



NRC NEWS

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NRC ISSUES AUGMENTED INSPECTION TEAM REPORT ON SAN ONOFRE NUCLEAR GENERATING STATION STEAM GENERATORS

Faulty computer modeling that inadequately predicted conditions in steam generators at the San Onofre Nuclear Generating Station and manufacturing issues contributed to excessive wear of the components, U.S. Nuclear Regulatory Commission inspectors have concluded.

Unit 3 at the plant near San Clemente, Calif., operated for about one year following replacement of its steam generators when control room operators received alarms Jan. 31 that indicated reactor coolant was leaking into a steam generator. The leak was unexpected and Southern California Edison Co. operators responded appropriately by shutting down the reactor. Plant safety systems functioned as designed in the shutdown.

The team also determined that Southern California Edison provided the NRC with all the information required under existing regulations about proposed design changes to its steam generators prior to replacing them in 2010 and 2011.

These and other findings of the Augmented Inspection Team sent to the plant were contained in a report released today. The inspection was conducted by a team from the NRC's Region IV and Region II offices, the resident inspector from San Onofre Nuclear Generating Station, one engineer from the NRC Office of New Reactors, two engineers from the NRC Office of Nuclear Reactor Regulation, and one engineer from the NRC Office of Research.

The NRC will schedule a meeting in the near future to receive and respond to public comments and questions about the now-finalized report and the inspection report process, and other issues that may arise. Open items in the report will be subject to follow-up inspections

The inspection team was directed, in part, to identify the circumstances surrounding the tube degradation; review the licensee's actions following discovery of the conditions; evaluate the licensee's review of potential causes of the unusual steam generator tube wear; review the computer modeling used in the design of the steam generators; and assess the differences in wear

between the Unit 2 and Unit 3 steam generators, manufactured by Mitsubishi Heavy Industries. Tube degradation occurred in both units, but it was greater in Unit 3 than Unit 2.

In an effort to identify the causes, the licensee brought in a large number of outside industry experts, consultants, and steam generator manufacturers, including Westinghouse and AREVA, to perform thermal-hydraulic and flow induced vibration modeling and analysis. The licensee identified the most probable causes of the tube-to-tube wear as a combination of higher than predicted thermal/hydraulic conditions and changes in the manufacturing of the Unit 3 steam generators, a conclusion with which the NRC team agreed. The changes in the manufacturing resulted in less contact forces between anti-vibration bars and the tubes. The combination of these causes allowed excessive vibration to occur.

The report also identifies 10 issues requiring additional follow-up by the NRC including: (1) further review of the adequacy of the plant's post trip/transient procedure; (2) review of the adequacy of acoustical alarms used to identify loose parts in steam generators; (3) evaluation of steam generator retainer bar design for vibration impacts; (4) evaluation of and control of the Unit 3 divider plate repair; (5) Unit 3 steam generator shipping requirements; (6) lack of tube bundle support for steam generators during shipment; (7) evaluation and disposition of accelerometer data used to measure unusual movement of steam generator shipping packages; (8) review of the process used by the NRC to approve the plant's steam generator replacement; (9) control of manufacturing differences; and (10) adequacy of Mitsubishi Heavy Industries' computer simulation modeling.

Operators shut down Unit 3 on Jan. 31, after the tube leak in one steam generator was identified; Unit 2 had been shut down for a scheduled maintenance outage. Both reactors have remained safely shutdown. On March 27, the NRC issued a Confirmatory Action letter documenting actions that Southern California Edison officials have agreed to take prior to seeking permission to restart the reactors. The NRC has been conducting inspections to determine the extent and cause of the tube degradation. The plant will not be permitted to restart until the licensee has developed a plan to prevent further steam generator tube degradation and the NRC independently verifies that it can be operated safely.

At San Onofre, NRC requires steam generator tubes with more than 35 percent wear to be plugged. As reported by the company to the NRC last week, in Unit 2, 1,595 tubes showed some wear and 510 were plugged – six tubes had wear of more than 35 percent. In Unit 3, 1,806 tubes showed wear of some kind and 807 tubes were plugged – 381 tubes had wear greater than 35 percent. The licensee chose to plug some tubes with wear less than 35 percent as a preventive measure. Details on Unit 2 wear can be found [here](#), and at this location for [Unit 3](#). Each reactor has two steam generators and each steam generator has 9,727 tubes.

The report is available on the NRC web page for San Onofre's steam generator tube degradation at: <http://www.nrc.gov/info-finder/reactor/songs/tube-degradation.html>.

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