

RISK TOOL PRESENTATION

DIVISION OF SPENT FUEL MANAGEMENT

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NUCLEAR ENGINEER

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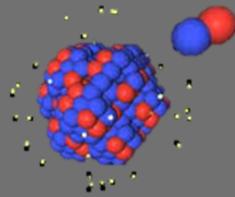
Risk Tool Working Group

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SPENT FUEL STORAGE JOB AID RISK INFORMING REVIEWS TOOL



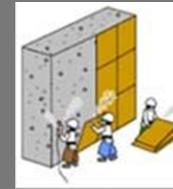
Shielding
Analysis



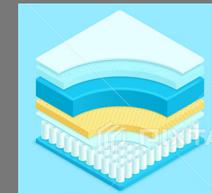
Criticality
Hazard



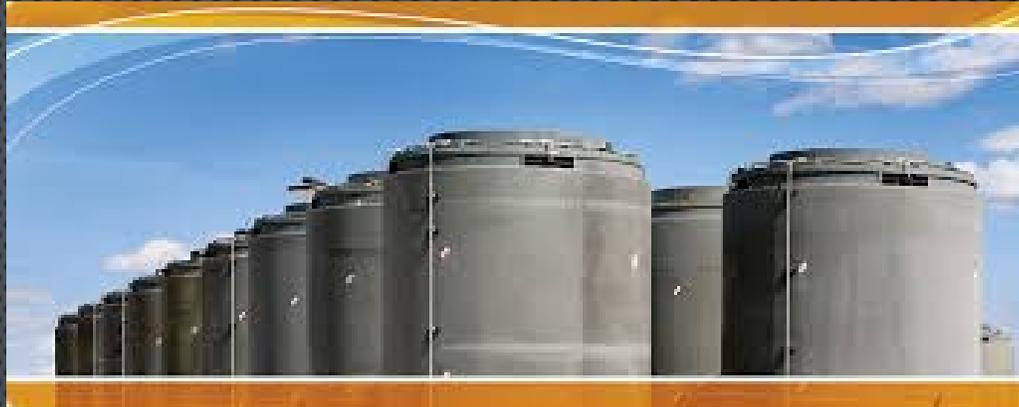
Thermal And
Confinement
Evaluation



Structural
Analysis



Materials
Evaluation



Risk Tool

What it does:

- Risk Tool and Job Aid provides the impetus for culture shift for risk to become part of the daily conversation of a review.
- Provides an initial raw risk (on a component by component basis) for the reviewer to consider.
- Worksheet provides documentation of risk considerations; this worksheet will be used during the acceptance review and potentially in RAI development.
- Worksheet facilitates risk discussions amongst the review team.
- Job Aid provides for suggested levels of review based on risk.
- The Risk Tool is based on available risk studies, safety margin investigations, selected NRC SERs, and input from NRC Senior Technical Reviewers.

Spent Fuel Storage Job Aid for Risk Informing Reviews



Support the focus of the review (e.g., the depth of the review) based on risk.

Brings information from Risk Tool, which includes sample of prior safety evaluations, into the licensing process.

Provide a step-by-step resource for the staff to risk inform technical reviews.

SPENT FUEL STORAGE JOB AID RISK INFORMING REVIEWS TOOL



*Division of Fuel Management
 November 2020*

• INTRODUCTION

Risk considers the likelihood of an operational event and the severity of potential consequences to workers, the public, and the environment. For the purpose of this job aid, to “risk-inform” a review of an application means to consider the risk associated with a change to an SSC when selecting the depth of the review for the requested licensing action.

The purpose of this job aid is to support risk-informing reviews of spent fuel dry storage systems by using: 1) a tree diagram in a file titled, “Risk Tool Tree Diagram,” and 2) a report, titled, “Development of Dry Cask Risk Tools”

This job aid should be used as a starting point in assessing the scope, level of effort (e.g., depth of review), and the complexity of the review of the requested licensing action. The reviewer should still follow the Standard Review Plan (SRP), NUREG-2215, for a general approach to establish reasonable assurance. In addition to the SRP, the reviewer may use risk information to determine the appropriate level of rigor needed to make a safety determination.



Figure 1. Considerations and purpose of the risk-informing tool.



As discussed below, there may be aspects of a requested licensing action that would warrant adjustments to the initial assessed risk level and depth of the review.

II. HOW TO USE THE RISK TOOL?

The staff should use this tool in evaluation of licensing action requests. This job aid is intended to be used during the acceptance review, or in the absence of an acceptance review, as the first step in the staff's detailed technical review. The staff should use the "Risk Tool Tree Diagram," the document "Development of Dry Cask Risk Tools," and the following worksheet and table below when implementing an acceptance review and documenting the use of this tool.

Table 1. Risk Tool Worksheet

	1	2	3	4	5
LAR Change #	Change Proposed in the LAR	Present as a gate in the Risk Tool Tree Diagram? (Y/N)	LAR change is adequately informed by the Risk Tool Report? (Y/N)	If response to Column 3 is "Y", list the relative risk	If response to Column 3 is "N", describe why it is out of scope
1					

Table 2. Guidance: Risk Tool

	Question	Go to the Risk Tool Worksheet
A	What is the change to be evaluated?	Provide a brief description of change in column No. 1
B	Is the type of change requested included as a “gate” in the Risk-Informed Tool Tree Diagram?	Enter “Yes” or “No” in column No. 2 of the Worksheet). If “Yes”, go to Question C . If “No”, then this Job Aid is not applicable to the review. Proceed to column No. 5 and document that “ <i>There is not a gate for this change.</i> ” Then, proceed with the review according to SRP
C	Is the rationale discussion associated with the gate in the Risk Tool Report informative of the change requested?	Enter “Yes” or “No” in column No. 3 of the Worksheet. If the “Yes” consider the risk recommendation in the preliminary plans for the depth of review. Go to Question D . If “No”, then this Job Aid is not applicable to the review. Go to Question E ,
D	What is the preliminary risk level?	Using the Risk Tool result, and other information as appropriate, document the preliminary risk level in column No. 4 of the Risk Tool Worksheet (low, medium, high or undetermined). Proceed to the review according to SRP.
E	How is the change different from the description in the Risk Tool Report?	Briefly describe in column No. 5 why the requested change is out of scope of the Risk Tool Report, then proceed with the review according to SRP



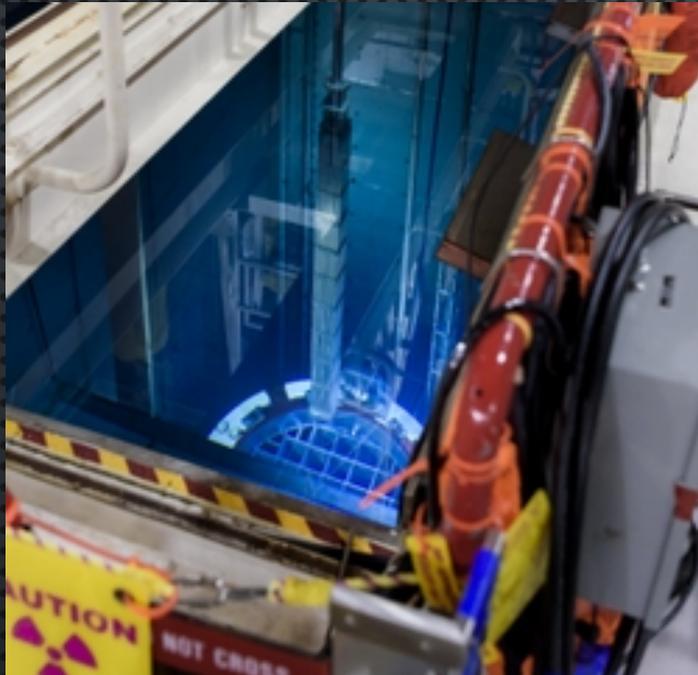
• **LIMITATIONS OF THE RISK TOOL**

There may be aspects of a licensing action request that would warrant adjustments to the assessed risk level and depth of the review. In all instances, whether the Risk Tool is applicable or not, the staff should continue to apply engineering judgment. The Risk Tool is not expected to address all future actions requested. This Job Aid does not replace NRC staff experience, rather, it seeks to enhance it. The table below includes examples of benefits of the Risk Tool and additional information the staff must consider in making adjustments to the Risk Tool’s preliminary risk determination.

Table 2. Risk-Informing Tool: Benefits and Additional Considerations

Benefits	Additional Considerations
1. Provide a preliminary determination of risk significance of the action requested early in the process.	1. Complexity and quality of the application.
2. Plan review strategy and develop RAIs.	2. Introduction of new designs.
3. Start a discussion about the risk significance of the action requested with other staff reviewers.	3. New and modified methods of evaluation and boundary conditions.
4. Facilitate conversations of risk amongst the review team and, as appropriate, branch chiefs.	4. New design standards.
	5. Uncertainties and margins to safety criteria.
	6. Experience from prior operations and licensing actions.
	7. Potential for the cumulative effects of several changes to create a higher risk than that identified for each individual change.

It is important to point out that the current Risk Tool Tree Diagram has limited details for some areas. For example, Increased Burnup (Gate 2.1.1) does not expand to further sub-gates for shielding and thermal review. The reviewers should assume that Gate 2.1.1 implies that shielding and thermal reviewers should examine the risk on the impact on these areas because increased burnup will affect source terms and decay heat.



IV. ESTIMATING DEPTH OF A REVIEW

(continued)

After a licensing action has been assigned a High, Medium or Low relative risk, the reviewer follows the general guidance below to inform the appropriate level of rigor needed to make a safety determination.

Comparison between NEI and NRC Recommended Approach

NEI Recommended Approach for Low Risk:

- Simple check that sound methodologies have been applied
- Verification that the results of any PIRT have been correctly applied
- No independent confirmatory analysis

1. NRC Recommended Approach for Low Risk (green gate):

- a) The Technical Reviewer should review the statements provided in the application letter, proposed CoC/license revision, and the SAR to ensure that they are consistent and meet 10 CFR Part 72 requirements.
- b) Recognize that all components and systems discussed in the Risk Tool Report need to be reviewed, even for those items that are assessed as low risk. An item may be considered low risk because of the reasons stated in the Risk Tool Report or other reasons (e.g., there being redundancies, the amendment request change is very small from what was previously determined to be safe).
- c) Review should focus on verifying that the SAR contains the necessary analyses to demonstrate regulatory compliance based on guidance in the SRP, and that the analytical approaches are reasonable. Guidance documents, including the SRP, are a useful resource when performing the review.
- d) Limited to little or no confirmatory analysis for compliance is necessary. The Technical Reviewer should generally consider the applicant's analyses to be complete and accurate and forego independent confirmation unless the reviewer disagrees with the initial conclusions.
- e) For a low-risk significant change in an amendment request, the estimated level for review does not mean an LAR change is exempted from any regulatory requirement. In all cases, the staff must still make a finding regarding the ability of the storage system to meet all relevant portions.

**Comparison between NEI and
NRC Recommended Approach**

**NEI Recommended Review Approach For
Medium Risk:**

- Check that sound methodologies have been applied
- Verification that the results of any PIRT have been correctly applied
- Limited Independent Confirmatory Analysis (results reasonably close, but not exact)
- Spot check of inputs and assumptions

**NRC Job Aid Recommended Approach
For Medium Risk (yellow gate):**

- The Technical Reviewer should review the statements provided in the application letter, proposed CoC/license revision, and the SAR to ensure that they are consistent and meet 10 CFR Part 72 requirements.
- The review should focus on verifying that the SAR is complete and correct in key areas where the amendment request change could be expected to significantly impact safety. Key methods of evaluations, input and output parameters, and boundary conditions are checked and verified to be reasonable based on the SRP guidance. Guidance documents, including the SRP, are a useful resource when performing the review.
- The Technical Reviewer may perform confirmatory analyses, for those items important to safety.

**Comparison between NEI and
NRC Recommended Approach**

**NEI Recommended Review Approach
For High Risk:**

- Independent Confirmatory Analysis
- Detailed Review of Inputs and assumptions

**NRC Job Aid Recommended Approach
For High Risk (red gate):**

- a) The Technical Reviewer should review the statements provided in the application, proposed CoC/license revision, and the SAR to ensure that they are consistent and meet 10 CFR Part 72 requirements.
- b) The Technical Reviewer should review the SAR, any supporting analyses, verify that methods of evaluation are deemed appropriate, and, if relevant, consider prior approved licensing actions. Guidance documents, including the SRP, are a useful resource when performing the review.
- c) The Technical Reviewer should verify that the values for input parameters and boundary conditions that support the applicant's analyses are correct.
- d) The Technical Reviewer should consider performing confirmatory analyses to verify that the applicant's results are reasonable and correct.

What next?

The Risk Tool Working Group will:

- Finalize the Job Aid for pilot use after the December Workshop.
- Plan for the pilot process in January/February (e.g., we will seek to internally pilot the acceptance reviews of a few applications using the risk tool to gain lessons-learned)
- Hold a future public meeting after the pilot period to discuss lessons learned and seek feedback from the public on the tool (e.g., 8+ months after the Risk tool has been piloted)



MATERIALS EXAMPLE FOR RISK TOOL

By

John Wise

Materials Engineer

Materials Example

Increased service temperature of concrete overpack (Shielding and structural functions)

Use of Risk Tool

- Gates 1.2.1.1, 1.2.1.2, “Neutron and Gamma Shields” ⇒ **Medium Risk**
- Risk Tool basis
 - Concrete directly protects personnel and public from radiation
 - Safety margins typically large
 - Routine radiation monitoring activities likely to catch significant degradation

Materials Example *cont'd*

- Staff Assessment (additional considerations)
 - Changes in concrete properties at high temperature is a known phenomenon (e.g., see NUREG/CR-6900)
 - Potential for elevated temperatures to enhance degradation mechanisms during extended storage terms
- Initial Staff Conclusion
 - **Medium** level of review is appropriate
- Technical Review
 - Verify concrete temperatures conform to ACI Code
 - Ensure that test data supports operating at higher temperatures than allowed in ACI Code
 - Consider value of inspection/monitoring activities in making a safety finding



SHIELDING EXAMPLE FOR RISK TOOL

By

Zhian Li

Criticality and Shielding Engineer

Shielding Example

LAR Request:

- ❖ **Add new loading pattern with decreased canister total decay load**
- ❖ Decay heat is bounded by previously approved loading pattern for every cell
- ❖ Includes a decay heat and burnup, enrichment, and cooling time equation
- ❖ The TS has a fuel qualification table to calculate the source terms

Use of Risk Tool:

- Find the gate from the Excel Risk Tool.
- Gate 2.7, Cask Loading Pattern (**green?**).

Shielding Example *cont'd*

Staff Assessment:

- ❖ decreased canister total decay heat load (green)
- ❖ Decay heat is bounded by the previously approved loading pattern for every cell (green)
- ❖ Includes a decay heat and burnup, enrichment, and cooling time (green)
- ❖ The Technical Specification has a fuel qualification table to calculate the source terms (green)

Result:

- Green, Low risk review.

Review:

- Verify decay heat and source terms are bounded by the previously approved loading pattern.



STRUCTURAL EXAMPLE FOR RISK TOOL

By

Tim McCartin

Senior Risk Analyst

Structural Example

Change in Material Properties of Canister Design (thickness and materials with potential effect on structural function)

Use of Risk Tool

- Gates 1.1.1.1.1, “Shell Body” ⇒ **High Risk**
- Risk Tool basis
 - Modification of canister design could increase risk of canister or canister weld failure due to canister drop.
 - Very unlikely canister failure for small drop heights
 - However, no arguments for large safety margin and no redundant confinement function results in high risk

Structural Example *cont'd*

➤ Staff Assessment

- Information in NUREG-1864 suggests safety margin for canister failure (e.g., majority of drop events cited in risk tool are for drops of 1 foot and drops less than 5 feet have a failure rate less than one in one-million – Table 12)
- Information in NUREG-1864 suggests cladding would maintain its integrity in a small drop such as 1 foot (e.g., cladding yield strength not exceeded until drops of transfer cask are in range of 20-40 feet [page C-9]; probability of cladding failing is noted as 0.0 for drops as low as 1 foot [Table 13, page 4-26])
- The likelihood of a drop height (e.g., greater than 5) sufficient to fail the canister or the cladding is extremely small due to maximum height of most lifts

Structural Example *cont'd*

➤ Initial Staff Conclusion

- Medium level (possibly low depending on extent of design change) of review is appropriate.

➤ Technical Review

- Verify potential drop heights during canister lifting activities.
- Look for applicant to provide structural properties of new design demonstrating comparable structural performance of previous designs (review could result in revising risk to high).

Note: In this example, the staff determined that the raw risk tool results (i.e., high risk), should actually be performed as a medium (or low) risk review. There may be instances, depending on the requested change, where staff determination could elevate the risk of a review (e.g., low to medium).