GE Hitachi Nuclear Energy

fact sheet

Zinc Injection Passivation (GEZIP)

Control of Shutdown Dose Rates

A passivation process developed by GEH for stainless steel piping surfaces in BWRs has demonstrated that shutdown dose rates due to buildup of radioactive isotopes -- predominantly Co-60 -- can be reduced and controlled by the GEZIP process. The use of GEH's Zinc Injection Passivation process has shown reductions of up to a factor of 10 for plants which have decontaminated and then applied the GEZIP process according to GEH's recommendations. For plants which have not decontaminated, GEZIP has arrested the cycle-to-cycle increase in the first cycle of GEZIP operation, then reduced dose rates consistently in each succeeding cycle. Plants which have applied GEH's noble metal technology (NobleChem™) and continued the GEZIP process at GEH's recommended levels have achieved the best dose rate reductions. Those plants which have combined these efforts with aggressive Co source term reduction have had the lowest long-term low dose rates.

Depleted Zinc Oxide

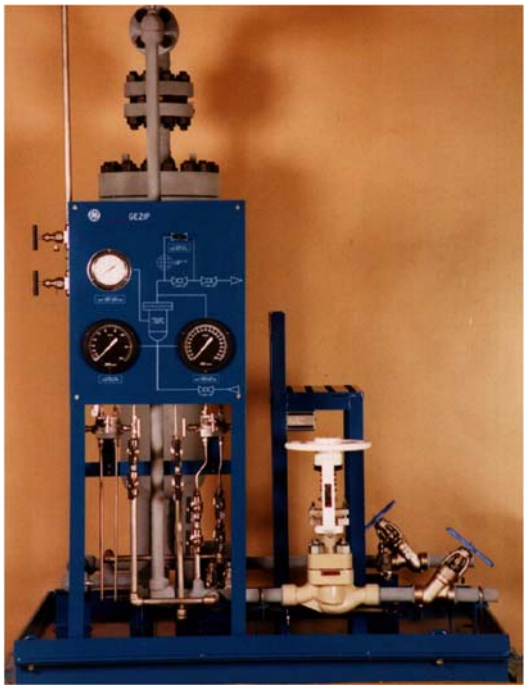
The GEZIP process adds zinc oxide in which the zinc has been depleted to an isotopic concentration of less than 1% Zn-64. This special material, known as depleted zinc oxide (DZO) forms little or no radioactive Zn-65 in the reactor. When added to the feedwater, the zinc oxide (as ionic zinc) becomes incorporated in the plant's stainless steel corrosion film, by occupying sites in the lattice structure where Co would be incorporated, thus minimizing or effectively excluding additional incorporation of Co–60 from reactor water. In addition, the zinc changes the structure of the stainless steel corrosion film, resulting in a thinner, more tightly adherent film, which is less able to hold Co-60. Zn injection also makes the crud deposits on the fuel more tenacious, (Zn-Fe spinel) so that activated Co-60 remains in the fuel deposits instead of being released to the coolant where it would be available to deposit on piping. The combination of these effects results in lower shutdown dose rates on plant primary system piping due to less Co-60 in the piping corrosion film.

GEZIP Skid

The passive GEZIP System is designed to continuously inject a dilute water solution of ionic zinc into the reactor feedwater. A stream of water taken downstream from the feedwater pump discharge is routed through a dissolution vessel containing depleted zinc oxide (DZO) pellets. The sintered DZO pellets dissolve in the diverted feedwater stream providing the ionic zinc. The stream containing the dissolved DZO is returned upstream of the feedwater pump suction and is blended with the main feedwater flow.

Plant Savings

The reduction of radiation levels from the application of the GEZIP process results in the reduction of personnel exposure during drywell work. Lower exposure translates directly into cost savings due to ALARA exposure reduction and more efficient work practices.



GEZIP Skid

For more information, contact your GE Hitachi Nuclear Energy sales representative.

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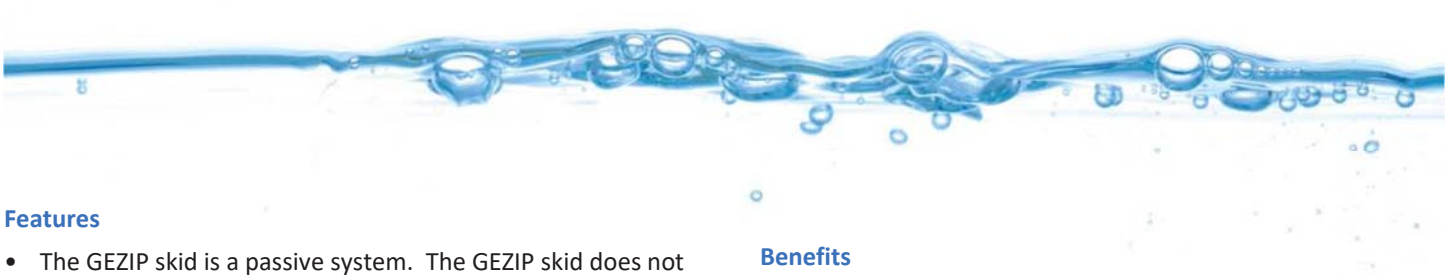

Features

- The GEZIP skid is a passive system. The GEZIP skid does not require electrical power or an air supply to operate.
- Flow through the skid is driven by the differential pressure between the discharge and suction of the reactor feed pumps.
- Zinc dissolution is controlled by the flow rate through the skid and the quantity of DZO pellets.
- A manual flow control valve is used to adjust the flow to the desired rate.
- The processes for DZO pellet production have been carefully developed and are controlled to provide the most consistent and highest purity material available.

Benefits

- DZO displaces radioactive Co-60 from the corrosion film (oxide layer), lowering shutdown dose rates and keeps more Co-60 on the fuel.
- DZO provides the additional benefit of reducing crack growth rates by forming a more protective oxide layer on base metals, such as stainless steel and Alloy 600.
- The passive operating system requires only minimal operation and maintenance.
- At the low FW Fe concentrations typical of most Japanese BWRs, even a small amount of injected Zn (i.e. ~0.1 to 0.3 ppb range) can have a clear beneficial effect on post-shutdown dose rates.
- Simplistic design makes installation and incorporation easy with little personnel training and procedural revision.

Proven Results

Zinc injection has been shown, both through extensive laboratory testing and by inspection results from operating reactors, to lower radiation dose rates. The addition of zinc does this in two ways: suppressing the release of activated cobalt from the fuel by making the fuel crud layer more tenacious and by reducing the incorporation of Co-60 into the corrosion films of the primary system piping and components.

Did you know? Zn injection was actually developed after it was noted from early BWR experience that plants with a natural low-level Zn source in the feed water (from brass condenser tubing) had consistently lower recirculation piping post-shutdown dose rates.

Available Now

GEH provides the equipment system for adding the depleted zinc oxide to the plant. The equipment is a passive (no electrical power required) skid-mounted piping system which includes a small vessel for the DZO (supplied as sintered pellets) and associated piping, valves, and flow and temperature indicators.

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