



**ACRS MEETING WITH
THE U.S. NUCLEAR
REGULATORY
COMMISSION**

December 6, 2018



Overview

Mike Corradini

Accomplishments

Since our last meeting with the Commission on April 5, 2018, we issued 13 Reports

- **Draft Proposed Rule, “Emergency Preparedness for Small Modular Reactors and Other New Technologies”**

Reports

- **Draft Digital Instrumentation & Controls Interim Staff Guidance, Digital I&C-ISG-06, “Licensing Process,” Revision 2**
- **Report on the Safety Aspects of the APR1400**

Reports

- **Draft SECY Paper, “Functional Containment Performance Criteria for Non-Light Water Reactor Designs**
- **Safety Evaluation for WCAP-17936-P, Revision 2, “AP1000 In-Containment Cables and Non-Metallic Insulation Debris Integrated Assessment”**

Reports

- **Long-Term Core Cooling for the APR1400**
- **Safety Evaluation for Topical Report APR1400-F-A-TR-12004-P, Revision 1, “Realistic Evaluation Methodology for Large-Break Loss of Coolant Accident of the APR1400”**

Reports

- **Safety Evaluation of the NuScale Power, LLC Topical Report TR-0616-48793, Revision 0, “Nuclear Analysis Codes and Methods Qualification” and Safety Evaluation of the NuScale Power, LLC Topical Report TR-0116-21012, Revision 1, “NuScale Power Critical Heat Flux Correlations”**

Reports

- **Brunswick Steam Electric Plant Units 1 and 2 Maximum Extended Load Line Limit Analysis Plus License Amendment Request**
- **Interim Letter: Chapters 7 and 8 of the NRC Staff's Safety Evaluation Report with Open Items Related to the Certification of the NuScale Small Modular Reactor**

Reports

- **Safety Evaluation of the NuScale Power, LLC Topical Report TR-0915-17564-P, Revision 1, “Subchannel Analysis Methodology”**
- **Report on the Safety Aspects of the License Renewal for the Waterford Steam Electric Station, Unit 3**

Reports

- **Report on the Safety Aspects of the License Renewal for the River Bend Station, Unit 1**

Ongoing / Future Reviews

- **Design Certification**
 - **NuScale**
- **Early Site Permit**
 - **Clinch River**
- **License Renewal**
 - **Seabrook**
- **MELLLA+**
 - **Browns Ferry Units 1, 2 & 3**

Ongoing / Future Reviews

- **Guidance and Bases**
 - **Draft Regulatory Guide DG-1327, “Reactivity-Initiated Accidents”**
 - **NUREG-2224 on High Burnup Fuel Storage and Transportation**
 - **NUREG/BR-0058, “Regulatory Analysis Guidelines”**
- **Licensing Modernization Framework**

Ongoing / Future Reviews

- **Digital I&C**
 - **Integrated Action Plan**
- **Rulemaking**
 - **Non-Power Production or Utilization Facility**

Ongoing / Future Reviews

- **Thermal-Hydraulic Phenomenology**
 - **GSI-191**
 - **PWR Owners Group In-vessel Debris Test Results**
 - **Framatome**
 - **AURORA-B Transient Code Suite: LOCA**
 - **RAMONA5 for ATWS**

Ongoing / Future Reviews

- **Thermal-Hydraulic Phenomenology**
 - **Westinghouse**
 - **D5 Critical Power Correlation for SVEA-96 Optima3 Fuel**
 - **WCAP-16260P, Revision 2, “The Spatially Corrected Inverse Count Rate Methods for Subcritical Reactivity Measurement”**

Ongoing / Future Reviews

- **Reliability and PRA**
 - **Level 3 PRA**
 - **Human Reliability Analysis Method Development**
 - **IDHEAS program**
 - **Control Room Abandonment Risk**



**Draft Proposed Rule,
“Emergency Preparedness
For Small Modular Reactors and
Other New Technologies”**

Dennis Bley

History Leading to Rule

- **SECY-10-0034: EP key issue for SMRs**
- **SECY-11-0152: Intent to develop tech-neutral, dose-based, consequence-oriented EP**
- **SECY-14-0038: Requested to revise EP toward more performance-based oversight regimen**
- **SECY-15-0077: Proposed rule-making EP framework for SMRs & ONTs**

Related Activities

- **WASH-3 – uncontrolled release → exclusion area of $R = 0.01 \sqrt{P}$**
- **Practical power reactors must rely more on containment than isolation**
- **1960 – Siting criteria considered: ACRS recommended caution**
- **1962 – 10 CFR Part 100 site criteria pointed to TID-14844: RG 1.3/1.4**

Related Activities

- **1973 – WASH-1400: source terms calculated for release categories**
- **1978 – NUREG-0396: planning basis for emergency response plans**
- **1995 – NUREG-1465 replaces TID-14844**
- **2000 – Alternative radiological source terms 10 CFR 50.67 & RG 1.183**

Related ACRS Letters

- **1950 – WASH-3**
- **1964 – Engineered Safeguards**
- **1976 – ACRS hearing testimony
before JCAE**
- **1984 – Draft Task Action Plan on
Containment Performance**
- **1987 – Source Term Uncertainty**

Related ACRS Letters

- **1999 – Defense-in-Depth in Risk-informed Regulation**
- **2007 – Technology-Neutral Framework**
- **2013 – NGNP Key Licensing Issues**
- **2017 – Non-LWR Vision & Strategy**
- **2018 – Principal Design Criteria RG**
- **2018 – Functional Containment SECY**

Proposed Rule (1)

- **Replicates most of 10 CFR 50.47 & Appendix E, with two changes**
 - **Organizes Emergency Plan requirements**
 - **Alternative EPZ requirements**
- **Emergency Plan requirements**
 - **Organized into more logical order**
 - **Performance-based requirements**

Proposed Rule (2)

- **EPZ requirements**
 - **Main purpose of new rule**
 - **Currently plume exposure pathway EPZ 10 miles & ingestion pathway EPZ 50 miles**
- **Proposed rule EPZ requirements**
 - **Plume exposure pathway <10 mSv i.e., <1 Rem**
 - **Purpose: provide area where predetermined protective actions are implemented, which reduce dose and associated early health effects**

Proposed Rule (3)

- **Proposed rule EPZ requirements**
 - **Applicant would consider plume exposure doses from a spectrum of credible accidents for the facility**
 - **The rule would allow SMR and ONT applicants to develop reduced EPZ sizes, commensurate with the accident source terms, fission product releases, and accident dose characteristics specific to their reactor designs**

Guidance DG-1350

- **Guidance for preparing Emergency Plans is thorough and easy to follow**
- **Guidance for using the new alternative EPZ**
 - **Key to defending a smaller EPZ is the source term**
 - **Guidance for determination of release scenarios and source terms for possible accidents criteria is sparse**

Source Term

- **Developing mechanistic source terms is not an easy task; it involves complex physics and chemical phenomena including the evolution and transport of aerosols**

ACRS Findings & Recommendations

1. No technical obstacles to the rulemaking

- Recommend that rulemaking moves forward**

2. Staff will need to provide guidance to define their expectations for the technical adequacy of mechanistic source terms

ACRS Comment

- **Arguments presented in the draft rule and guidance apply equally well to all reactors**
 - **No technical basis for restricting use of the new rule to SMRs and ONTs with a limit on thermal power**
 - **Staff to request stakeholder input on this topic**



**Draft Digital Instrumentation &
Controls Interim Staff
Guidance, Digital I&C-ISG-06,
“Licensing Process,” Revision 2**

Charles Brown

Background – Purpose & Scope

- **ISG-06 defines the licensing process for review of license amendment requests (LARs) for safety-related DI&C modifications in operating plants and in new plants once they become operational**
- **Provides industry guidance for pre-LAR activities and LAR review**
- **Revision 1 issued in 2011**

Revision 1 vs Draft Revision 2

- **Incorporated Lessons Learned and Industry Feedback**
- **Added focus on fundamental design principles**
 - **Redundancy**
 - **Independence**
 - **Deterministic Processing**
 - **Diversity and Defense-in-Depth**
 - ***Control of Access***

Revision 1 vs Draft Revision 2

- **Alternate Review Process added that provides LAR approval before completion of detailed design, implementation or factory acceptance testing**

ACRS Observations

- **ISG emphasizes software development but largely silent on hardware configuration control and management**
- **Did not address applicant ownership of the I&C system changes during the development process**

ACRS Observations

- **Staff has ensured that four of the five fundamental digital design principles are addressed in the ISG**
- **We remain concerned that the fifth critical fundamental design principle for architecture design of DI&C applications, Control of Access, is not included**

ACRS Observations

- **Currently, design approaches and administrative controls to restrict internal plant access to systems are used**
- **Control of Access also means preventing remote electronic access to in-plant systems and networks from sources external to the plant**

ACRS Observations

- **To ensure remote access is prevented, plant and system data transmission should be configured to be one-way from in-plant to external recipients using only hardware-based processes, which are not configured by software**
- **Our letter report urged the staff to formally incorporate this principle into the licensing design evaluation process**

Conclusions & Recommendations

- **Draft Digital ISG-06, “Licensing Process,” Revision 2, should be issued for public comment**
- **Provide the draft final Digital I&C-ISG-06, Revision 2, for our review following resolution of public comments and address the configuration management concern before final publication**

EDO Response

- **The EDO response was satisfactory regarding the specific recommendations in the July 18, 2018 ACRS Letter**
- **However, the revised ISG did not address our concern regarding the fifth fundamental design principle for Control of Access**

ACRS Continuing Concern

- **Our November 8, 2018 response letter requested staff to provide the basis for not explicitly addressing the Control of Access critical fundamental design principle for the architecture design of DI&C or any other revision that would help ensure prevention of remote electronic access from sources external to the plant**
- **We will continue to follow this concern**



Safety Aspects of the APR1400 Pressurized Water Reactor

Ronald Ballinger

ACRS Letter Reports Issued

- **APR1400 Design Certification – July 2018**
 - **Four Interim Letter Reports**
- **Four Topical Reports**
- **Long-Term Core Cooling Report**

APR1400 Design

- **Based on CE System 80+ with Safety Enhancement Features**
 - **Innovative ECCS-Fluidic Device**
 - **In-Vessel Retention Option**
- **Instrumentation & Control**
 - **Common Q Platform**
- **Probabilistic Risk Assessment Used for Design Decisions**

Conclusion

- **The APR1400 design is mature and robust**
- **There is reasonable assurance that it can be constructed and operated without undue risk to the health and safety of the public**

Review: Lessons Learned

- **Essential that staff and applicant be supportive and responsive in their interactions with ACRS**
- **Scheduling flexibility is essential to successful and timely review**

Abbreviations

ACRS	Advisory Committee on Reactor Safeguards	MELLLA+	Maximum Extended Load Line Limit Analysis Plus
ATWS	Anticipated Transient Without Scram	mSv	milliSieverts
CE	Combustion Engineering	NGNP	Next Generation Nuclear Plant
CFR	<i>Code of Federal Regulations</i>	Non-LWR	Non-Light Water Reactor
ECCS	Emergency Core Cooling System	NRC	Nuclear Regulatory Commission
EDO	Executive Directors for Operations	ONTs	Other New Technologies
EP	Emergency Planning	PRA	Probabilistic Risk Assessment
EPZ	Emergency Planning Zone	RG	Regulatory Guide
GSI	Generic Safety Issue	SMR	Small Modular Reactor
I&C	Instrumentation and Control	TR	Topical Report
IDHEAS	Integrated Human Event Analysis System		
ISG	Interim Staff Guidance		
JCAE	Joint Committee on Atomic Energy		
LAR	License Amendment Request		
LOCA	Loss-of-Coolant Accident		
LR	License Renewal		