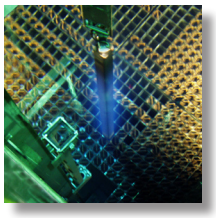

Frequently Asked Questions

Fuel Reliability Guidelines

What is a fuel failure at a nuclear power plant?

A fuel failure refers to a breach in the metal fuel cladding that encases the fuel pellets. The breach can potentially lead to radioactive material (fission products) leaking into the coolant.

What are the causes of fuel failures?

Fuel failures have been traced to several different causes. The most common are corrosion, mechanical "fretting" wear (e.g., foreign material such as a piece of wire vibrating against the fuel rod surface), and pellet cladding interaction (stress buildup on the cladding due to contact with the fuel pellets and interaction with the aggressive radioactive environment on the inside of the fuel rod).

What impacts does a fuel failure have on a nuclear power plant?

Fuel failures can cause nuclear power plants to shut down before they normally would have to for refueling or plant maintenance, leading to lost generation, additional inspections, and replacement fuel purchases. Individual events can cost nuclear plants as much as $40 to $80 million per event, depending on the contributing conditions. The actions associated with identifying and addressing a fuel failure can also lead to unnecessary radiation exposure to workers and equipment.

Do fuel failures differ according to the type of nuclear reactor?

Yes. The two main types of nuclear reactor types, boiling water reactors and pressurized water reactors, tend to have different primary failure causes. The leading fuel failure cause for boiling water reactors is the presence of debris ("foreign material"), which can become trapped in the assembly and vibrate against the fuel rod surface. The primary fuel failure cause for pressurized water reactors is grid-to-rod fretting, where the flow through the fuel assembly (including "cross-flow") induces a relative motion between the fuel rod and the surrounding spacer grids, which can lead to wear and failure. Boiling water reactors have channels that completely separate adjacent fuel assemblies and eliminate cross-flows, but boiling water reactors also generate high steam velocities at the upper end of the fuel assembly that make debris fretting (e.g., piece of wire wearing against the fuel rod) much more likely.

What is the nuclear industry doing to reduce fuel failures?

Collectively, the U.S. nuclear industry has committed to reducing fuel failures. The Fuel Integrity Initiative, which is the industry's plan to reach the Zero by 2010 goal, outlines a number of steps for reducing fuel failures. These include transitioning to the most robust fuel assembly designs as soon as possible; improving foreign material exclusion practices (eliminating "debris"); and developing guidelines for all areas of fuel reliability that address the technological, procedural and operational practices that will enable plant operators to eliminate fuel failures by 2010.

What is EPRI's role?

EPRI is developing a set of five fuel reliability guidelines to assist nuclear plant operators in defining specific actions that should be taken to eliminate the conditions that can lead to fuel failure. Three guidelines are currently available: Fuel Surveillance and Inspection, Pressurized Water Reactor Fuel Cladding Corrosion and Crud, and Boiling Water Reactor Fuel Cladding Corrosion and Crud. Two additional guidelines will be available by August: Grid-to-Rod Fretting and Pellet Cladding Interaction.

EPRI also assists the industry by conducting post-failure analyses and related research and development to ascertain the underlying causes for key failure mechanisms. These activities can point to related factors, such as water chemistry control, that may need modification to avoid fuel failures.

What types of procedures are contained in the guidelines?

The guidelines divide suggested actions into three categories: mandatory, recommended, and good practices. Mandatory practices must be implemented at all plants where applicable. Needed practices must be implemented wherever possible, although alternative approaches are acceptable. Good practices are encouraged, and are expected to provide significant operational and reliability benefits. Across the three completed guidelines, there are five mandatory, 15 needed, and 40 good practices.

Are all nuclear power plants required to comply with the new guidelines?

All U.S. nuclear owners and operators will be required to comply with the guidelines, consistent with the industry's commitment to the Zero by 2010 initiative. While there is no imperative for international nuclear owners to adhere to the guidelines, adopting the mandatory, needed and good practices is expected to provide corresponding operational, safety and economic benefits. A number of EPRI's international members are planning to implement the guidance.

When will the EPRI guidelines be implemented?

After each of the guidelines is formally issued, nuclear power plants will have six months to incorporate the EPRI guidance into their fuel management and inspection programs. Full implementation, e.g., modifications to fuel designs or to the plant, will take longer.

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