

Current Commission Issues: Power Reactors

Commissioner George Apostolakis
U. S. Nuclear Regulatory Commission
CmrApostolakis@nrc.gov

Nuclear Plant Safety Course
Massachusetts Institute of Technology
June 13, 2011

Issue Overview

- **Response to Fukushima**
- **Emergency Preparedness**
- **Safety Culture Policy**
- **Containment Accident Pressure (CAP)**
- **PWR Sump Performance (GSI-191)**
- **Seismic Requirements (GI-199)**
- **Fire Protection**
- **Small Modular Reactors (SMRs)**

NRC Response to Fukushima

- **Initial NRC response coordinated through Headquarters Operations Center**
- **NRC Office of Nuclear Reactor Regulation has now assumed responsibility for support & coordination efforts**
- **Revolving teams of NRC officials with appropriate expertise have been deployed to Japan since the day after the event**
- **NRC played a key role in coordinated U.S. response to the event**

NRC Response to Fukushima Regulatory Actions

- **Temporary Instruction 2515/183, “Follow-up to the Fukushima Daiichi Nuclear Station Fuel Damage Event”**
 - **Observations “indicate a potential industry trend of failure to maintain equipment and strategies required to mitigate some design and beyond design basis events”**
 - **However, “no functions were compromised that would have resulted in damage to the fuel elements or containment”**
- **NRC Bulletin 2011-01, “Mitigating Strategies”**
 - **Confirm mitigative strategy equipment is in place and available**
 - **Provide information on:**
 - **Equipment maintenance, testing, & availability controls**
 - **Coordination with local emergency response organizations**

NRC Response to Fukushima Task Force

- **Near-Term Review (90 days)**
 - **Conduct methodical and systematic review of relevant NRC regulatory requirements, programs, and processes**
 - **Recommend whether the agency should make near-term improvements to our regulatory system**
 - **Recommend content, structure, and estimated resource impact for longer-term review**
 - **Report to Commission after 30, 60, & 90 days**

- **Current Assessment**
 - **To date the task force has not identified any issues that undermine our confidence in the continued safety and emergency planning of U.S. plants**
 - **Task force review likely to recommend actions to enhance safety and preparedness**

NRC Response to Fukushima Task Force

- **Longer-Term Review (9 months)**
 - **Specific information on sequence of events and equipment status**
 - **Evaluate policy issues & potential interagency issues**
 - **Lessons learned for facilities other than operating reactors**
 - **Receive input and interact with all key stakeholders**
 - **Report within six months after beginning of long-term effort**
 - **Advisory Committee on Reactor Safeguards to review final long-term report and provide letter report to the Commission**

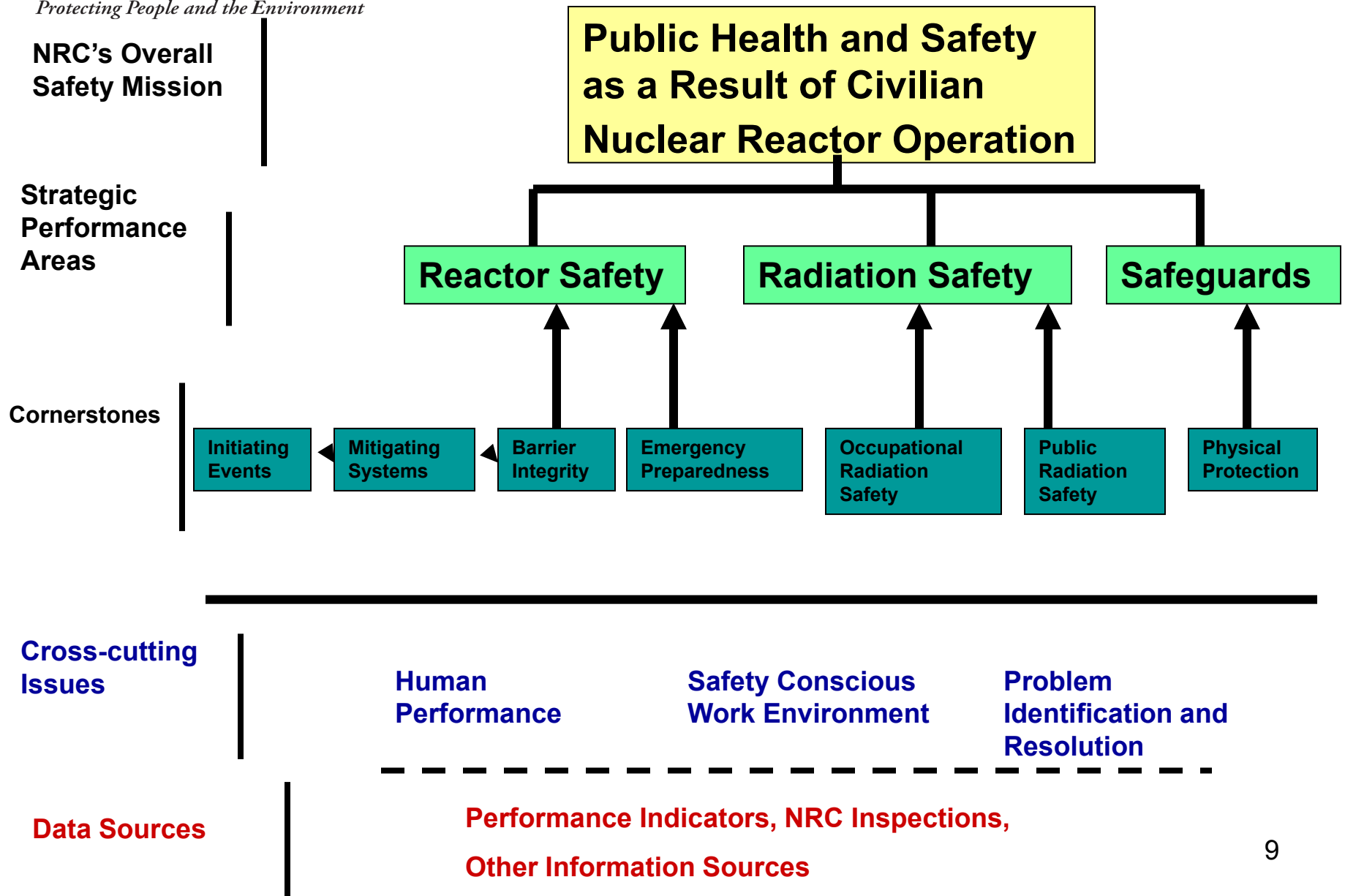
Emergency Preparedness Changes (10 CFR 50.47 & 10 CFR Part 50, Appendix E)

- **After 9/11/2001, NRC determined it was necessary to modify certain requirements in the emergency preparedness (EP) program to ensure licensees continued to adequately protect public health and safety**
- **NRC issued Order EA-02-026, “Order for Interim Safeguards and Security Compensatory Measures,” dated February 25, 2002**
- **NRC staff also performed a comprehensive review of EP regulations and guidance**
- **These two activities resulted in an NRC staff proposal to make changes to NRC’s EP rule**

Emergency Preparedness Changes (10 CFR 50.47 & 10 CFR Part 50, Appendix E)

- **Some highlights of proposed EP rule changes include:**
 - **Requirements for licensees to include hostile action scenarios in EP drills and exercises**
 - **Requirements for specific emergency plan provisions to protect onsite emergency responders in emergencies resulting from hostile action at nuclear power plants**
 - **Requirements for licensees to identify and describe the assistance expected from offsite response organizations during an emergency, including hostile action**

Reactor Oversight Process



Final Safety Culture Policy Statement

- **Approved in March 2011**
- **Nuclear Safety Culture is defined as *the core values and behaviors resulting from a collective commitment by leaders and individuals to emphasize safety over competing goals to ensure protection of people and the environment.***
- **Safety and security are equally important in a positive safety culture**
- **All entities regulated by NRC are responsible for developing and maintaining a positive safety culture**
- **NRC will include appropriate means to monitor safety culture in its oversight programs and internal management processes**

ROP Safety Culture Components



ROP Safety Culture Components

- **Human Performance – Resources: The licensee ensures that personnel, equipment, procedures, and other resources are available and adequate to assure nuclear safety, specifically, those necessary for:**
 - **Maintaining long term plant safety by maintenance of design margins, minimization of long-standing equipment issues, minimizing preventative maintenance deferrals, and ensuring maintenance and engineering backlogs which are low enough to support safety**
 - **Training of personnel and sufficient qualified personnel to maintain work hours within working hours guidelines**
 - **Complete, accurate and up-to-date design documentation, procedures, and work packages, and correct labeling of components**
 - **Adequate and available facilities and equipment, including physical improvements, simulator fidelity and emergency facilities and equipment**

Example of Findings

- **In a 2008 regulatory inspection, it was discovered that during the replacement of a safety-related 125 VDC station battery breaker in 2004, electrical connection integrity was not adequate to ensure that the equipment would be able to perform its safety function (thus the condition existed for four years)**
- **The *resources* component in the *human performance area* was assessed to contribute to this performance deficiency because the licensee failed to establish adequate procedures and programs related to electrical connection integrity**

Containment Accident Pressure (CAP)

- **Accident analyses for many operating reactors rely on pressure higher than that present before the postulated accident to provide net positive suction head (NPSH) margin for pumps in the emergency core cooling systems and containment heat removal system**
- **In calculating NPSH margin, inclusion of some or all of the pressure developed in the containment during an accident is referred to as CAP credit**
- **ACRS expressed concerns with the NRC staff's practice to credit CAP, based largely on ACRS position on defense-in-depth, which is to maintain the independence of the containment function and the accident mitigation function by not relying on CAP**

Containment Accident Pressure (CAP)

- **Commission approved current staff procedure allowing CAP credit with improved guidance that includes margin and uncertainty determinations in CAP calculations**
 - **Existing regulations, guidance and plant technical specifications are intended to ensure that containment is a low-leakage, robust structure, the integrity of which is demonstrated periodically**
 - **ECCS and containment heat removal pumps are typically robust and have been shown to tolerate some levels of cavitation without sustaining damage**
 - **Risk from allowing CAP credit for a BWR/3 with a Mark I containment with a leak detection interval of once per month is very small, based on a generic risk assessment**
 - **Adequate protection of public health and safety is provided even when CAP credit is allowed**
- **Commission directed staff to revise Regulatory Guide 1.174 because language on defense-in-depth was subject to different interpretations**

PWR Sump Performance (GSI – 191)

- **Debris blockage of the sumps during loss-of-coolant accidents could impede long-term core cooling**
- **Very complex issue that has many variables and requires plant specific resolution**
- **Critical testing regarding in-vessel effects needed for final resolution expected to be completed by end of 2011**
- **NRC is considering risk-informed resolution approach**

Seismic Requirements (GI-199)

- **Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants**
 - **New data and models resulted in increased estimates of the seismic hazards at many plants in the Central and Eastern United States (CEUS)**
 - **NRC staff reviewed and evaluated this new information along with recent U.S. Geological Survey (USGS) seismic hazard estimates for the CEUS**
 - **Estimated seismic hazard levels at some current CEUS operating sites might be higher than seismic hazard values used in design and previous evaluations**

Seismic Requirements (GI-199)

- **Overview of GI-199 Safety/Risk Assessment Results**
 - **Operating power plants are safe**
 - **Though still small, some seismic hazard estimates have increased**
 - **NRC will request needed information to perform regulatory assessments**

- **Proposed Generic Letter Information Needs (expect to issue by end of 2011)**
 - **Updated site specific hazard curves and response spectra**
 - **Fragility information**
 - **Contributors to seismic risk**
 - **Identification of potential plant-specific improvements**

Fire Protection

- **Large number of licensees rely on compensatory measures to comply with their approved program**
- **Licensees planning to transition to a new regulatory approach using National Fire Protection Association Standard (NFPA) 805**
- **NFPA 805 is a national consensus standard that allows licensees to utilize performance-based methods to demonstrate that the installed fire protection systems and features are sufficient to meet specific fire protection and nuclear safety goals, objectives and performance criteria**
- **Pilot activities & infrastructure documents are complete**

Fire Protection

- **NRC expects to begin receiving submittals from non-pilot plants this summer**
- **Commission has approved a staggered schedule for NFPA 805 submittals**
- **Fire PRAs have matured sufficiently for the NRC to make regulatory decisions in support of implementing this new approach**
- **Fire PRA methods will continue to evolve and the NRC staff will continue to work collaboratively with industry**
- **NRC will continue to grant enforcement discretion to licensees transitioning to NFPA 805**

Small Modular Reactors (SMRs)

- **Near-term focus on Integral Pressurized Water Reactor (iPWR) technology reviews**
- **iPWRs**
 - **Pressurized Water Reactors with nuclear steam supply components (e.g., steam generator, control rods, reactor coolant pumps) within the reactor vessel**
- **Risk-Informed Review Guidance for iPWRs**
 - **Risk-insights enhance safety focus of reviews**
 - **Considers both safety importance and risk significance**
 - **Graded approach**
 - **Integrates performance-based program requirements**

Small Modular Reactors (SMRs)

- **Commission also directed NRC staff to:**
 - **Provide a paper that explores the feasibility of including risk information in categorizing systems, structures and components (SSCs) as safety-related and nonsafety-related for the design-specific SMR review plans**
 - **Consider stakeholder input, as appropriate**
 - **Determine if there are legal obstacles to this approach, namely to determine if this can be done without a rule change**
 - **Address potential application to the overall regulatory framework and not be limited to SMRs**
 - **Include a review of previous Commission policies on the spectrum of new/advanced reactor policy issues that may have used “safety-related” or “non-safety related” SSC classification as part of the policy resolution**