

TOLEDO EDISON COMPANY
DAVIS-BESSE NUCLEAR POWER STATION UNIT ONE
SUPPLEMENTAL INFORMATION FOR LER NP-32-80-02

DATE OF EVENT: February 14, 1980

FACILITY: Davis-Besse Unit 1

IDENTIFICATION OF OCCURRENCE: The design of two Reactor Coolant System (RCS) pipe whip restraints on each coolant loop did not meet the acceptance criteria

Conditions Prior to Occurrence: The unit was in Mode 1, with Power (MWT) = 2772, and Load (Gross MWE) = 923.

Description of Occurrence: While performing the analysis to verify the design of the RCS pipe whip restraints in compliance with Item 6.a of OI&E Inspection Report No. 50-346/79-23 it was discovered that four RCS pipe whip restraints, designated HLR-5 and HLR-6, two on each hot leg did not meet the acceptance criteria set forth in Section II, Paragraph 1.1 of the "Davis-Besse Nuclear Power Station Unit 1 Verification Study of Pipe Whip Restraints on the Reactor Coolant System", dated December 7, 1979. The analysis showed that the bolts connecting restraints HLR-5 and HLR-6 to their supporting beams did not remain elastic as required in Section II, Paragraph 1.1.b of our December 7, 1979 report, and thus limited the capacity of the restraints.

Designation of Apparent Cause of Occurrence: The cause of the occurrence was a design error by the architect/engineer, Bechtel Power Corporation. The designer failed to take into account the eccentricity in the bolted connection between restraints HLR-5 and HLR-6 and their support beams. This eccentricity caused a non-uniform load distribution to the bolts, which was not originally considered, thus underpredicting the load to the maximum stressed bolt, with the result being the connection not meeting acceptance criteria. Bechtel has reviewed all other pipe whip restraints to see if any contain bolted connections which could have a similar design error. This review verified that no other pipe whip restraints have similar bolted eccentric connections. Based on this review, there is no reason to believe that this design error was a result of a generic deficiency in the original design method.

Analysis of Occurrence: Pipe whip restraints are not required for normal operation. The analysis performed thus far indicates that the bolted connection between pipe whip restraints HLR-5 and HLR-6 and their support beams fails to meet the acceptance criteria when subjected to a double ended hot leg pipe rupture at the steam generator inlet nozzle or at restraint HLR-6. A review of the RCS pipe stress analysis shows that the pipe stress levels at these two locations are 46 and 57 percent of the stress levels required by NRC Branch Technical Position MEB 3-1 for postulating a pipe break. These non-mechanistic pipe breaks are postulated, in accordance with NRC criteria even though not justified by calculated pipe stress levels, because they are at either a terminal pipe end or one of the two highest stressed intermediate locations.

The analysis which indicated the bolted connection would not meet acceptance criteria was a single degree of freedom dynamic analysis. The analysis modeled the bolts using a tension and shear spring for each bolt. Finite element models were developed for restraints HLR-5 and HLR-6 and their supporting beams. These models were then coupled and analyzed using time-history and energy balance techniques. An RCS blow-down time-history, developed by Babcock and Wilcox was used as the forcing function. An allowable stress of 0.9 of the dynamic yield stress was established for the bolts in the connection between HLR-5 and HLR-6 and their support beams. The criteria was also established that if any one bolt were stressed to the allowable it would constitute a failure of all the bolts in the connection. The connection was shown to be unacceptable under these criteria. However, there are several factors which have not been considered which make the above analysis conservative; they are:

1. The analysis used a single degree of freedom model instead of a multi-degree of freedom model.
2. The analysis assumed that the load resulting from the pipe break was totally applied at the point of the pipe break instead of at multiple locations along the pipe, (i.e. pipe bends).
3. No inelastic load redistribution of the bolt loads was considered.
4. No damping of the system was assumed at impact.
5. The energy absorbing capacity of other structures, such as the secondary shield walls, was not considered.
6. No loss of energy was considered to occur at impact between the RCS hot leg and the restraint.

Considering the above factors of conservatism the capacity of the bolted connection between restraints HLR-5 and HLR-6 and their support beams will increase by a minimum of 70 percent to a maximum of 220 percent. In the current analysis the bolted connection falls short of our acceptance criteria by 60 percent. This demonstrates there is a high probability that the restraints will perform their intended function.

Based on the conservatisms in establishing the acceptance criteria, the conservative analytical methodology and the low calculated stress levels in the RCS piping, continued operation of the facility until the refueling outage, currently scheduled to begin April 10, 1980, will pose no danger to the health and safety of the public or station personnel.

The Company Nuclear Review Board has reviewed this occurrence, in particular the low stress levels in the RCS piping and the low probability of the occurrence of a design basis accident which would require restraints HLR-5 and HLR-6 to perform their intended design function. The Company Nuclear Review Board has determined that continued operation until shutdown for the scheduled refueling outage does not compromise the health and safety of the public.

Corrective Action: Under Facility Change Request 80-047, pipe whip restraints HLR-5 and HLR-6 and their support beams will be modified during the refueling outage currently scheduled to begin April 10, 1980. The modifications will either increase the capacity of the connection between restraints ELR-5 and HLR-6 and their support beams or reduce the load transmitted to the connection by the addition of shear plates and reducing the gap between the restraints and the hot leg pipe. The facility will not be returned to operation, after the refueling outage, until these modifications are completed.

Failure Data: There are no previous reported instances where these pipe whip restraints have not met acceptance criteria.

LER #80-010