



RIC 2011
**Current Areas of Safety
Research at the U.S. NRC**

Dr. Brian Sheron, Director
Office of Nuclear Regulatory Research
March 9, 2011



**NRC Office of Nuclear Regulatory
Research (RES)**

- Major NRC program office
- Mandated by Congress
- About 260 staff, >\$68M funding
- Engineers, scientists, analysts

2



Why Perform Research?

- Support regulatory decisions on nuclear reactors, nuclear materials, and radioactive waste
- Provide technical support, technical tools, and information to identify and resolve safety issues for current and new designs and technologies
- We accomplish this through:
 - Testing
 - Tool and data development; analytical models
 - Confirmatory research and analyses
 - National and International Collaboration

3



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

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

4



SOARCA: Results and Insights

- Selected scenarios could reasonably be mitigated, either preventing core damage or delaying/reducing the radiation release
- For cases assumed to proceed unmitigated, accidents progress more slowly and usually result in smaller and more delayed radiological releases than previously assumed/predicted
- Individual latent cancer risk for selected scenarios generally comes from population returning home after event is over and is thousands of times lower than the NRC safety goal and millions of times lower than other cancer risks (assuming the linear no-threshold hypothesis)

5



SOARCA: Status and Research Plans

- Continue to integrate external peer review comments and licensee fact checks
- Uncertainty analysis underway using MELCOR and MACCS by sampling from distributions
- Finalize results for 2 pilot plants
- Options are being considered for additional research

6



SOARCA: Options for Additional Research

- Conduct SOARCA consequence analysis on other reactor or containment designs for select scenarios
- Use SOARCA tools (MELCOR and MACCS2) and consider SOARCA insights in a site Level 3 PRA pilot study



Cancer Risk Study

- NRC has asked the National Academy of Sciences (NAS) to perform a state-of-the-art study on cancer risk for populations surrounding nuclear facilities.
- The study is an update to the NCI 1990 report "Cancer in Populations Living Near Nuclear Facilities"
 - NCI report showed no increased risk of death from cancer in populations living near nuclear facilities



Cancer Risk Study: Status

- January 2011- NAS formed 19-person expert committee
 - First committee meeting held on February 24-25, 2011 in Washington DC
 - Five additional public meetings with the expert committee to be scheduled throughout the United States in 2011
- For more information on the status of the study, schedule of public meetings, and composition of the committee:

<http://www.nationalacademies.org/cancerriskstudy>



Seismic Research Background

- Risk-informed frameworks use probabilistic methods to assess what can go wrong and how likely it is to go wrong
- Significant advances have been made in the ability to assess seismic hazard over last few decades
- The updated hazard assessments are being coupled with state-of-the-art advances in seismic engineering and seismic risk assessment methods to assure adequate safety
- NRC is sponsoring several projects to update seismic hazard models and seismic engineering analysis and design approaches



Seismic Research (continued)

- Current case-by-case updates to existing seismic source models and lack of ground motion recordings has led to discrepancies in seismic hazard assessments for the Central and Eastern United States
- Current research will lead to
 - Assessment of the implications of updated seismic data and methods on operating plants
 - A stable and consistent regional seismic model
 - New ground motion prediction relationship
 - Guidance on implementing probabilistic seismic hazard analyses
- These efforts will help bring seismic hazard in the Central and Eastern United States to the state-of-the-art and increase long-term regulatory stability.



Reactor Pressure Vessel Embrittlement

- Irradiation embrittlement limits the lifespan of light-water reactor (LWR) pressure vessels
 - Surveillance capsule data limited at high fluences
 - Test reactor data show increased embrittlement trends at high fluences that are not clear based solely on LWR surveillance data
- As a result, NRC is compiling a comprehensive database of worldwide embrittlement information obtained from surveillance and test reactor programs
 - Next step is to develop an international consensus on embrittlement mechanisms, magnitudes, and trends to guide decisions regarding plant operability



Digital Instrumentation and Control (I&C) Research Areas

- Safety Aspects of Digital Systems
 - Communications among digital systems
 - Safety assessment of software tools
 - Analytical assessment of digital systems
 - Digital system reliability
 - Digital system PRA
- Security Aspects of Digital Systems
- Advanced Nuclear Power Concepts
- Knowledge Management and Research Collaboration

13



Background Material

- RES Web site:
<http://www.nrc.gov/about-nrc/organization/resfuncdesc.html>
- NUREG-1925 "Research Activities 2010-2011"
<http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1925>

14
