



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

October 6, 2017



Overview

Dennis C. Bley

Accomplishments

Since our last meeting with the Commission on April 6, 2017, we issued 15 Reports

- **Safety Evaluation of License Amendment Request by South Texas Project Nuclear Operating Company to Adopt a Risk-Informed Resolution of Generic Safety Issue-191**
- **Consequential Steam Generator Tube Rupture**

Reports

- **Safety Evaluation of the NuScale Power, LLC Topical Report TR-0815-16497-P, “Safety Evaluation of Passive Nuclear Power Plant Electrical Systems,” Revision 1**
- **Draft Proposed Rulemaking 10 CFR 73.53, “Requirements for Cyber Security at Nuclear Fuel Cycle Facilities,” Related Parts 70, 73, and 40, and Draft Regulatory Guide-5062, “Cyber Security Programs for Nuclear Fuel Cycle Facilities”**

Reports

- **APR1400**
 - **Interim Letter: Chapters 6, 12, 13, 14, 16, 17, and 19 of the NRC Staff's Safety Evaluation Report with Open Items**
 - **Interim Letter: Chapters 3, 4, 9, and 15 of the NRC Staff's Safety Evaluation Report with Open Items**
 - **Interim Letter: Chapters 7 and 18 of the NRC Staff's Safety Evaluation Report with Open Items**

Reports

- **NuScale**
 - **Topical Report TR-1015-18653-P, “Design of Highly Integrated Protection System Platform”**
- **License Renewal**
 - **South Texas Project Units 1 & 2**
 - **Subsequent License Renewal**

Reports

- **Guidance and Bases**
 - **NUREG-1530, "Reassessment Of NRC's Dollar Per Person-Rem Conversion Factor Policy"**
 - **NUREG/BR-0058, Revision 5, "U.S. Nuclear Regulatory Commission Guidance on Performing Regulatory and Cost-Benefit Analyses"**

Reports

- **Browns Ferry Units 1, 2 and 3
Extended Power Uprate**
- **Draft Safety Evaluation of the
PWROG -14001-P, PRA Model for the
Generation III Westinghouse
Shutdown Seal**
- **Safety Evaluation for WCAP-17642-P,
Westinghouse Performance Analysis
and Design Model (PAD5)**

Ongoing / Future Reviews

- **Design Certification**
 - **APR 1400**
 - **NuScale**
- **Construction Permit**
 - **Northwest Medical Isotopes (Mo99 production)**
- **SOARCA**

Ongoing / Future Reviews

- **License Renewals**
 - **Seabrook**
 - **Waterford Unit 3**
- **AP1000**
 - **WCAP assessing potential debris generation from AP1000 cables and non-metallic insulation (GSI-191)**

Ongoing / Future Reviews

- **Guidance and Bases**
 - **Draft Regulatory Guide DG-1327, “Reactivity-Initiated Accidents”**
 - **NUREG on High Burnup Fuel Storage and Transportation**
 - **NUREG/BR-0058**
 - **Regulatory Guide 1.174, Revision 3**

Ongoing / Future Reviews

- **Digital I&C**
 - **10 CFR 50.59 Guidance**
 - **Diversity and Defense-in-Depth against Common Cause Failure**
- **Thermal-Hydraulic Phenomenology**
 - **GSI-191**
 - **PWR Owners Group In-vessel Debris Test Results**
 - **AREVA's AURORA-B Transient Code Suite**

Ongoing / Future Reviews

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

Ongoing / Future Reviews

- **Metallurgy and Reactor Fuels**
 - **Consolidation of Dry Cask and Dry Fuel Storage Standard Review Plans**
- **Future Plant Design**
 - **Licensing Modernization Framework**
 - **RG Advanced Reactor Design Criteria**



South Texas Risk-Informed GSI-191 Resolution

Michael Corradini

Background: GSI-191

- **Identification of safety issue**
 - **Post-LOCA long-term cooling issue**
 - **LOCA generated debris can be transported to containment sump**
 - **Potential clogging of ECCS strainers**
 - **Downstream in-vessel debris clogging**
 - **1996 issuance of GSI-191**
 - **2004 issuance of Generic Letter**

Background: GSI-191

- **Staff developed three options**
 - **Opt 1: Compliance with staff approved models**
 - **Opt 2: Mitigation and alternative methods**
 - **Opt 2A: Deterministic – refined testing**
 - **Opt 2B: Risk-informed – STP Pilot**
 - **Opt 3: Separate strainer/in-vessel issues**
- **Plants that may use Option 2B:**
 - **Calvert Cliffs, Vogtle, St. Lucie, Diablo Canyon, Point Beach, Turkey Point, Palisades, Callaway, Wolf Creek, Seabrook**

STP GSI-191 Related Actions

- **STP Units 1 & 2 have fibrous insulation on the RCS**
 - **Large burden associated with insulation removal – dose & cost**
- **Actions taken:**
 - **Replaced original strainers with new larger strainers (3 strainers 1818 ft²)**
 - **Replaced Marinite® insulation with NUKON insulation**

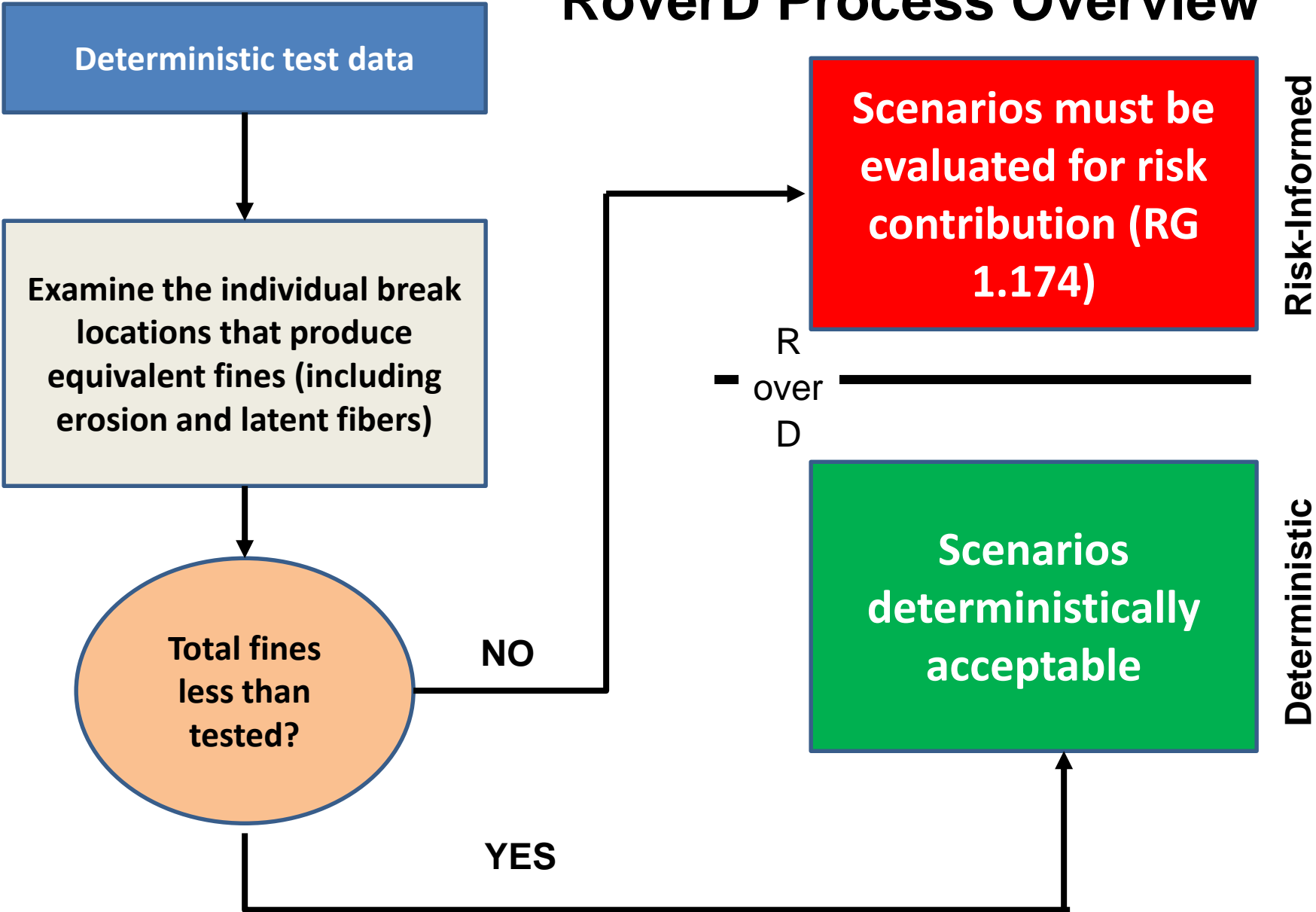
STPNOC Licensing Application

Jan 2013: STP requested to use of risk-informed method to resolve GSI-191

Dec 2014: RoverD approach to bound uncertainties

- Ensure tested fine fiber amounts bound all debris species on filter screens & into core**
- Assume scenarios that exceed tested fine fiber amounts lead to core damage and assess risk**
- Confirm containment integrity is maintained for defense-in-depth**

RoverD Process Overview

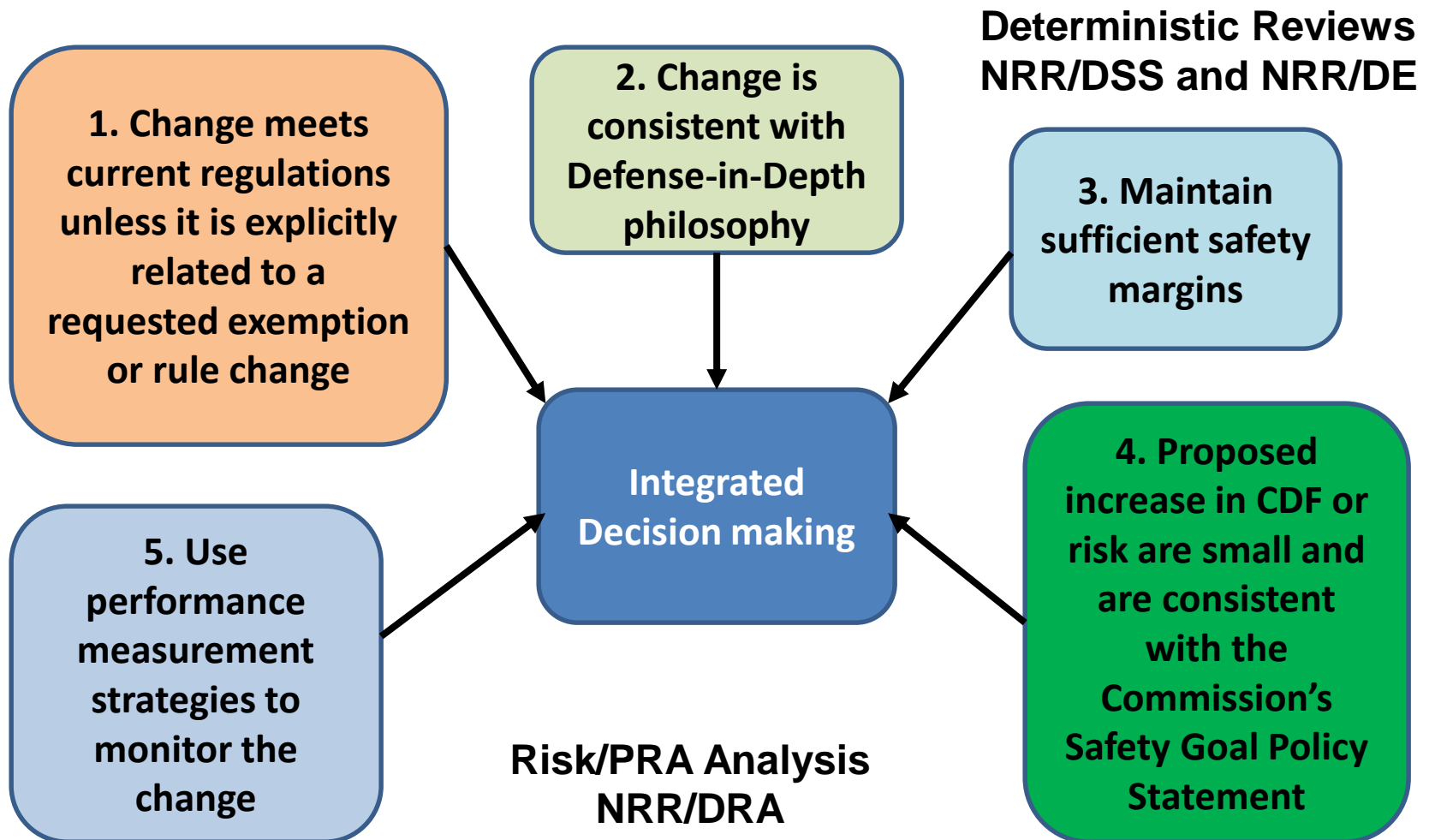


NRC: Bases of Review

- **Staff's safety evaluation report employed RG 1.174 structure**
- **Five key principles of risk-informed regulation**

Staff Methodology

Five Key Principles of Risk-Informed Regulation



NRC Review Conclusions

- **Principle 1:**
 - **Regulations are met by this exemption**
- **Principles 2 & 3:**
 - **Defense-in-Depth: actions identified are adequate in response to LOCA event; i.e., verified balance between prevention and mitigation; redundancy; barrier independence**
 - **Safety Margins: margins are adequate; i.e., construction/inspection per codes; licensing basis values for strainers**

NRC Review Conclusions

- **Principles 4 & 5:**
 - **Performance monitoring approach consistent with NRC guidance**
 - **Analysis shows contribution to the increase in risk due to debris is small and consistent with RG 1.174 (Δ CDF-debris, Δ LERF-debris)**
 - **Bounding calculation provided confidence that risk is within acceptance guidelines**

ACRS Conclusions

- **The STP proposed change to its licensing basis as described in its LAR is acceptable**
- **The STP proposed changes to the technical specifications are acceptable, and there are no changes to the radiological source term as previously approved for STP Units 1 and 2**

ACRS Conclusion and Recommendation

- **There is reasonable assurance that the health and safety of the public will not be affected by operation of STP Units 1 and 2 in the proposed manner**
- **The staff should ensure that future application of this methodology benefit from more systematic implementation of the risk assessment process**



Consequential Steam Generator Tube Rupture

Joy L. Rempe

Background

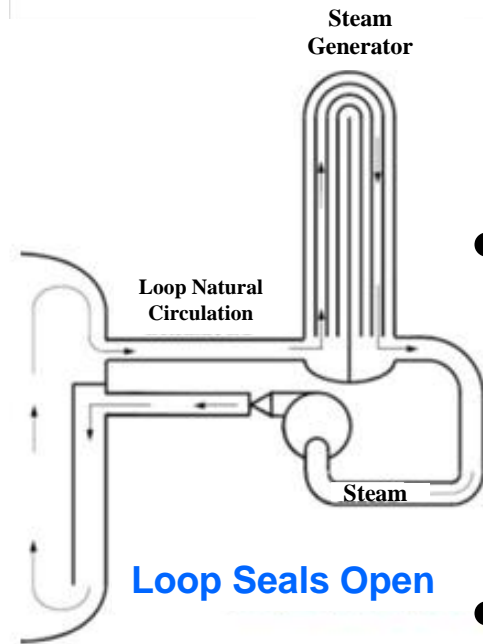
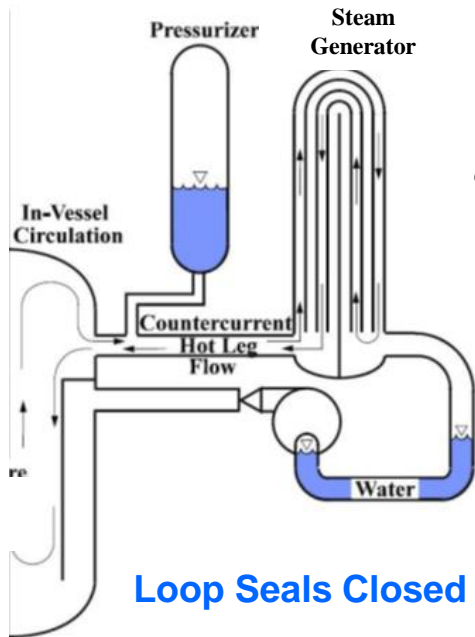
- **Consequential Steam Generator Tube Rupture (C-SGTR) occurs when tube failures are induced by other events**
- **C-SGTR events may dominate plant risk if they lead to significant radionuclide releases that bypass containment**
- **User need on C-SGTR issued in 2009**

RES Approach

- **The Office of Nuclear Regulatory Research (RES) applied:**
 - **Computational fluid dynamics and systems analysis codes for evaluating thermal hydraulic response**
 - **Finite element codes and simplified software tools for evaluating structural response**
 - **New software tool for predicting risk**
- **Two PWR designs considered:**
 - **Four-loop Westinghouse plant**
 - **Two-loop Combustion Engineering plant**

RES Approach

- **Evaluations considered:**
 - **steam generator tube defects**
 - **several vulnerable RCS locations**
 - **design basis and severe accidents**
 - **short-term and long-term station blackouts**
 - **loop seals closed, loop seals open, and intermediate cases**
- **Risk characterized using**
 - **probability of containment bypass due to C-SGTR**
 - **Large Early Release Frequency**
- **NUREG-2195 reports results**



ACRS Conclusions and Recommendations

- **NUREG-2195 should be published. The methods documented in this report have advanced the state-of-the-art for evaluating phenomena that contribute to consequential failures of steam generator tubes, which can be significant contributors to risk of offsite radionuclide releases.**

ACRS Conclusions and Recommendations

- **Results indicate that C-SGTR vulnerability depends on plant-specific design and operations.**
- **NUREG-2195 methods should be applied in plant-specific risk assessments. Such evaluations should explore opportunities for mitigation strategies to reduce the potential for bypass accidents.**



**NuScale Topical Report,
“Safety Classification of Passive
Nuclear Power Plant Electrical
Systems,” Revision 1**

Michael Corradini

Background

- **A reactor design with no safety-related equipment dependent on electrical power to perform its safety function would not require use of Class 1E AC or DC power systems**
- **NuScale submitted a topical report to obtain approval of a set of passive design attributes that would justify the use of non-safety-related electrical power systems**

Background

- **Topical report specified “Conditions of Applicability” that described plant design features and operational attributes that justifies this conclusion.**
- **The report also provided augmented design, qualification, and quality assurance provisions as minimum requirements for electrical systems determined to be non-safety related yet needed for accident monitoring**

Background

- **These attributes and augmented requirements were proposed to be generic for any passive NPP electrical system**
- **Staff found this proposed concept with the conditions of applicability and augmented QA requirements acceptable, but added specific limitations and conditions**

Concept of Highly Reliable Non-Class 1E DC Power System

- **Commercial grade valve regulated lead-acid batteries are a DC power source suitable with IEEE standards**
- **Twice the full-load capacity of a typical Class 1E DC power system**
- **Condition 1: Sufficient detail in design to verify that relevant QA program meets RG 1.155 Appendix A guidance**
- **Condition 2: Seismic Category I**

Post-accident Monitoring

- **Topical report only applies to a design in which no parameters are needed for operator actions during any design basis event**
- **Used only for safety status indication**
- **Reliability of these instruments should be substantially similar to that of a Class 1E electrical system**
- **Condition 3: No operator actions needed**

Safe Shutdown, Core Cooling, Pressure Boundary Integrity

- **Condition 4: Demonstrate that conditions of applicability are consistent with the functional requirements contained in the plant principal design criteria.**
- **Subcriticality and decay heat removal in order to maintain fuel cladding integrity as safe shutdown criteria**
- **Condition 6: Demonstrate that this is consistent with GDC 26 and GDC 27**

Safe Shutdown, Core Cooling, **Pressure Boundary Integrity**

- **Passive plant response to some anticipated operational occurrences includes establishing a direct coolant flow path between the reactor core and the containment**
- **Condition 5: Systems necessary to retain reactor coolant within the RCS boundary are designed with sufficient reliability so a challenge to containment does not occur with the frequency of an AOO**

ACRS Conclusion and Recommendation

- **The topical report is acceptable for use only as a reference document for the NuScale plant electrical systems design subject to the staff limitations and conditions**
- **The staff SER on this topical report should be amended accordingly**

ACRS Recommendation

- **Design, qualification, and quality assurance provisions applied to non-safety DC power supplies should also be applied to non-safety AC or DC power supplies that support:**
 - 1. Operation of risk-significant systems and components**
 - 2. Performance of risk-significant human actions that are identified in the site-specific PRA**



U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

Proposed Cyber Security Rulemaking and Guidance for Nuclear Fuel Cycle Facilities

Charles Brown

Background

- **SRM for SECY-14-0147 directed the staff to proceed with a cyber security rulemaking for fuel cycle facilities (FCFs)**
- **Proposed rule amends 10 CFR Part 73, “Physical Protection of Plants and Materials,” and related Parts 40 and 70.**
- **Associated draft guidance, DG–5062 provides implementation guidance for the new required cyber security program**

Proposed Rule Objectives

- **Protect against:**
 - **Radiological sabotage**
 - **Unauthorized removal, theft, diversion, and loss of material control for special nuclear material**
 - **Radiological exposure, acute chemical exposure, or ingestion of materials exceeding allowable limits**
 - **Loss or unauthorized disclosure of classified information or classified matter**

Proposed Rule 10 CFR 73.53 and related Parts 70, 73 and 40

- **Rule requires FCF applicants and licensees, current or new, to establish, implement, and maintain a cyber security program that detects, protects against, and responds to a cyber attack capable of causing one or more of the consequences of concern**

Rule Requirements

- **Rule establishes four types of consequences of concern:**
 - **Latent consequences - design basis threat**
 - **Latent consequences - safeguards**
 - **Active consequences - safety**
 - **Latent consequences - safety and security**

Other Rule Requirements

- **Develop cyber security plan defining how objectives are met**
- **Cyber security team, security controls, identification of digital and vital digital assets**
- **Configuration management system**
- **Reviews of cyber security program, event reporting, tracking of degraded controls, and records and record retention**

To Meet FCFs Performance Objectives

- **Cyber security achieved through Control of Access (ensuring only authorized access to digital assets that execute plant processes) and material control and accountability methods for special nuclear material**
- **Cyber threats have two basic sources: external (from non-isolated internet facing systems) and those initiated internal to the plant**

Rule Approach

- **Identify all digital assets that, if compromised by a cyber-attack, would result in a consequence of concern**
- **Analyze each asset to find if it is a vital digital asset by considering whether or not it has an alternate means available that addresses all threat vectors. Those with no alternate means are vital**

Rule Approach

- **Draft guidance specifies a procedure to screen out components that do not need to be part of the cyber security plan**

Rule Concerns

- **Rule requires all digital assets to be assessed, vital assets identified, and then protected and maintained against threat vectors using several hundred cyber security controls**
- **Our concern is the administrative burden will grow and become excessive with this bottom up approach**

Importance of Digital Asset Isolation from the External World

- **Isolation is important as a defensive measure and may result in an easier determination of which digital assets are vital and thus reduce the resources needed to achieve adequate cyber security protections to only internal threats**

High-Level Principle Approach

- **Draft guidance describes a boundary concept approach**
- **No definitive discussion of acceptable defensive architectures and isolation concepts from external threats identified or an example appendix for its application**

Conclusions and Recommendations

- **Proposed rulemaking, draft regulatory guide, and related documents should be issued for public comment**

Conclusions and Recommendations

- **Guidance should be more specific on methods to screen components based on high-level principles as an alternative to a detailed examination of every digital asset**
- **Approach should be discussed with industry during the public comment period and addressed when the final rule and regulatory guide are completed**

Continuing Engagement

- **Industry has also expressed concerns with the scope of the proposed rule, but we have not yet discussed specific industry concerns in detail with the staff**
- **We look forward to meet with the staff after the public comment period for the proposed rulemaking**