Nuclear Services/Engineering Services

RadTrack™ Automated System for Radiation Analysis of the Reactor Environment

Background

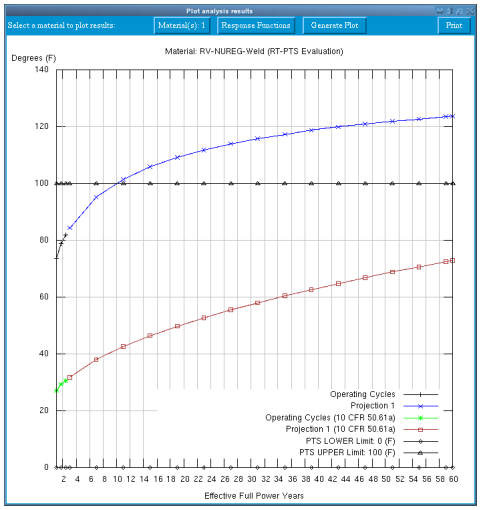
Radiation exposure data factor into several aspects of aging management at today's nuclear power plants:

- 10CFR50.61 and 10CFR50.61a address concerns over potential pressurized thermal shock (PTS) events in pressurized water reactors (PWRs). The calculated PTS parameters for reactor vessel materials are a strong function of radiation fluence.
- Reactor vessel internals inspections may identify flaws in reactor internals components. Radiation fluence data is critical in determining whether the identified flaw meets acceptance criteria.
- 10CFR50, Appendix G, requires the determination of specific fracture toughness for normal operations and anticipated operational occurrences for power reactors.
- Implementation of WCAP-16168 for the reactor vessel in-service inspection interval extension requires continuous monitoring of through-wall cracking frequency (TWCF). TWCF is a strong function of radiation fluence.
- Several replaceable reactor components are lifetime-limited by cumulative radiation exposure (e.g., control rod assemblies).
- In order to satisfy these requirements, Westinghouse customers need methods for quickly and accurately obtaining radiation exposure data on plant-, cycle- and location-specific bases. In response, Westinghouse offers the RadTrack™ automated system for radiation analysis of reactor environments.

Description

The RadTrack code system is a software tool designed to determine a reactor's radiation environment using the seamless integration of state-of-the-art, U.S. Nuclear Regulatory Commission (NRC)-approved radiation transport methodologies coupled with a user-friendly interface. The user interface can be accessed from a laptop or desktop computer, directing a remote server to perform the calculations.

All RadTrack system calculations are performed on plant-specific, cycle-specific and location-specific bases. The geometry of the model, the power history and the materials properties are unique to the specific reactor being analyzed.



RT_{PTS} parameters can be calculated and displayed directly by the RadTrack system

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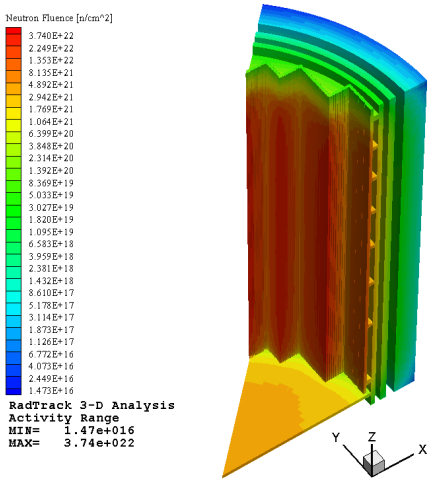
RadTrack System Benefits

- Radiation tracking capabilities for reactor pressure vessels (RPV) materials and reactor internals
- Reporting of common radiation-dependent response functions, including fast neutron fluence (E > 1.0 MeV) and iron displacements per atom
- Projections of the radiation environment at any future time to allow instant evaluation of RPV materials and reactor internals to compare with NRC guidelines
- Integrated, automated embrittlement equation solvers (10CFR50.61 and 10CFR50.61a) and through-wall cracking frequency tracking
- Plant-specific reactor models with neutron/gamma flux library delivered up to the latest fuel cycle
- Radiation transport calculation module that allows the user to explore hypothetical core designs and examine the impact on critical materials
- Deterministic radiation transport codes provide rapid, accurate, high-resolution results throughout the problem domain and eliminate the need for time-consuming variance reduction efforts associated with Monte Carlo methods
- Mobile component (e.g., control rod assemblies) radiation exposure tracking capability
- Advanced 3-D contour plotting and visualization capabilities to plan future inspections



The RadTrack code system generates 3-D contour plots of radiation exposure for the reactor vessel and internals

Applications of the RadTrack System

- Tracking reactor vessel embrittlement or TWCF pursuant to regulatory requirements
- Exploring hypothetical fuel designs and the impact on critical materials in the reactor
- Responding immediately to radiation exposure and materials questions that may arise if a flaw is found during the inspection of a reactor vessel internals component
- Tracking the exposure to mobile components (e.g., control rod assemblies), enabling engineers to make informed decisions about how they are deployed and to extend the service lifetime
- Analyzing reactor dosimetry to demonstrate the validity of radiation transport calculations to regulatory authorities
- Identifying material hardness properties for specific locations in the reactor vessel and reactor vessel internals to determine the most appropriate cutting tool during plant decommissioning

Deliverables

Westinghouse provides the following deliverables:

- Access to the RadTrack code system graphical user interface on a Windows®-based computer operating system
- Customized reactor models and a library of neutron/gamma flux files
- User manuals and supporting documentation, including verification and validation documents

Future Capabilities

- Support for boiling water reactors
- Activation product tracking, generating color-coded contour maps displaying waste classification of major reactor components, which will assist users in creating waste segregation plans and minimize the packaging required for decontamination and decommissioning activities

Experience

Westinghouse has been using state-of-the-art, NRC-approved radiation transport methodologies in analyzing PWRs worldwide for more than 40 years. Using these methodologies, Westinghouse staff experts can work with customers in addressing specific requirements with the RadTrack code system.

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