LICENSEE EVENT REPORT

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	er and describing and compastic consequences (m) [CEP-32-80-08) A broken fuel assembly holddown spring was discovered 5/13/80 during a]
	post-refueling cure inspection. Subsequent video inspection and review of previous
	video tapes uncovered a rotal of 20 broken springs on Cycle I fuel (semblies (18 in)
	the core, 2 in the spent fuel pool). Extensive analysis into the consequences of con-
	timed plant operation with broken springs assured no miverse safety effects would
	occur. Areas of concern included fuel lift, apring holddown force, effects of frag-
	ments and control red interference. There was no danger to public or station personnel.
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	Spring failure was initiated by fatigue induced by wear and/or material defects.
	Final breakage was caused primarily by stress corresion cracking. A combination of
ETE	improper heat treatment, spring etress, and long periods of plant operation between
DE	200-300°F contributed to these failure modes. All 177 springs used in Cycle 1 have
EE.	been replaced with improved material.
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TOLEDO EDISON COMPANY DAVIS-RESSE NUCLEAR POVER STATION UNIT ONE SUPPLEMENTAL INFORMATION FOR LER NP-32-80-08

DATE OF EVENT: May 14, 1980

PACHITY: Davis-Besse Unit 1

IDENTIFICATION OF OCCURRENCE: Failed fuel assembly hold-down strings

Conditions Prior to Occurrence: The unit was in Mode 6 with Power (MWT) = 0 and Load (Gross MAE) = 0.

Description of Occurrence: Paring an Inspection of the reactor core following completion of the 1980 refueling, one fuel assembly hold-down spring was found to be broken. This assembly was previously irradiated in the cycle 1 core.

Subsequent review of available videotapes uncovered several other apparently broken springs. All were damaged prior to removal of the reactor vessel upper pleasum before refueling. Further video inspection of all 133 cycle 1 fuel assemblies remaining in the core for cycle 2 and the 34 assemblies transferred to the spent fuel pool identified a total of twenty (20) broken hold-down springs. Of these, 18 were in the core and two were in the spent fuel pool.

Most failures involved a single break near the transition region between the "dead" and "live" coils of a spring. The single major exception was one spring which had one break at the lower transition region and another about 1/3 coil up, leaving a spring section approximately five inches long wedged between the "dead" and "live" coils.

Designation of Apparent Cause of Occurrence: Investigation into the cause of the apring failures covered several areas: metallographic examinations of broken and unbroken irradiated springs and of Inconel X-750 spring material archive samples; investigation of spring manufacturing records and the material boars from which they were produced; and evaluation of reactor operating history.

Metallurgical examination of broken springs has determined that the initiating mechanism for spring failure was fatigue induced by either wear and/or inherent material defects. Final breakage was caused primarily by stress corrosion cracking but may have been aided by continued fatigue. Examination of archive spring material and broken and unbroken springs revealed increased susceptibility to both fatigue and stress corrosion cracking beyond currently accepted standards. The metal exhibited large grain structure at the surface, which increases the likelihood of fatigue failure, and duples interior grain structure (combined large and small grain) which is undesirable for stress corrosion cracking. Such a grain structure is indicative of improper heat treatment. This possible variation in heat treatment is judged a primary contributor to spring breakage. Samples of material failed to pass etch tests and rising load tests confirming susceptibility to stress corrosion cracking.

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Evaluation of plant operating history showed several areas which may have contributed to spring failure. The high static stress on hold-down springs was increased by both reactor coolant flow and various plant transients such as beatup and cooldown, leading to increased fatigue cycling. Fairly long periods of reactor operation at hot shurdown, in the range 200-300°F, could have provided the caralyst to induce stress corrosion cracking.

Analysis of Occatronce: There was no danger to the 1 .1th and safety of the public or to station personnel.

Babcock and Wileox conducted an extensive analysis into the consequences of continued plout operation with one or more broken hold-down springs. Areas of concern included fuel assembly hydraulic lift force analysis, hold-down capability of a broken spring, effects of broken spring fragments, control rod interference and potential consequences of operation with fuel assembly lift. Results of this arelysis assure that the plant can be operated safely with broken springs.

At no time during operation with broken springs did any of these postulated events occur. All spring fragments were retained within the fuel assembly upper end fittings; there is no evidence of fuel assembly movement and all control rods properly inserted during the reactor shutdown. Brief elaboration of each analysis point follows.

The largest spring fragment which can escape a fuel assembly upper end fitting into the Reactor Coolant System is less than a full coil (3/4 point) and would not cause damage affecting safe plant operation. Spring failure modes have been postulated which can induce additional drag on a control rod. This would increase rod drop time for that control rod but the overall reactivity insertion effect is acceptable for the safety analysis. In the extremely unlikely event that a fragment might prevent a control rod from inserting, no conditious adversely affecting plant safety would occur. The shutdown margin always assumes failure of the highest worth rod to insert and such a rod would be detected in mouthly control rod exarcising required by Technical Specifications.

A maximum of 56 fuel assemblies can lift with no hold-down force; however, testing on simulated breaks shows that even a spring with a double break will retain sufficient force to prevent lifting. Even if a fuel assembly did lift, there would be no adverse consequences with respect to fuel assembly or control component damage, reactivity insertion (0.1% A K/K if all rodded assemblies lift), or safe plant operation.

Corrective Action: The held-down springs on all 133 fuel assemblies from cycle 1 that are used in cycle 2 were replaced between June 26, 1980 and July 6, 1980 under Facility Change Request 80-162. Replacement of springs on all fuel assemblies in the spent fuel pool was completed by June 16, 1981. The replacement springs were manufactured to current specifications, incorporating improvements in grain size control, annualing process, ceiling and dimensional standards, and several other areas.

The springs on all 44 fresh fuel assemblies were manufactured to these specifications originally so did not require replacement. These new springs are much less suspectible to fatigue and stress corrosion cracking and are expected to perform satisfactorily.

Hold-dorn springs on all cycle 2 fuel assemblies will be videotaped at the accord refueling outage to confirm their acceptability. In the extremely unlikely event of spring failure prior to that time continued plant operation will not be affected, as justified by the safety analysis results. However, routine surveillance should uncover possible significant effects. Technical Specifications require monthly exercising of control rods to detect interference. Also, the vibration and loose parts monitoring system can detect spring fragments down to four nunces (1/3 coil) should any pieces escape the upper end fitting.

These corrective actions and supporting safety evaluations lead to the conclusion that continued safe operation of Davis-Besse is assured.

Failure Data: There have been no previous similar reportable occurrences.

LER #80-040