PMNorthAnna3COLPEmails Resource

From: Thomas Kevern
Sent: Tuesday, April 21, 2009 4:50 PM
To: Regina.Borsh@dom.com; Dominion.Naps3ColaRAI@DOM.COM
Cc: NorthAnna3COL Resource
Subject: FW: Perry Fiberglass Pipe History/failures
Attachments: History of Fiberglass Pipe Issues at the Perry Nuclear plant.pdf

Gina:
Follow-up to our telecon re plant service water (section 9.2.1) issues. Forwarded is information re fiberglass piping events at Perry plant.
Tom

-----Original Message-----
From: Larry Wheeler
Sent: Tuesday, April 21, 2009 4:32 PM
To: Thomas Kevern
Cc: Steven Bloom
Subject: FW: Perry Fiberglass Pipe History/failures

Tom:

A lot of good info here on Perry's issues with fiberglass service water and Circ water.

Perry Nuclear Power Plant contact:

Jeff Haddick
Design Engineer
First Energy
440-280-7594

Hearing Identifier: NorthAnna3_Public_EX
Email Number: 720

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Subject: FW: Perry Fiberglass Pipe History/failures
Sent Date: 4/21/2009 4:50:08 PM
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From: Thomas Kevern

Created By: Thomas.Kevern@nrc.gov

Recipients:
"NorthAnna3COL Resource" <NorthAnna3COL.Resource@nrc.gov>
Tracking Status: None
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History of Fiberglass Pipe Issues at the Perry Nuclear plant.pdf	20807	

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History of Fiberglass Pipe Issues at the Perry Nuclear Plant

Preface:
A significant amount of information exists that pertains to the history of Perry's fiberglass pipe problems in the N71 Circulating Water System and the P41 Service Water system. There are numerous Condition Reports (CRs) and Nonconformance Reports (NRs) that document fiberglass pipe defects and repairs. There are over a dozen Technical Assignment Files TAFs) pertaining to the history and the work on fiberglass piping at Perry. There were several Perry Projects that were implemented in the mid to late 1990's, which involved the implementation of several Engineering Change Packages (ECPs). Currently, there is Program Plan that addresses the "maintenance" of the fiberglass piping in the N71 Circulating Water System. Although it is somewhat difficult to briefly summarize the history of events pertaining to the fiberglass pipe at Perry, the following discussion provides a high level (big picture) overview of the issue.

Summary:
During plant construction in the 1970's, buried fiberglass piping was installed in three of Perry's piping systems: the P41 Service Water System, the N71 Circulating water System and the P54 Fire Protection System. The Service Water and Circulating Water piping is large bore pipe that suffered much damage/abuse during installation and these are the two systems that Perry has had related issues with. Bulldozers and heavy equipment were used to install the piping. This caused impact damage as well as deflection damage. The impact damage was typically repaired, if it was identified. The deflection damage occurred during backfill when the soil was reinstalled around/over the piping. The deflection damage involved bending the fiberglass pipe out-of-round so that these locations ended up with an egg-shape circumference. This damage, coupled with marginal design and (in the case of Service Water) poor manufacturing led to future reliability problems at the Perry Plant.

The first fiberglass event occurred on December 22, 1991 and involved the failure of an above ground 36" diameter Circulating Water supply side elbow upstream of the Unit 1 Auxiliary Condensers. The elbow shattered into numerous pieces and approximately 2 million gallons of water flooded the plant yard before the system could be isolated. The plant was off-line for 3 or 4 weeks. The immediate actions were to recover evidence to support root cause investigation and to repair the failed elbow. The root cause indicated that the failure initiated from a pre-exiting construction cut or grind mark on the inside surface of the elbow. The repair involved splicing in one of the Unit 2 fiberglass elbows and "beefing it up" with additional fiberglass laminate to increase the elbow wall thickness. Both inside and outside joint laminate patch overlays were installed on either end of the elbow to splice it in place, whereas only outside joint overlays previously existed. The same wall thickness enhancement was done the return side elbow. Calculations were performed to determine adequate elbow wall thickness. For this event, documents and correspondence of interest would be NR 91-N-112, LER-91-027, Post

Scram Restart Report 1-91-2, NRC Confirmatory Action Letter CAL-RIII-91-016, NRC Inspection Reports, Perry to NRC Letters PY-CEI/OIE-0388L and PY-CEI/OIE-0389L.

The second fiberglass event occurred on March 26, 1993 and involved the failure of a below ground 30" diameter Service Water supply line to the Unit 1 Turbine Building Closed Cooling heat exchangers. The pipe failed underground creating a large sinkhole and again approximately 2 million gallons of water flooded the plant yard before the system could be isolated. The plant was off-line for approximately 2 months. The immediate actions were to recover evidence to support root cause investigation and to repair the failed piping. The root cause indicated that the failure initiated from a pre-exiting construction repair area. The failure consisted of a blown out 360 degree circumferential section of the piping approximately 8" wide. The repair involved splicing in a length of newly fabricated fiberglass pipe. The pipe was of thicker wall diameter and again internal as well as external laminate overlays were used on either end of the splice. Calculations supported the thickness of the spliced in spool piece. During the plant shutdown, extensive internal pipe inspections were conducted. Numerous defects were identified and repairs needed to be implemented. For this event, documents and correspondence of interest would be NR 93-N-074, CR 93-073, LER 93-010, Post Scram Restart Report 1-93-1, USNRC Inspection Report 50-440/93006, Perry to NRC Letters PY-CEI/NRR-01644L and PY-CEI/OIE-0401L.

Following these events, significant evaluation of Perry's fiberglass piping was conducted. Internal/external commitments and the Perry Course of Action Plan included steps to resolve these system piping problems and arrive at long-term solutions. Fiberglass industry experts were contracted to work with Perry engineers to develop a long-term plan for each system based on extensive analysis of the Perry's existing fiberglass piping systems. Material testing of pipe samples from each system was conducted to determine material strengths and to characterize the condition of the piping. Numerous calculations were performed. Projects ensued, which evaluated the options available. Options included pipe replacement, pipe upgrades (i.e., "beefing up" the pipe wall with added fiberglass laminate), pipe liners and periodic repeated piping inspections.

The results of the analyses found that the Service Water piping was of marginal design and of poor fabrication. The design of the installed piping was not up to the current standards of the mid-1990s and was felt to be inadequate for long-term service. Testing revealed low margins of safety and the design was of hoop filament wound construction that was susceptible to circumferential failure. It therefore needed to be replaced or upgraded via added internal laminate. Inspection revealed that sections of the piping had voids due to lack of laminate resin during its original manufacture. These areas allowed groundwater intrusion into the pipe wall, further degrading its strength. Although an internal corrosion liner was present, the numerous cracks due to impact damage and the deflected piping cracks allowed water intrusion from the inside as well. Structural enhancement of the piping could have been pursued, but this was determined not to be cost effective. The piping network was extensive (approximately 5000 liner feet) and internal repairs would be time consuming requiring very lengthy outage time to implement. The pipe size also made this option questionable, since the system piping ranged in size from 8” up to 54” diameter. Repairs could not be implemented in piping smaller than 30” in diameter and could only be reasonably implemented in pipe that was at least 36” in diameter. The smaller size piping would need to be replaced anyway. The ultimate decision was to replace the supply side piping with carbon steel and to install an internal structural pipe liner in the return side piping. These actions were taken in the mid-1990s and there have been no incidents of fiberglass problems since. These actions were meant to be permanent, because the piping cannot be easily inspected and the Service Water system is always running (even during plant refuel outages).

The results of the analyses found that although the Circulating Water piping was of marginal design, its condition/fabrication was of much better quality. Again, the design of the installed piping was not up to the current standards of the mid-1990s, however, the pipe was much more robust. The pipe wall of the 12 foot diameter main process lines is 1” thick as opposed to the thin walled Service Water piping. The pipe design was of axial filament wound construction that was much more resistant to circumferential failure. Internal inspected damage was also much less than that observed in the Service Water system. An external corrosion liner is present on this piping and was observed to be in relatively good shape. The option to replace the system was ruled out, due to the extensive outage time required to replace the approximate 1500 liner feet of 12 foot diameter piping and the approximate 500 linear feet of 36” diameter piping. Structural enhancement, coupled with a program of repeated inspections during refuel outages was the decided choice for this system. It turned out to be the most practical and the most cost effective method of “maintaining” the system piping for the rest of plant life. The large pipe size facilitates ample access for inspections. Repairs were implemented over several outages to address any damaged areas and enhancements were made to those internal pipe wall surfaces that were determined to be the most highly stressed. Radius of curvature measurements were recorded throughout the piping system at 5 foot intervals to characterize the deflected condition of the piping. From that information, the most deflected (and highly stressed areas) were identified. Calculations were completed to determine the deflected threshold at which added laminate would be needed to “beef up” the pipe wall to improve its strength. Selected upgrades were implemented on both the supply and return sides of the system. Inspections were conducted every outage until the “structural” enhancements were completed (RFO6). The internal corrosion liner condition on the return side of the system was breaking down much quicker than the liner on the supply side, so it was decided to replace it as well. This was accomplished in RFO8 and RFO11. Internal pipe inspections are now scheduled for every third outage. This is the present “maintenance” plan for the fiberglass piping in the Circulating Water system. This approach requires repeated pipe inspections to confirm piping integrity at regular intervals and to make repairs, as necessary. The inspection intervals may be changed based on inspection findings.