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Millstone Power Station
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Dominion

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Docket No. 50-336
B18580

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Millstone Nuclear Power Station, Unit No. 2
Supplemental Response to NRC Bulletin 2001-01
Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles

On January 24, 2002, Dominion Nuclear Connecticut, Inc. (DNC) met with the Nuclear Regulatory Commission (NRC) to discuss the inspection of the Millstone Unit No. 2 reactor head during the upcoming refueling outage. During this meeting the previous submittals made by DNC on September 4, 2001,(1) and December 28, 2001,(2) were discussed along with the plans and contingencies for the upcoming inspection.

Following the January 24, 2002 meeting, the NRC requested that the information presented be summarized and submitted on the docket by DNC. A summary of the inspection methodology, the statistical analysis used for the contingency plan, and the risk associated with a postulated catastrophic failure of a single reactor vessel head nozzle was requested. The purpose of this letter is to provide that information.

Attachment 1 contains a summary of the methodology for the inspection, the information outlining the risk analysis completed to support the contingency plans and the Control Rod ejection accident analysis.

There are no regulatory commitments contained within this letter.

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(1) J. A. Price letter to U.S. Nuclear Regulatory Commission, "Response to NRC Bulletin 2001-01, Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles," dated September 4, 2001.

(2) J. A. Price letter to U.S. Nuclear Regulatory Commission, "Supplemental Response to NRC Bulletin 2001-01, Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles," dated December 28, 2001.

A088

Should there be any questions regarding this submittal, please contact Mr. Paul R. Willoughby at (860) 447-1791, extension 3655.

Very truly yours,

DOMINION NUCLEAR CONNECTICUT, INC.

J. Alan Price
Site Vice President - Millstone

Attachment (1)

cc: H. J. Miller, Region 1 Administrator
J. T. Harrison, NRC Project Manager, Millstone Unit No. 2
NRC Senior Resident Inspector, Millstone Unit No. 2

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Attachment 1

Millstone Nuclear Power Station, Unit No. 2

Supplemental Response to NRC Bulletin 2001-01
Summary of Inspection Methodology,
Contingency Plan Risk Analysis and Accident Analysis

Supplemental Response to NRC Bulletin 2001-01 Summary of Inspection Methodology, Contingency Plan Risk Analysis and Accident Analysis

Following the January 24, 2002, meeting between the Nuclear Regulatory Commission (NRC) and Dominion Nuclear Connecticut, Inc. (DNC), the NRC requested that the information presented be submitted on the docket by DNC. The information requested by the NRC included a summary of the methodology for the inspection, the information outlining the risk analysis completed to support the contingency plans and the Control Rod ejection accident analysis.

Methodology

DNC performed an evaluation of an alternate examination technique to be used to inspect the Millstone Unit No. 2 reactor head vessel penetrations (RVHP) in lieu of a bare head visual examination. The inspection employs two methods to examine 1) the interference fit of the penetration tube with the head and 2) the penetration tube itself.

The method chosen to inspect the RVHP interference fit is an ultrasonic test (UT) technique which focuses on the amount of acoustic energy reflected at the interface between the Inconnel 600 penetration tube and the carbon steel vessel head. The UT technique is based on the fact that if the contact surface of the interference fit is disturbed by erosion, corrosion, or deposits of foreign material (corrosion products or boron deposits), the amount of acoustic energy reflected at that interface is altered significantly.

The evaluation concluded that ultrasonic C-scan presentations can also be utilized to reliably detect a leak path through the interference fit portion of the annular region, above the J-groove weld in the RVHPs. Based on a review of actual empirical test data, the technique provides a reliable substitute, or alternate examination method, for a bare head visual inspection currently utilized for the detection of leaking RVHPs.

Secondly, the penetration tube is examined using ultrasonic testing to ensure the integrity of the tube itself. Ultrasonic inspection techniques have been successfully demonstrated, by the vendor chosen by DNC to perform the inspection, for the detection of axial and circumferential cracking in the RVHPs, in the tube away from the J-groove weld, and in the tube over the weld. The performance demonstration was witnessed by DNC personnel, Electric Power Research Institute representatives, and personnel from various other utilities.

Contingency Plan Risk Analysis

DNC plans to perform 100% volumetric inspection of the Unit 2 RVHPs during the upcoming 2R14 refueling outage. However, as this is a first of its kind inspection approach, there is the possibility of UT equipment failure or some unanticipated interference due to head geometry. Therefore, DNC has developed a contingency plan to inspect less than 100% of the penetrations based on a finite-population statistical method using a 90% confidence limit which is similar to the Steam Generator Tube inspection standard. The statistical method predicts, with a 90% confidence limit, the upper bound on the number of uninspected RVHPs with potentially unacceptable flaws. It is also predicated on the caveat that any indication of primary water stress corrosion cracking (PWSCC) will require inspection of the entire population of penetrations.

Based on this approach, a minimum number of 65 of 78 penetrations would need to be inspected without any PWSCC detected. This contingency plan would only be exercised if all confidence requisites are met.

Accident Analysis

The Control Element Assembly (CEA) ejection accident is initiated by a failure in the control rod drive pressure housing which is assumed to result in the rapid ejection of a CEA. This results in a rapid nuclear power transient and a highly perturbed power distribution which could lead to localized fuel damage. In addition, the rapid nuclear power excursion can result in a significant short-term heatup of the coolant with a resultant Reactor Coolant System (RCS) pressure increase, although in the long-term, the RCS will depressurize due to the break in the reactor coolant pressure boundary.

The short term consequences of accident are analyzed in Millstone Unit No. 2 FSAR Section 14.4.8 for both rated power and hot zero power operating conditions. Separate evaluations are performed for deposited enthalpy, DNBR, RCS pressurization, and radiological dose consequences. The results of the CEA ejection accident meet the established analysis acceptance criteria. The deposited enthalpy is less than 280 cal/g. Less than 11.5% of the core will experience fuel failure due to the penetration of the DNBR limits, and the maximum RCS pressure will not exceed 110% of design pressure. The radiological consequences are well within the 10 CFR 100 exposure limits.

The longer term consequences of the CEA Ejection accident are characterized by a small-break Loss of Coolant Accident (LOCA) as the failure of the pressure housing is assumed to result in a breach of the primary coolant pressure boundary. The small break LOCA is evaluated in FSAR Section 14.6.5. The limiting break location is in the RCS cold leg. In the CEA ejection, the break is more characteristic of a hot leg break and the reactor trip is earlier. Because of this, the long-term aspects of the CEA ejection are bounded by the assumptions provided in the Millstone Unit No. 2 FSAR Section 14.6.5 for a small break LOCA.

The risk analysis shows the following results for a medium break LOCA, in this case the catastrophic failure of a RVHP:

- successful mitigation of the event requires operation of only one HPSI pump;
- the break location at the top of the reactor vessel head is favorable as all ECCS flow is available for core cooling; and
- the MAAP computer program simulation results predict no core damage or containment failure given successful mitigation of this postulated scenario.