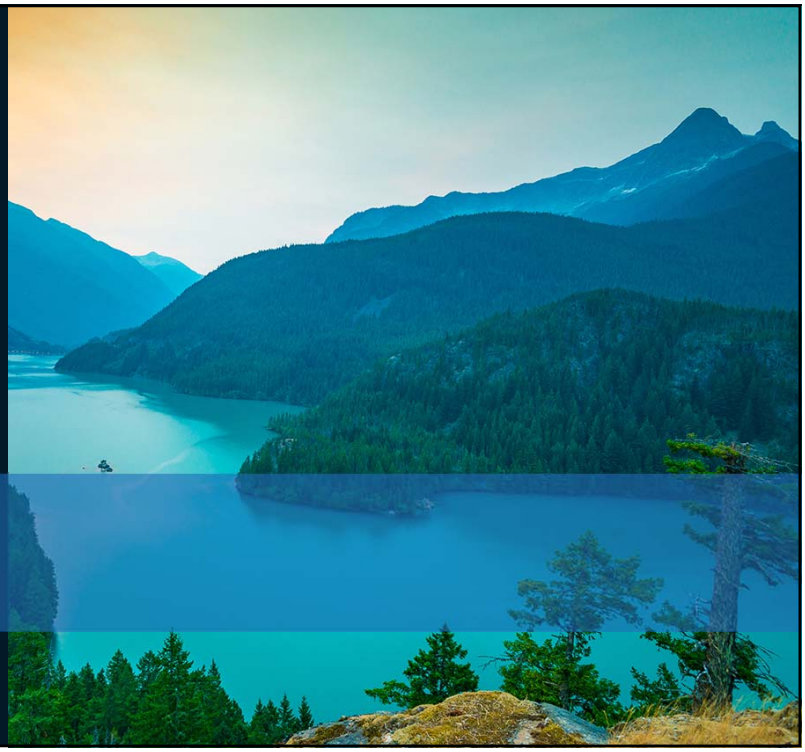
Understanding Dry Storage Safety Margin - Transforming Dry Storage Licensing

Rod McCullum, NEI

US Nuclear Regulatory Commission
Regulatory Information Conference
Session W30, March 11, 2020
White Flint, MD

NUCLEAR ENERGY INSTITUTE



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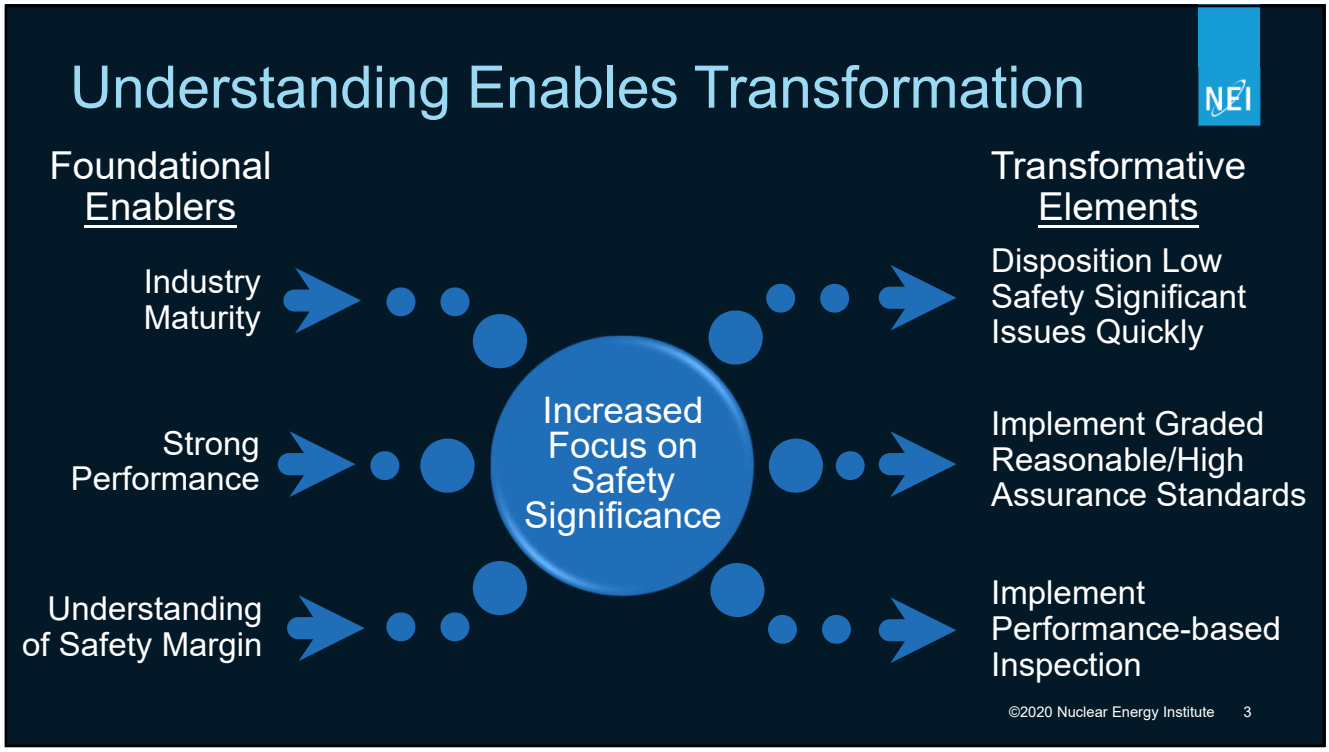
The Importance of Understanding Margin

- Memorandum from NMSS Director Mark Dapas to NMSS Staff 1/15/2019
  - *"Reviewers should consider the relative margin to any applicable regulatory limits pertaining to the item under review. If the licensee or applicant has reasonably demonstrated that there is significant margin from the regulatory limits, then a detailed review of the item may not be warranted beyond confirming the adequacy of the licensee's or applicant's models, codes, and/or approach, including any key parameters and assumptions, used to demonstrate that significant margin exists."*
  - *"Regulatory standards should already include the appropriate margin the Commission previously deemed necessary to provide for adequate protection. There is no requirement or expectation for additional margin beyond these regulatory standards, even if additional margin is reflected in any "acceptance criteria" contained within guidance documents."*


Understanding Enables Transformation
NEI
Foundational Enablers
Industry Maturity
Strong Performance
Understanding of Safety Margin
Increased Focus on Safety Significance
Transformative Elements
Disposition Low Safety Significant Issues Quickly
Implement Graded Reasonable/High Assurance Standards
Implement Performance-based Inspection
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Dry Storage Experience

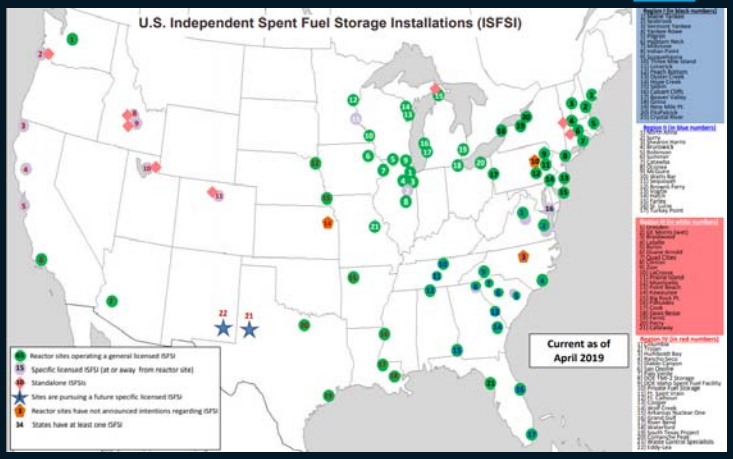
Used fuel inventory*
- Approximately 83,978 MTU
- Increases 2 - 2.4k MTU annually

ISFSI** storage
- 140,492 assemblies
- 39,860 MTU (46%)
- 3,196 casks/modules loaded
- 73 Operating ISFSIs
  - 72 dry storage, 1 pool
- Eventually to be deployed at 76 sites
  - Fuel from 119 reactors

Long term commitment to ISFSIs
- Licenses being extended to 60 years
- Licenses extensions approved at 32 sites

Transport to CIS in TX or NM could begin in 2023-2024 Timeframe

Work on permanent repository (Yucca Mtn.) on indefinite hold



*As of December, 2019
** ISFSI = Independent Spent Fuel Storage Installation


NRC's TRANSFORMATION VISION & FOCUS AREAS
Focus on our people
Innovate
MODERN, RISK-INFORMED REGULATOR
Accept Risk
Use technology

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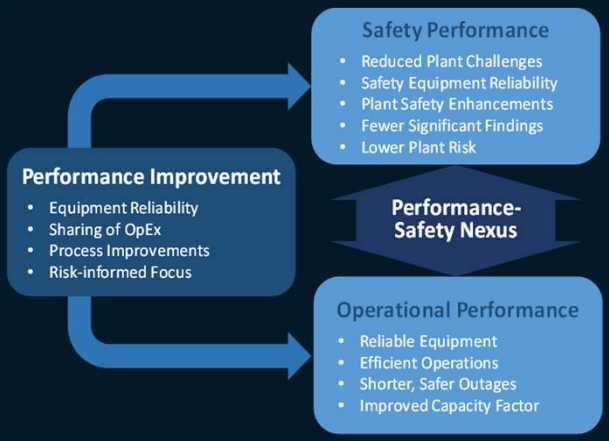
NEI Report*: Performance-Safety Nexus

1. U.S. Industry Performance at All Time Highs

2019 Industry Performance: A Record-Setting Year for Nuclear

The U.S. commercial nuclear industry set several performance records in 2019, allowing us to enter the new decade on our strongest footing ever. Highlights of the industry's annual performance and preliminary cost data include:

- The 98 reactors operating in 2019 generated 809.4 million MWh of electricity, a record high.
- The fleet achieved a record high 93.4 percent average capacity factor.
- Improved efficiencies reduced total generating costs to an industry average of $30.42/MWh, the lowest since EUCG started collecting costs in 2002. Total generating costs consist of operations, capital, and fuel costs, all of which have seen decreasing cost trends.
- The industry achieved the ambitious *Delivering the Nuclear Promise* goal of a 30-percent reduction in total generating costs, reducing it nearly 32 percent since 2012.



2. Industry Operational Performance Levels Improves Safety
3. Risk-Informed Focus Improves Safety

*NEI 20-04, 3/4/2020

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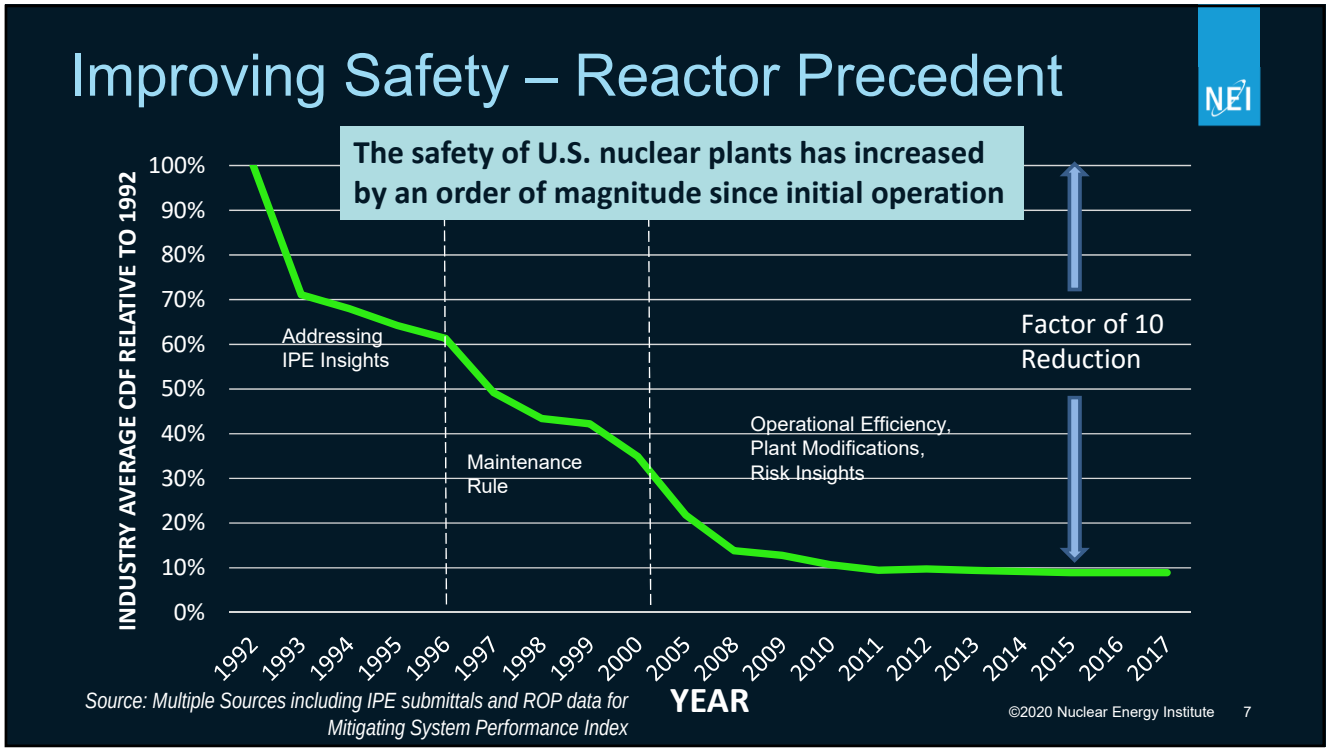
Improving Safety – Reactor Precedent



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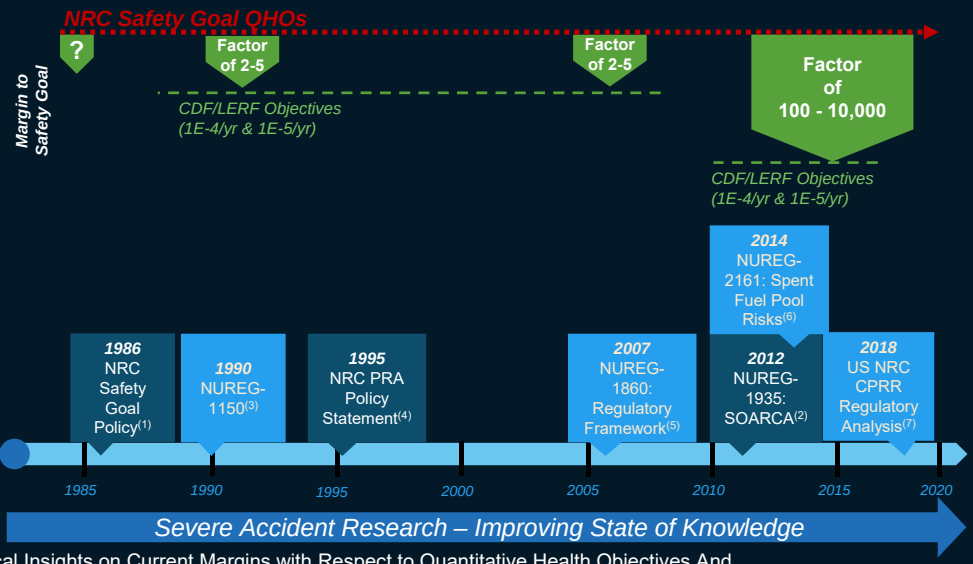
Understanding Safety Margin – Reactor Precedent



Source: "Technical Insights on Current Margins with Respect to Quantitative Health Objectives And Subsidiary Risk Goals", Electric Power Research Institute White Paper 3002012967, May 2018.

Building on Dry Storage Experience

Used fuel inventory*
- Approximately 83,978 MTU
- Increases 2 - 2.4k MTU annually

ISFSI** storage
- 140,492 assemblies
- 39,860 MTU (46%)
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** ISFSI = Independent Spent Fuel Storage Installation

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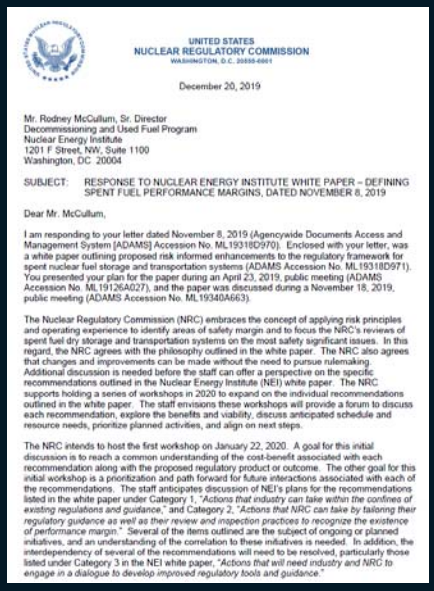
Shared Expectations on the Application of Risk Principles



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

December 20, 2019

Mr. Rodney McCullum, Sr. Director
Decommissioning and Used Fuel Program
Nuclear Energy Institute
1201 F Street, NW, Suite 1100
Washington, DC 20004

SUBJECT: RESPONSE TO NUCLEAR ENERGY INSTITUTE WHITE PAPER – DEFINING SPENT FUEL PERFORMANCE MARGINS, DATED NOVEMBER 8, 2019

Dear Mr. McCullum,

I am responding to your letter dated November 8, 2019 (Agencywide Documents Access and Management System [ADAMS] Accession No. ML19318D970). Enclosed with your letter, was a white paper outlining proposed risk informed enhancements to the regulatory framework for spent nuclear fuel storage and transportation systems (ADAMS Accession No. ML19318D971). You presented your plan for the paper during an April 23, 2019, public meeting (ADAMS Accession No. ML19126A027), and the paper was discussed during a November 18, 2019, public meeting (ADAMS Accession No. ML19340A663).

The Nuclear Regulatory Commission (NRC) embraces the concept of applying risk principles and operating experience to identify areas of safety margin and to focus the NRC's reviews of spent fuel dry storage and transportation systems on the most safety significant issues. In this regard, the NRC agrees with the philosophy outlined in the white paper. The NRC also agrees that changes and improvements can be made without the need to pursue rulemaking. Additional discussion is needed before the staff can offer a perspective on the specific recommendations outlined in the Nuclear Energy Institute (NEI) white paper. The NRC supports holding a series of workshops in 2020 to expand on the individual recommendations outlined in the white paper. The staff envisions these workshops will provide a forum to discuss each recommendation, explore the benefits and viability, discuss anticipated schedule and resource needs, prioritize planned activities, and align on next steps.

The NRC intends to host the first workshop on January 22, 2020. A goal for this initial discussion is to reach a common understanding of the cost-benefit associated with each recommendation along with the proposed regulatory product or outcome. The other goal for this initial workshop is a prioritization and path forward for future interactions associated with each of the recommendations. The staff anticipates discussion of NEI's plans for the recommendations listed in the white paper under Category 1, "*Actions that industry can take within the confines of existing regulations and guidance*," and Category 2, "*Actions that NRC can take by tailoring their regulatory guidance as well as their review and inspection practices to recognize the existence of performance margin.*" Several of the items outlined are the subject of ongoing or planned initiatives, and an understanding of the correlation to these initiatives is needed. In addition, the interdependency of several of the recommendations will need to be resolved, particularly those listed under Category 3 in the NEI white paper, "*Actions that will need industry and NRC to engage in a dialogue to develop improved regulatory tools and guidance.*"

Spent Fuel Performance Margins
Industry Category 1 Recommendations – Industry Action

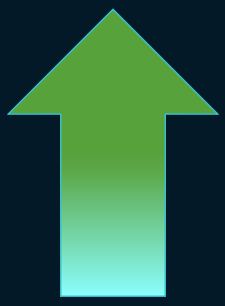
Recommendation III-1: Utilize more realistic source terms.

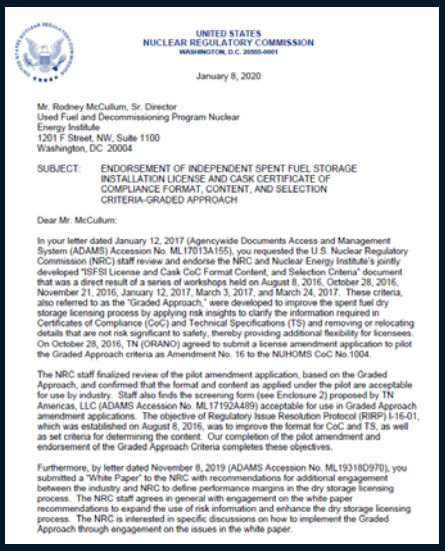
Recommendation III-2: When utilizing conservative source term calculations, do not also apply a source term uncertainty (i.e. burnup uncertainty).

Recommendation IV-3: Develop an industry consensus based thermal modeling methodology and document this as a best practices guide.

Recommendation VI-1: Follow the precedent established through Regulatory Issue Resolution Protocol I-16-01 "graded approach" CoC

Progress Already Made on Cat. 1 Recommendations





UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 8, 2020

Mr. Rodney McCullum, Sr. Director
Used Fuel and Decommissioning Program Nuclear
Energy Institute
1201 F Street, NW, Suite 1100
Washington, DC 20004

SUBJECT: ENDORSEMENT OF INDEPENDENT SPENT FUEL STORAGE INSTALLATION LICENSE AND CASK CERTIFICATE OF COMPLIANCE FORMAT, CONTENT, AND SELECTION CRITERIA-GRADED APPROACH

Dear Mr. McCullum:

In your letter dated January 12, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17013A155), you requested the U.S. Nuclear Regulatory Commission (NRC) staff review and endorse the NRC and Nuclear Energy Institute's jointly developed "ISFSI License and Cask CoC Format Content, and Selection Criteria" document that was a direct result of a series of workshops held on August 8, 2016, October 28, 2016, November 21, 2016, January 12, 2017, March 3, 2017, and March 24, 2017. These criteria, also referred to as the "Graded Approach," were developed to improve the spent fuel dry storage licensing process by applying risk insights to clarify the information required in Certificates of Compliance (CoC) and Technical Specifications (TS) and removing or relocating details that are not risk significant to safety, thereby providing additional flexibility for licensees. On October 28, 2016, TN (ORANO) agreed to submit a license amendment application to pilot the Graded Approach criteria as Amendment No. 16 to the NUHOMS CoC No.1004.

The NRC staff finalized review of the pilot amendment application, based on the Graded Approach, and confirmed that the format and content as applied under the pilot are acceptable for use by industry. Staff also finds the screening form (see Enclosure 2) proposed by TN Americas, LLC (ADAMS Accession No. ML17192A489) acceptable for use in Graded Approach amendment applications. The objective of Regulatory Issue Resolution Protocol (RIRP) I-16-01, which was established on August 8, 2016, was to improve the format for CoC and TS, as well as set criteria for determining the content. Our completion of the pilot amendment and endorsement of the Graded Approach Criteria completes these objectives.

Furthermore, by letter dated November 8, 2019 (ADAMS Accession No. ML19318D970), you submitted a "White Paper" to the NRC with recommendations for additional engagement between the industry and NRC to define performance margins in the dry storage licensing process. The NRC staff agrees in general with engagement on the white paper recommendations to expand the use of risk information and enhance the dry storage licensing process. The NRC is interested in specific discussions on how to implement the Graded Approach through engagement on the issues in the white paper.

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NEI
NUCLEAR ENERGY INSTITUTE

February 25, 2020

Mr. John Tappert
Director, Division of Rulemaking, Environmental, and Financial Support
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Request to withdraw NEI Petition for Rulemaking PRM 72-7 "Spent Fuel Cask Certificate of Compliance Format and Content," October 3, 2012

Project Number: 689

Dear Mr. Tappert:

On October 3, 2012, the Nuclear Energy Institute (NEI)[1] submitted a petition (PRM-72-7; Docket No. NRC-2010-0304) to amend 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste" in an effort to improve the efficiency of the Part 72 licensing process. This petition sought amendments to Part 72 to incorporate specific criteria for the format and content of the Certificates of Compliance (CoCs) for spent fuel storage casks. The primary purpose of the proposed changes to Part 72 was to ensure that the level of detail in CoCs is consistent and risk informed. The petition also called for six other changes that industry believed would result in complimentary improvements in NRC's regulatory framework.

On July 18 2014, the NRC accepted PRM-72-7 (79 Federal Register 41938) for consideration in rulemaking. However, the petition did not receive a sufficiently high priority to warrant expenditure of NRC resources to undertake a rulemaking in the near term. Accordingly, industry and NRC began exploring alternate means to achieve the desired improvements in regulatory efficiency. A series of public workshops was conducted in 2016 and 2017, which led to what became known as the "Graded Approach" to establishing the format and content of CoCs. A process for piloting this approach was defined as Regulatory Issue Resolution Protocol (RIRP) I-16-01. On October 28, 2016, TN (ORANO) agreed to submit a license amendment application to pilot the Graded Approach criteria as Amendment No. 16 to the NUHOMS CoC No. 1004.

[1] The Nuclear Energy Institute (NEI) is the organization responsible for establishing unified industry policy on matters affecting the nuclear energy industry, including the regulatory aspects of generic operational and technical issues. NEI's members include entities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel cycle facilities, nuclear materials licensees, and other organizations and entities involved in the nuclear energy industry.

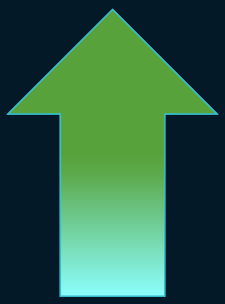
Spent Fuel Performance Margins
Industry Category 2 Recommendations – NRC Action

Recommendation II-1: Develop an Acceptance Review Grading process based on risk insights.

Recommendation III-3: In cases where applicants have applied conservative source terms, conservative modeling, and source term uncertainty (i.e. burnup uncertainty) in their applications conduct a much less detailed review.

Recommendation IV-2: Where Phenomena Identification and Ranking Table (PIRT) results are used (Recommendation IV-1), revise its internal review guidance to limit the review to verification that the results of the PIRT have been appropriately applied instead of trying to independently repeat results.

Progress Already Made on Cat. 2 Recommendations



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 24, 2020

MEMORANDUM TO: Division of Fuel Management Staff
Office of Nuclear Materials Safety and Safeguards

FROM: Andrea L. Kock, Director */RA/*
Division of Fuel Management
Office of Nuclear Materials Safety and Safeguards

SUBJECT: LICENSING PROCESS EXPECTATIONS

The purpose of this memorandum is to provide high-level expectations to staff in the Division of Fuel Management (DFM) in the Office of Nuclear Materials Safety and Safeguards (NMSS) for processing licensing actions. Licensing is one of the core U.S. Nuclear Regulatory Commission (NRC) functions, and there is a rich history of guidance on how to accomplish this aspect of our government business in a more risk-informed manner (e.g. SRM-SECY-98-0144, Yellow Announcement 99-019, "Risk-Informed Decision-making for Nuclear Material and Waste Applications" Agencywide Document Access Management System [ADAMS] Accession No. ML080720238). Going forward, risk informed thinking must be applied as we execute our licensing processes. The Commission recently reaffirmed this in Staff Requirements Memorandum SECY-19-0036, "Application of the Single Failure Criterion to NuScale Power LLC's Inadvertent Actuation Block Valves", dated July 2, 2019 (ADAMS Accession No. ML19183A434).

We've made substantial progress over the last few years in both business lines to further risk-inform decision making in the licensing process. For example, on January 15, 2019, the Director of NMSS issued "Key Principles for Nuclear Materials Safety and Safeguards Reviews" (ADAMS Accession No. ML19015A290). The purpose of that memorandum was to reiterate some of the key principles that guide the way we conduct our work and make decisions, particularly with respect to the concept of "reasonable assurance of adequate protection." Specifically, these key principles are:

- focus staff resources and expertise on the most safety-significant portions of a licensing decision;
- focus staff effort on reaching a "reasonable assurance" conclusion based on the entire system performance rather than an individual component; and
- enable the staff to acknowledge that a new technology may be safer than an existing technology although it may lack operating experience and years of performance data or may not meet the regulatory review standards developed for the existing technology.

Spent Fuel Performance Margins
Category 3 Recommendations – Actions to be Defined (1 of 2)

Recommendation IV-1: Define the parameters on which thermal modeling should be focused via a Phenomena Identification and Ranking Table – PIRT – and use it to focus reviews.

Recommendation IV-4: Provide a thermal modeling metric such as a peak cladding temperature limit (PCT) that is based on most current scientific information.

Recommendation IV-5: Develop a graded approach for thermal modeling analyses considering the effects of multiple overlapping conservativisms to prevent gross ruptures and its relationship to providing reasonable assurance.

Recommendation V-1: Revise the guidance in Section 6.4 of NUREG-1536 so that typical/realistic/representative dose rates provided in the FSAR are sufficient to demonstrate that the design meets the regulatory dose requirements

Spent Fuel Performance Margins
Category 3 Recommendations – Actions to be Defined (2 of 2)

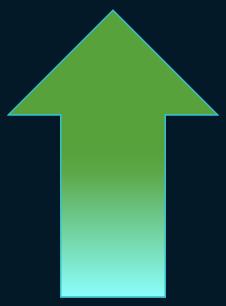
Recommendation V-2: Revise the guidance in Chapter 6 of the proposed NUREG-2215 with respect to details of modeling of the dose rate evaluations to consider the experiences from the many loaded dry storage systems.

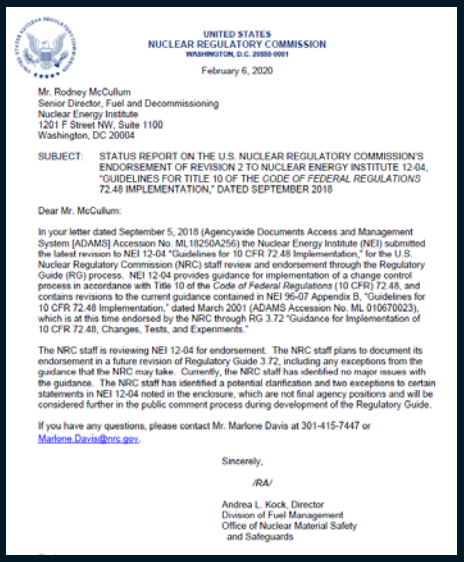
Recommendation VI-2: Align approaches in fuel qualification information for dry cask storage systems CoC (Tech Specs) with current practices in operating reactors (fuel qualification is not in the TS).

Recommendation VII-1: Align approaches in criticality safety analyses for dry cask storage systems with current practices in spent fuel pools.

Recommendation VII-2: Develop a more realistic approach to the modeling of fuel reconfiguration scenarios in criticality analysis.

Related Progress





UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

February 6, 2020

Mr. Rodney McCullum
Senior Director, Fuel and Decommissioning
Nuclear Energy Institute
1201 F Street NW, Suite 1100
Washington, DC 20004

SUBJECT: STATUS REPORT ON THE U.S. NUCLEAR REGULATORY COMMISSION'S ENDORSEMENT OF REVISION 2 TO NUCLEAR ENERGY INSTITUTE 12-04, "GUIDELINES FOR TITLE 10 OF THE *CODE OF FEDERAL REGULATIONS* 72.48 IMPLEMENTATION," DATED SEPTEMBER 2018

Dear Mr. McCullum:

In your letter dated September 5, 2018 (Agencywide Documents Access and Management System [ADAMS] Accession No. ML18250A256) the Nuclear Energy Institute (NEI) submitted the latest revision to NEI 12-04 "Guidelines for 10 CFR 72.48 Implementation," for the U.S. Nuclear Regulatory Commission (NRC) staff review and endorsement through the Regulatory Guide (RG) process. NEI 12-04 provides guidance for implementation of a change control process in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 72.48, and contains revisions to the current guidance contained in NEI 96-07 Appendix B, "Guidelines for 10 CFR 72.48 Implementation," dated March 2001 (ADAMS Accession No. ML 010670023), which is at this time endorsed by the NRC through RG 3.72 "Guidance for Implementation of 10 CFR 72.48, Changes, Tests, and Experiments."

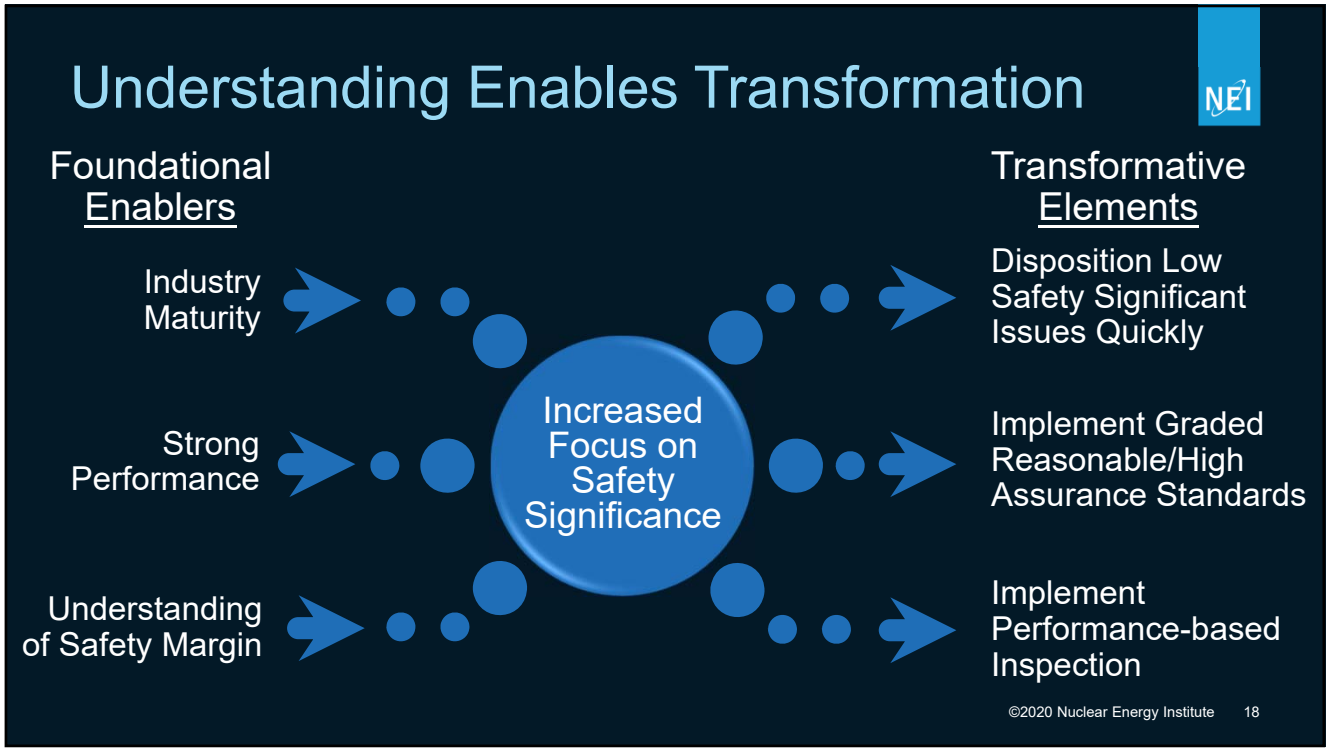
The NRC staff is reviewing NEI 12-04 for endorsement. The NRC staff plans to document its endorsement in a future revision of Regulatory Guide 3.72, including any exceptions from the guidance that the NRC may take. Currently, the NRC staff has identified no major issues with the guidance. The NRC staff has identified a potential clarification and two exceptions to certain statements in NEI 12-04 noted in the enclosure, which are not final agency positions and will be considered further in the public comment process during development of the Regulatory Guide.

If you have any questions, please contact Mr. Marlone Davis at 301-415-7447 or Marlone.Davis@nrc.gov.

Sincerely,

/RA/

Andrea L. Kock, Director
Division of Fuel Management
Office of Nuclear Material Safety
and Safeguards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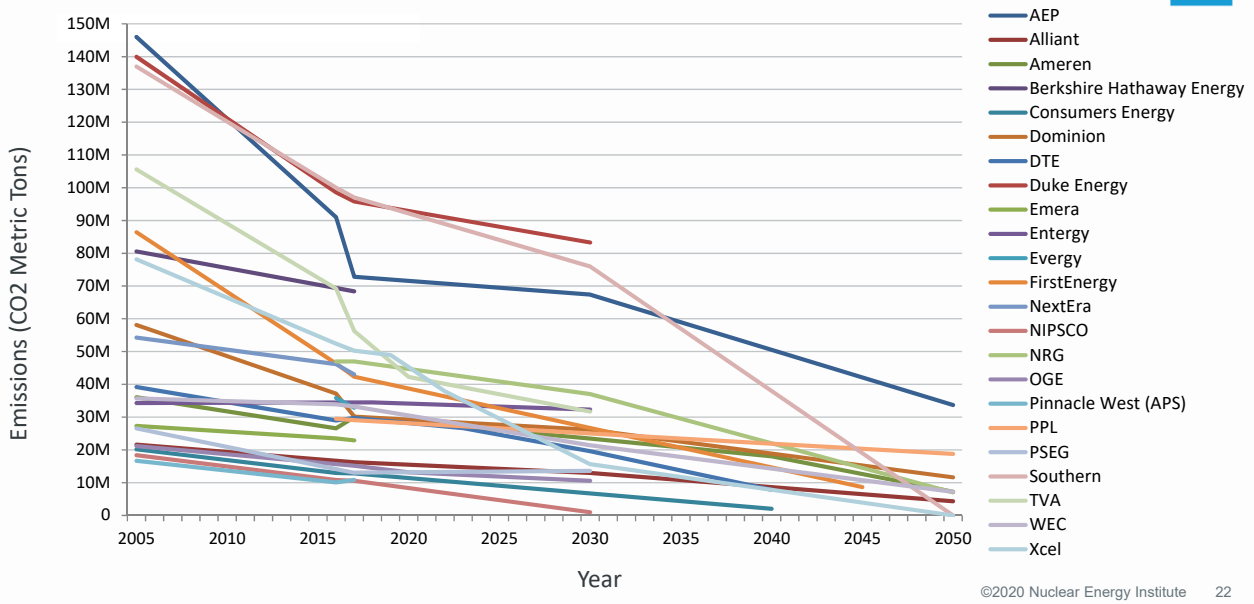
Industry and NRC staff are fully engaged to improve used fuel dry storage licensing efficiency by implementing the recommendations of NEI's November 2019 White Paper, "Defining Spent Fuel Performance Margins"

What dry storage transformation looks like

1. Improved safety
2. Fewer License Amendments
3. Lesser industry workload to prepare *each* Amendment/New Application
4. Lesser NRC workload to review *each* Amendment/New Application
5. Improved prospects for bringing innovation to market
6. Lower risk of dry storage delay adversely affecting plant operations
7. Shorter pool to pad times for plants entering decommissioning
8. Stronger surety of fuel movement off reactor sites
9. More workable aging management
10. Improved confidence in consolidated interim storage

Transforming Dry Storage Licensing allows resources to be focused on…

Decarbonization Trajectory of U.S. Utilities



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PROTECTING PEOPLE
and the
ENVIRONMENT
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