The Antenna

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A new unique fuel reliability code and associated handbook is provided by A.N.T. International. The code has a new unique and sensitive methodology to detect fuel rod defects, small or large, even in a core with high coolant activity background from previous fuel failures.

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NEW UNIQUE FUEL RELIABILITY CODE AND HANDBOOK

Primary failure results from the formation of one or more leakage paths through the cladding, end plugs or welds of an affected fuel rod. As a result, activity release rates generally increase at the time of failure, as the stored inventory of long-lived gaseous and soluble fission products are released, and then continue at rates that depend on the local power in the leaking rod and of the effective size of the leakage path.

Secondary degradation involves changes to a fuel rod subsequent to its initial failure, enlarging the effective size of the leakage path or produce a second (and often larger) path, thereby increasing activity release rates. Although the fission products released directly from a rod can be large enough to pose activity issues, the most significant factor associated with secondary degradation is the dispersal of fuel into the primary system. Large increases in the activity release rates during and after secondary degradation can adversely affect plant operation and almost always add to the cost of running a nuclear plant.

An important aspect to successful NPP operation is detecting fuel failures as soon as they occur, assessing the condition of the leaking fuel and estimate the activity release evolution. It is specifically important to minimize fuel washout since the resulting tramp uranium will increase the background radiation level in the core for up to 10 years. Also, significant tramp uranium levels in the core will make it more difficult to detect new failures, due to the increased background activity level.

The first step to get a good understanding of the mechanisms behind the current primary failures modes and degradation, is to assess if the core is defected or not by coolant measurements during operation. Reliability monitoring during reactor operation is intended to minimize these effects and is based on analyses of the activities of radionuclides in the primary system (primarily xenon, krypton and iodine) with respect to composition and trends relative to time and operating conditions. The composition of fission products in the primary coolant changes with the occurrence of a leak in a fuel rod and varies with the condition of the leak and with operating conditions.

Reliability monitoring provides a means of assessing the state of the fuel during operation, managing the core to minimize the risk of secondary degradation, configuring the next core loading and planning the coming refueling outage. The effects of fuel failures extend throughout plant operation both during and after the cycle in which failure occur, with combined costs to the affected utility and fuel vendor of $1.4 M to $12.3 M.

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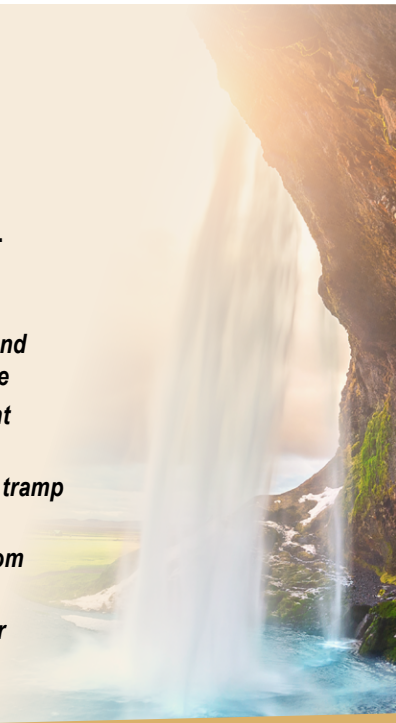
THE DELIVERABLES ARE:

1. A FUEL RELIABILITY HANDBOOK WITH THE FOLLOWING CONTENT LIST:

- ***A. Introduction***
- ***B. Fuel reliability***
  - *I. Primary causes of fuel failures*
  - *II. Secondary degradation of failed fuel causing fuel washout*
  - *III. Current PWR fuel reliability monitoring*
  - *IV. Root cause examinations of failed/degraded fuel*
- ***C. Means to improve fuel reliability***
- ***D. Methodology to determine the burnup of failed fuel (if fuel washout occurs)***
- ***E. Fuel reliability code***
  - *I. Introduction*
  - *II. Basics*
  - *III. User manual*

2. THE SOFTWARE IS EASY TO USE. THE METHODOLOGY USED IN THE SOFTWARE IS UNIQUE AND WITH A HIGH RESOLUTION. THE SOFTWARE CAN DETERMINE IF:

- ***A. The core is defect free or not***
- ***B. The utility was successful in identifying and discharging leaking fuel during the outage***
- ***C. A failed rod is degrading to such an extent that fuel washout may occur later***
- ***D. Fuel washout is occurring and how much tramp uranium has deposited onto the core***
- ***E. Get burnup indication of the failed fuel from other radionuclides than Cs isotopes***
- ***F. Some possibility to determine the number of failed rods***



A.N.T. INTERNATIONAL WILL ALSO FORM A FUEL RELIABILITY CODE - PWR GROUP TO ESTABLISH A FORUM FOR USERS TO EXCHANGE INFORMATION AND EXPERIENCE.

THE MOST RECENT A.N.T. INTERNATIONAL EXPERT

MR. MATTHEW EYRE
FUEL MATERIAL

Mr. Matthew Eyre has a Bachelor's and Master's degrees in Nuclear Engineering from the University of Virginia. He has over 40 years of experience in the operation, maintenance, fuel performance and spent fuel management of US light water reactors.

During his career, Matthew has authored and has contributed to numerous technical papers and industry articles. He has re-ceived industry awards regarding his innovations, which have improved the operations and maintenance of nuclear power plants. Matthew has patents (issued and pending) in the area of spent fuel management.

Through A.N.T. International independent World Class Network of 28 Experts we can provide unique knowledge and experience in the nuclear field.

READ MORE ABOUT OUR EXPERTS »

CUSTOMER FEEDBACK

> **A.N.T. INTERNATIONAL GIVES FAST FEEDBACK ON OUR QUESTIONS**

Based upon the A.N.T. International updated knowledge and international experience, A.N.T. International is the strategic partner in Materials Technology to manage material reactor vessel internal issues and develop material degradation models for service and evaluate the structural integrity of the reactor vessel materials.

A.N.T. International gives fast feedback on our questions and can support in solving plant problems and assist in different research projects because of their experienced team of Experts. In particular, they helped us in developing specific methodologies to assess material degradation for Long Term Operation, LTO.

Also: **The A.N.T International Experts**, **LCC** (LWR Chemistry and component integrity programme), **ZIRAT** (Zirconium Alloy Technology)/IZNA (Information on Zirconium Alloys) programmes, and **AWIKI** are included in our procedures of external consulting to find the state of art knowledge to manage materials issues.

Mr. Juan Ramos Nervi
Materials and Micromechanics Division Head
Nucleoeléctrica Argentina S. A.

Juan Ramos coordinates the characterization and material degradation modeling programs. His expertise areas are micromechanics, pressure vessel embrittlement and zirconium alloys. Nucleoeléctrica has a CANDU power plant and two PHWRs.

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