AmerenUE
Callaway Plant

PO Box 620
Fulton, MO 65251

June 11, 2008

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Stop P1-137
Washington, DC 20555-0001

ULNRC-05518

Ladies and Gentlemen:

DOCKET NUMBER 50-483
CALLAWAY PLANT UNIT 1
UNION ELECTRIC CO.
FACILITY OPERATING LICENSE NPF-30
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
REGARDING REPORT OF FIRST REPLACEMENT STEAM GENERATOR
TUBE IN-SERVICE INSPECTION (TAC NO. MD7372)
Reference: AmerenUE ULNRC-05450, Results of First Replacement Steam Generator Tube In-Service Inspection, dated October 25, 2007

By the referenced letter and pursuant to Technical Specification 5.6.10, "Steam Generator Tube Inspection Report," AmerenUE (Union Electric Company) submitted a report of the results of Callaway Plant's first replacement steam generator tube in-service inspection.

From its review of this report, the NRC staff transmitted via e-mail a request for additional information (RAI) containing several individual questions/requests for which responses from AmerenUE are needed in order to support completion of the NRC's review. Accordingly, this letter provides AmerenUE's response to the NRC's RAI in Attachment 1. Within the attachment, each of the individual questions/responses contained in the associated RAI is stated and immediately followed with AmerenUE's response. Text from the NRC's RAI is shown in italics.

Additional information supporting AmerenUE's responses to the RAI questions is provided in Attachments 2 through 4 of this letter. Responding to the NRC's RAI requires no changes to be made to the subject report, and there are no new commitments in this letter.

A047
NRR

For any questions regarding the attached information, please contact Scott A. Maglio at 573-676-8719 or Tom Elwood at 573-676-6479.

Sincerely,

Keith A. Mills 11 June 08

Keith A. Mills
Manager, Plant Engineering

DJW/nls

Attachments:
1) Responses to NRC RAI Questions/Requests Regarding the Report of Results of Callaway Plant's First Replacement Steam Generator Tube In-Service Inspection
2) Tube Sheet Naming Convention
3) Tube Sheet Map (Cold Leg)
4) Tube Sheet Map (Hot Leg)

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RESPONSE TO NRC RAI QUESTIONS/REQUESTS REGARDING THE REPORT OF RESULTS OF CALLAWAY PLANT'S FIRST REPLACEMENT STEAM GENERATOR TUBE IN-SERVICE INSPECTION

RESPONSES TO NRC PRELIMINARY RAI QUESTIONS/REQUESTS

In its letter dated October 25, 2007, Union Electric Company (the licensee) submitted the report of results from Callaway Plant's first replacement steam generator tube in-service inspection. This report is currently under review by the NRC staff. Via e-mail sent to AmerenUE on March 5, 2008, the NRC staff has requested the following additional information.

1. *You indicated that no active degradation was identified in your steam generators during the 15th Refueling Outage steam generator tube inspections; however, you also indicated that you had identified several tubes with wear at the anti-vibration bars. Please clarify your definition of "active degradation mechanism". The staff has found that the industry's (Electric Power Research Institute's) definition of active degradation in Revision 6 to the Pressurized Water Reactor Steam Generator Examination Guidelines is misleading since tubes could have degradation that is progressing (or present on the tubes) but the degradation could be classified as "not active" (refer to ML010320218 and ML012200349). As a result, please confirm that other than wear at the anti-vibration bars, that you did not find any service-induced indications (i.e., those not attributable to manufacturing) during your inspections. If you did find other indications, please provide the location, orientation, and measured sizes of these indications.*

Response

As discussed in the Pressurized Water Reactor (PWR) Steam Generator (SG) Guidelines, Rev. 6, the definition of Active Degradation Mechanism is as follows:

> **Active Degradation Mechanism**: A combination of 10 or more new indications (≥20% through-wall) of thinning, pitting, wear (excluding loose part wear), or impingement and previous indications that display an average growth rate equal to or greater than 25% of the repair limit in one inspection-to-inspection interval in any one steam generator,
>
> One or more new or previously identified indications (≥20% through-wall) which display a growth equal to or greater than the repair limit in one inspection-to-inspection interval, or
>
> Any crack indication (outside diameter intergranular attack/stress corrosion cracking or primary-side stress corrosion cracking)

Based on this definition, Callaway has no active degradation mechanisms.

PWR SG Guidelines, Revision 7 has been implemented into Callaway's SG Program since the issuance of the 180-day report transmitted via ULNRC-05450 dated October 25, 2007. Revision 7 has changed the definition of active degradation mechanism to the following:

> **Active Degradation Mechanism**: Historical term now synonymous with the term "existing" degradation that is found in the EPRI SG Integrity Assessment Guidelines.

It is believed this change in definition was in response to ML010320218 and ML012200349. Based on this definition, Callaway did not find any service-induced indications other than the AVB bar wear during the RF-15 inspection.

2. *Please provide the effective full power months at the time of your first in-service inspection following the replacement of your steam generators.*

Response

The replacement steam generators had 18 effective full power months (EFPM) of service when they were inspected during RF-15.

3. *For future reference, please provide the following information regarding the design of your replacement steam generators: the tubesheet thickness (with and without clad), the method used to expand the tubes into the tubesheet and the extent of expansion, the extent to which any tubes were stress relieved following bending, the radius of the smallest radius tubes, the tube support plate thickness (including the flow distribution baffle, if any), the anti-vibration bar cross section (e.g., rectangular) and the depth of penetration of the anti-vibration bars. In addition, please provide a tubesheet map, sketch of each stream generator showing the tube support naming convention, and clarify the number of tubes in the steam generators since you indicated that you performed a 100% inspection which was indicated to be 5536 tubes, (and other prior documentation from meetings with the Nuclear Regulatory Commission indicates that there are 5872 tubes per steam generator).*

Response

Tubesheet thickness (with and without clad):

Thickness without clad: 22.047"
Cladding thickness: 0.24"

Method used to expand tubes into tubesheet:

Hydraulic expansion

Extent of expansion:

Tubes were expanded throughout the entirety of the tubesheet.

Extent to which any tubes were stress relieved following bending:

Rows 1-18 were stress relieved.

The radius of the smallest radius tubes:

2.559"

The tube support plate thickness (including the flow distribution baffle, if any):

1.192"

The anti-vibration bar cross section (e.g., rectangular):

Rectangular 0.5" X 0.1388"

The depth of penetration of the anti-vibration bars:

Not known

Provide a tubesheet map:

See Letter Attachments 3 and 4.

Provide sketch of each steam generator showing the tube support naming convention:

See Letter Attachment 2 (representative of each steam generator).

Clarify the number of tubes in the steam generators since you indicated that you performed a 100% inspection which was indicated to be 5536 tubes, (and other documentation from meetings with the Nuclear Regulatory Commission indicates that there are 5872 tubes per steam generator):

Bobbin Straights and Bobbin Candycane rows were unintentionally omitted from Table 1 of the original submitted report. Table 1 should appear as follows:

ECT Task	Extent	SG A	SG B	SG C	SG D	Total
100% Bobbin F/L	Tube end hot to tube end cold	5535	5536	5536	5536	22143
Bobbin Straights	O8H-THE	336	336	336	336	1344
Bobbin Candycane	O8H-TEC	336	336	336	336	1344
MRPC periphery tubes	Top of Tubesheet +3"/-3"	935	935	935	935	3740
MRPC S.I.	Specified location	40	48	52	35	175

There are 5872 tubes per steam generator. One tube was plugged in SG A prior to putting it in service.

4. *Regarding the scope of your inspections, discuss whether any plug or secondary side inspections (including foreign object search and retrieval inspections) were performed. If so, discuss the results. If any loose parts or degraded conditions were identified, please discuss the actions taken to ensure acceptable steam generator performance until the next scheduled inspection.*

Response

The single existing plug in SG A was inspected. FOSAR was performed on all 4 SGs. No foreign objects were discovered. Visual inspection of the steam drum on SG A and SG D was performed. No degraded conditions were identified. Utilizing primary side eddy current data, a Sludge Loading Analysis report was performed for all 4 SGs. An expected light layer of magnetite was confirmed.

5. *Please clarify the following sentence: "Callaway did not perform repairs to any tubes because no tubes exceeded the repair criteria." In particular, confirm that no tube repairs were performed since no tubes exceeded the repair criteria and tube integrity will be maintained until the next steam generator inspection given the flaw sizes that were left in service. The staff notes that sometimes repair may be necessary*

to ensure tube integrity even though the depth of the flaw does not exceed the tube repair criteria. This depends on plant-specific growth rates and other considerations.

Response

Operational assessments were performed per the EPRI Integrity Assessment Guidelines. A repair limit of 21% through-wall (TW) was established (using conservative growth rates) in order to validate Callaway's tube integrity for 4.2 EFPY. This repair limit is stricter than the 40% TW limit provided in the Callaway Plant Technical Specifications. Neither limit was exceeded (greatest indication was 14% TW) and therefore no tubes were plugged during RF-15.

6. *Please clarify whether the +Point examinations performed in the periphery at the top of the tubesheet included both the hot- and cold-leg tubes.*

Response

Periphery tubes in both the hot and cold leg tubes were inspected with the +Point. Refer to Letter Attachments 3 and 4 for more detail.

7. *The staff is aware of at least one chemical excursion that affected the steam generator water chemistry. Please discuss the nature of all chemical excursions that occurred during your first cycle of operation. In addition, discuss the implications of these chemical excursions.*

Response

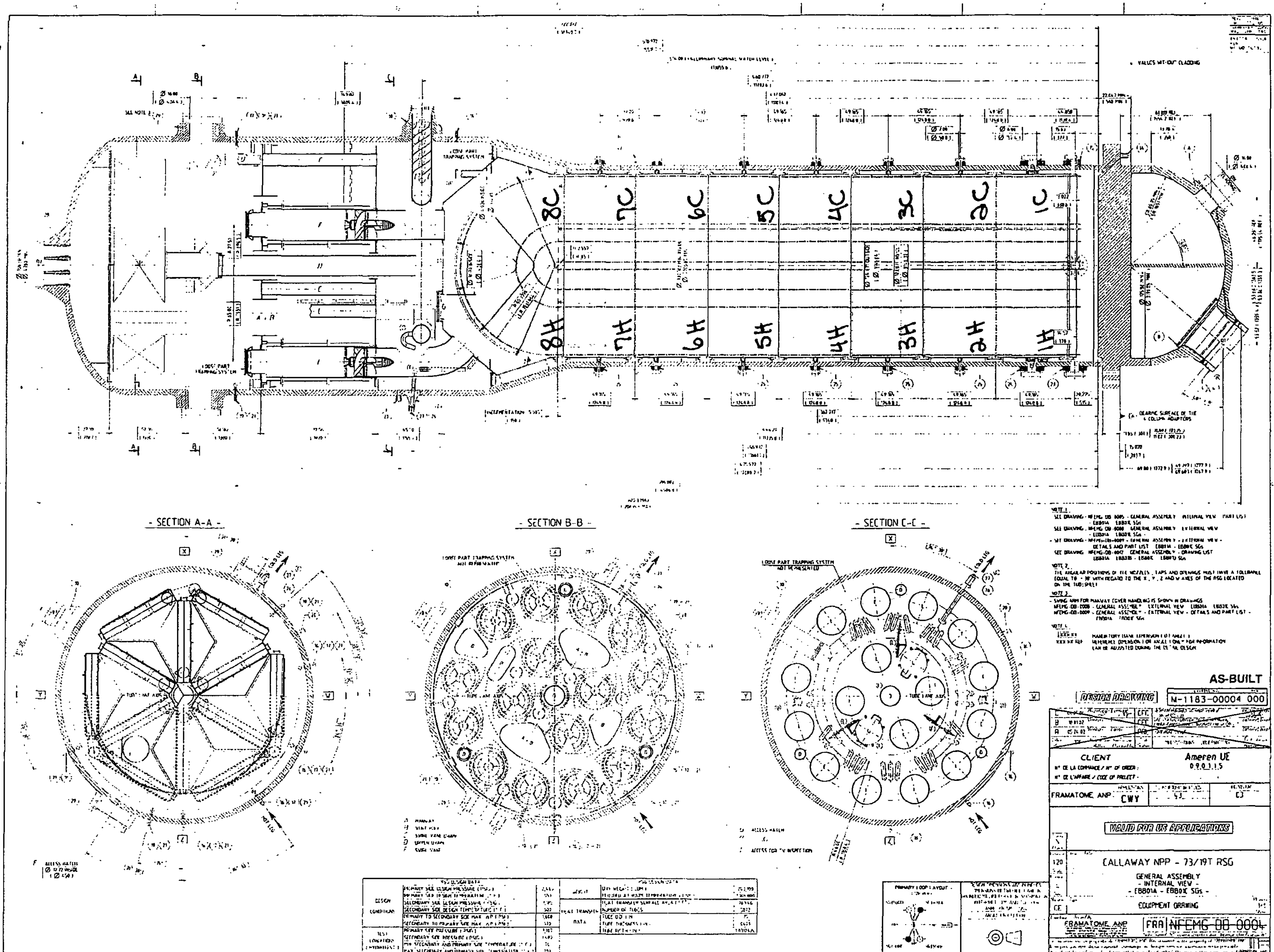
On 3/9/07 Chemistry noted a high sodium trend in the Hotwell Section 4. The increase occurred rapidly. Per plant procedure APA-ZZ-01021, steam generator blow down limits were exceeded and the plant entered action level 3 (action levels based on the EPRI Secondary Water Chemistry Guidelines) on sodium, sulfate and chloride. Prolonged operations in Action Level 3 could shorten the life of the steam generators. The plant entered action level 3 at 8:20 am and was subsequently shut down at 10:43 am. The prompt shutdown resulted from reactor manual trip due to loss of control of 'C' steam generator water level.

As part of the corrective action program, an investigation into the chemistry problems of this event revealed that the cause of the impurity ingress was a circulation water intrusion caused by a puncture of an IP condenser tube Section 4, in turn caused by a slop-drain support failure. All actions taken to mitigate the chemistry impact to the steam generators were done in accordance with the EPRI Secondary Water Chemistry Guidelines, and as a result, significant consequences were likely prevented.

An integrated exposure analysis was conducted as a reference. This analysis showed that the excursion was 35 ppb-days versus 50 ppb-days which would have required plant shutdown. It is likely that all actions taken were necessary to keep steam generator exposure from reaching levels that might have accelerated steam generator degradation. Assessments of degradation indicated that the likelihood of accelerated tube degradation is small. A complete analysis was conducted including a post-event hide-out return. The hideout return analysis at the outage following the excursion indicated very low rates of hide-out return.

Attachment 2 to
ULNRC-05518

TUBE SHEET NAMING CONVENTION



	RSG DESIGN DATA	
DESIGN CONDITIONS	PRIMARY SIDE DESIGN PRESSURE (PSIG)	[illegible]
	PRIMARY SIDE DESIGN TEMPERATURE (°F)	[illegible]
	SECONDARY SIDE DESIGN PRESSURE (PSIG)	[illegible]
	SECONDARY SIDE DESIGN TEMPERATURE (°F)	[illegible]
	PRIMARY TO SECONDARY SIDE MAX. ΔP (PSI)	1,660
	SECONDARY TO PRIMARY SIDE MAX. ΔP (PSI)	[illegible]
TEST CONDITIONS (HYDROTEST)	PRIMARY SIDE PRESSURE (PSIG)	[illegible]
	SECONDARY SIDE PRESSURE (PSIG)	[illegible]
	MIN SECONDARY AND PRIMARY SIDE TEMPERATURE (°F)	[illegible]
	MAX SECONDARY AND PRIMARY SIDE TEMPERATURE (°F)	[illegible]

	RSG DESIGN DATA	
WEIGHT	DRY WEIGHT (LBM)	[illegible]
	FLOODED AT ROOM TEMPERATURE (LBM)	[illegible]
HEAT TRANSFER DATA	HEAT TRANSFER SURFACE AREA (FT²)	[illegible]
	NUMBER OF TUBES	[illegible]
	TUBE OD (IN)	.75
	TUBE THICKNESS (IN)	[illegible]
	TUBE PITCH (IN)	[illegible]

TUBE SHEET MAP (COLD LEG)

Callaway Unit 1
04/07 - 1RFO15

C/L Top of Tubesheet +Point Examination w/ Probe 610PP

AREVA - FDMS map module Version 5.0

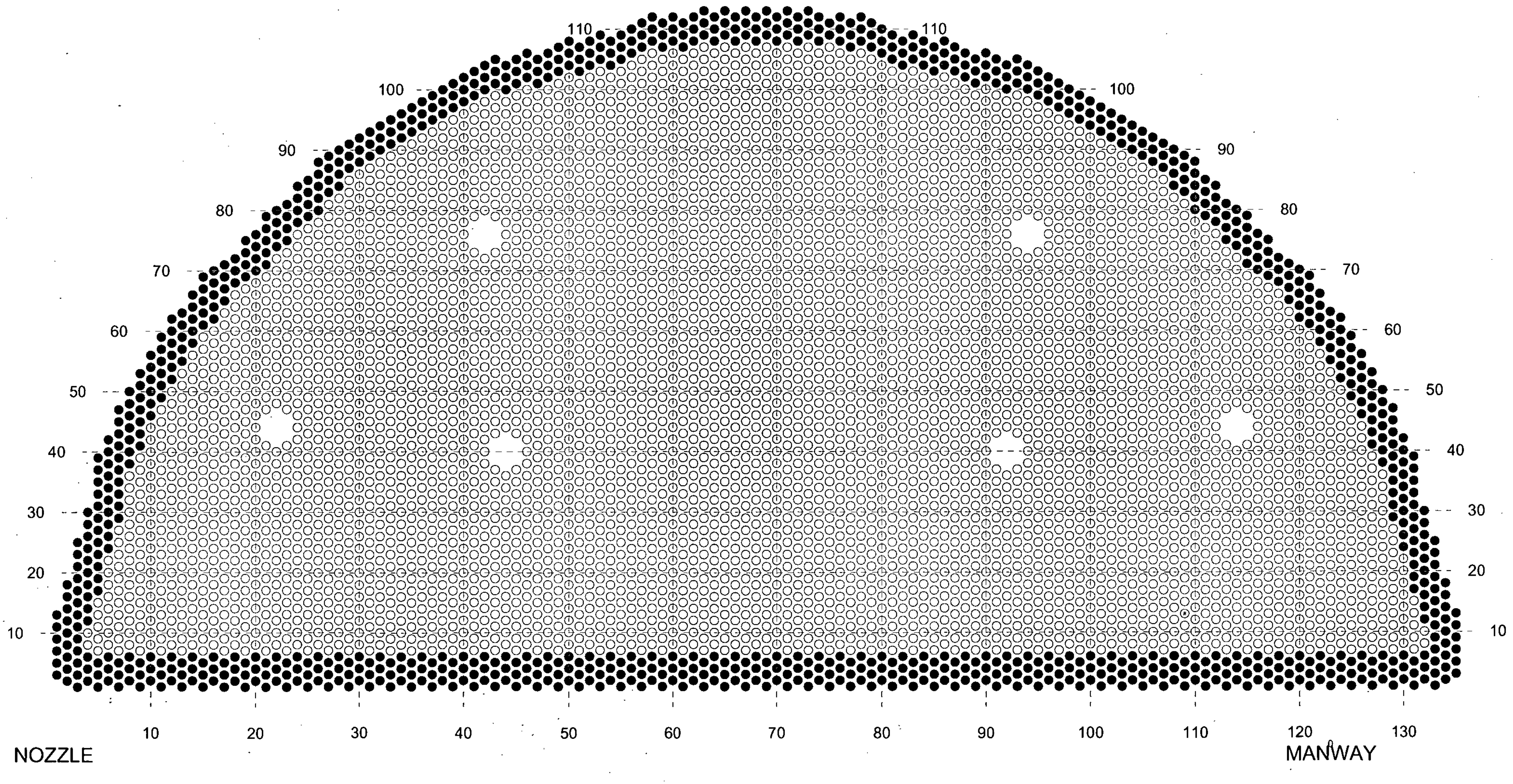
GROUP	TUBES
A C/L TTS +3/-3	965

S/G A
COLD
PRIMARY FACE

TOTAL TUBES: 5872
SELECTED TUBES: 965
OUT OF SERVICE (#): 1

SCALE: 0.084494 X
Thu Mar 22 17:01:46 2007

Callaway Unit 1: S/G A COLD FANP - 73/19T(GV/CA294)



TUBE SHEET MAP (HOT LEG)

Callaway Unit 1
04/07 - 1RFO15

H/L Top of Tubesheet +Point Examination w/ Probe 610PP

AREVA - FDMS map module Version 5.0

GROUP	TUBES
A H/L TTS +3/-3	965

S/G A
HOT
PRIMARY FACE

TOTAL TUBES: 5872
SELECTED TUBES: 965
OUT OF SERVICE (#): 1

SCALE: 0.084494 X
Thu Mar 22 16:59:42 2007

Callaway Unit 1: S/G A HOT FANP - 73/19T(GV/CA294)