Omaha Public Power District

444 South 16th Street Mall
Omaha NE 68102-2247

July 27, 2004
LIC-04-0080

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

Reference: 1. Docket No. 50-285
2. NRC Bulletin 2004-01, "Inspection of Alloy 82/182/600 Materials Used in the Fabrication of Pressurizer Penetrations and Steam Space Piping Connections at Pressurized Water Reactors"

SUBJECT: Response to Item 1 of NRC Bulletin 2004-01, "Inspection of Alloy 82/182/600 Materials Used in the Fabrication of Pressurizer Penetrations and Steam Space Piping Connections at Pressurized Water Reactors"

In response to the requests of Reference 2, the Omaha Public Power District (OPPD) provides the attached response information. The attachment contains the initial 60 day response information requested in Reference 2.

I declare under penalty of perjury that the foregoing is true and correct. (Executed on July 27, 2004.)

If you have additional questions, or require further information, please contact Thomas R. Byrne at (402) 533-7368. The Commitment made in this letter is provided in Attachment 2.

Sincerely,

7-27-04

Ralph L. Phelps
Division Manager
Nuclear Engineering

RLP/TRB/trb

Attachment 1 - Response to Item 1 of NRC Bulletin 2004-01, "Inspection of Alloy 82/182/600 Materials Used in the Fabrication of Pressurizer Penetrations and Steam Space Piping Connections at Pressurized Water Reactors"

Attachment 2 - List of Commitments

ATTACHMENT 1

Response to Item 1 of NRC Bulletin 2004-01, "Inspection of Alloy 82/182/600 Materials Used in the Fabrication of Pressurizer Penetrations and Steam Space Piping Connections at Pressurized Water Reactors"

Response to Bulletin 2004-01, "Inspection of Alloy 82/182/600 Materials Used in the Fabrication of Pressurizer Penetrations and Steam Space Piping Connections at Pressurized Water Reactors"

NRC Request (1)(a):

A description of the pressurizer penetrations and steam space piping connections at your plant. At a minimum, this description should include materials of construction (e.g., stainless steel piping and/or weld metal, Alloy 600 piping/sleeves, Alloy 82/182 weld metal or buttering, etc.), joint design (e.g., partial penetration welds, full penetration welds, bolted connections, etc.), and, in the case of welded joints, whether or not the weld was stress-relieved prior to being put into service. Additional information relevant with respect to determining the susceptibility of your plant's pressurizer penetrations and steam space piping connections to [primary water stress corrosion cracking] PWSCC should also be included.

OPPD Answer:

The Fort Calhoun Station Unit No. 1 (FCS) Pressurizer has 87 penetrations, which include:

- 8 Level Nozzles
- 2 Temperature Nozzles
- 2 Safety Valve Nozzles
- 1 Spray Nozzle
- 1 Relief Valve Nozzle
- 1 Surge line Nozzle (Bulletin requires no description)
- 72 Heater Penetrations

Fabrication issues, such as rework, reaming, and excessive grinding are a factor in the susceptibility of pressurizer penetrations to primary water stress corrosion cracking. After the failure of one pressurizer temperature nozzle in October 2000, the Omaha Public Power District (OPPD) obtained the fabrication records of the pressurizer penetrations and has concluded that no fabrication issues exist on any of the remaining pressurizer penetrations. This assessment confirmed the validity of an earlier review performed by Combustion Engineering (CE). Furthermore, OPPD plans numerous station material upgrades, and will replace the pressurizer in the Fall of 2006. Fabrication parameters are being carefully controlled in the replacement pressurizer to avoid the Alloy 600 heater sleeve failures that occurred in the CE plant fleet.

Level Nozzles

There are eight 1" schedule 160 level nozzles, four in the upper end and four in the lower end of the pressurizer. These nozzles were fabricated from ASTM A-508-64 CL alloy steel forgings clad and fitted with SA-182 Type 316 stainless steel alloy socket weld ends. The steel alloy end facilitates welding the SA-182 Type 316 stainless steel socket weld safe ends to the schedule 160 seamless ASTM A-376 Type 316 stainless steel piping in the water level instrumentation lines.

The stainless steel safe ends are butt welded to spool pieces of Alloy 600 (SB-166) intermediate safe ends. Post-weld heat treatment consisted of heating to 1150°F and holding for one hour/inch of weld thickness. A maximum interpass temperature of 350°F was maintained. The weld filler material for the nozzle to spool piece was 1/8" and 5/32" Alloy 182, which was deposited by using shielded manual arc. The weld filler material for the spool piece to safe end seam was 1/16" Alloy 82, which was deposited by using gas tungsten arc manual welding.

Temperature Nozzles

There are two 1" schedule 160 temperature nozzles, one in the upper head and one in the lower shell (in the heater area) of the pressurizer. The nozzles were fabricated from two ring segments of Alloy 600 (SB-166) with SA-182 Type 316 stainless steel socket weld safe ends.

The inside diameter of the nozzles was bored to the finished configuration, and the nozzles were partial penetration J-welded to the inside of the pressurizer after final pressurizer vessel stress relief. The weld filler material was 1/8" Alloy 182, which was deposited by using shielded manual arc welding.

In October 2000, temperature nozzle TE-108 was found leaking after a refueling outage. A weld pad Alloy 52/152 temper bead fillet weld repair was performed. No non-destructive evaluation (NDE) was performed.

Safety Valve Nozzles

There are two 3" I.D. by 6" O.D. relief valve nozzles both located in the upper head. These nozzles were fabricated from ASTM A-508-64 CL 2 forged alloy steel with Type 304 stainless steel cladding and fitted with Alloy 600 (SB-166) nozzle flanges to provide a 3" – 2500 lb flange connection to the safety valves. The safety valve piping is made from stainless steel.

The weld had a double v-groove, root machined out configuration. The weld filler metal was 1/8" and 5/32" Alloy 182, which was deposited by using shielded manual arc welding. Post-weld heat treatment consisted of heating to 1150°F and holding for one hour/inch of weld thickness. A maximum interpass temperature of 350°F was maintained.

Spray Nozzle

There is one 4" schedule 160 spray nozzle fabricated from ASTM A-508-64 CL 2 forged alloy steel with Type 304 stainless steel cladding and fitted with an SA-182 Type F-316 stainless steel alloy safe end. This nozzle provides the connection to the internal spray nozzle. The stainless steel safe end is butt welded to an Alloy 600 (SB-166) spool piece intermediate safe end. The spray nozzle piping is made from stainless steel.

Post-weld heat treatment consisted of heating to 1150°F and holding for one hour/inch of weld thickness. A maximum interpass temperature of 350°F was maintained. The weld filler metal for the nozzle to spool piece was 1/8" and 5/32" Alloy182, which was deposited by using shielded manual arc welding. The weld filler material for the safe end to spool piece seam was 1/16" Alloy 82, which was deposited using gas tungsten arc welding.

Relief Valve Nozzle

There is one relief valve nozzle located in the upper head of the pressurizer. This nozzle is fabricated from ASTM A-508-64 CL 2 forged alloy steel with Type 304 stainless steel cladding. A SA-182 Type 316 stainless steel safe end is then butt welded to an Alloy 600 (SB-166) spool piece intermediate safe end. The relief valve piping is made of stainless steel.

Post-weld heat treatment consisted of heating to 1150°F and holding for one hour/inch of weld thickness. A maximum interpass temperature of 350°F was maintained. The weld filler metal for the nozzle to spool piece was 1/8" and 5/32" Alloy 182, which was deposited by using shielded manual arc welding. The weld filler material for the safe end to spool piece seam was 1/16" Alloy 82, which was deposited using gas tungsten arc welding.

Heater Penetrations

FCS has 72 immersion type heaters installed in the bottom of the pressurizer. The heater sleeves are made of drawn and annealed Alloy 600 (SB-167) material, and are welded to an overlay of Alloy 82 internal cladding by partial penetration J-groove welds.

Installation of the heater sleeves occurred after final heat treatment of the pressurizer bottom head assembly. The weld filler metal for the J-groove welds was 1/16" Alloy 82, which was deposited by using gas tungsten arc manual welding.

NRC Request (1)(b):

A description of the inspection program for Alloy 82/182/600 pressurizer penetrations and steam space piping connections that has been implemented at your plant. The description should include when the inspections were performed; the areas, penetrations and steam space piping connections inspected; the extent (percentage) of coverage achieved for each location which was inspected; the inspection methods used; the process used to resolve any inspection findings; the quality of the documentation of the inspections (e.g., written report, video record, photographs); and, the basis for concluding that your plant satisfies applicable regulatory requirements related to the integrity of pressurizer penetrations and steam space piping connections. If leaking pressurizer penetrations or steam space piping connections were found, indicate what followup NDE was performed to characterize flaws in the leaking penetrations.

OPPD Answer:

OPPD performs a visual inspection of all pressurizer penetrations during each outage. This visual inspection is accomplished in two stages:

- During an outage each pressurizer heater sleeve is visually inspected by VT-2 qualified Quality Control personnel. The inspection is performed by looking at each insulated pressurizer heater sleeve through twelve port holes in the bottom of the pressurizer. Close to a 360° inspection of each heater sleeve is achieved. Documentation of the inspection is in the form of photographic evidence. If any leaks are found, then insulation would be removed and the leak would be repaired. Any leaks discovered during the inspection would be documented and dispositioned by the FCS Corrective Action Program.

- Then, during heat up, FCS procedure OP-ST-RC-3007 "Reactor Coolant System Integrity Test Following Opening, Repair, or Modification," is performed at system pressure by VT-2 qualified Quality Control personnel. All the pressurizer penetrations are included in this visual test. During performance of this visual walk down, the coverage of the visual test would vary depending on the accessibility of an item. However, this inspection coverage is supplemented by the noise coming from any steam leakage that may not be directly visible. OP-ST-RC-3007 is retained as a plant record, and any leaks would be documented and dispositioned by the FCS Corrective Action Program.

OPPD did not perform NDE on a water space temperature element nozzle that failed in October 2000, however as a preventative measure a mechanical nozzle seal assembly (MNSA) was installed on the other temperature element in steam space. In 2002, Eddy Current Testing confirmed that no cracking was present in the steam space temperature element nozzle and the MNSA was removed.

After the first evidence of circumferential cracking in pressurizer heater sleeve nozzles was found at Palo Verde Unit No. 2 in the Fall of 2003, a re-evaluation was deemed to be necessary to show that the FCS visual inspection program still ensured that pressurizer integrity was maintained. FCS was included in Westinghouse analysis report WCAP-16180-NP, "Operability Assessment for Combustion Engineering Plants with Hypothetical Circumferential Flaw Indications in Pressurizer Heater Sleeves," December 2003 (submitted to the NRC under Reference 1). The report concluded that the most limiting location is the outermost (highest angle) site. For this location, with the most limiting yield strength and highest stress location (just below the J-groove weld), a 30° circumferentially oriented flaw will require 10 years to grow to the critical flaw size for sleeve ejection. If an alternative criterion of a detectable leak rate (0.5gpm) is used then at least 7.8 years would be required to propagate a flaw to critical flaw size. Therefore, based on this conservative data, the currently implemented visual inspection program at FCS is sufficient to ensure the integrity of the pressurizer by being able to find this 0.5gpm leakage prior to a critical flaw size being reached. In the Fall of 1990, OPPD was able to detect a 0.2gpm increase in RCS leakage when an upper CEDM housing failed during operations, so a 0.5gpm increase in leakage should also be detectable.

NRC Request (1)(c):

A description of the Alloy 82/182/600 pressurizer penetration and steam space piping connection inspection program that will be implemented at your plant during the next and subsequent refueling outages. The description should include the areas, penetrations and steam space piping connections to be inspected; the extent (percentage) of coverage to be achieved for each location; inspection methods to be used; qualification standards for the inspection methods and personnel; the process used to resolve any inspection indications; the inspection documentation to be generated; and the basis for concluding that your plant will satisfy applicable regulatory requirements related to the structural and leakage integrity of pressurizer penetrations and steam space piping connections. If leaking pressurizer penetrations or steam space piping connections are found, indicate what followup NDE will be performed to characterize flaws in the leaking penetrations. Provide your plans for expansion of the scope of NDE to be performed if circumferential flaws are found in any portion of the leaking pressurizer penetrations or steam space piping connections.

OPPD Answer:

In Reference 2, a commitment was made by the CE fleet, which included FCS, on the details of a pressurizer visual inspection program. The following commitments were made in this letter:

- Perform a bare metal visual inspection of 100% of all pressurizer heater sleeve locations in such a way that visual access to the bare metal 360° around each sleeve can be attained.
- Perform NDE capable of characterizing crack orientation of all sleeves for which visual examination shows evidence of leakage. The NDE of each leaking sleeve will be performed prior to repair of the sleeve.
- If the NDE defines the flaw as potential circumferential cracking below the sleeve attachment weld, the NRC will be notified immediately and an appropriate inspection plan developed. The plan will define additional sleeves to be inspected by the NDE sufficient to determine the extent of condition commensurate with the characterization of the flaw.

During the Spring 2005 refueling outage, OPPD plans to apply the same criteria in Reference 2 to every pressurizer penetration and piping connection site detailed in the answer to request (1)(a) of this response. Any pressurizer penetration circumferential cracking along with circumferential cracking below the sleeve attachment welds will result in NRC notification and additional NDE. Quality Control VT-2 qualified personnel will perform the visual testing on the pressurizer, and NDE where necessary will consist of Eddy Current Testing with ECT-3 qualified personnel. Results of the visual inspection will be documented in Quality Control reports, and a report will be issued on the results of the Eddy Current Testing. Any leaks found during the inspection will be documented and dispositioned by the FCS Corrective Action Program.

OPPD plans to replace the FCS pressurizer during the 2006 refueling outage. Beyond 2006, FCS plans to perform, at a minimum, OP-ST-RC-3007 and visual inspections of each penetration. It is likely that these penetrations will be made from 316 stainless steel.

OPPD plans to satisfy structural and leakage requirements for the pressurizer based on Westinghouse report WCAP-16180-NP as explained in the FCS response to NRC Request (1)(b) of Bulletin 2004-01 above.

NRC Request (1)(d):

In light of the information discussed in this bulletin and your understanding of the relevance of recent industry operating experience to your facility, explain why the inspection program identified in your response to item (1)(c) above is adequate for the purpose of maintaining the integrity of your facility's RCPB and for meeting all applicable regulatory requirements which pertain to your facility.

OPPD Answer:

In order to maintain the material integrity of the reactor coolant pressure boundary (RCPB), programs, including requirements for performance of detailed examinations during outages, must be in place that assure that integrity is met during plant operations.

OPPD is very serious about maintaining the material integrity of the RCPB. This is very evident from the fact that OPPD plans to replace the FCS steam generators, pressurizer, and reactor vessel head in Fall 2006. OPPD performs reactor coolant system (RCS) leak rate test OP-ST-RC-3001 on a daily basis rather than at every third day, which is the industry standard. OPPD also meets the requirements of NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants," by having a detailed visual walk down of the RCS with VT-2 qualified Quality Control personnel, and an active boric acid corrosion prevention program, which is controlled and documented in Program Basis Document PBD-10, Boric Acid Corrosion Prevention.

NRC regulations at 10 CFR 50.55a are being met by OPPD by the in-service testing program, which follows ASME Code testing requirements and acceptance standards for identified leakage for ASME Code Class 1 components (which include the RCPB).

Circumferential cracking of any RCPB is a major concern, which OPPD is addressing through the cumulative effects of all the current programs that are in force and the enhanced visual testing, which will be performed on the pressurizer. The conservatism of the programs is reflected in WCAP-16180-NP, where 0.5 gpm long term leakage rates would have to occur in order to reach critical crack flaw sizes.

In April 2004, the Electric Power Research Institute (EPRI) issued a draft report, MRP-113, "Material Reliability Program: Alloy 82/182 Pipe Butt Weld Safety Assessment for US PWR Plant Designs." This report contains significant analytical data, which provides time to through-wall leakage and development of critical crack flaw sizes for dissimilar Alloy 82/182 butt welds for all three major NSSS vendors. OPPD has reviewed MRP-113 and plans to implement the recommendation that all dissimilar metal butt welds that operate at greater than or equal to 350°F will be visually inspected within the next two refueling cycles unless examinations were performed during the last refueling outage. However, it should be noted that OPPD will not visually inspect welds which will be replaced during the 2006 refueling outage.

References

1. Letter from Westinghouse Owners Group (Frederick P. "Ted" Schiffley II) to NRC (Document Control Desk) dated December 23, 2003, "WOG CE Fleet Operability Assessment Regarding Pressurizer Heater Sleeves" (WOG-03-643)

2. Letter from Westinghouse Owners Group (Frederick P. "Ted" Schiffley II) to NRC (Document Control Desk) dated January 30, 2004, "WOG CE Fleet Pressurizer Heater Sleeve Inspection Program" (WOG-04-057)

ATTACHMENT 1

Commitment

Commitment

1. During the Spring 2005 refueling outage, OPPD plans to apply the same criteria in Reference 2 to every pressurizer penetration and piping connection site detailed in the answer to request (1)(a) of this response.