50-498/499

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 17, 1997

LICENSEE: Houston Lighting and Power Company (HL&P), et al.

FACILITY: South Texas Project, Units 1 and 2 (STP)

SUBJECT: SUMMARY OF JANUARY 9, 1997, MEETING ON HL&P'S RESPONSE TO BULLETIN 96-01, "CONTROL ROD INSERTION PROBLEMS"

On January 9, 1997, representatives of HL&P and NRC met to discuss the above subject. Meeting attendees are listed in Attachment 1. A handout provided by the licensee is Attachment 2.

The Nuclear Regulatory Commission (NRC) opened the meeting with the following background discussion summary. In a previous meeting on May 24, 1996, HL&P indicated that due to 2 new indications of incomplete rod insertion (IRI) in lower burnup assemblies in Unit 1, HL&P was strongly considering performing a mid-cycle rod drop test in January 1997, when rodded assembly burnups approached the value corresponding to the lowest burnup fuel assembly with the observed IRI condition (32 GWD/MTU). By letter dated November 27, 1996, HL&P provided the results of testing on selected assemblies and concluded that the cause of IRI is excessive guide tube distortion in the dashpot due to the in-vessel axial compressive load. HL&P further concluded that the since fuel assemblies are built as designed, the most likely cause of guide tube bowing is inadequate resistance to buckling in the fuel assembly design. In the same letter, HL&P indicated that future STP loading will limit end-of-cycle (EOC) fuel assembly burnups under all control rods to the extent practical, that rod drop testing will be performed at EOC and at each outage of sufficient duration where more than 1250 MWD/MTU burnup has accumulated since the most recent test, and that the results of their evaluation indicates there is substantial shutdown margin in Unit 1 Cycle 7, and therefore, there is no need for additional testing.

During NRC's review of HL&P's letter dated November 27, 1996, (prior to this meeting), NRC was concerned with the proposed deletion of the previously considered January 1997, rod drop testing because (1) the existing fuel assembly design is inadequate for buckling, and no substantial design modifications have been made to address this, (2) rodded assembly burnups in Unit 1 have now approached the value corresponding to the lowest burnup fuel assembly with the observed IRI condition during the last cycle, and (3) 49 of 57 assemblies in rodded locations in Unit 1 will exceed 32 GWD/MTU by EOC (to date, Unit 2 has not experienced IRI). NRC concluded that HL&P should reconsider its proposed deletion of the January 1997, rod drop test, and communicated this position to HL&P. HL&P then requested a meeting with NRC.

During the January 9, 1997, meeting HL&P indicated that it will perform a mid-cycle rod drop test in Unit 1 on January 18, 1997, unless cold weather conditions force them to postpone the test for 1 week. Also, the EOC for Unit 2 is set for February 8, 1997, at which time HL&P will conduct a rod-drop test in Unit 2. With these 2 new sets of data, HL&P indicated that it will be able to define the need for further testing.

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HL&P indicated that their findings of previous tests are that (1) control rod drag is related to burnup, (2) guide tube drag and distortion is maximum in the dashpot, (3) assembly growth is consistent with design predictions, (4) maximum rod drop time (to dashpot entry) in Unit 1 Cycle 6 was well below the Technical Specification limit, (5) recoil behavior of rod drop traces during Unit 1 beginning-of-cycle (BOC) Cycle 7 was much better than Cycle 6, and (6) high core residence time (accumulated effective-full-power days (EFPD)) was observed in all fuel with IRI. Based on their findings, HL&P's corrective actions include limiting Unit 1 Cycle 7 (U1C7) rodded fuel assembly burnups to 38 GWD/MTU at EOC, limiting U2C6 to 32.5 GWD/MTU and 1001 EFPD, limiting U1C8 to 28 GWD/MTU and 900 EFPD, and working with the fuel vendor for long-term fuel design changes. Some preliminary long-term design changes currently under consideration include (1) using zirlo guide tubes, (2) having the fuel rods resting on the bottom nozzle, (3) using a bottom grid that rests on the dashpot region, and (4) using a thicker guide tube wall. The earliest that HL&P would possibly begin to implement these design changes is for U1C8.

Based on the substantially lower EOC fuel burnup and core residence time than Cycle 6, improved rod drop recoil performance at BOC, and previous testing results (which show that guide tube distortion is limited to the dashpot region, therefore, rod drop times and shutdown margin can be met with substantial margin), HL&P concluded with a high degree of confidence that control rod safety limits will be met with substantial shutdown margin during operation of U1C7. The NRC indicated that the meeting was very informative and requested that HL&P provide the NRC staff with the restart criteria that HL&P will use following the January 18, 1997, rod drop test. HL&P indicated that it would provide the restart criteria by January 15, 1997.

Thomas W. Alexion

Thomas W. Alexion, Project Manager
Project Directorate IV-1
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Office of Nuclear Reactor Regulation

Docket Nos. 50-498 and 50-499

Attachments: 1. List of Meeting Attendees
2. HL&P Meeting Handout

cc w/atts: See next page

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MEETING BETWEEN HL&P AND NRC ON BULLETIN 96-01

January 9, 1997

Name	Organization
T. Cloninger	HL&P
D. Leazar	HL&P
R. Dunn	HL&P
E. Kee	HL&P
S. Head	HL&P
L. Connor	for STS
A. Wyche	Bechtel
J. Roe	NRC
W. Beckner	NRC
J. Lyons	NRC
M. Chatterton	NRC
H. Conrad	NRC
F. Grubelich	NRC
J. Rajan	NRC
K. Thomas	NRC
T. Alexion	NRC

ATTACHMENT 1

SOUTH TEXAS PROJECT

PRESENTATION:

DISCUSSION OF CONTROL ROD INSERTION ISSUES

TO

NRC

January 9, 1997

ATTACHMENT 2

VISION: STP - - A WORLD-CLASS POWER PRODUCER

PURPOSE

Communicate STP-specific information regarding incomplete rod insertion, and present the reasons why Unit 1 Cycle 7 operation will meet control rod safety limits through end of cycle

STP Team:

Ted H. Cloninger - Vice President, Nuclear Engineering

David A. Leazar - Manager, Nuclear Fuel & Analysis

Roland F. Dunn - Supervisor, Reactor Engineering

Ernie J. Kee - Unit 1 Reactor Engineer

Scott M. Head - Supervisor, Nuclear Licensing

STP UNIT 1 INCOMPLETE ROD INSERTION (IRI) BACKGROUND

Assembly ID	Core Location	08/29/95	12/18-19/95	03/02/96	05/18/96
		Steps above rod bottom/Fuel burnup (gwd/mtu)/Core residence time (efpd)			
E10	E11	0 /23/ 747	0 /27/ 856	0 /30/ 926	6 /32/ 1001
F25	N09	0 /40/ 979	6 /44/ 1088	6 /46/ 1157	6 /49/ 1232
F26	F10	0 /41/ 979	6 /44/ 1088	6 /47/ 1157	12 /49/ 1232
F29	K10	0 /42/ 979	0 /45/ 1088	6 /48/ 1157	6 /50/ 1232
F41	F06	0 /41/ 979	0 /44/ 1088	6 /47/ 1157	6 /49/ 1232
F47	C07	0 /40/ 979	0 /44/ 1088	0 /46/ 1157	6 /49/ 1232
F53	D08	0 /38/ 979	0 /41/ 1088	6 /44/ 1157	6 /46/ 1232
F59	C09	0 /41/ 979	6 /44/ 1088	6 /47/ 1157	6 /49/ 1232
F60	K08	0 /26/ 979	0 /30/ 1088	0 /33/ 1157	6 /36/ 1232
F64	N07	0 /40/ 979	6 /44/ 1088	6 /46/ 1157	12 /49/ 1232
R27	C05	0 /35/ 979	0 /38/ 1088	0 /41/ 1157	6 /43/ 1232

STP PREVIOUS TESTING CONCLUSIONS

Fuel Testing:

- Show that RCCA drag is related to burnup
- Guide tube drag and distortion is maximum in dashpot, essentially no drag above the dashpot
  - Consistent with fuel design (i.e., makes sense physically due to dashpot reduced diameter and length)
  - Causes incomplete insertion at the bottom of RCCA travel
- Assembly growth consistent with design predictions and well below design limit
  - All fuel assemblies offloaded in Cycle 6 were measured
  - Low growth minimizes spring compression effect seen at Wolf Creek
  - Increases as burnup increases
  - No anomalous growth at low burnup observed

STP PREVIOUS TESTING CONCLUSIONS

Rod Drop Time Testing:

- Rod drop traces provide information regarding the rod's residual energy (if any) at rod bottom
  - Unit 1 BOC Cycle 6 recoil behavior is statistically significant to future performance·

    7 of 11 RCCAs with low BOC recoil had IRI on 03/02/96
    8 of 11 RCCAS with low BOC recoil had IRI at EOC

  - Unit 1 Cycle 7 loading pattern produced significantly more recoils at BOC than Cycle 6:

BOC Cycle 6	BOC Cycle 7
7 RCCAs = 0 recoil	0 RCCAs = 0 recoil
4 RCCAs = 1 recoil	1 RCCA = 1 recoil
46 RCCAs $\geq$ 2 recoils	56 RCCAs $\geq$ 2 recoils

- No degradation in Tech Spec rod drop time and no slowing down above dashpot
  - All rod drops showed significant margin to the 2.8 seconds Tech Spec limit
  - Maximum rod drop time in Cycle 6 was 1.65 seconds
- High core residence time (accumulated core burnup in EFPD) observed in all IRI fuel (thrice-burned)

STP UNIT 1 CYCLE 6 VS. CYCLE 7 FUEL BURNUPS AND CORE RESIDENCE TIME EFPD

Cycle 6 Reactor Trip on 08/29/95, zero stuck rods:

Fuel Burnup gwd/mtu	Core efpd	# of Rodded F/As	# of Stuck Rods
6	134	8	0
18 - 22	489	12	0
23 - 26	698 - 747	5	0
26	979	4	0
34 - 35	979	8	0
37 - 41	979	20	0

Cycle 6 Reactor Trip /Rod Testing on 12/18-19/95, four stuck rods:

Fuel Burnup gwd/mtu	Core efpd	# of Rodded F/As	# of Stuck Rods
11	243	8	0
22 - 27	598	12	0
27 - 29	807 - 856	5	0
30	1088	4	0
38 - 42	1088	16	0
44 - 45	1088	12	4

Cycle 6 Rod Drop Testing on 03/02/96, seven stuck rods:

Fuel Burnup gwd/mtu	Core efpd	# of Rodded F/As	# of Stuck Rods
14	312	8	0
24-29	667	12	0
29-31	877-926	5	0
33	1157	4	0
41	1157	8	0
43-47	1157	20	7

STP UNIT 1 CYCLE 6 VS. CYCLE 7 FUEL BURNUPS AND CORE RESIDENCE TIME EFPD

Cycle 6 EOC Rod Drop Testing on 05/18/96, eleven stuck rods:

Fuel Burnup gwd/mtu	Core efpd	# of Rodded F/As	# of Stuck Rods
18	387	8	0
26 - 33	742	12	0
32 - 33	952	2	0
32	1001	3	1
36	1232	4	1
43 - 47	1232	16	2
49 - 50	1232	12	7

Cycle 7 Fuel Burnup and Core EFPD on 01/17/97:

Fuel Burnup gwd/mtu	Core efpd	# of Rodded F/As
10	220	8
24 - 27	607	36
29 - 30	784	5
31 - 32	962	8

Cycle 7 Fuel Burnup and Core EFPD at EOC, 09/97:

Fuel Burnup gwd/mtu	Core efpd	# of Rodded F/As
20	451	8
33 - 37	838	36
36 - 38	1015	5
37 - 38	1193	8

STP INCOMPLETE ROD INSERTION ROOT CAUSE

- IRI is caused by excessive guide tube distortion in the dashpot due to in-vessel axial compressive loading and inadequate resistance to buckling in the fuel assembly design

- Contributing factors include irradiation and time at temperature

- Based on this root cause, STP dashpot design, and results of our testing program, incomplete rod insertion at STP is limited to the !ower dashpot - safety evaluations demonstrate meeting control rod safety limits with substantial margin

STP UNIT 1 CYCLE 7 ANALYZED SHUTDOWN MARGIN CASES WITH HYPOTHETICAL STUCK RODS

All cases assume the highest worth stuck rod is fully withdrawn
BOC and EOC shutdown margin and trip reactivity met for the following cases:

	# Stuck rods*	Position**
Case 1	12	18
Case 2	20	12
Case 3	56	6

*no core location or fuel burnup restrictions, e.g., any 12 or any 20 rods
**based on digital rod position indication (DRPI) - includes 4 step uncertainty

STP IRI Corrective Actions

- U1 C7 rodded fuel assemblies limited to less than 38 gwd/mtu at EOC
- U2 C6 rodded fuel assemblies limited to less than 32.5 gwd/mtu and 1001 EFPD at EOC
- U1 C8 rodded fuel assemblies limited to less than 28 gwd/mtu and 900 EFPD at EOC
- Working with fuel vendor to identify long term fuel design changes by 04/97
- Perform U2 C5 EOC rod drop testing on 02/08/97

  Expect incomplete rod insertion results to be similar to U1 EOC-6 (e.g., 11 RCCAs - 2 @ 12 steps, 9 @ 6 steps)

Projected Cycle 5 Fuel Burnup and Core EFPD at EOC, 02/97:

Fuel Burnup gwd/mtu	Core efpd	# of Rodded F/As
19	439	8
32	914	4
39 - 40	914	20
39 - 40	1292	8
44 - 53	1292	17

STP IRI Conclusions for Unit 1 Cycle 7 Operation

- A fuel assembly's core residence time is an important contributor to IRI; Cycle 7 EOC rodded fuel burnups and core residence time are substantialiy lower than Cycle 6
- Testing shows guide tube distortion is limited to the dashpot region, therefore, rod drop times and shutdown margin (SDM) can be met with substantial margin

  Assumed SDM cases with hypothetical stuck rods show that control rod safety limits can be met for bounding conditions, e.g., N-1 rods stuck at 6 steps

  Cycle 6 experience shows IRI at a maximum of 12 steps for fuel with substantially higher burnup and residence time than all Cycle 7 rodded fuel
- BOC rod drop recoil is an indicator of a rod's ability to achieve full insertion, Cycle 7 recoil data indicates significantly better performance than Cycle 6
- Based on substantially lower EOC fuel burnup and core residence time than Cycle 6, improved rod drop recoil performance at BOC, and previous STP testing results, STP has a high degree of confidence that control rod safety limits will be met with substantial margin during operation of Unit 1 Cycle 7

STP Future Testing Plans

- Results of Unit 1 mid-January 1997 and Unit 2 Cycle 5 end of cycle rod drop test results will be evaluated to determine whether future testing is necessary
- STP will submit written test reports for the above rod drop tests, similar to those sent previously

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MChatterton (MSC1)
HConrad (HFC)
FGrubelich (FXG)
JRajan (JRR)
KThomas (KMT)
JDyer, RIV (JED2)

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2. HL&P Meeting Handout

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