REGULAT●Y INFORMATION DISTRIBUTIO● SYSTEM (RIDS)

ACCESSION NBR: 8012160435 DOC. DATE: 80/12/09 NOTARIZED: NO DOCKET #
FACIL: 50-269 Oconee Nuclear Station, Unit 1, Duke Power Co. 05000269
50-270 Oconee Nuclear Station, Unit 2, Duke Power Co. 05000270
50-287 Oconee Nuclear Station, Unit 3, Duke Power Co. 05000287

AUTH. NAME	AUTHOR AFFILIATION
PARKER, W. O.	Duke Power Co.
RECIP. NAME	RECIPIENT AFFILIATION
DENTON, H. R.	Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards addl info re insp of fuel assembly holddown springs at facility & safety evaluation of operation w/broken springs in core.

DISTRIBUTION CODE: A001S COPIES RECEIVED: LTR 1 ENCL 1 SIZE: 6
TITLE: General Distribution for after Issuance of Operating License

NOTES: M Cunningham: all amends to FSAR & changes to Tech Specs. 05000269
AEOD, Ornstein: 1cc.
M Cunningham: all amends to FSAR & changes to Tech Specs. 05000270
AEOD, Ornstein: 1cc.
M Cunningham: all amends to FSAR & changes to Tech Specs. 05000287
AEOD, Ornstein: 1cc

	RECIPIENT ID CODE/NAME		COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME		COPIES LTTR	COPIES ENCL
ACTION:	REID, R	04	13	13				
INTERNAL:	D/DIR, HUM FAC	08	1	1	DIR, DIV OF LIC		1	1
	I&E	06	2	2	NRC PDR	02	1	1
	OELD	11	1	0	OR ASSESS BR	10	1	0
	REG FILE	01	1	1				
EXTERNAL:	ACRS	09	16	16	LPDR	03	1	1
	NSIC	05	1	1				

DEC 17 1980

TOTAL NUMBER OF COPIES REQUIRED: LTTR ~~37~~ 49 ENCL ~~27~~ 38

S

DUKE POWER COMPANY
POWER BUILDING
422 SOUTH CHURCH STREET, CHARLOTTE, N. C. 28242

WILLIAM O. PARKER, JR.
VICE PRESIDENT
STEAM PRODUCTION

December 9, 1980

TELEPHONE: AREA 704
373-4083

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287

Dear Sir:

In a letter dated July 1, 1980, the NRC Staff requested information concerning the inspection of fuel assembly holddown springs at the Oconee Nuclear Station and the safety evaluation of operation with broken springs in the core. My letter of July 8, 1980 referenced Licensee Event Report (LER) RO-269/80-15 dated June 6, 1980, as providing the requested information. However, the Staff has indicated that this response is considered to be inadequate. Therefore, attached please find Duke Power Company's responses which address directly each of the July 1 questions.

Duke considers that the attached responses, in conjunction with LER RO-269/80-15, adequately address the NRC questions and that no further information is required.

Very truly yours,

William O. Parker, Jr.

William O. Parker, Jr.

FTP:scs

A001 s 1/1

8012160435

Q

DUKE POWER COMPANY
OCONEE NUCLEAR STATION

Answers to Holddown Spring
Questions from NRC

Question 1

(If the reactor is down for refueling and the reactor vessel head is off) Examine all fuel assembly holddown springs in the core and in the spent fuel pool and report the number and extent of damage on the springs and affected assembly components.

Or

(Alt.) (If the reactor is operating.) Review video tapes of the core from the last refueling and examine all assemblies in the spent fuel pools. Report the number and extent of damage on the springs and affected assembly components.

Response

Oconee Units 1 and 2 are currently operating; Oconee Unit 3 is shutdown for refueling. Prior to Unit 3's shutdown, the 531 fuel assemblies in the three Oconee cores were examined by review of the post-refueling, core verification videotapes. No broken or damaged holddown springs were observed in the cores. All 686 fuel assemblies in the spent fuel pools have been specially examined by underwater TV. Four of these 686 spent assemblies have been observed to have broken holddown springs. All four springs appear to be only broken once. There is no apparent damage to the fuel assemblies or other components. It should be noted that the broken end of one spring appears to be in contact with two fingers of the orifice rod assembly in this fuel assembly.

During the current refueling outage, all fuel assemblies in the Unit 3 core will be visually examined prior to fuel movement using an underwater TV camera.

Question 2(a)

Provide a discussion of the safety significance of operating with one or more broken springs in the core. Your discussion should include, but not necessarily be limited to the following:

a. Assume the holddown spring is broken, provide an estimate of the flow conditions under which the assemblies would be levitated. (Provide the value of the force required to lift the assembly, the flow conditions under which that force would be supplied, the number of coolant pumps that would be in operation under such conditions, and the schedule of reactor operations under which such conditions might have been achieved.) Contrarily, demonstrate the margin between the assembly weight and the calculated maximum applied lift-off force, if there is such margin.

Response

Assuming no holddown force, no fuel assemblies at Oconee will lift during one, two, or three pump operation. During four pump operation, the Oconee Units will experience the following fuel assembly lift forces at the location of maximum lift:

Oconee 1	-68 lbf
Oconee 2	+24 lbf
Oconee 3	+ 9 lbf

It is important to note that fuel assemblies with control rod assemblies always experience a negative lift force under all pump combinations.

Actual holddown springs were tested after having been broken to determine what residual holddown forces remained. The springs were cut at either one or two locations corresponding to the locations where breaks were observed in the field. The residual holddown forces that were measured during these tests ranged from 64 to 500 lbf. Therefore, it can be concluded that no fuel assemblies at Oconee would experience a net positive lift during normal operation if a holddown spring were to break in a manner similar to the previously discovered broken holddown springs.

Question 2(b)

b. Have any loose assembly parts (i.e., broken springs, pieces of cladding) been observed anywhere in the primary system? Describe your methods for loose part detection. Are there installed noise detectors capable of detection of broken springs, pieces of cladding, or vibrating assemblies?

Response

No loose parts have been observed in the primary systems of the Oconee Units. The Oconee loose parts monitors employ a piezoelectric crystal sensor, amplifier, and speaker system to detect loose objects impacting in the primary system. At each Unit there are 22 sensors located about the NSSS. There are four on the incore detector guide piping; there are four on the reactor coolant pump (RCP) suctions; there are four on the RCP discharges; there are four at points along the steam generators; there are two on the two core flood lines to the reactor vessel; there are two on two control rod drive mechanisms; there are two on the main feedwater lines. All 22 points are being specially monitored on a weekly basis to detect abnormal conditions. No holddown spring pieces, pieces of cladding, or fuel assembly vibration have been detected.

Question 2(c)

c. Have there been any excore or incore neutron detector indications of levitated assemblies? Describe the expected reactivity effects that would result from lift-off or reseating of assemblies with broken hold-down springs. What efforts are being utilized to detect loose assemblies by either nuclear or mechanical monitoring devices?

Response

There has been no excore or incore detector indication of levitated fuel assemblies. In addition, periodic neutron noise analysis which indicates fuel assembly and reactor internals vibration has not shown any unusual results over the current Oconee cycles.

If fuel assemblies were to lift off during normal steady state operation, a safety concern does not exist. If a lifted assembly were to reseat during operation, a small increase in core reactivity would occur due to the relative motion between the fuel assembly and a partially inserted control rod. Conservative calculations have predicted that a single fuel assembly lifting 1.5 inches (the maximum possible) would change the core reactivity .002% $\Delta k/k$ at hot full power and .006% $\Delta k/k$ at hot zero power. The limiting reactivity insertion would occur if the fuel assemblies in all 61 control rod locations were lifted the maximum distance. As discussed in the response 2(a), assemblies in control rod locations retain positive holddown during normal operation even with no spring force. Thus, this limiting reactivity insertion is a hypothetical event. For this condition a maximum reactivity insertion of only 0.1% $\Delta k/k$ at HFP is predicted. The resulting transient would, at worst, be characterized by a small, rapid increase in neutron power tripping the plant on high flux in the first few seconds of the transient. The transient would also result in a small increase in reactor coolant system pressure with no change in core inlet temperature for approximately 10 seconds (one loop transit time). Thus, even this hypothetical reactivity insertion does not significantly affect the steady state and transient safety analysis; the potential reactivity insertion from a small number of spring failures, if lifting were to occur, is shown to be of no consequence.

Questions 2(d) and 2(e)

d. Have there been any observed indications of lateral repositioning of loose assemblies? Describe the methods used to detect lateral assembly motion. Describe the degree of lateral repositioning that is physically (dimensionally) possible after lift-off. What are the postulated worst-case effects of a laterally displaced assembly?

e. (i) Describe the degree of "worst-case" mechanical damage that would be expected as a result of movement of a "loose" assembly (one with a broken spring) against adjacent assemblies, core baffle, or other core components.

(ii) Discuss the results of flow tests or other experiments that have provided measurements of axial or lateral vibratory motion of an assembly after lift-off or that would otherwise support the response to Question 2.e(i).

Response

As discussed in response to Question 2(a), fuel assemblies with broken holddown springs would not be expected to lift off during normal operation. Furthermore, there have been no indications that any of these assemblies did lift off. Three fuel assemblies at Davis-Bessee containing broken holddown springs were visually examined. No evidence of lift or of wear from lift or lateral displacement was found; no fuel assembly damage of any kind was found. There has also been no evidence of fuel assembly damage due to lift or lateral displacement at Oconee.

A fuel assembly suddenly experiencing a loss of holddown could move upward a maximum of 1.5 inches, with a corresponding impact energy level of less than 50 ft.-lbs. This level of impact is far below the energy necessary to damage the fuel assemblies. For example, LOCA analysis has shown that the fuel assembly can withstand impact energies in the range of 500 ft-lbs. Thus, gross impact of fuel assemblies can be eliminated as a cause for concern, but there is the possibility of lower level vibrations which could cause some wear. Also, there is the possibility of spacer grid mismatch due to lifting of one assembly while its neighbor remains seated. The fuel assembly can lift up to 1.5 inches whereas 1.2 inches lift will result in a mismatch of the spacer grid outside strips between adjacent assemblies. Long-term operation under this condition would, at worst, result in some wearing of the peripheral fuel rods.

Horizontal vibration of the fuel assembly while in the lifted condition may be more pronounced at the lower end fitting since it may not be held tightly by the grid pads. Lateral motion in which two adjacent assemblies contact at the lower end fitting is possible and could cause wear on the lower end fitting. However, the lower end fitting has thick cross sections which can withstand significant wear without loss of function. Peripheral assemblies might contact the core baffle plates but again wear would not be a significant problem. The lower end fitting of a fuel assembly which is postulated to lift 1 1/2 inches can raise up onto the chamfered leadin surfaces of the guide blocks such that 0.4 inches of lateral respositioning could theoretically occur. However, lateral repositioning is nominally limited to the clearances between the lifted assembly and adjacent seated assemblies or baffle plates which are 0.05 inches and 0.1 inches respectively.

The upper end fitting will remain closely aligned by the upper grid pads at all times. Lateral vibration would not be expected to increase. For this reason upper end fitting wear or control component wear would not be expected to be greater than the low levels experienced during normal operation.

There have been several tests run to determine the flow required to cause fuel assembly lift. These tests also provide an indication of assembly vibration levels in the lifted condition. They were run in the Control Rod Drive Line Test facility (Alliance Research Center), which is a single fuel assembly test loop simulating reactor flow, temperature and pressure. A displacement transducer was used in determining fuel assembly lift. During these tests, the hold-down spring remains uncompressed since the maximum loop flow is incapable of lifting the assembly with the spring compressed. The flow is increased in small increments until the assembly lifts at which point the flow is then varied to determine the lift velocity as accurately as possible. There has been no indication of vertical oscillation of the assembly during these tests. Also, the fuel assemblies were examined after each test and no evidence of impact or wear has been found. These results indicate that severe vibration will not result for a lifted assembly.

Question 3

Provide a description of the cause of the failures and corrective action to reduce the likelihood of future failures at your facility.

Response

An unirradiated holddown spring from the same heat of inconel material as three of the four broken Oconee springs has been examined. This material exhibited a coarse outer grain structure that is indicative of less resistance to fatigue. This material also exhibited properties which indicate that it is susceptible to stress corrosion cracking. It is believed that the mechanism of failure for these three springs is by crack initiation due to fatigue in the outer grain structure followed by stress corrosion cracking to final fracture. These types of material properties and the failure mode are similar to the problems with the Davis-Besse springs. The fact that the failure rate of the Oconee material was much lower than that of the Davis-Besse material is explained by the fact that the Oconee material exhibited less susceptibility to stress corrosion cracking than the Davis-Besse material.

The fourth broken holddown spring at Oconee was fabricated from an inconel heat uncommon to any of the springs examined by B&W for material properties and made to a design used only in Oconee 1's first core. No archives were available for this obsolete design (of which there are none in use today). A hot cell examination of the broken spring was considered to be of limited value since this design was no longer in use. Therefore, no such examination was performed.

Prior to the discovery of broken holddown springs at a B&W plant and following the analysis of broken springs, B&W instituted several new specifications in the procurement of holddown springs. These changes should insure that no material with poor fatigue resistance will be used in future springs.