CATEGORY 1

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SUBJECT: Forwards response to NRC Bulletin 96-001, "Control Rod Insertion Problems," dtd 960308 that requires licensee provide written responses to bulletin requested actions within 30 days of date of bulletin.

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Carolina Power & Light Company
Robinson Nuclear Plant
3581 West Entrance Road
Hartsville SC 29550

Robinson File No: 13510H
Serial: RNP-RA/96-0075

APR 04 1996

United States Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23
THIRTY DAY RESPONSE TO NRC BULLETIN 96-01,
"CONTROL ROD INSERTION PROBLEMS"

Gentlemen:

The NRC issued Bulletin 96-01, "Control Rod Insertion Problems," dated March 8, 1996, that requires licensees provide written responses to the bulletin's Requested Actions within thirty days of the date of the bulletin. Accordingly, the response is due by April 8, 1996.

The information provided in response to NRC Bulletin 96-01, Required Responses (1) and (2) are contained in the enclosures to this letter. Based on the information provided in Enclosure 2, we certify that the control rods at H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2 are determined to be operable.

Questions regarding this matter may be referred to me at (803) 857-1802.

Very truly yours,

R. M. Krich
Manager - Regulatory Affairs

JSK/klb
Enclosures
c: Mr. S. D. Ebneter, Regional Administrator, USNRC, Region II
Ms. B. L. Mozafari, USNRC Project Manager, HBRSEP
Mr. W. T. Orders, USNRC Senior Resident Inspector, HBRSEP

IE57

Affidavit

State of South Carolina
County of Darlington

C. S. Hinnant, having been first duly sworn, did depose and say that the information contained in letter 96-0075 is true and correct to the best of his information, knowledge and belief; and the sources of his information are officers, employees, contractors, and agents of Carolina Power & Light Company.

C S Hinnant

Sworn to and subscribed before me

this 4th day of April 19 96

(Seal) Albert Garrison
Notary Public for South Carolina

My commission expires: March 22, 2005

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2 THIRTY DAY RESPONSE TO NRC BULLETIN 96-01, "CONTROL ROD INSERTION PROBLEMS"

NRC Bulletin 96-01, "Control Rod Insertion Problems," dated March 8, 1996, requested licensees to address the following Requested Actions.

(1) Promptly inform operators of recent events (i.e., reactor trips and testing) in which control rods did not fully insert and subsequently provide necessary training, including simulator drills, utilizing required procedures for responding to an event in which the control rods do not fully insert upon reactor trip (e.g., boration of a pre-specified amount).

(2) Promptly determine the continued operability of control rods based on current information. As new information becomes available from plant rod tests and trips, licensees should consider this new information together with data already available from Wolf Creek, South Texas, North Anna, and other industry experience, and make a prompt determination of control rod operability.

(3) Measure and evaluate at each outage of sufficient duration during calendar year 1996 (e.g., end of cycle, maintenance, etc.), the control rod drop times and recoil data for all control rods. If appropriate plant conditions exist where the vessel head is removed, measure and evaluate drag forces for all rodded fuel assemblies.

   a. Rods failing to meet the rod drop time in the Technical Specifications (TS) shall be deemed inoperable.

   b. Rods failing to bottom or exhibiting high drag forces shall require prompt corrective action in accordance with Appendix B to Part 50 of Title 10 of the Code of Federal Regulations (i.e., 10 CFR Part 50).

(4) For each reactor trip during each calendar year 1996, verify that all control rods have promptly fully inserted (i.e., bottomed) and obtain other available information to assess the operability and any performance trend of the rods. In the event that all rods do not fully insert promptly, conduct tests to measure and evaluate rod drop times and rod recoil.

NRC Bulletin 96-01 required licensees to provide the following written information.

(1) Within 30 days of the date of this bulletin, a report certifying that the control rods are determined to be operable; actions taken for Requested Actions (1) and (2) above; and the plans for implementing Requested Actions (3) and (4).

(2) Within 30 days of the date of this bulletin, a core map of rodded fuel assemblies indicating fuel type (i.e., materials, grids, spacers, guide tube inner diameter) and current and projected end of cycle burnup of each rodded assembly for the current cycle; when available, provide the same information for the next cycle.

(3) Within 30 days after completing Requested Action (3) for each outage, a report that summarizes the data and that documents the results obtained; this is also applicable to Requested Action (4) when any abnormal rod behavior is observed.

Required Response 1

Actions Taken for Requested Action (1)

All licensed operators have been notified of the concerns identified in NRC Bulletin 96-01 by means of a real-time training memorandum dated March 19, 1996. This is a training vehicle which provides immediate information and requires the operators to provide written documentation that they have read and understand the information provided.

A training Need Analysis has been completed and modifications to the Initial Licensed Operator Training program and Licensed Operator Continuing (i.e., Requalification) Training program have been identified. The Initial Training program will include an event similar to those described in NRC Bulletin 96-01 and will be covered in both classroom and simulator training. Licensed Operator Continuing Training will include the scenarios developed for the Initial Training program, to be completed before Refueling Outage (RO)-17, scheduled to begin during the month of September 1996. The Licensed Operator Continuing Training program will be subsequently modified to include similar training on a periodic frequency. This frequency will be determined by plant management.

Actions Taken for Requested Action (2)

The control rods are determined to be operable based on the following information.

a) Beginning of Cycle (BOC) Rod Drop Testing

Control rod drop time data for the last 10 fuel cycles (i.e., Cycles 8 - 17) were reviewed. No correlation between fuel assembly burnup and All Rods Out (ARO) to dashpot entry times, or from dashpot entry to rod bottom times, was noted. The drop times showed no evidence of a trend and exhibited the same amount of data scatter in new fuel assemblies as in fuel assemblies with burnups between 7,000 MWD/MTU and 55,400 MWD/MTU.

b) Performance of Rod Cluster Control Assembly (RCCA) Stepping Tests

The results of procedure Operating Surveillance Test (OST)-011, "Rod Cluster Control Exercise and Rod Position Indication," performed during Cycle 17 (i.e., the current operating cycle) were reviewed. This surveillance test procedure is performed on a biweekly frequency. None of the completed procedures had recorded abnormalities.

c) Recent Control Rod Trip Data

Reactor trip information for the last five years was reviewed. Ten reactor trips occurred during this time period. Seven of the trips occurred at or near 100% reactor power and actuated all the control rods. Three of the trips occurred during Hot or Cold Shutdown condition and actuated only Shutdown Bank "A" control rods. One reactor trip, on August 16, 1991, had three indications of incomplete control rod insertion. The three control rods (i.e., K-02, F-14, and L-09) had post-trip rod position indications of 60 inches, 15 inches, and 9 inches, respectively. The operators borated for the worth of the three control rods in accordance with End Path Procedure (EPP)-004, "Reactor Trip Response." Subsequent investigation revealed that the Rod Position Indication (RPI) signal conditioning module for control rod K-02 had failed causing an erroneous position indication. We also determined that the RPI signal conditioning modules for control rods F-14 and L-09 had experienced a zero shift causing these control rod's erroneous position indications. However, the investigation concluded that all the control rods were fully inserted. No anomalous control rod behavior was observed in any of the other reactor trips.

d) Anomalous Behavior on RCCA Change Out During Refueling Operations

There have been no reported or observed problems in removing control rods from assemblies or inserting control rods into assemblies during the last three ROs, i.e., RO-14, 15, or 16.

e) Current Cycle Burnup in Rodded Locations

See the attached tables, "Current and Projected End of Cycle 17 Data," and "Projected End of Cycle 18 Data."

f) Excess Shutdown Margin for Current Core Design

Cycle 17 had a 2,236 pcm BOC excess shutdown margin at 100% power. The excess shutdown margin at End of Cycle (EOC), 100% power, is 789 pcm.

g) S15H Lead Test Assembly Program

In addition to the above considerations, we have recently completed a Lead Test Assembly (LTA) program that involved insertion of a high burnup fuel assembly in rodded core location H-08 (i.e., center of core). Fuel assembly S15H had a cage burnup of 42,600 MWD/MTU during rod drop testing at the beginning of Cycle 15, and a burnup of 55,400 MWD/MTU during rod drop testing at the beginning of Cycle 16. As noted in Item a) above, the ARO to dashpot entry drop times and the dashpot entry to rod bottom times for this fuel assembly were not statistically different than the drop times seen in fuel assemblies with lower burnups or in new fuel assemblies.

Three reactor trips occurred during the LTA program. The approximate cage burnup of fuel assembly S15H at the time of each reactor trip during Cycles 15 and 16 was as follows.

Cycle	Date	S15H Burnup
15	August 22, 1993	44,600 MWD/MTU
16	April 3, 1994	55,600 MWD/MTU
16	August 2, 1994	58,100 MWD/MTU

No anomalous control rod behavior was noted during any of these reactors trips.

The cage burnup of fuel assembly S15H at the EOC 16 was 64,531 MWD/MTU. Although the control rods were not tripped at the EOC 16, a review of data from the plant shutdown indicated no abnormal control rod behavior.

There have been no reported or observed problems from removing control rods or inserting control rods into fuel assembly S15H during ROs-14, 15, or 16. In addition, fuel assembly S15H was subjected to a series of visual and physical examinations during RO 15 and again following final discharge at the EOC 16. No unusual fuel assembly bowing or guide tube distortion was noted during these examinations.

h) Review of Industry Experience

The review of industry data shows that all of the incomplete control rod insertion events (i.e., Wolf Creek, South Texas, and North Anna) have occurred in Westinghouse 17x17 fuel assemblies. H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2 uses a Siemens Power Corporation 15x15 High Thermal Performance (HTP) design fuel assembly. Discussions with the fuel vendor revealed that their experience has shown the 15x15 design to be more resistant to fuel assembly bow than the 17x17 design. In addition, the 15x15 design, in

general, has a larger clearance between the RCCA rodlet outside diameter and the guide tube inside diameter than the 17x17 design. Both of these features will help to ensure complete control rod insertion.

Conclusion

Based on a review of the available industry data, as well as HBRSEP, Unit No. 2 plant data, and particularly from our experience with the S15H LTA program, we have determined that the control rods are currently operable and capable of fully inserting upon reactor trip.

Plans for Implementing Requested Action (3)

We plan to address NRC Bulletin 96-01 Requested Action (3) during calendar year 1996 by following the actions until such time as Westinghouse and the Westinghouse Owners Group (WOG) have identified the appropriate data to support a root cause determination. We will provide updated information as necessary if our plans for implementing Requested Action (3) are modified to support the collection of appropriate data for the root cause determination.

The criteria that will be used to determine when to perform rod drop tests, including collection of recoil data, will be based on the following guidelines.

- A scheduled reactor shutdown for at least 36 hours will require rod drop testing before reactor restart. This applies when the decision to shutdown the reactor is made at least 36 hours before the actual reactor shutdown.
- A unscheduled reactor shutdown with a duration of at least 72 hours will require rod drop testing before reactor restart. An unscheduled reactor shutdown for this purpose is one where the decision to shutdown the reactor is made 36 hours or less before the actual shutdown.
- A reactor shutdown of any duration will activate personnel to set up and begin rod drop testing. The decision to terminate rod drop testing and begin reactor startup will be made by the Plant General Manager based on current information on the incomplete RCCA insertion issue.

We plan to perform drag force testing during RO-17, currently scheduled to start during the month of September 1996. The testing will be performed either in the reactor vessel or in the spent fuel pit.

Plans for Implementing Requested Action (4)

We plan to address NRC Bulletin 96-01, Requested Action (4) during calendar year 1996 by the following actions until such time as Westinghouse and the WOG have identified the appropriate data to support a root cause determination. We will provide updated information as necessary if our plans for implementing Requested Action (4) are modified to support the collection of appropriate data for the root cause determination. Procedure EPP-004, "Reactor Trip Response," currently requires operators to verify that rod bottom indication is received for all control rods following a reactor trip, and requires the initiation to borate the Reactor Coolant system if more than one control rod does not cause a rod bottom indication to be received. For any of the control rods that do not indicate a rod bottom position, and the control rod is subsequently determined not to be fully inserted, then the control rod drop times and recoil will be measured and evaluated. All control rods will be considered to be operable based on BOC rod drop testing results and the biweekly rod exercise tests until there is evidence of incomplete control rod insertion, or a significant adverse trend in the control rod drop times.

Required Response 2

A core map of rodded fuel assemblies indicating fuel type (i.e., materials, grids, spacers, guide tube inner diameter), a table of current and projected EOC burnup of each rodded assembly for the current cycle, Cycle 17, and a table of the planned core design for Cycle 18 are attached. A core map for Cycle 18 is not yet available.

Attachment 1.

CP&L H.B. Robinson Unit #2

Reactor Core for Cycle 17

N

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01
R							UD10-X46	UD10-X50	UD10-X54						
P					UD10-W21	UD10-W35 R-CR06	UD10-Y23	UD10-X15	UD10-Y24	UD10-W39 R-CR08	UD10-W22				
N				UD10-W29	UD10-X27	UD10-Y31	UD10-W43 R-CR33	UD10-Y08	UD10-W42 R-CR23	UD10-Y32	UD10-X31	UD10-W30			
M			UD10-W32	UD10-X11	UD10-Y40	UD10-P15 R-CR42	UD10-Y13	UD10-W05 R-CR43	UD10-Y14	UD10-P12 R-CR45	UD10-Y43	UD10-X06	UD10-W28		
L		UD10-W23	UD10-X26	UD10-Y39	UD10-X10 R-CR49	UD10-X18	UD10-X39 R-CR25	UD10-X01	UD10-X44 R-CR50	UD10-X19	UD10-X05 R-CR46	UD10-Y44	UD10-X25	UD10-W19	
K		UD10-W36 R-CR31	UD10-Y30	UD10-P26 R-CR27	UD10-X24	UD10-Y20	UD10-S29	UD10-Y04 R508	UD10-S30	UD10-Y17	UD10-X21	UD10-P16 R-CR13	UD10-Y35	UD10-W40 R-CR34	
J	UD10-X53	UD10-Y22	UD10-W47 R-CR09	UD10-Y12	UD10-X41 R-CR502	UD10-S26	UD10-X37	UD10-W15	UD10-X34	UD10-S32	UD10-X42 R-CR41	UD10-Y09	UD10-W46 R-CR36	UD10-Y27	UD10-X47
H	UD10-X49	UD10-X16	UD10-Y07	UD10-W07 R-CR503	UD10-X02	UD10-Y03 R501	UD10-W12	UD10-J20 R-CR21	UD10-W10	UD10-Y01 R-CR05	UD10-X04	UD10-W06 R-CR01	UD10-Y05	UD10-X14	UD10-X51
G	UD10-X45	UD10-Y21	UD10-W48 R-CR32	UD10-Y11	UD10-X35 R-CR26	UD10-S25	UD10-X43	UD10-W13	UD10-X40	UD10-S27	UD10-X36 R-CR48	UD10-Y10	UD10-W45 R-CR14	UD10-Y28	UD10-X55
F		UD10-W37 R-CR46S	UD10-Y29	UD10-P17 R-CR35	UD10-X23	UD10-Y19	UD10-S31	UD10-Y02 R-CR18	UD10-S28	UD10-Y18	UD10-X22	UD10-P27 R-CR39	UD10-Y36	UD10-W34 R-CR03	
E		UD10-W24	UD10-X30	UD10-Y38	UD10-X07 R-CR505	UD10-X17	UD10-X33 R-CR28	UD10-X03	UD10-X38 R-CR29	UD10-X20	UD10-X12 R-CR504	UD10-Y41	UD10-X29	UD10-W20	
D			UD10-W31	UD10-X08	UD10-Y37	UD10-P14 R-CR47	UD10-Y16	UD10-W08 R-CR51	UD10-Y15	UD10-P13 R-CR07	UD10-Y42	UD10-X09	UD10-W27		
C				UD10-W25	UD10-X28	UD10-Y34	UD10-W44 R-CR19	UD10-Y06	UD10-W41 R-CR17	UD10-Y33	UD10-X32	UD10-W26			
B					UD10-W18	UD10-W38 R-CR52	UD10-Y26	UD10-X13	UD10-Y25	UD10-W33 R-CR02	UD10-W17				
A							UD10-X56	UD10-X52	UD10-X48						

Attachment 2

HBRSEP, Unit No. 2 - Current and Projected End of Cycle 17 Data
Rodded Core Locations
All Siemens Power Corporation 15x15 Fuel Assemblies

Control Bank	Core Location	Assembly Serial #	Assembly Region	Current Assembly Burn Up 03/05/96 GWD/MTU	Projected EOC17 Assembly Burn Up GWD/MTU	Fuel Assembly Spacer/Grid Type*	Guide Tube Inside Diameter Above Dashpot Inches +/- 0.002	Guide Tube Inside Diameter Below Dashpot Inches +/- 0.002
CA	E09	X33	19	26.118	33.443	HTP/IFM/Bi-M	0.511	0.455
CA	G11	X35	19	25.890	33.243	HTP/IFM/Bi-M	0.511	0.455
CA	G05	X36	19	26.109	33.443	HTP/IFM/Bi-M	0.511	0.455
CA	E07	X38	19	25.890	33.238	HTP/IFM/Bi-M	0.511	0.455
CA	L09	X39	19	25.874	33.233	HTP/IFM/Bi-M	0.511	0.455
CA	J11	X41	19	26.106	33.446	HTP/IFM/Bi-M	0.511	0.455
CA	J05	X42	19	25.868	33.217	HTP/IFM/Bi-M	0.511	0.455
CA	L07	X44	19	26.097	33.430	HTP/IFM/Bi-M	0.511	0.455
CB	B06	W33	18	37.309	40.795	HTP/IFM/Bi-M	0.511	0.455
CB	F02	W34	18	37.197	40.674	HTP/IFM/Bi-M	0.511	0.455
CB	P10	W35	18	37.296	40.789	HTP/IFM/Bi-M	0.511	0.455
CB	K14	W36	18	37.191	40.672	HTP/IFM/Bi-M	0.511	0.455
CB	F14	W37	18	37.135	40.617	HTP/IFM/Bi-M	0.511	0.455
CB	B10	W38	18	37.359	40.842	HTP/IFM/Bi-M	0.511	0.455
CB	P06	W39	18	37.347	40.836	HTP/IFM/Bi-M	0.511	0.455
CB	K02	W40	18	37.144	40.629	HTP/IFM/Bi-M	0.511	0.455
CC	M06	P12	14	43.031	48.685	Bi-M**	0.511	0.455
CC	D06	P13	14	43.061	48.707	Bi-M**	0.511	0.455
CC	D10	P14	14	43.050	48.697	Bi-M**	0.511	0.455
CC	M10	P15	14	43.047	48.702	Bi-M**	0.511	0.455
CC	K04	P16	14	43.105	48.782	Bi-M**	0.511	0.455
CC	F12	P17	14	43.054	48.734	Bi-M**	0.511	0.455
CC	K12	P26	14	42.538	48.258	Bi-M**	0.511	0.455
CC	F04	P27	14	42.546	48.260	Bi-M**	0.511	0.455
CD	H08	J20	9	37.637	41.445	Bi-M**	0.511	0.455
CD	M08	W05	18	41.251	47.375	HTP/IFM/Bi-M	0.511	0.455
CD	H04	W06	18	40.648	46.773	HTP/IFM/Bi-M	0.511	0.455
CD	H12	W07	18	40.644	46.772	HTP/IFM/Bi-M	0.511	0.455
CD	D08	W08	18	41.268	47.382	HTP/IFM/Bi-M	0.511	0.455
SA	C07	W41	18	36.693	43.220	HTP/IFM/Bi-M	0.511	0.455
SA	N07	W42	18	36.528	43.074	HTP/IFM/Bi-M	0.511	0.455
SA	N09	W43	18	36.671	43.211	HTP/IFM/Bi-M	0.511	0.455
SA	C09	W44	18	36.551	43.085	HTP/IFM/Bi-M	0.511	0.455
SA	G03	W45	18	36.505	42.981	HTP/IFM/Bi-M	0.511	0.455
SA	J03	W46	18	36.647	43.116	HTP/IFM/Bi-M	0.511	0.455
SA	J13	W47	18	36.497	42.978	HTP/IFM/Bi-M	0.511	0.455
SA	G13	W48	18	36.632	43.097	HTP/IFM/Bi-M	0.511	0.455
SB	L05	X05	19	28.905	36.183	HTP/IFM/Bi-M	0.511	0.455
SB	E11	X07	19	28.941	36.219	HTP/IFM/Bi-M	0.511	0.455
SB	L11	X10	19	28.904	36.188	HTP/IFM/Bi-M	0.511	0.455
SB	E05	X12	19	28.920	36.193	HTP/IFM/Bi-M	0.511	0.455
SB	H06	Y01	20	11.166	19.296	HTP/IFM/Bi-M	0.511	0.455
SB	F08	Y02	20	11.155	19.281	HTP/IFM/Bi-M	0.511	0.455
SB	H10	Y03	20	11.178	19.313	HTP/IFM/Bi-M	0.511	0.455
SB	K08	Y04	20	11.140	19.274	HTP/IFM/Bi-M	0.511	0.455

* SPC Spacer/Grid Definitions (Quantity) and Materials

HTP = High thermal performance spacer, (6) all zircaloy 4

IFM = Intermediate flow mixer grid, (3) all zircaloy 4

Bi-M = Bi-metallic spacer, (1) zircaloy 4 with inconel springs

**Seven bi-metallic spacers only

HBRSEP, Unit No. 2 - Projected EOC 18 Data (16.548 GWD/MTU)
Rodded Core Locations
All Siemens Power Corporation 15x15 Fuel Assemblies

Control Bank	Core Location	Assembly Serial #	Assembly Region	Projected Assembly Burn Up GWD/MTU	Fuel Assembly Spacer/Grid Type*	Guide Tube Inside Diameter Above Dashpot Inches +/- 0.002	Guide Tube Inside Diameter Below Dashpot Inches +/- 0.002
CA	G11	X25	19	45.715	HTP/IFM/Bi-M	0.511	0.455
CA	G05	X26	19	45.751	HTP/IFM/Bi-M	0.511	0.455
CA	E07	X27	19	45.719	HTP/IFM/Bi-M	0.511	0.455
CA	L07	X28	19	45.765	HTP/IFM/Bi-M	0.511	0.455
CA	J11	X29	19	45.752	HTP/IFM/Bi-M	0.511	0.455
CA	J05	X30	19	45.707	HTP/IFM/Bi-M	0.511	0.455
CA	E09	X31	19	45.753	HTP/IFM/Bi-M	0.511	0.455
CA	L09	X32	19	45.723	HTP/IFM/Bi-M	0.511	0.455
CB	P06	X17	19	44.467	HTP/IFM/Bi-M	0.511	0.455
CB	B06	X18	19	44.532	HTP/IFM/Bi-M	0.511	0.455
CB	B10	X19	19	44.453	HTP/IFM/Bi-M	0.511	0.455
CB	P10	X20	19	44.533	HTP/IFM/Bi-M	0.511	0.455
CB	F14	X21	19	44.487	HTP/IFM/Bi-M	0.511	0.455
CB	K14	X22	19	44.491	HTP/IFM/Bi-M	0.511	0.455
CB	K02	X23	19	44.526	HTP/IFM/Bi-M	0.511	0.455
CB	F02	X24	19	44.489	HTP/IFM/Bi-M	0.511	0.455
CC	K04	Y09	20	40.904	HTP/IFM/Bi-M	0.511	0.455
CC	F04	Y10	20	40.921	HTP/IFM/Bi-M	0.511	0.455
CC	F12	Y11	20	40.898	HTP/IFM/Bi-M	0.511	0.455
CC	K12	Y12	20	40.918	HTP/IFM/Bi-M	0.511	0.455
CC	M10	Y13	20	41.043	HTP/IFM/Bi-M	0.511	0.455
CC	M06	Y14	20	41.015	HTP/IFM/Bi-M	0.511	0.455
CC	D06	Y15	20	41.042	HTP/IFM/Bi-M	0.511	0.455
CC	D10	Y16	20	41.017	HTP/IFM/Bi-M	0.511	0.455
CD	H08	M24	12	37.221	Bi-M**	0.511	0.455
CD	M08	X01	19	50.880	HTP/IFM/Bi-M	0.511	0.455
CD	H12	X02	19	50.763	HTP/IFM/Bi-M	0.511	0.455
CD	D08	X03	19	50.879	HTP/IFM/Bi-M	0.511	0.455
CD	H04	X04	19	50.762	HTP/IFM/Bi-M	0.511	0.455
SA	C09	Y37	20	39.314	HTP/IFM/Bi-M	0.511	0.455
SA	G13	Y38	20	39.224	HTP/IFM/Bi-M	0.511	0.455
SA	J13	Y39	20	39.238	HTP/IFM/Bi-M	0.511	0.455
SA	N09	Y40	20	39.305	HTP/IFM/Bi-M	0.511	0.455
SA	G03	Y41	20	39.240	HTP/IFM/Bi-M	0.511	0.455
SA	C07	Y42	20	39.304	HTP/IFM/Bi-M	0.511	0.455
SA	N07	Y43	20	39.305	HTP/IFM/Bi-M	0.511	0.455
SA	J03	Y44	20	39.215	HTP/IFM/Bi-M	0.511	0.455
SB	L05	Y17	20	39.322	HTP/IFM/Bi-M	0.511	0.455
SB	E05	Y18	20	39.332	HTP/IFM/Bi-M	0.511	0.455
SB	E11	Y19	20	39.333	HTP/IFM/Bi-M	0.511	0.455
SB	L11	Y20	20	39.332	HTP/IFM/Bi-M	0.511	0.455
SB	F08	Z13	21	22.969	HTP/IFM/Bi-M	0.511	0.455
SB	H10	Z14	21	22.996	HTP/IFM/Bi-M	0.511	0.455
SB	K08	Z15	21	22.989	HTP/IFM/Bi-M	0.511	0.455
SB	H06	Z16	21	23.007	HTP/IFM/Bi-M	0.511	0.455

* Spacer/Grid Definitions (Quantity) and Materials
HTP = High thermal performance spacer (6), all zircaloy 4
IFM = Intermediate flow mixer grid (3), all zircaloy 4
Bi-M = Bi-metallic spacer (1), zircaloy 4 with inconel springs

**Seven bimetallic spacers only