Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402-2801

August 31, 2001

10 CFR 50.54(f)

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Gentlemen:

| | | |
|---|---|---|
| In the Matter of | ) | Docket Nos. 50-327 |
| Tennessee Valley Authority | ) | 50-328 |
| | | 50-390 |

SEQUOYAH NUCLEAR PLANT (SQN) UNITS 1 AND 2, AND WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 RESPONSE TO NRC BULLETIN 2001-01, "CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES," DATED AUGUST 3, 2001

This letter provides TVA's 30-day response to the subject bulletin for SQN and WBN, which requested information pertaining to the structural integrity of the reactor pressure vessel head penetration nozzles. In accordance with the bulletin, Enclosures 1 and 2 provide TVA's response to the requested information for SQN and WBN, respectively. In accordance with the requested information for item number 5 contained in the subject bulletin, TVA plans to submit the required response to this item for WBN Unit 1 and SQN Units 1 and 2 within 30 days of restart following their next refueling outages.

TVA is a member of the Material Reliability Project Alloy 600 Issue Task Group which has developed a generic program to address this issue. Accordingly, TVA has utilized the information/guidance developed by this utility group to respond to this NRC bulletin.

A088

No commitments have been made as a result of this letter. If you have questions regarding this response, please contact Terry Knuettel at (423) 751-6673.

Sincerely,

Mark J. Burzynski
Manager
Nuclear Licensing

Subscribed and sworn to before me
this 31st day of August 2001

Barbara J. Graveen
Notary Public

My Commission Expires January 25, 2003

Enclosures
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cc: Continued on page 3

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**ENCLOSURE 1**

**SEQUOYAH NUCLEAR PLANT (SQN) UNITS 1 AND 2 RESPONSE TO NRC BULLETIN 2001-01, "CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES"**

The following provides the response for SQN on the subject bulletin. Pursuant to Section 182a, Atomic Energy Act of 1954, as amended, and 10 CFR 50.54(f), all holders of pressurized-water reactor (PWR) operating licenses for nuclear power reactors must submit the following written information.

Based on the susceptibility ranking, TVA is only addressing Item 1 for SQN in this 30-day response. Accordingly, the following provides SQN's response to the subject bulletin:

**NRC Request:**

1. All addressees are requested to provide the following information:

   a. the plant-specific susceptibility ranking for your plant(s) (including all data used to determine each ranking) using the PWSCC susceptibility model described in Appendix B to the MRP-44, Part 2, report;

**TVA Response:**

The industry susceptibility ranking uses Oconee Unit 3 as the benchmark case. Only time and temperature are variables in the rank assessment. The methodology utilized was prescribed in MRP-44, Part 2, Report, Appendix B.

SQN Units 1 and 2 are ranked as plants in the ***"greater than 30 EFPY from Oconee Unit 3" category."***

The operating time and temperature data used in determining the ranking are given in Table 1.

**Table 1**
Data used in ranking SQN reactor vessel head penetrations (VHP)

| Unit | EFPY (through Feb. 2001) | RV Head Temperature (°F) | Ranking |
|---|---|---|---|
| 1 | 11.9 | 547 | 69 |
| 2 | 12.1 | 547 | 68 |

**NRC Request:**

   b. a description of the VHP nozzles in your plant(s), including the number, type, inside and outside diameter, materials of construction, and the minimum distance between VHP nozzles;

**TVA Response:**

SQN Unit 1 and 2 were originally designed as Westinghouse four loop upper head injection plants with their reactor heads manufactured by Rotterdam Dockyard. Each unit has 78 control rod drive mechanism (CRDM) penetrations, four auxiliary head adapter penetrations, and one head vent penetration. The CRDM penetrations in the reactor pressure vessel (RPV) head are 4.0 inches in diameter with a specified interference fit of 0.001 to 0.0014 inches. The CRDM penetration nozzle inside diameter (ID) is 2.75 inches. The auxiliary head adapter penetration RPV head hole is 5.375 inches in diameter with a specified interference

fit of 0.0004 to 0.0012 inches. The auxiliary head adapter penetration nozzle ID is 4.375 inches. The RPV head vent hole penetration hole is 1.028 inches and the head vent penetration tubing diameter is specified as 1.024 outside diameter (OD) and 0.768" ID. The CRDM penetrations and head vent penetrations are located 11.97 inches center to center typical. The auxiliary adapter penetration is located on the periphery with the nearest CRDM 14.243 inches away (center to center). The penetrations are Alloy 600 with the CRDMs procured to specification SB-167 and the auxiliary head penetrations and the head vent procured to specification SB-166. The CRDM and head vent penetrations were supplied by Sandvik Steel Company. To date, domestic CRDM tube leakage has not been associated with Sandvik Steel Company supplied material.

**NRC Request:**

c. a description of the RPV head insulation type and configuration;

**TVA Response:**

SQN Units 1 and 2 have horizontal reflective (mirror) insulation on the RPV head above the CRDM penetrations. Refer to Enclosure 1, Attachment 1, Item 18, "Mirror Insulation," for additional configuration information.

**NRC Request:**

d. a description of the VHP nozzle and RPV head inspections (type, scope, qualification requirements, and acceptance criteria) that have been performed at your plant(s) in the past four years and the findings. Include a description of any limitations (insulation or other impediments) to accessibility of the bare metal of the RPV head for visual examinations;

**TVA Response:**

SQN has been performing visual inspections of CRDM RPV head penetrations since 1994, that include looking for evidence of leakage. The inspections were performed because of industry recommendations for Ten Year In-Service Inspection (ISI) inspections. The inspections began in 1994 and continue to be performed every refueling outage. The next inspections are planned for the upcoming Unit 1 fall outage.

The inspections consisted of lifting the RPV head insulation about 2-3 inches (because of the high radiation exposure associated with removing the RPV head insulation) and visually looking for evidence of leakage using a flashlight and other visual aids.

The inspections were limited to a best effort examination of the two outer periphery rows of the RPV penetrations (which are the most susceptible in four loop Westinghouse units). These inspections were performed by senior metallurgical/welding engineers. The acceptance criteria is "no evidence of leakage."

The results of the visual inspections are shown below and indicate no evidence of leakage from the head penetrations.

**Table 2**
**SQN Unit 1**

| Outage Cycle | Area Examined On CRDM | Inspection Results |
|---|---|---|
| U1C6 | Two outer periphery rows | No leakage |
| U1C7 | Two outer periphery rows | No leakage |
| U1C8 | Two outer periphery rows | No leakage |
| U1C9 | Two outer periphery rows | No leakage |
| U1C10 | Two outer periphery rows | No leakage |

**Table 3**
**SQN Unit 2**

| Outage Cycle | Area Examined On CRDM | Inspection Results |
|---|---|---|
| U2C6 | Two outer periphery rows | No leakage |
| U2C7 | Two outer periphery rows | No leakage |
| U2C8 | Two outer periphery rows | No leakage |
| U2C9 | Two outer periphery rows | No leakage |
| U2C10 | Two outer periphery rows | No leakage |

**NRC Request:**

e. a description of the configuration of the missile shield, the CRDM housings and their support/restraint system, and all components, structures, and cabling from the top of the RPV head up to the missile shield. Include the elevations of these items relative to the bottom of the missile shield.

**TVA Response:**

Enclosure 1, Attachment 1 provides a table that contains the general description of the components within the area of the upper reactor cavity between the RPV head and the CRDM missile shields. Refer to Enclosure 1, Attachment 2 for a sketch of the general arrangement in this area.

**ENCLOSURE 1**
**ATTACHMENT 1**
**SEQUOYAH NUCLEAR PLANT (SQN) UNITS 1 AND 2 RESPONSE TO**
**NRC BULLETIN 2001-01, "CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES"**
**RESPONSE TO ITEM 1.e.**

| # | SQN Component | Elevation (Approximate) feet | Distance From Bottom Of Missile Shield (Approximate) (feet) | Function | Configuration |
|---|---|---|---|---|---|
| 1 | CRDM Missile Shield | 737.3 (Top)<br>733.8 (Bottom) | 3.5 (Top)<br>0.0 (Bottom) | Absorbs the kinetic energy due to impact of a CRDM housing during a postulated "Rupture of a Control Rod Drive Mechanism Housing" accident as described in section 15.4.6 of the SQN FSAR. Also provides radiation shield during normal plant operations and compartmentation during postulated LOCA events. | The CRDM missile shield consists of 3 sections of reinforced concrete with a 1 inch thick steel liner on the bottom surface. Each section is 3.5 feet thick. The central section is 29.0 feet long by 11.9 feet wide. The side sections are 9.5 and 11.0 feet wide, respectfully. The missile shields are accurately located and bolted in place by fifty eight 2.75 inch anchor bolts. There is 1 CRDM missile shield (in 3 sections) per RPV. |
| 2 | Seismic Support For CRDM/I&C Cables | 733.8 (Top)<br>728.2 (Bottom) | 0.0 (Top)<br>5.6 (Bottom) | Supports the electrical and I&C cables for the CRDMs and Rod Position Indicators (RPIs) . Includes quick disconnect points for cables on panels attached to the support framework. | Vertical support and seismic restraint for the electrical cables is provided by a horizontal 9.0 by 9.0 foot frame which is restrained horizontally by 4 adjustable length tie rods attached to the frame corners. It is supported vertically from the bottom of the CRDM missile shields at 2 locations. Electrical panels are attached to the vertical support members. There is one seismic support for CRDM/I&C cables per RPV. |
| 3 | CRDM/I&C Cables And Cable Trays | 731 (Top)<br>728 (Bottom) | 2.8 (Top)<br>5.8 (Bottom) | Provides power and I&C signals for CRDMs, RPIs, and thermocouples in RPV. | Cables enter reactor cavity through cable trays/swing arms and are plugged into electrical panels mounted on the seismic support described above. Instrument connections are also provided and |

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**ATTACHMENT 1**
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**RESPONSE TO ITEM 1.e.**

| # | SQN Component | Elevation (Approximate) feet | Distance From Bottom Of Missile Shield (Approximate) (feet) | Function | Configuration |
|---|---|---|---|---|---|
| | | | | | are mounted on the CRDM platform. Cables are then routed to the CRDM/I&C attachment points at approximately elevation 729, via channels provided by the seismic support. There are numerous electrical and I&C cables connecting to the CRDMs, RPIs, and RPV thermocouples. |
| 4 | CRDM Platform | 728.2 (Top)<br>727 (Bottom) | 5.6 (Top)<br>6.8 (Bottom) | Provides horizontal (lateral) seismic restraint for upper ends of CRDM housings. Also has a monorail attached to handle RPV flange bolts and tensioners. | Lateral restraint for upper end of CRDM housings is provided by 15.3 foot outside diameter welded circular platform. Platform is restrained against horizontal motion by 6 adjustable tie rod supports. Lateral support for the upper end of the CRDM housings is provided by square spacer plates which attach to the housings so that adjacent plates have small horizontal gaps relative to each other. The entire bundle of plates is restrained horizontally at its outer periphery by the welded platform. Thus, each CRDM housing can move vertically relative to adjacent CRDMs but the entire bundle is restrained horizontally. Vertical support for the platform is provided by three 5 inch diameter lifting rods. There is one CRDM platform per RPV. |
| 5 | Lifting Rods | 730.6 (Top)<br>706.6 (Bottom) | 3.0 (Top)<br>27.1 (Bottom) | Provides vertical support for CRDM platform during operation. Upper end attaches to spreader assembly to lift RPV | Three 5 inch diameter lifting rods (legs) are pinned to lifting lugs on the RPV head. The rods are evenly spaced 120 degrees apart and are vertical at a radius of 6.83 feet from the RPV centerline. Top |

| # | SQN Component | Elevation (Approximate) feet | Distance From Bottom Of Missile Shield (Approximate) (feet) | Function | Configuration |
|---|---|---|---|---|---|
| | | | | head assembly during refueling outages. | end of rods is pinned to spreader assembly when lifting the head assembly for outages. Spreader assembly is removed during plant operation. The CRDM platform is supported from leveling rings and nuts which are attached to the lifting rods and bolted to the platform. There are 3 lifting rods per RPV. |
| 6 | Full Length CRDMs | 729.3 (Top)<br>710.7 (Bottom*)<br>*At seal weld to control rod housing head adapter. | 4.5 (Top)<br>23.1 (Bottom) | Provides movement of control rods in RPV to control fuel reactivity when unit is operating and to shutdown reactor when required. Each CRDM withdraws and holds or inserts full length control rods in response to electrical control signals from reactor control system. Latch and rod travel housings provide pressure boundary integrity for design pressure of 2500 psia. | Bottom of latch housing assembly is threaded on to CRDM housing adapter and seal welded at elevation 710.7 feet. Electromagnetic mechanism for moving rods is located in the area from 11.1 inches to 50.7 inches above the seal weld. Outside dimensions of mechanism in this area are 10.8 inches by 10.8 inches. Pressure boundary integrity in the lower portion is provided by the latch housing which is approximately 7.5 inches outside diameter. Upper portion from 55.2 to 218.3 inches above the seal weld is 3.80 inches outside diameter (rod travel housing). There are a total of 57 full length CRDM assemblies per RPV. |
| 7 | Part Length CRDMs | 729.1 (Top)<br>710.7 (Bottom*)<br>* At seal weld to control rod housing head adapter. | 4.7 (Top)<br>23.1 (Bottom) | Latch and rod travel housings provide pressure boundary integrity for design pressure of 2500 psia. These CRDMs have been de-activated, and there are no electrical/I&C cables connected to | Bottom of latch housing assembly is threaded on to CRDM housing adapter and seal welded at elevation 710.7 feet. Electromagnetic mechanism for moving rods is located in the lower portion. Pressure boundary integrity in the lower portion is provided by the latch housing. There are 8 part length CRDM |

**ENCLOSURE 1**
**ATTACHMENT 1**
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**NRC BULLETIN 2001-01, "CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES"**
**RESPONSE TO ITEM 1.e.**

| # | SQN Component | Elevation (Approximate) feet | Distance From Bottom Of Missile Shield (Approximate) (feet) | Function | Configuration |
|---|---|---|---|---|---|
| | | | | them. The control rod mechanism is locked in the fully withdrawn position. | assemblies per RPV. |
| 8 | UHI Cap Off Assemblies | 709.4 (Top)<br>709.2 (Bottom) | 24.4 (Top)<br>24.6 (Bottom) | Pipe caps provide pressure boundary integrity for 4 auxiliary head adapter penetrations which were originally for UHI system piping (now removed). One cap has a head vent line attached. | Pressure boundary components are 5.44 inch XXS ASME SA 403WP type 304 pipe caps. A small vent pipe is attached to one cap. There are a total of 4 UHI cap off assemblies per RPV. |
| 9 | Head Vent Line | 730.6 (Top)<br>709.4 (Bottom) | 3.2 (Top)<br>24.4 (Bottom) | Provides vent and pressure boundary integrity from RPV head UHI cap attachment to pressurizer safety and relief valve discharge line outside reactor cavity. | One inch 304 stainless steel schedule 160 vent pipe is socket welded to UHI cap boss. Line runs vertically from UHI cap to elevation 730 feet, stair steps and exits cavity horizontally through a blowout panel opening at elevation 730.6 feet. There is one head vent line per RPV. |
| 10 | Head Adapter Plugs/ Cooling Baffle Dummy Can Assemblies | 716.9 (Top)<br>710.7 (Bottom) | 18.9 (Top)<br>23.1 (Bottom) | Head adapter plugs provide pressure boundary integrity for 7 Unit 1 and 8 Unit 2 CRDM type penetrations which are spares. cooling baffle cans provide proper flow paths for air cooling of CRDM electrical components. | Head adapter plugs are threaded on to head adapters and seal welded at the bottom in a similar manner as the CRDMs. Cooling baffle dummy cans are made from sheet metal and are formed to direct the cooling air flow over CRDMs. Type I cans are held in place by bolts threaded into the top of the adapter plugs. There are a total of 7 Unit 1 and 8 Unit 2 head adapter plugs and 15 Unit 1 and 16 Unit 2 cooling baffle dummy cans (8 Type II cans in both Units, and 7 Type I cans in Unit 1, 8 Type I cans in Unit 2) per RPV. |

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**ATTACHMENT 1**
**SEQUOYAH NUCLEAR PLANT (SQN) UNITS 1 AND 2 RESPONSE TO**
**NRC BULLETIN 2001-01, "CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES"**
**RESPONSE TO ITEM 1.e.**

| # | SQN Component | Elevation (Approximate) feet | Distance From Bottom Of Missile Shield (Approximate) (feet) | Function | Configuration |
|---|---|---|---|---|---|
| 11 | RVLIS Piping | 710.2 (Top)<br>709.9 (Bottom) | 23.6 (Top)<br>23.9 (Bottom) | Provides pressure boundary integrity and pressure reading for use by RVLIS system in determining reactor vessel water level. | RVLIS pipe attaches to head penetration vent and runs horizontal until it penetrates the CRDM shroud. Valves and instrumentation are located outside the shroud. Pipe is ¾ inch diameter schedule 160, 304 stainless steel. There is one RVLIS pipe per RPV. |
| 12 | Thermo-couple Column Assemblies | 717.1 (Top)<br>710.7 (Bottom) | 16.7 (Top)<br>23.1 (Bottom) | Provides pressure boundary integrity and sealed pathway for leads to thermocouples inside RPV. | Lower part of each thermocouple column assembly threads on to head adapter and is seal welded in manner similar to the CRDMs. Upper part is clamped to lower part and provides seal for thermocouple leads. Protection sleeve is attached to upper part to protect leads during refueling outages. There are 6 Unit 1 and 5 Unit 2 thermocouple column assemblies per RPV. |
| 13 | CRDM, Thermo-couple and Plugged Head Penetratio ns | 711 (Top)<br>Bottom varies with contour of RPV head. | 22.8 (Top)<br>Bottom varies with contour of RPV head. | Provides pressure boundary integrity and support for lower portion of CRDMs and other attached components. | Lower portion is Inconel tube inserted through 4.0 inch diameter holes bored in RPV head. Inconel (ASME SB167) tube is welded to inside of the head with a J-groove type weld. Upper portion is ASTM A182 Type 304 stainless steel tube with a threaded head adapter at the top. There are a total of 78 head penetrations of this type per RPV. |
| 14 | Auxiliary Head Penetra-tions | 709.0 (Top)<br>708.2 (Bottom) | 24.8 (Top)<br>25.5 (Bottom) | Provides pressure boundary integrity and support for UHI cap off assemblies. | Inconel (ASME SB166) tube (4.375 inch ID, 5.375 inch OD) is welded to inside of head with a partial penetration weld. Upper portion is ASME SA 182 Grade F 304 stainless steel tube which is welded to UHI cap off assembly described above. |

**ENCLOSURE 1**
**ATTACHMENT 1**
**SEQUOYAH NUCLEAR PLANT (SQN) UNITS 1 AND 2 RESPONSE TO**
**NRC BULLETIN 2001-01, "CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES"**
**RESPONSE TO ITEM 1.e.**

| # | SQN Component | Elevation (Approximate) feet | Distance From Bottom Of Missile Shield (Approximate) (feet) | Function | Configuration |
|---|---|---|---|---|---|
| | | | | | There are a total of 4 auxiliary head penetrations per RPV. |
| 15 | Head Vent Penetra-tion | 709.5 (Top)<br>708.8 (Bottom) | 24.3 (Top)<br>25.0 (Bottom) | Provides pressure boundary integrity and support for attached RVLIS piping. | Lower portion is Inconel tube inserted through 1.028 inch diameter holes bored in RPV head. Inconel (ASME SB166) tube is welded to inside of the head with a J-groove type weld. Upper portion is ASTM A312 Type 304L 1-inch schedule 160 stainless steel pipe. There is one penetration of this type per RPV. |
| 16 | CRDM Shroud | 715.4 (Top)<br>708 (Bottom) | 18.4 (Top)<br>25.8 (Bottom) | Directs cooling flow to CRDM electrical components to ensure functionality of those components when RPV is at operating temperature. | Cooling Baffle Assembly is typically called the CRDM shroud. Upper portion is irregular shape to match outside contour of CRDM bundle. Cooling air is drawn to CRDM coolers via ducting from the CRDM Shroud. The lower portion of the shroud has four 32 inch duct attachments (two attachments are plugged). It is made of ¼ inch stainless steel plate which is 11.7 feet inside diameter. It is bolted to a stainless steel shroud support skirt which is the same diameter and is also considered part of the assembly. There is one CRDM Shroud per RPV. |
| 17 | CRDM Cooling Ductwork | 731.1 (Top)<br>708 (Bottom) | 2.7 (Top)<br>25.8 (Bottom) | Provides cooling for CRDMs through Cooling Baffle Assembly (CRDM Shroud). | Ducts attach to shroud at 2 locations. These ducts are routed outside the CRDM shroud, CRDM bundle, head assembly lifting legs, CRDM platform, and CRDM cable support described above. There are 2 ducts providing the cooling air during operation of a unit. |
| 18 | Mirror | 709.8 (Top) | 23.9 (Top) | Provides thermal | Removable metal "mirror" insulation |

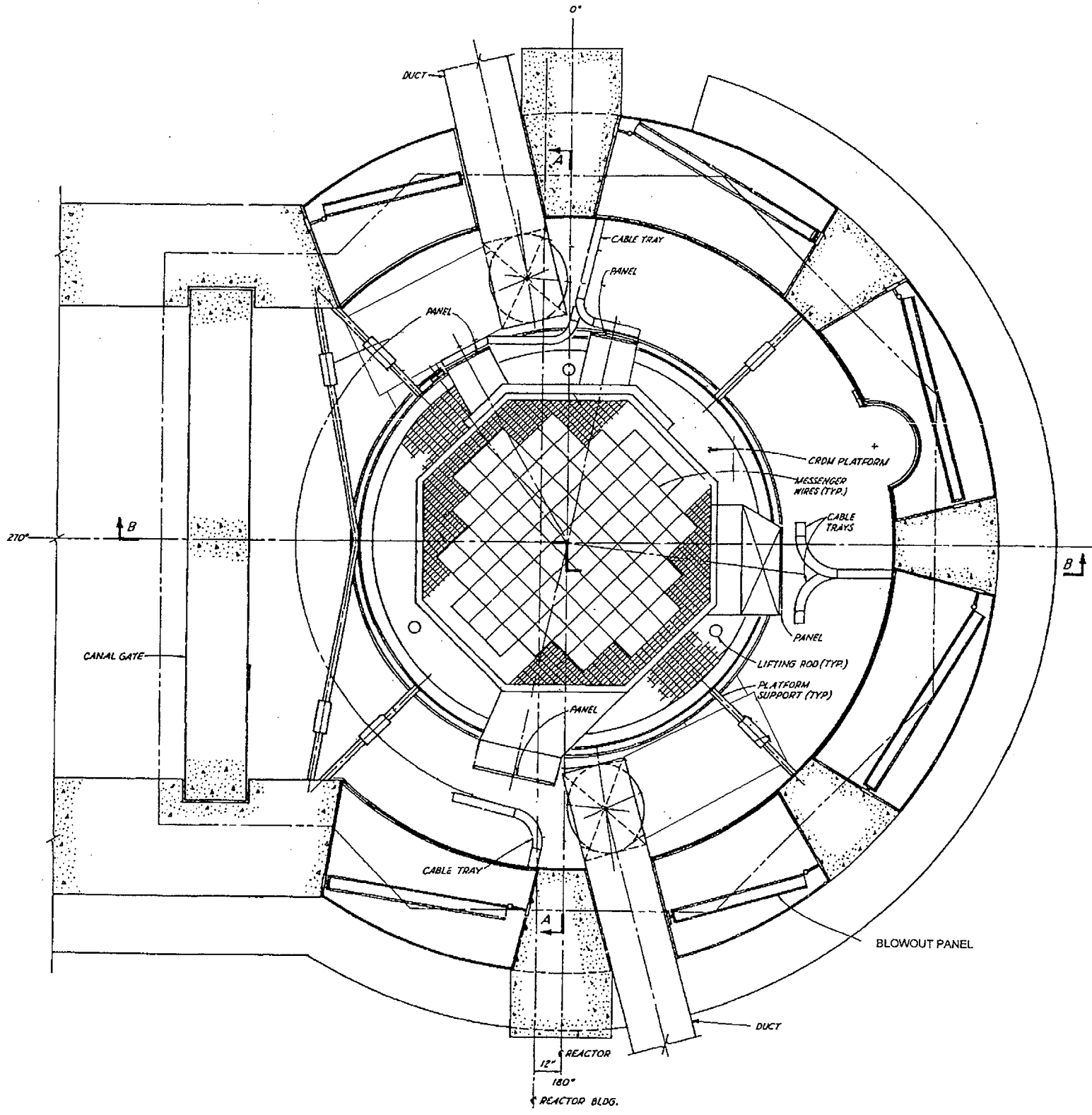
**ENCLOSURE 1**
**ATTACHMENT 1**
**SEQUOYAH NUCLEAR PLANT (SQN) UNITS 1 AND 2 RESPONSE TO**
**NRC BULLETIN 2001-01, "CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES"**
**RESPONSE TO ITEM 1.e.**

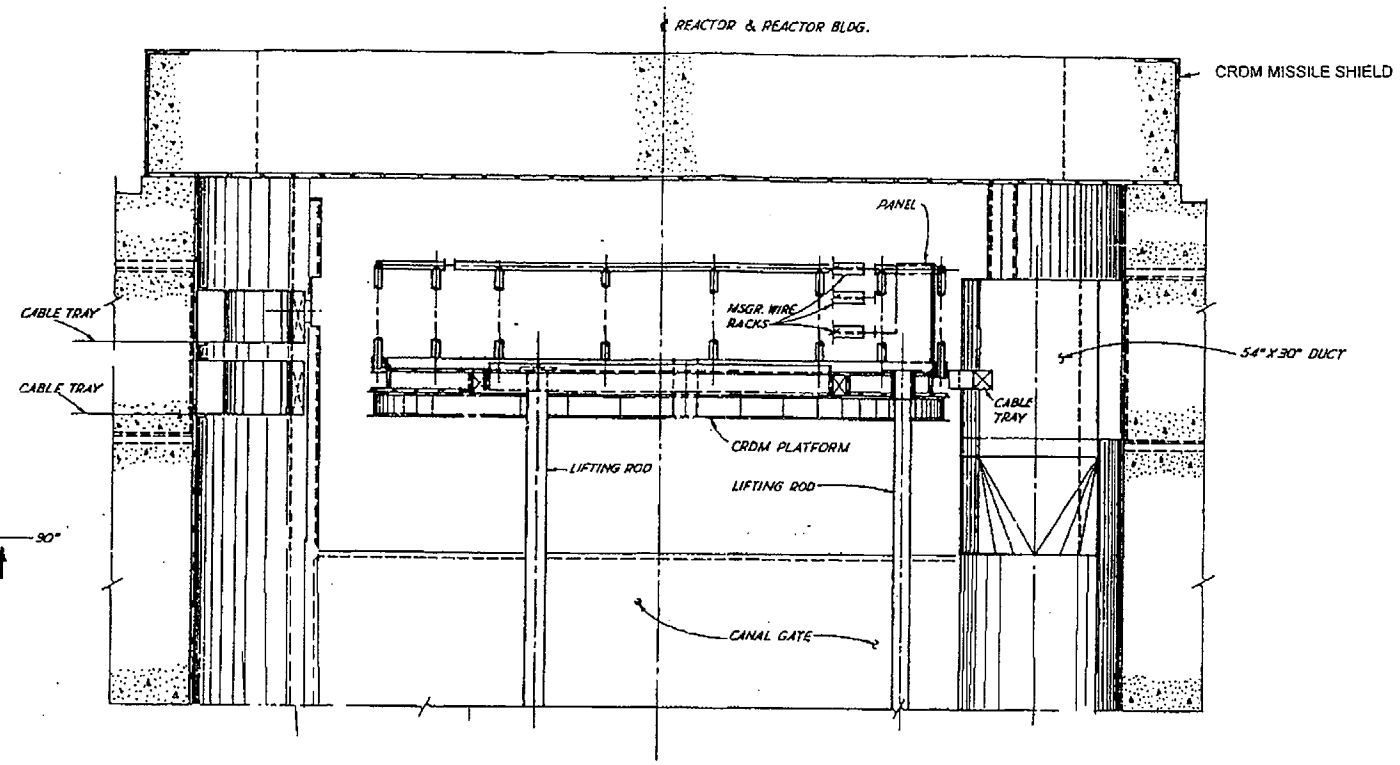
| # | SQN Component | Elevation (Approximate) feet | Distance From Bottom Of Missile Shield (Approximate) (feet) | Function | Configuration |
|---|---|---|---|---|---|
| | Insulation | 702.1 (Bottom) | 31.7 (Bottom) | insulation for RPV head. | is a product of Diamond Power Division of Babcock and Wilcox. Insulation is both inside and outside the CRDM shroud and above the RPV flange. There is one insulation assembly per RPV head. |
| 19 | Blowout Panels | 731.1 (Top)<br>726.6 (Bottom) | 2.7 (Top)<br>7.2 (Bottom) | Blowout panels open to provide flow path from RPV cavity to lower compartment during postulated LOCA events and stay closed during normal operation to control environmental temperatures. | Hinged steel panels (doors) have shear keys which allow panel opening when differential pressure limit is exceeded. Panels are hinged vertically. Height of panels is 4.5 feet. Width of panels varies. There are 6 Blowout Panels per RPV. |
| 20 | Hydrogen Igniters | 730 (Top)<br>729.5(Bottom) | 3.8 (Top)<br>4.3 (Bottom) | Mitigate hydrogen accumulation effects after postulated degraded core accident. | Hydrogen igniters are small electrical assemblies mounted at various locations inside containment, as described in SQN FSAR section 6.2.5A. There are 68 hydrogen igniters per RPV. Two of the 68 are located inside the RPV cavity, mounted to the cavity wall at elevation 730 feet. |
| 21 | Canal Gate | 733.8 (Top)<br>702.1 (Bottom) | 0.00 (Top)<br>31.7 (Bottom) | Provides compartmentation (devider barrier) for postulated LOCA events. Provides environmental control and radiation shield during normal operations. Removed as required during refueling operations. | Canal gate is made in 3 separate sections. Each section is a reinforced concrete block with stainless steel mating surfaces. Each section is 10.5 feet tall, 2.5 feet thick, and 20.1 feet long. Gaskets provide seals around mating surfaces. There is one canal gate (in 3 sections) per RPV. |

ENCLOSURE 1
ATTACHMENT 2

SEQUOYAH NUCLEAR PLANT (SQN) UNITS 1 AND 2 RESPONSE TO NRC BULLETIN 2001-01, "CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES"

General Arrangement In Upper Reactor Cavity Area
(Unit 1 is shown. Unit 2 is opposite hand.)

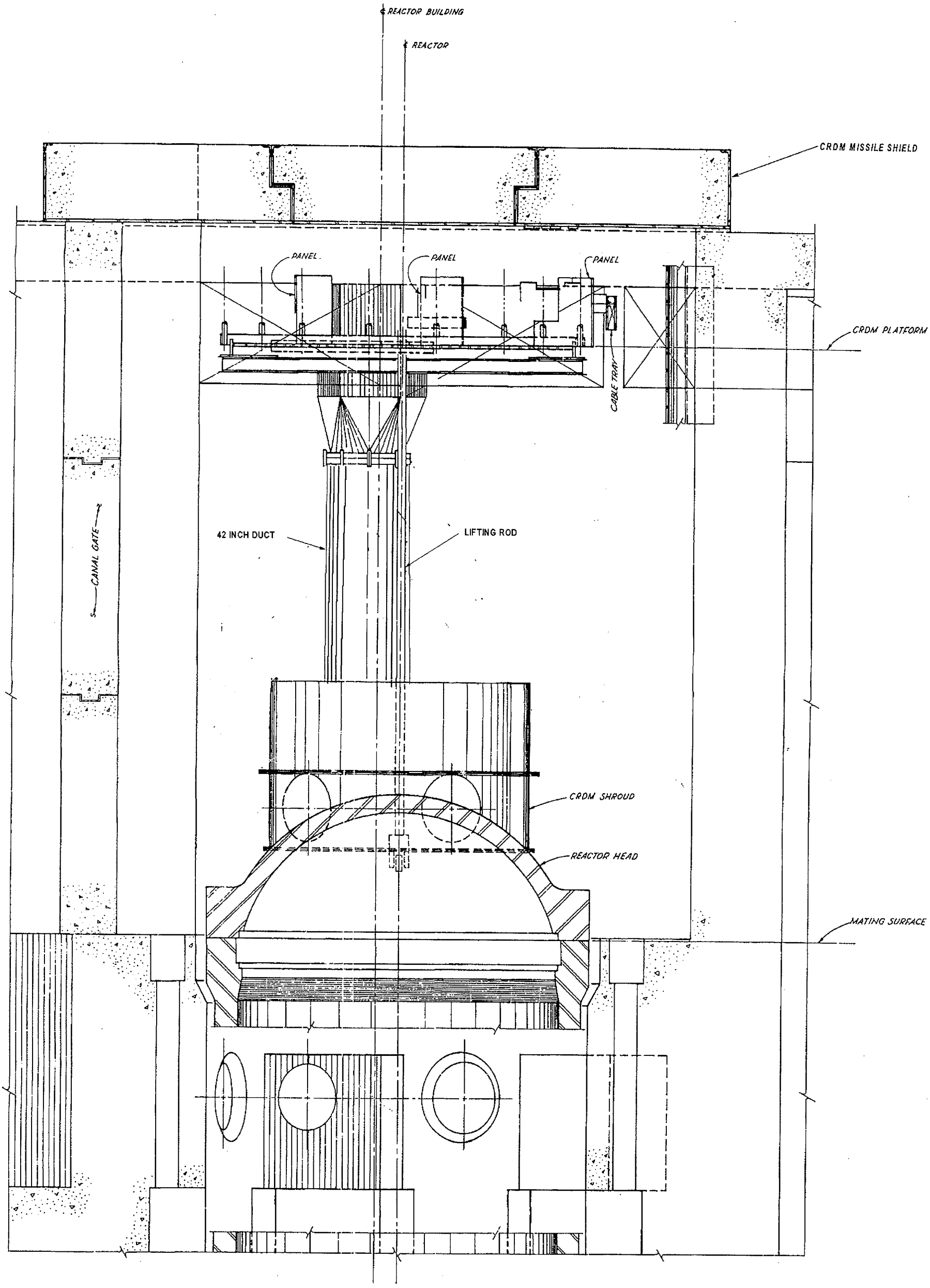



SECTION A - A

COMPONENTS OMITTED FOR CLARITY INCLUDE:
- SEISMIC SUPPORT FOR CRDM / I&C CABLES
- CRDMS
- UHI CAP OFF ASSEMBLIES
- HEAD VENT LINES
- HEAD ADAPTER PLUGS
- COOLING BAFFLE DUMMY CANS
- RVLIS PIPING
- THERMOCOUPLE COLUMNS
- HEAD PENETRATIONS
- MIRROR INSULATION
- HYDROGEN IGNITERS

# SEQUOYAH NUCLEAR PLANT
# GENERAL ARRANGEMENT
# UPPER REACTOR CAVITY AREA
# (SHEET 1)




SECTION B - B

SEQUOYAH NUCLEAR PLANT
GENERAL ARRANGEMENT
UPPER REACTOR CAVITY AREA
(SHEET 2)

**ENCLOSURE 2**

**WATTS BAR NUCLEAR PLANT (WBN) UNIT 1**
**RESPONSE TO**
**NRC BULLETIN 2001-01, "CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES"**

The following provides the response for WBN on the subject bulletin. Pursuant to Section 182a, Atomic Energy Act of 1954, as amended, and 10 CFR 50.54(f), all holders of pressurized-water reactor (PWR) operating licenses for nuclear power reactors must submit the following written information.

Based on the susceptibility ranking, TVA is only addressing Item 1 for WBN in the 30-day response. Accordingly, the following provides WBN's response to the subject bulletin:

**NRC Request:**

1. All addressees are requested to provide the following information:

   a. the plant-specific susceptibility ranking for your plant(s) (including all data used to determine each ranking) using the PWSCC susceptibility model described in Appendix B to the MRP-44, Part 2, report;

**TVA Response:**

The industry susceptibility ranking uses Oconee Unit 3 as the benchmark case. Only time and temperature are variables in the rank assessment. The methodology utilized was prescribed in MRP-44, Part 2, Report, Appendix B.

WBN Unit 1 is ranked as plants in the ***"greater than 30 EFPY from Oconee Unit 3" category."***

The operating time and temperature data used in determining the ranking are given in Table 1.

**Table 1**
Data used in ranking WBN reactor vessel head penetrations (VHP)

| Unit | EFPY (through Feb. 2001) | RV Head Temperature ($^{o}$F) | Ranking |
|---|---|---|---|
| 1 | 4.3 | 557 | 63 |

**NRC Request:**

   b. a description of the VHP nozzles in your plant(s), including the number, type, inside and outside diameter, materials of construction, and the minimum distance between VHP nozzles;

**TVA Response:**

WBN Unit 1 was originally designed as a Westinghouse four loop upper head injection plant with its reactor head manufactured by Rotterdam Dockyard. The unit has 78 control rod drive mechanism (CRDM) penetrations, four auxiliary head adapter penetrations, and one head vent penetration. The CRDM penetrations in the reactor pressure vessel (RPV) head are 4.0 inches in diameter with a specified interference fit of 0.0004 to 0.0012 inches. The CRDM penetration nozzle inside diameter (ID) is 2.75 inches. The auxiliary head adapter penetration RPV head hole is 5.000 inches in diameter. This

penetration design is significantly different from the CRDM penetration and head vent penetration. A 5 inch cladded hole is in the carbon steel RPV head and the Alloy 600 auxiliary head adapter (5.000inch ID and 6.496 outside diameter [OD]) is welded (with Inconel) to a Inconel buttered low alloy weld build-up on the RPV head exterior. The RPV head vent penetration tubing OD is specified as 1.287 inch OD and 0.866 inch ID. The CRDM penetrations and head vent penetrations are located 11.97 inches center to center typical. The Auxiliary Adapter penetration is located on the periphery with the nearest CRDM 14.243 inches away (center to center). The penetrations are Alloy 600 with the CRDM procured to specification SB-167 and the auxiliary head penetrations and the head vent procured to specification SB-166. The CRDM and head vent penetrations were supplied by Sandvik Steel Company. To date, domestic CRDM tube leakage has not been associated with Sandvik Steel Company supplied material.

**NRC Request:**

c. a description of the RPV head insulation type and configuration;

**TVA Response:**

WBN Unit 1 has horizontal reflective (mirror) insulation on the RPV head above the CRDM penetrations. Refer to Enclosure 2, Attachment 1, Item 18, "Mirror Insulation" for additional configuration information.

**NRC Request:**

d. a description of the VHP nozzle and RPV head inspections (type, scope, qualification requirements, and acceptance criteria) that have been performed at your plant(s) in the past four years and the findings. Include a description of any limitations (insulation or other impediments) to accessibility of the bare metal of the RPV head for visual examinations;

**TVA Response:**

WBN has not performed inspection of the RPV head penetrations due to low susceptibility ranking, low operating temperature (557 degree F), 4.3 EFPY of operation, and Sandvik CRDM tubing.

**NRC Request:**

e. a description of the configuration of the missile shield, the CRDM housings and their support/restraint system, and all components, structures, and cabling from the top of the RPV head up to the missile shield. Include the elevations of these items relative to the bottom of the missile shield.

**TVA Response:**

Enclosure 2, Attachment 1 provides a table that contains the general description of the components within the area of the upper reactor cavity between the RPV head and the CRDM missile shields. Refer to Enclosure 2, Attachment 2 for a sketch of the general arrangement in this area.

**ENCLOSURE 2**
**ATTACHMENT 1**
**WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 RESPONSE TO**
**NRC BULLETIN 2001-01, "CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES"**
**RESPONSE TO ITEM 1.e.**

| # | WBN Component | Elevation (Approximate) (feet) | Distance From Bottom Of Missile Shield (Approximate) (feet) | Function | Configuration |
|---|---|---|---|---|---|
| 1 | CRDM Missile Shield | 760.3 (Top)<br>756.8 (Bottom) | 3.5 (Top)<br>0.0 (Bottom) | Absorbs the kinetic energy due to impact of a CRDM housing during a postulated "Rupture of a Control Rod Drive Mechanism Housing" accident as described in section 15.4.6 of the WBN FSAR. Also provides radiation shield during normal plant operations and compartmentation during postulated LOCA events. | The CRDM missile shield consists of 3 sections of reinforced concrete with a 1 inch thick stainless steel liner on the bottom surface. Each section is 3.5 feet thick. The central section is 29.0 feet long by 11.9 feet wide. The side sections are 9.5 and 11.0 feet wide, respectfully. The missile shields are accurately located via lateral guides and bolted in place by forty eight 2.75 inch anchor bolts. There is 1 CRDM missile shield (in 3 sections) per RPV. |
| 2 | Seismic Support For CRDM/I&C Cables | 756.8 (Top)<br>751.3 (Bottom) | 0.0 (Top)<br>5.5 (Bottom) | Supports the electrical and I&C cables for the CRDMs and Rod Position Indicators (RPIs). Includes quick disconnect points for cables on panels attached to the support framework. | Vertical support and seismic restraint for the electrical cables is provided by a horizontal 9.0 by 9.0 foot frame which is restrained horizontally by 4 adjustable length tie rods attached to the frame corners. It is supported and stabilized vertically from the bottom of the CRDM missile shields at 4 locations (2 support points and 2 stabilizer points). Electrical panels are attached to the vertical support members. There is one seismic support for CRDM/I&C cables per RPV. |
| 3 | CRDM/I&C Cables And Cable Trays | 755 (Top)<br>752 (Bottom) | 1.8 (Top)<br>4.8 (Bottom) | Provides power and I&C signals for CRDMs and thermocouples in RPV. | Cables enter reactor cavity through cable trays/swing arms and are plugged into electrical panels mounted on the seismic support described above. Cables are then |

**ENCLOSURE 2**
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**RESPONSE TO ITEM 1.e.**

| # | WBN Component | Elevation (Approximate) (feet) | Distance From Bottom Of Missile Shield (Approximate) (feet) | Function | Configuration |
|---|---|---|---|---|---|
| | | | | | routed to the CRDM/I&C attachment points at approximately elevation 752, via channels provided by the seismic support. Instrument connections are also provided and are mounted to the CRDM platform. There are numerous electrical and I&C cables connecting to the CRDMs, RPIs, and RPV thermocouples. |
| 4 | CRDM Platform | 751.2 (Top)<br>750 (Bottom) | 5.6 (Top)<br>6.8 (Bottom) | Provides horizontal (lateral) seismic restraint for upper ends of CRDM housings. Also has a monorail attached to handle RPV flange bolt tensioners during refueling outages. | Lateral restraint for upper end of CRDM housings is provided by 15.3 foot outside diameter welded circular platform. Platform is restrained against horizontal motion by 6 adjustable tie rod supports. Lateral support for the upper end of the CRDM housings is provided by square spacer plates which attach to the housings so that adjacent plates have small horizontal gaps relative to each other. The entire bundle of plates is restrained horizontally at its outer periphery by the welded platform. Thus, each CRDM housing can move vertically relative to adjacent CRDMs but the entire bundle is restrained horizontally. Vertical support for the platform is provided by three 5 inch diameter lifting rods for the RPV head assembly. There is 1 CRDM platform per RPV. |
| 5 | Lifting Rods | 753.8 (Top)<br>729.7 (Bottom) | 3.0 (Top)<br>27.1 (Bottom) | Provides vertical support for CRDM platform during operation. Upper end attaches to spreader assembly to lift RPV | Three 5 inch diameter lifting rods (legs) are pinned to lifting lugs on the RPV head. The rods are evenly spaced 120 degrees apart and are vertical at a radius of 6.8 feet from the RPV centerline. |

**ENCLOSURE 2**
**ATTACHMENT 1**
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**NRC BULLETIN 2001-01, "CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES"**
**RESPONSE TO ITEM 1.e.**

| # | WBN Component | Elevation (Approximate) (feet) | Distance From Bottom Of Missile Shield (Approximate) (feet) | Function | Configuration |
|---|---|---|---|---|---|
| | | | | head assembly during refueling outages. | Top end of rods is pinned to spreader assembly when lifting the head assembly for outages. Spreader assembly is removed during plant operation. The CRDM platform is supported from leveling rings and nuts which are attached to the lifting rods and bolted to the platform. There are 3 lifting rods per RPV. |
| 6 | Full Length CRDMs | 752.3 (Top)<br>733.7 (Bottom*)<br>*At seal weld to control rod housing head adapter. | 4.5 (Top)<br>23.1 (Bottom) | Provides movement of control rods in RPV to control fuel reactivity when unit is operating and to shutdown reactor when required. Each CRDM withdraws, holds or inserts full length control rods in response to electrical control signals from reactor control system. Latch and rod travel housings provide pressure boundary integrity for design pressure of 2500 psia. | Bottom of latch housing assembly is threaded on to CRDM housing adapter and seal welded at elevation 733.7 feet. Electromagnetic mechanism for moving rods is located in the area from 11 inches to 51 inches above the seal weld. Outside dimensions of mechanism in this area are 10.8 inches by 10.8 inches. Pressure boundary integrity in the lower portion is provided by the latch housing which is approximately 7.5 inches outside diameter. Upper portion from 55 to 218 inches above the seal weld is 3.80 inches outside diameter (rod travel housing). There are 57 full length CRDM assemblies per RPV. |
| 7 | Part Length CRDMs | 752.1 ( Top)<br>733.7 (Bottom*)<br>*At seal weld to control rod housing head adapter. | 4.7 (Top)<br>23.1 (Bottom) | Latch and rod travel housings provide pressure boundary integrity for design pressure of 2500 psia. These CRDMs have been de-activated and there are no electrical / I&C cables connected to them. The control rod mechanism is | Bottom of latch housing assembly is threaded on to CRDM housing adapter and seal welded at elevation 733.7 feet. Electromagnetic mechanism for moving rods is located in the lower portion. Pressure boundary integrity in the lower portion is provided by the latch housing which is approximately 7.5 inches outside diameter. Upper portion |

**ENCLOSURE 2**
**ATTACHMENT 1**
**WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 RESPONSE TO**
**NRC BULLETIN 2001-01, "CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES"**
**RESPONSE TO ITEM 1.e.**

| # | WBN Component | Elevation (Approximate) (feet) | Distance From Bottom Of Missile Shield (Approximate) (feet) | Function | Configuration |
|---|---|---|---|---|---|
| | | | | locked in the fully withdrawn position. | is about 3.80 inches outside diameter (rod travel housing). There are 8 part length CRDM assemblies per RPV. |
| 8 | UHI Cap Off Assemblies | 732.5 (Top)<br>732.0 (Bottom) | 24.3 (Top)<br>24.8 (Bottom) | Pipe caps provide pressure boundary integrity for 4 auxiliary head adapter penetrations which were originally for UHI system piping (now removed). One cap has a head vent line attached. | Pressure boundary components are 6 inch XXS ASME SA 403WP type 304 pipe caps. A 1 inch vent pipe is attached to one of the 4 caps. A 3/8 inch diameter flow restriction hole is drilled through the pipe cap and welding boss with the vent line attached. There are a total of 4 UHI cap off assemblies per RPV. |
| 9 | Head Vent Line | 753.0 (Top)<br>732.5 (Bottom) | 3.8 (Top)<br>24.3 (Bottom) | Provides vent and pressure boundary integrity from RPV head UHI cap attachment to pressurizer safety and relief valve discharge line outside reactor cavity. | One inch 304 stainless steel schedule 160 vent pipe is socket welded to UHI cap boss. Line runs vertically from UHI cap to elevation 752.0 feet, horizontally to a 1 foot vertical riser, horizontally through a blowout panel opening at elevation 753 feet, and then down to a 12-inch pressurizer discharge line outside the reactor cavity. There is one head vent line per RPV. |
| 10 | Head Adapter Plugs/ Cooling Baffle Dummy Can Assemblies | 737.9 (Top)<br>733.7 (Bottom) | 18.9 (Top)<br>23.1(Bottom) | Head adapter plugs provide pressure boundary integrity for 8 CRDM type penetrations which are spares. Cooling Baffle Cans provide proper flow paths for air cooling of CRDM electrical components. | Head adapter plugs are threaded on to head adapters and seal welded at the bottom in a similar manner as the CRDMs. Cooling baffle dummy cans are made from sheet metal and are formed to direct the cooling air flow over CRDMs. Type I cans are held in place by bolts threaded into the top of the adapter plugs. There are a total of 8 head adapter plugs and 16 cooling baffle dummy cans (8 type I and 8 type II cans) per RPV. |
| 11 | RVLIS | 733.2 (Top) | 23.6 (Top) | Provides pressure | RVLIS pipe attaches to 1 inch head |

**ENCLOSURE 2**
**ATTACHMENT 1**
**WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 RESPONSE TO**
**NRC BULLETIN 2001-01, "CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES"**
**RESPONSE TO ITEM 1.e.**

| # | WBN Component | Elevation (Approximate) (feet) | Distance From Bottom Of Missile Shield (Approximate) (feet) | Function | Configuration |
|---|---|---|---|---|---|
| | Piping | 732.9 (Bottom) | 23.9 (Bottom) | boundary integrity and pressure reading for use by RVLIS system in determining reactor vessel water level. | vent penetration via a socket weld fitting and runs horizontal at elevation 733.2 feet until it penetrates the CRDM shroud. Valves and instrumentation are located outside the shroud. Pipe is 3/4 inch diameter schedule 160, 304 stainless steel. There is one RVLIS pipe per RPV. |
| 12 | Thermo-couple Column Assemblies | 740.1 (Top)<br>733.7 (Bottom) | 16.7 (Top)<br>23.1 (Bottom) | Provides pressure boundary integrity and sealed pathway for leads to thermocouples inside RPV. | Lower part of each thermocouple column assembly threads on to head adapters and is seal welded in a manner similar to the CRDMs. Upper part is clamped to lower part and provides seal for thermocouple leads. Protection sleeve is attached to upper part to protect leads during refueling outages. There are 5 thermocouple column assemblies per RPV. |
| 13 | CRDM, Thermo-couple and Plugged Head Penetra-tions | 734.1 (Top)<br>Bottom varies with contour of RPV head. | 22.7 (Top)<br>Bottom varies with contour of RPV head. | Provides pressure boundary integrity and support for lower portion of CRDMs and other attached components. | Lower portion is Inconel tube inserted through 4.00 inch diameter holes bored in RPV head. Inconel (ASME SB167) tube is welded to inside of the head with a J-groove type weld. Upper portion is ASME SA182 Type 304 stainless steel pipe with a threaded head adapter at the top. Tube outside and inside diameters are 4.00 and 2.75 inches, respectively. There are 78 head penetrations of this type per RPV. |
| 14 | Auxiliary Head Penetra-tions | 732.0 (Top)<br>731.2 (Bottom) | 24.8 (Top)<br>25.5 (Bottom) | Provides pressure boundary integrity and support for UHI cap off assemblies. | Lower portion is Inconel pipe welded to outside of RPV head. Inconel (ASME SB166) tube (5 inch ID, 6.5 inch OD) is welded to outside of head with a full penetration weld. Upper portion is ASME SA 182 Type 304 stainless |

| # | WBN Component | Elevation (Approximate) (feet) | Distance From Bottom Of Missile Shield (Approximate) (feet) | Function | Configuration |
|---|---|---|---|---|---|
| | | | | | steel tube (5 inch ID, 6.3 inch OD) which is welded to UHI cap off assembly described above. There are a total of 4 auxiliary head penetrations per RPV. |
| 15 | Head Vent Penetra-tion | 733.2 (Top)<br>731.8 (Bottom) | 23.6 (Top)<br>25.0 (Bottom) | Provides pressure boundary integrity and support for attached RVLIS piping. | Lower portion is Inconel tube inserted through 1.29 inch diameter holes bored in RPV head. Inconel ASME SB166 tube (1.29 inch OD, 0.87 inch ID) is welded to inside of the head with a J-groove type weld. Upper portion is ASME SA182 Type 304 1 inch schedule 160 stainless steel pipe. Upper portion contains a 90 degree bend and a horizontal run at elevation 733.2 feet, which attaches to RVLIS piping. There is one penetration of this type per RPV. |
| 16 | CRDM Shroud | 738.5 (Top)<br>730.1 (Bottom) | 18.8 (Top)<br>27.3 (Bottom) | Directs cooling flow to CRDM electrical components to ensure functionality of those components when RPV is at operating temperature. | Upper portion of CRDM shroud is irregular shape to match outside contour of CRDM bundle. Lower portion of shroud has four 32 inch duct attachments. It is made of ¼ inch stainless steel plate which is 11.7 feet inside diameter. It is bolted to a stainless steel shroud support skirt which is the same diameter and is also considered part of the assembly. There is 1 CRDM shroud assembly per RPV. |
| 17 | CRDM Cooling Ductwork | 754.1 (Top)<br>731.6 (Bottom*)<br><br>* Inside reactor cavity | 2.7 (Top)<br>25.2 (Bottom*)<br><br>* Inside reactor cavity | Provides cooling air for CRDMs through CRDM Shroud. | Ducts attached to CRDM shroud are 32 inch diameter 16 gage steel. These ducts are routed outside the CRDM shroud, CRDM bundle, lifting rods, CRDM platform, and CRDM cable support described above. Cooling air enters the top of the CRDM shroud and exits the four 32 |

| # | WBN Component | Elevation (Approximate) (feet) | Distance From Bottom Of Missile Shield (Approximate) (feet) | Function | Configuration |
|---|---|---|---|---|---|
| | | | | | inch ducts which are attached to the shroud at centerline elevation 732.9 feet. Cooling air is provided by CRDM coolers located in the lower compartment outside the reactor cavity. The coolers take suction from ducting attached to the 32 inch diameter ducts. Cooling air enters the reactor cavity through dampers in blowout panels and other openings in the cavity wall. During unit operation there are normally 2 CRDM coolers and 4 ducts providing the cooling air for the CRDMs. Two additional CRDM coolers are normally available for use in standby. |
| 18 | Mirror Insulation | 732.8 (Top)<br>725.1 (Bottom) | 24.0 (Top)<br>31.7 (Bottom) | Provides thermal insulation for RPV head. | Removable metal "mirror" insulation is a product of Diamond Power Division of Babcock and Wilcox. Insulation is both inside and outside CRDM shroud. The portion inside the shroud is in horizontal plane at elevation 732.8 feet. There is 1 insulation assembly per RPV head. |
| 19 | Blowout Panels | 754.1 (Top)<br>749.6 (Bottom) | 2.7 (Top)<br>7.2 (Bottom) | Blowout panels open to provide flow path from RPV cavity to lower compartment during postulated LOCA events and stay closed during normal operation to control environmental temperatures. | Hinged steel panels (doors) have shear keys which allow panel opening when differential pressure limit is exceeded. Panels are hinged vertically. Height of panels is 4.5 feet. Width of panels varies. There are 6 blowout panels per RPV. |
| 20 | Hydrogen Igniters | 753.5 (Top)<br>753.0 (Bottom) | 3.3 (Top)<br>3.8 (Bottom) | Mitigate hydrogen accumulation effects after postulated degraded core | Hydrogen igniters are small electrical assemblies mounted at various locations inside containment, as described in WBN |

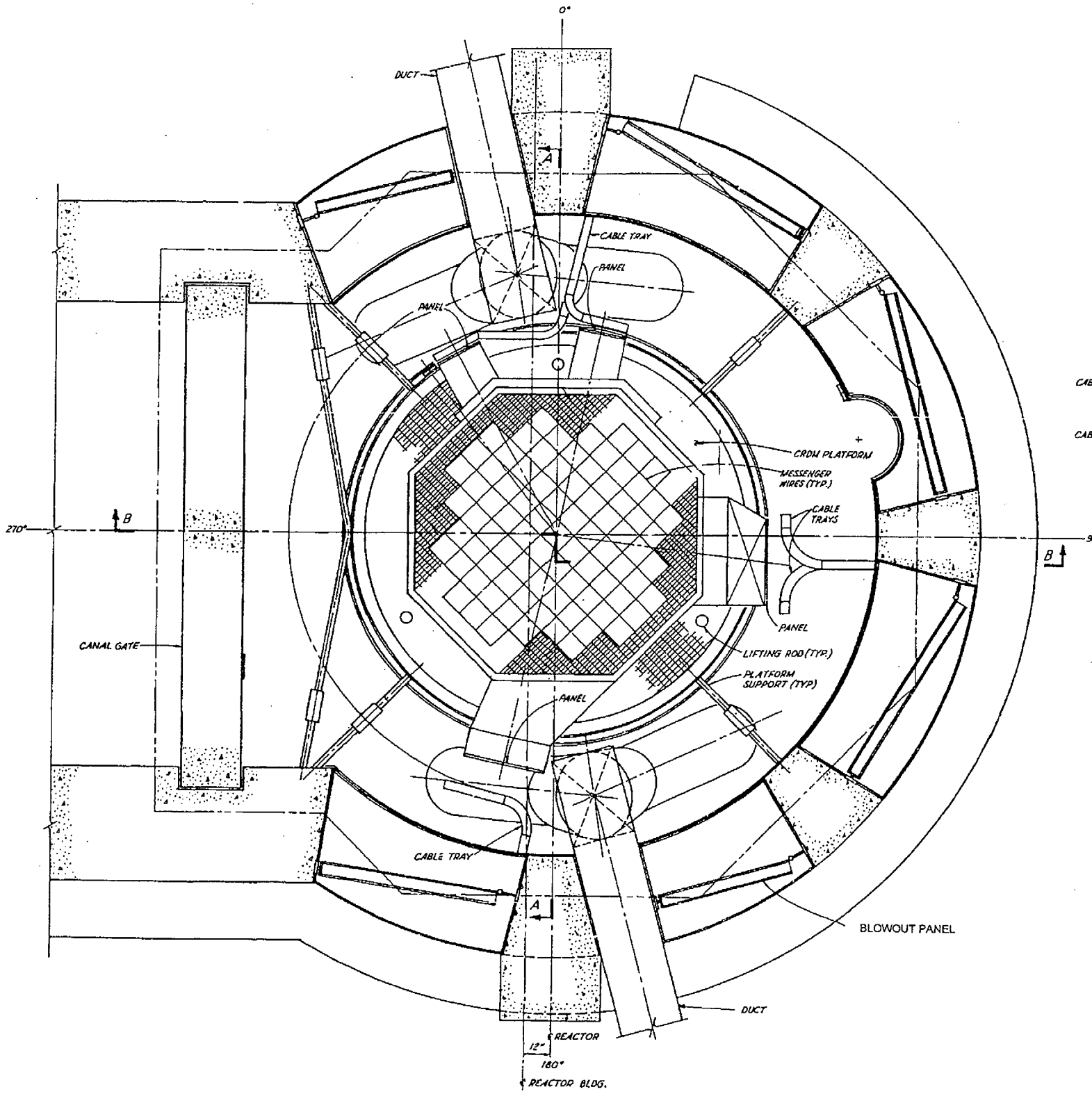
**ENCLOSURE 2**
**ATTACHMENT 1**
**WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 RESPONSE TO**
**NRC BULLETIN 2001-01, "CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES"**
**RESPONSE TO ITEM 1.e.**

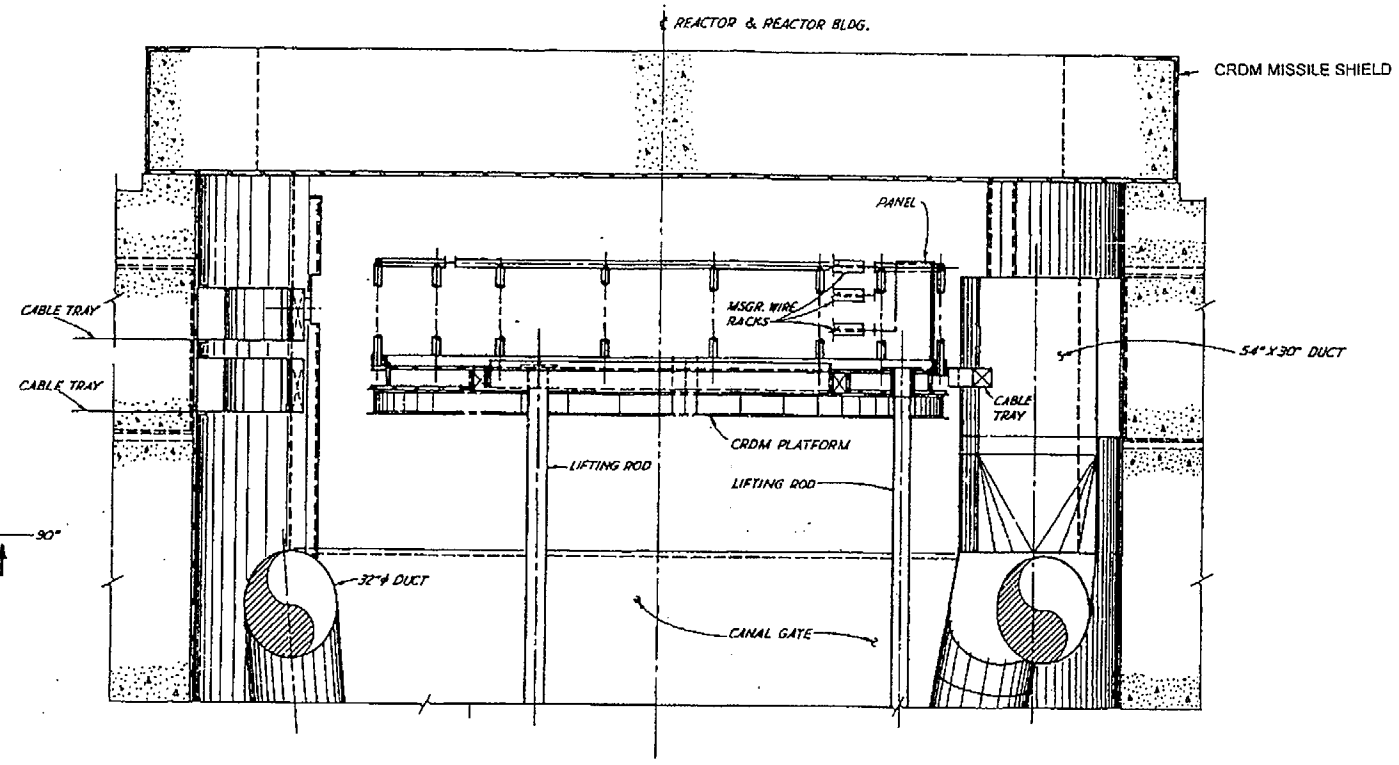
| # | WBN Component | Elevation (Approximate) (feet) | Distance From Bottom Of Missile Shield (Approximate) (feet) | Function | Configuration |
|---|---|---|---|---|---|
| | | | | accident. | FSAR section 6.2.5A. There are 68 hydrogen igniters per RPV. Two of the 68 are located inside the RPV cavity, mounted to the cavity wall at elevation 753 feet. |
| 21 | Canal Gate | 756.8 (Top)<br>725.1 (Bottom) | 0.00 (Top)<br>31.7 (Bottom) | Provides compartmentation for postulated LOCA events. Provides environmental control and radiation shield during normal operations. Removed as required during refueling operations. | Canal gate is made in 3 separate sections. Each section is a reinforced concrete block with stainless steel mating surfaces. Each section is 10.5 feet tall, 2.5 feet thick, and 20.2 feet long. Gaskets provide seals around mating surfaces. There is one canal gate (in 3 sections) per RPV. |

ENCLOSURE 2
ATTACHMENT 2

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 RESPONSE TO NRC BULLETIN 2001-01, "CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES"

General Arrangement In Upper Reactor Cavity Area

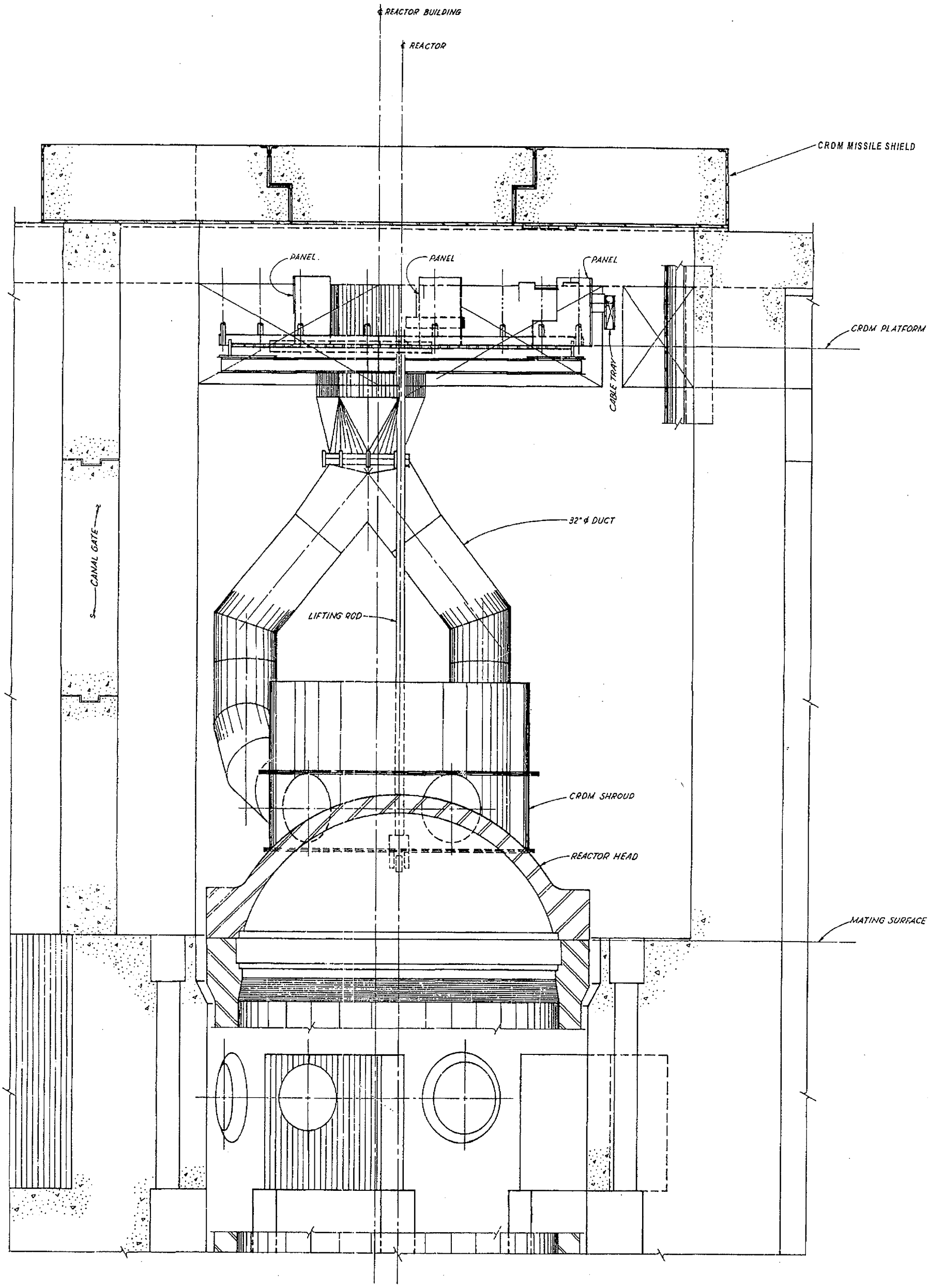



SECTION A-A

COMPONENTS OMITTED FOR CLARITY INCLUDE:
- SEISMIC SUPPORT FOR CRDM / I&C CABLES
- CRDMS
- UHI CAP OFF ASSEMBLIES
- HEAD VENT LINE
- HEAD ADAPTER PLUGS
- COOLING BAFFLE DUMMY CANS
- RVLIS PIPING
- THERMOCOUPLE COLUMNS
- HEAD PENETRATIONS
- MIRROR INSULATION
- HYDROGEN IGNITERS

# WATTS BAR NUCLEAR PLANT
# GENERAL ARRANGEMENT
# UPPER REACTOR CAVITY AREA
# (SHEET 1)




SECTION B - B

WATTS BAR NUCLEAR PLANT
GENERAL ARRANGEMENT
UPPER REACTOR CAVITY AREA
(SHEET 2)