



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
SUPPORTING THE ACTION TAKEN ON FUEL ASSEMBLY HOLDDOWN SPRING FAILURES

METROPOLITAN EDISON COMPANY
JERSEY CENTRAL POWER AND LIGHT COMPANY
PENNSYLVANIA ELECTRIC COMPANY

THREE MILE ISLAND NUCLEAR STATION, UNIT NO. 1

DOCKET NO. 50-289

Introduction

By our letter dated July 1, 1980, we requested Metropolitan Edison Company (the licensee) to furnish information on the holddown springs used in the fuel assemblies at the Three Mile Island Nuclear Station, Unit No. 1. Our concerns stemmed from the discovery of the fuel assembly holddown spring failures that occurred at Davis-Besse Unit No. 1, Crystal River Unit No. 3 and Oconee Unit No. 1. The holddown springs which are located in the upper fitting of the Babcock and Wilcox (B&W) Mark B-4 fuel assembly accommodate length changes due to thermal expansion and irradiation growth while still providing a positive holddown force for the assembly.

Discussion and Evaluation

In a letter dated September 10, 1980 (TLL 447), the licensee responded to our concern which indicated that no failed holddown springs have been identified at TMI-1 resulting from reviewing Cycle 5 verification tapes of the fuel assemblies now in the core and the special video examinations of fuel assemblies in the spent fuel pool. In addition, an evaluation performed by B&W indicated that no significant safety concerns exist for TMI-1 operation even if an unlikely event of broken holddown springs were to occur.

An archival material examination of the spring material performed by B&W revealed a coarse grain structure on the outer surface and a "duplex" material grain size (i.e., large variation between interior grain sizes). A coarse outer grain structure is indicative of reduced resistance to fatigue crack initiation from which we conclude that the failures were initiated from fatigue cracks, except for one of the failures (at Crystal River), however, these fatigue cracks appeared to have propagated by stress corrosion cracking (SCC). The conclusion that these cracks propagated by stress corrosion was supported by the intergranular nature of the cracks, coupled with etch tests indicating that the suspect material had lower than desired resistance to SCC. Examination of the heat treatment records revealed that there has been some variations in solution anneal and drawing schedules in two batches of springs, which have resulted in the "duplex" grain structure with lowered SCC resistance. Thus, the cause of

the failures was attributed to an improper material conditioning characterized by a coarse outer grain structure (which is indicative of less fatigue resistance) and a duplex inner structure (which is indicative of less resistance to stress corrosion cracking). In the case of the single Crystal River failure, we have judged this failure to have occurred solely by fatigue. Improper component design did not contribute to these failures for two basic reasons: 1) stress analysis indicated that the spring design was adequate for the loads involved and 2) except for the one failed spring at Crystal River 3, all the failed springs (at Davis-Besse 1 and Oconee 1) come from the batches with suspect improper material conditioning.

The material that was improperly conditioned was not used in fabricating the holddown springs for the fuel assemblies at TMI-1 and therefore such failures are not expected to occur. However, to further insure that such failure will not occur in the future, the licensee has committed that future reload fuel assemblies will contain holddown springs fabricated from materials which specifications call for improved material and process controls. The improved material will be more resistant to fatigue and stress corrosion cracking. In addition, the licensee has committed to establishing a fuel surveillance program to inspect fuel assemblies during each outage for indications of holddown spring failures or damage to other assembly components.

Based on our evaluation, we conclude that the licensee has adequately responded to our concerns in regard to the potential failures of the holddown springs of the fuel assemblies at TMI-1. In addition, we find the proposed commitments to a surveillance program described above insures against future failures and is acceptable. This action is not hazardous to public health and safety and therefore is acceptable.

Dated: April 20, 1981