

EXTENDED STORAGE & **BEYOND**

Alexander Velazquez-Lozada, Thermal Engineering
Long Term Spent Fuel Management Branch
Division of Spent Fuel Management
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
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OVERVIEW



EST Regulatory Program Review

Phase I. ANALYSIS OF TECHNICAL INFORMATION NEEDS

Phase II. ADDITIONAL RESEARCH AND TECHNICAL ANALYSIS

REGULATORY TECHNICAL BASIS AND GUIDANCE

SRP/NUREG-1927 ISGs, Reg. Guides

Phase III.

NUREG-XXXX
license renewal
Up to 100 years

EST
Subsequent License Renewal
beyond 100

Phase IV. IMPLEMENTATION

2010

2014

2015

2017

2020

CROSS CUTTING STRATEGIES:

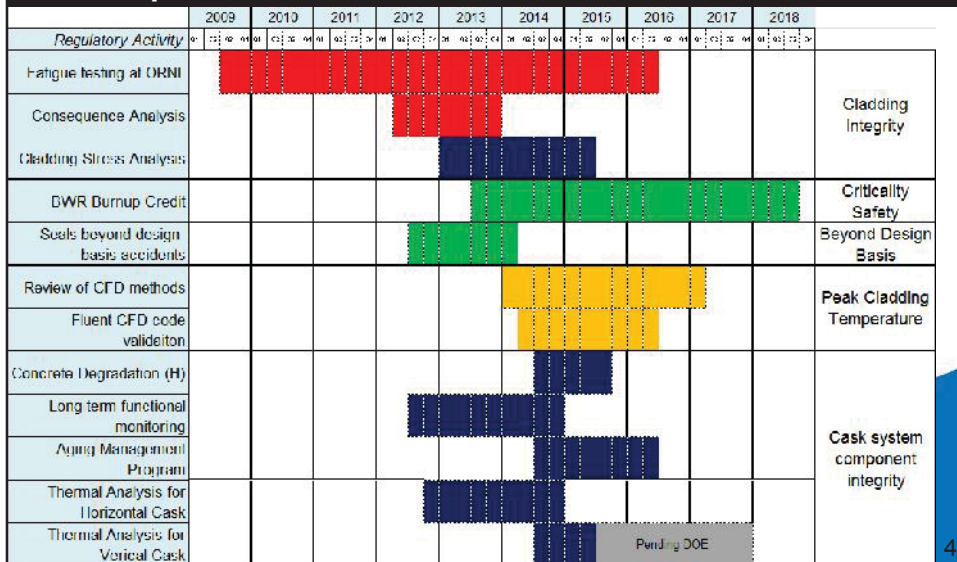
- Risk-Informed Enhancements
- Standards Development
- International Cooperation
- Technology Incentives
- Stakeholder Participation

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NMSS RESEARCH



Road Map



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PAST EFFORTS



Analysis of Technical Information Needs

- PRIORITY 1

- Degradation mechanisms

- Stress corrosion cracking of SS canister body and welds
 - Cladding Stress due to fuel pellets swelling and gas release

- Crosscutting areas

- Thermal calculations
 - Effects of residual moisture after normal drying
 - In-service monitoring methods for dry storage systems

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PAST EFFORTS *(Continued)*



Analysis of Technical Information Needs *(Continued)*

- PRIORITY 2

- Propagation of existing flaws in cladding
 - Wet corrosion, SCC, and metal fatigue of fuel assembly hardware
 - Structural and Thermal Fatigue, and Aging Effects
 - Cladding, Neutron absorbers, Fuel Basket
 - Low temperature creep and galvanic corrosion of cladding
 - Microbiologically induced corrosion
 - Concrete degradation

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PAST EFFORTS *(Continued)*



Work Completed

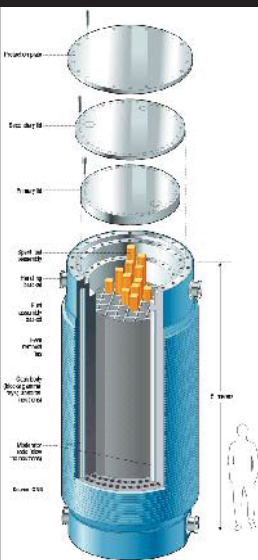
- Stress corrosion cracking analysis
 - NDE on atmospheric SCC, *(PNNL-22495, ML13276A196)*
 - SCC on chloride and non-chloride atmosphere *(NUREG/CR-7171, ML14051A417)*
- Potential residual moisture after vacuum drying
 - Evaluation of drying adequacy, *(ML13169A039)*
 - Factors that could affect the quantity of residual water, *(ML13192A125)*
 - Potential test plan, *(ML13192A127)*
- Analysis on Technical Information Needs *(ML14043A402)*
- Horizontal DCSS Thermal Analysis *(NUREG/CR-7191)*

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ONGOING ACTIVITIES



Vertical DCSS Thermal Analysis



MOTIVATION

- Flow pattern varies between the vertical and the horizontal cask
- Conduction and radiation inside the canister are the predominant heat transfer modes
- Convection and radiation are the predominant heat transfer modes at the outside wall of the dry casks system
- DOE-Demo will provide measured data to validate the 3D-CFD analysis

Illustration: Steve Stankiewicz
<http://spectrum.ieee.org/energy/nuclear/canned-heat>

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ONGOING ACTIVITIES *(Continued)*



In-service Monitoring and Cladding Stress Analyses

- Literature review of in service monitoring for
 - temperature and relative humidity
 - chloride concentration and microbial activity
 - internal pressure
 - materials degradation inside and outside the system
- Cladding Stress Analyses
 - FRAPCON-SFMOD, modified to predict up to 300 years
 - Fuel swelling & decay gas production were analyzed
 - The potential for delayed hydride cracking was assessed

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POTENTIAL NEW INITIATIVES



Future Work

- Potential internal corrosion and long term fatigue
- Neutron absorber potential long term degradation
- Microbiological corrosion
- Effects of thermal fluctuations

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ONGOING ACTIVITIES (Continued)



Aging Management Tables

ELEMENT	DESCRIPTION
Structure, system, or component (SSC)	SSC subject to aging-related degradation
Intended safety function	(e.g., criticality control, shielding, confinement, heat transfer, structural integrity, retrievability)
Material	(e.g., stainless steel, concrete)
Environment	SSC operating environment during normal conditions (e.g., air, water)
Aging mechanism	Degradation phenomenon potentially affecting the SSC
Relevant timeframe	Judgment on whether the aging mechanism is relevant to the first 60 years of operation, or is potentially manifested

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ONGOING ACTIVITIES (Continued)



Renewal Spent Fuel Management Strategy

- Enhancement of Standard Review Process (NUREG-1927)
- Coordinated review of aging management & regulations
- Development of learning, proactive, and responsive aging management by:
 - considering operating experience in Aging Management Programs
 - incorporating results of long term confirmatory research
- Development of a storage aging management report (2015) by:
 - creating inspection guidance
 - engaging stakeholder throughout 2014-15 to discuss proposed changes

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QUESTIONS?

