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NUCLEAR ENERGY INSTITUTE

October 15, 2020

Mr. Christian Araguas, Deputy Director
Division of Fuel Management
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Submittal of NEI/Industry-Developed Shielding Method of Evaluation Examples and Introductory Presentation for the November 2020 Table Top Exercise

Dear Mr. Araguas:

On behalf of the nuclear energy industry, the Nuclear Energy Institute (NEI)[1] submits the attached NEI/industry-developed shielding method of evaluation examples and introductory presentation for the November 2020 Table Top Exercise. We believe that these examples will demonstrate that changes to licensing practices will lead to more efficient focus of resources on the most safety-significant issues. We look forward to applying NRC's new licensing review practices to these examples in the table top exercise and the subsequent implementation of these practices in 2021.

We appreciate the NRC's engagement and participation in these actions and look forward to the table top exercises. If you have any questions or require additional information, please contact me.

Sincerely,

Mark A. Richter

Mark A. Richter

Attachments (3)

c: Ms. Andrea Kock

[1] The Nuclear Energy Institute (NEI) is responsible for establishing unified policy on behalf of its members relating to 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 and engineering firms, fuel cycle facilities, nuclear materials licensees, and other organizations involved in the nuclear energy industry.

Method of Evaluation Example for Table-Top Discussion

Holtec International Example

October 16, 2020 – DRAFT

DISCLAIMER: The following methodology is for discussion purposes only. The methodology may evolve significantly prior to submittal in a formal application, or may not be implemented at all.

- New information in FSAR
  - Chapter 2
    - Specific Acceptance Criteria
      - Overall Burnup (i.e. max), Enrichment (i.e. max) and cooling time (i.e. min) limits
      - Maximum dose rates in selected locations around the Transfer or Storage Cask
        - Dose locations would depend on the cask type
        - Number of dose locations to be as small as possible, but sufficient to represent differences in loaded fuel
        - Dose locations should be closer to the casks (surface or 1m), again to be representative of differences in the loaded fuel
  - Chapter 5
    - MOE, Source term part
      - Code and code version
      - Core operating conditions
      - Other fuel specific parameters (may depend on assembly types)
    - MOE, Dose Calculation Part
      - Code and Code version
      - Reference Model, including level of details in model
        - Dimensions and material specifications that are inputs to the model are not part of the MOE.
    - Representative Content
      - A content (bu/en/ct, maybe depending on basket location) that results in calculated dose rates at the limits specified in Chapter 2, when using the source term and dose calculation MOE
    - Dose results for representative content
      - Showing dose rates around the cask consistent with limits
      - Showing distances for single cask and cask arrangements where controlled are boundary dose limits would be met

        - This analysis is to satisfy 10CFR72.236(d), i.e. showing that the design, with content representing the approved, is capable to satisfy the 72.104 limits
    - Chapter 11
        - Occupational (Loading/Unloading) dose, consistent with dose limits/representative content
- New Information in CoC / Tech Spec
    - Dose Rate limits from FSAR Chapter 2 (maybe just by reference, then marked as not changeable in Chapter 2)
    - MOE in FSAR Chapter 5 (by reference)
        - Note again, Dimensions and material specifications are not part of the MOE
    - Together, these two requirements in the CoC/TS satisfy 10 CFR 72.236(a). The approved content is defined as any content that, when using the MOE, meets the specified dose rate limits.
- Changes to FSAR w/o LAR
    - Under 72.48, changes to the cask design can be made, including changes to dimensions, material specifications, and overall cask configurations, since these are not part of the MOE.
- Application
    - Generic Report (COLR-equivalent report)
        - Define a set of commonly used burnup/enrichment/cooling time combination
            - Could be in the form of tables or in the form of equations
        - Perform source term and dose analyses, using the MOE from FSAR
        - Provide reasonable assurance that the bounding condition is at or below the dose rates limits in the CoC/TS
        - This generically qualifies all assemblies within the defined sets of combinations, by reference to this report
        - Report is available to NRC for information
    - Site Specific Report (Site specific COLR-equivalent report)
        - Select/define burnup/enrichment/cooling time combinations of fuel at the site that needs to be qualified for loading.
        - If combinations are already bounded by those from a generic report (see above), and inputs to MOE are consistent with site-specific conditions, no further work is needed.
        - Site specific dimensions and material specifications, different from those used in the FSAR, may be used as inputs to the MOE
        - Perform source term and dose analyses covering all fuel, show that dose rates are below limits in the CoC/TS

        - Assemblies are qualified as content, for site-specific dimensions and material specifications.
        - Report is available to NRC for information
    - Other site-specific dose analyses and reports
        - There is also currently a requirement that site-specific surface dose evaluations are performed, and compared with corresponding dose measurements, to provide added assurance that the (calculated) area boundary dose rates meet the corresponding limits. This is generally independent from the MOE since it addresses a different part of the regulation (72.104). The methodology and models for this, and for the area boundary calcs, can be, but do not have to be the same as those defined under the MOE. If they are the same, this report can the site-specific report to satisfy the content requirements. Otherwise, for example, when different codes and/or code versions, and different inputs to source term calculations are used, a separate report to show acceptable content is needed.

Method of Evaluation Table-Top Discussion

TN Americas LLC

Draft 10.16.2020

DISCLAIMER: The following methodology is for discussion purposes only. The methodology may evolve significantly prior to submittal in a formal application, or may not be implemented.

- Much of the current information currently located in the Technical Specifications (TS) will be moved to a reactor Core Operating Limits Report (COLR)-equivalent report, which may be modified via the 72.48 process.
- A minimum cooling time (e.g., 1 year), maximum burnup (e.g., 62 GWd/MTU), and maximum enrichment (e.g., 5.0%) will be defined in the COLR-equivalent report.
- Minimum enrichment will not be limited by the COLR-equivalent report because minimum enrichment correlates with burnup in a predictable manner.
- Complex relationships between burnup, enrichment, and cooling time will not be limited by the TS but could be included in the COLR-equivalent report, if desired.
- UFSAR dose rates would be computed using bounding sources (no change from current approach).
- Simple methodologies already exist to rank the relative strength of source terms. Generic correlations to convert a source term into a dose rate at a key location (e.g., vent or dominant surface) could be derived and provided in the UFSAR. The dose rate computed using the correlation (using the design basis source as input) would be added as a limit in the COLR-equivalent report.
- Because surface sources are dominated by fuel on the basket periphery, the correlation would account for basket location (i.e., fuel to be loaded in the basket interior would have significantly less contribution to the limiting dose rate than peripheral assemblies). The correlation could potentially address the dose rate contribution from specific assemblies in the basket.
- Because the correlation converts any arbitrary source into a dose rate, there are no additional COLR-equivalent report restrictions on non-fuel assembly hardware, fuel reconstituted with stainless steel rods, etc., because all sources present are included as input to the correlation.
- This correlation serves as a “go/no go” as to whether or not fuel is bounded by the design basis UFSAR source. This correlation does <u>not</u> determine compliance with 72.104 at a site.
- To apply the method, the Licensee must characterize their fuel population, including non- fuel assembly hardware, to provide source term inputs consistent with the format of the correlation. This characterization would typically involve a depletion analysis that may account for actual irradiation history parameters. The Licensee may use a depletion program different than used in the UFSAR if the Licensee benchmarks their methods against UFSAR inputs and source terms and demonstrates similar results.
- Optionally, the Licensee may develop correlations specific to their fuel, following the methodology outlined in the UFSAR, to incorporate site-specific fuel parameters (e.g., MTU, axial length) or account for modifications to the storage system design.
- This methodology is unrelated to decay heat qualification. A candidate fuel assembly may pass the dose rate check and not be qualified for loading due to thermal constraints or site-specific dose rate constraints. Site-specific dose rate constraints are outside the scope of the method.

Method of Evaluation (defined in UFSAR)

1. Develop a model of the fuel, basket, and storage cask. Input parameters include geometry, materials, uranium loading, axial profile, etc.
2. Using this model, develop a correlation that converts a generic source term into a dose rate at a key specified location. This correlation allows any source to be ranked in comparison to any other source. This correlation is provided in the UFSAR.
3. Develop design basis source terms used in the UFSAR analysis. Design basis source terms are selected to maximize the dose rate over a range of burnup, enrichment, and cooling time combinations using the specified correlation. The dose rate computed by the correlation for the design basis source is included in the COLR-equivalent report as a limit.

Application of the Method of Evaluation (by Licensee)

1. The correlation provided in the UFSAR could be used directly if the inputs used to develop the correlation are similar to the inputs at a site.
2. A new correlation could be developed if the site fuel geometry, masses, axial profiles, etc. are significantly different than the UFSAR inputs.
3. The site fuel population is characterized by the Licensee, including non-fuel assembly hardware, and all other non-standard sources.
4. The correlation is used to rank the site population and confirm the ranking dose rates are less than the limit provided in the COLR-equivalent report.

Performance Margin Introduction

NEI Task Force

Z. I. Martin

October 16, 2020

Performance Margin – Introduction

Outline

- Describe Part 50 Core Operations Limits Report (COLR)
- Describe Applicability to Part 72
- Describe Vision for Cask Documents

Performance Margin – Introduction

Part 50 COLR

- Per 10 CFR 50.36, Part 50 Technical Specifications (TS) contain:
  - Safety Limits – guard against uncontrolled release of radioactivity
  - Limiting Safety System Settings
  - Limiting Control Settings
  - Limiting Conditions for Operations (LCOs)
  - Surveillance Requirements
  - Design Features
- Contain cycle specific core parameters
- Generic Letter (GL) 88-16 changed requirement for License Amendments

Performance Margin – Introduction

Part 50 COLR (cont'd)

- GL 88-16 'Removal of Cycle-Specific Parameter Limits from Technical Specifications' provided alternative to cycle specific License Amendments by requiring:
  1. The addition of the definition of a named formal report (now known as COLR) that includes the values of the parameter limits established using an NRC-approved methodology and consistent with all applicable limits of the safety analysis
  2. Addition of an administrative reporting requirement to submit a formal report on parameter limits to the NRC for information
  3. Modification of individual Technical Specification (TS) to note the parameters shall be maintained within the limits of the formal report identified in item 1
- COLR can be changed by licensee

Performance Margin – Introduction

Part 50 COLR (cont'd)

EXAMPLES

DEFINITION

CORE OPERATING LIMITS REPORT (COLR) - The COLR is the unit specific document that provides cycle specific parameter limits for the current reload cycle. These cycle specific parameter limits shall be determined for each reload cycle in accordance with Specification 5.6.3. Plant operation within these limits is addressed in individual Specifications.

Item 1

5.6.3 CORE OPERATING LIMITS REPORT

a. Core operating limits shall be established prior to each reload cycle, or prior to any remaining portion of a reload cycle, and shall be documented in the COLR for the following:
   1. LCO 3.1.1, "SHUTDOWN MARGIN (SDM)";
   2. LCO 3.1.3, "Moderator Temperature Coefficient (MTC)";
   3. LCO 3.1.5, "Shutdown Bank Insertion Limits";
   4. LCO 3.1.6, "Control Bank Insertion Limits";
   5. LCO 3.2.1, "Heat Flux Hot Channel Factor ($F_Q(X, Y, Z)$)";
   6. LCO 3.2.2, "Nuclear Enthalpy Rise Hot Channel Factor ($F_{\Delta H}(X,Y)$)";
   7. LCO 3.2.3, "AXIAL FLUX DIFFERENCE (AFD)";
   8. LCO 3.3.1, "Reactor Trip System (RTS) Instrumentation," $f_1(\Delta I)$ limits for Overtemperature ΔT and $f_2(\Delta I)$ limits for Overpower ΔT Nominal Trip Setpoints; and
   9. LCO 3.9.1, "Boron Concentration."

Item 3

b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:
   1. Topical 1
   2. Topical 2
   3. Topical 3

c. The core operating limits shall be determined such that all applicable limits (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, Emergency Core Cooling Systems (ECCS) limits, nuclear limits such as SDM, transient analysis limits, and accident analysis limits) of the safety analysis are met.

d. The COLR, including any midcycle revisions or supplements, shall be provided within 30 days of issuance for each reload cycle to the NRC.

Item 2

Performance Margin – Introduction

Applicability to Part 50.59

- Paraphrasing GL 88-16, for operating reactors the NRC believes that it is essential to safety that the plant is operated within the bounds of cycle-specific parameter limits which must be retained in the TS. However, the specific values may be modified by licensees, without affecting nuclear safety,
- Just as reactor cores each cycle, each cask has different fuel assemblies in different locations, with varying:
  - Burnup
  - Enrichment
  - Cool Times
  - Heat Loads

Performance Margin – Introduction

Applicability to Part 72

- Identify fuel safety limits, such as:
  - 400 °C fuel clad temperature
- Identify cask regulatory limits, such as:
  - 25 mrem off-site dose
- Use safety analyses to set cask safety limits, such as:
  - Cask internal pressure
- Use safety analyses to set cask safety limits, such as:
  - Cask internal pressure

Performance Margin – Introduction

Vision for Cask Documents

- Methods will be submitted to the NRC for approval in Topical Reports
- 72.236(a) specified tech spec limits generated with approved methods will be converted to a COLR-equivalent Part 72 document
- Future path is to convert the Approved Contents section of Tech Specs, generated with approved methods to a COLR-equivalent document
- COLR-equivalent submittal:
  - With initial License Amendment (General or Site Specific)
  - When changes are needed or requested by users
- Changes made under 10 CFR 72.48