCA Website is available at: www.nrc.gov/about-nrc/regulatory/research/soar/overview.html
- SOARCA Brochure (pending)
- Webinars- Staff is working to set up a webinars for the Regions
- Program Office Briefings: NRR scheduled for 12/16; follow-up with other Offices