

# CaskADES: Cask Analysis and Degradation Evaluation System



Connects Technology To Business....

Improving Reliability Through Health Monitoring and Predictive Maintenance

**CaskADES** is a modular software tool which combines information from various data streams to assess nuclear waste canister material degradation status for temporary/interim storage and potential transportation.

## CaskADES Modules

- Data Preprocessing
- Probabilistic material properties
- Residual stress analysis
- Pit initiation, death, and growth
- Maximum pit depth analysis
- Crack initiation and growth
- Remaining useful life estimation
- Fleet health management
- Transportation analysis
- Mitigation analysis
- Sensitivity analysis

### What can CaskADES do?

- Estimate the risk factor with high confidence for various scenarios (do nothing, moving to CISE, laser peening, shot peening, or cold spray).
- Predict the remaining useful life of dry storage systems for various scenarios.

### Which technologies does CaskADES use?

- Hybrid data fusion (physics-based and data-driven)
- Probabilistic fracture mechanics
- Bayesian inference
- Monte Carlo simulation

*Sample calculation book*

**GTC's Canisters CISE**

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**1 Introduction**

This document is the result of a degradation analysis to Chloride Ion Induced Stress Corrosion Cracking (CISCC) Degradation Evaluation System, which is a software tool developed by Global Technology Connection (GTC).

The CaskADES software uses a variety of data sources to provide a comprehensive analysis that ensures nuclear waste storage containers are safe and reliable. The system uses a combination of physics-based and data-driven approaches.

The Department of Energy (DOE), the Electric Power Research Institute (EPRI), the Nuclear Regulatory Commission (NRC), and the Nuclear Regulatory Commission (NRC) have identified stress corrosion cracking (SCC) as the cracking mechanism that is most likely to initiate due to sensitization resulting from the thermal profile associated with the welding process. Figures 23 and 24 show the measured near-surface and distanced-from-surface residual stresses at the HAZ of the circumferential welds, respectively.

Figure 1 shows those three factors that are most likely to initiate and propagate. Figure 1 shows those three factors that are most likely to initiate and propagate.

Figure 2 shows a flowchart of the algorithm used for crack growth to failure.

### CaskADES

Cask Analysis and Degradation Evaluation System

**Welcome**

**Setup**

**Location & Environment**

**Heat Load**

**Thermal Analysis**

**Corrosion Analysis**

**Stress Analysis**

**Mitigation**

**Risk Assessment**

**Initial Thermal Load & Duration**

Initial load, KW:

Analysis period, years:

Weld element (see weld map):

**Setup Load**

**Canister weld map**

Surface temperature of weld 1

Surface temperature, F

Time in service

**Figure 23: Residual stresses at a circumferential weld fusion zone (FZ). A: near-surface B: distanced-from-surface (17)**

While it is anticipated that the residual stresses to be largest to the weld FZ, the welds heat affected zones are the regions where localized corrosion is most likely to initiate due to sensitization resulting from the thermal profile associated with the welding process. Figures 23 and 24 show the measured near-surface and distanced-from-surface residual stresses at the HAZ of the circumferential welds, respectively.

**Figure 24: Residual stresses at a circumferential welds heat affected zone (HAZ). A: near-surface B: distanced-from-surface (17)**

This figure shows that, the residual stresses in the circumferential weld HAZ are tensile through the entire thickness of the shell and large enough to potentially support through-thickness cracks propagation.

**Stress Profiles in the longitudinal welds**

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