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SPAIN **R-384**

SHUTDOWN CHEMISTRY IN SPANISH PLANTS

Keywords: OPERATIONAL AND MAINTENANCE TECHNIQUES; SHUTDOWN CHEMISTRY; OUTAGE TIME; DOSE RATE; BORATION

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Objectives: Investigate shutdown procedure improvements implemented in Westinghouse designed Spanish PWRs in the areas of reduced critical path time, in-core and ex-core activated corrosion products solubilization and reactor coolant system radiation measurements.

Comments: Since 1986 the five large Spanish Westinghouse PWR plants have instituted a series of modifications to the refueling shutdown procedures that have achieved significant time optimization and potential benefits in terms of ex-core activity reduction. These changes were:

- Boration to refueling shutdown concentration prior to cooldown.
- Use of a new charge of resin in the Chemical and Volume Control System mixed bed demineralizer in the H^+/OH^- form for coolant purification during shutdown.
- Reactor Coolant System draindown as soon as the Co-58 peak in solubility has been confirmed, with a coincident hydrogen peroxide residual, and has been observed to be undergoing reduction by ion-exchange purification.
- Out-of-core radiation fields are believed to be reduced by application of this optimized procedure in several plants. Calculations performed at Vandellos 2 during the 2nd refueling shutdown yield an estimate of 20% reduction.
- Critical path time for the refueling outages has been reduced significantly. Calculations at Asco 2 2nd refueling indicated times savings about 2.5 days.

Remarks/Potential for dose limitation: This evaluation has demonstrated the benefit in terms of dose rate reduction of establishing acid-reducing environments and maintaining them for certain time periods prior to establishing acid-oxidizing chemistry.

References: Llovet, R., Kormuth, J.W., Fernandez Lillo, E., Boronat, M., Ortega, A., "Shutdown Chemistry in Spanish Plants," *Water Chemistry of Nuclear Reactor Systems 6*, Vol. 2, pp. 67-73, British Nuclear Energy Society, London, 1992.

Duration: from: 1986 to: 1992

Funding: N/A

Status: Completed

Last Update: September 16, 1993