From: A. Randolph Blough
To: David Lew, Diane Screnci, Michael Modes, Neil Sheehan, Pete Eselgroth
Date: Fri, Jul 28, 2000 9:55 AM
Subject: Re: IP2 Special Inspection

thanks, michael; i appreciate the very clear tutorial.
randy
>>> Michael Modes 07/27 8:48 AM >>>
Thank you Randy for taking the time to constructively comment on the questions and answers. I will include your comments 2,3, and 4 in revising the document. Perhaps I can shed some light on the hour glassing problem.

There is general agreement that denting is due to the growth of magnetite corrosion product between the support plate and steam generator tube, with the volume of magnetite approximately equal to twice the volume of the metal consumed. Magnetite is an iron oxide formed when iron enters solution from steel objects, such as the support plate itself, and is deposited in the crevice. Studies have identified other corrosion products, such as iron phosphate, metallic copper, and silica particles with traces of sodium, calcium and manganese, as present in the material deposited in the crevice between the support plate and the steam generator tube, however magnetite contributes the greatest stress in causing the denting of the tube and deformation of the adjacent tube support.

One of the earliest reported side affects of denting was the deformation of inner row tubing U-bends which resulted in stress corrosion cracking. In this process the growth of the upper most tube support plate, as it was deformed by the deposit in the crevice, caused partial collapse of the two U-bend legs in an inward direction producing an over-bend condition in the tubing. This resulted in an oval cross-section distortion of the tube. This stress configuration led to cracking in the apex of the tube bend. The direct measurement of the over-bend condition is difficult and can be inferred by attempting to measure the degree of inward collapse of the tube. This measurement of ovality is subject to large inaccuracies.

A more common affect of the denting of the tubes is the bending of the adjacent ligaments which gives the appearance of changing the adjacent flow slot to one with inward bulging or an hour glass appearance. This distortion leads to fracture of the ligament and ultimately separation of the ligament from the support structure. This is an easily observed indication of denting and the inferred U-bend deformation.

Metal creep, on the other hand, is caused by the migration of interstitial lattice vacancies at high temperature and stress. These migrations lead to accumulation of the vacancies into holes, called vacancy pinning, visible under a microscope and an increase in the over all volume of the material. This increase in volume is one of the means by which the degree of creep is measured. The superheater header of a steam boiler is subjected to regular girth measurements, for example, to determine the amount of swelling. This swell measurement can then be correlated directly with the amount of creep in the header.

If left unattended the creep will continue with the holes further aligning into micro cracking, cracking and finally rupture of the material. Generally the materials used in nuclear power are not subjected to the high temperature and stress level combinations needed to facilitate creep. Creep, on the other hand, plagues the fossil fuel power industry and is the main cause of boiler water wall tubing failure.

Thank You
M
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>>> A. Randolph Blough 07/26 2:46 PM >>>
looks good. some comments on Q's and A's:
1. hourglassing --- answer says its caused by denting of the tube. I thought both hourglassing and

17/201

2

denting were caused by expansion (creep) of the support plate metal over time at high temps, and the hourglassing occurs because the tube, as it dents, provides resistance to the expansion. pls let me know, i may be way off.
2. "how can you consider allowing ...S/U...poor perforamnce...?"
i suggest we add a sentence onto the end of the answer; it would go something like, "Although there are several longstanding performance issues at IP2, and a performance improvement program is being pursued, overall safety perfomance is acceptable."
3. "...violation, CP, order...?"
answer need some work.....sounds too much like the inspection isn't even over.....also, the words "develop the technical basis for the event ..." are unclear to me.
4. we should probably have an answer for q's like, "Doesn't this prove that the whole outage is caused by ConEd's imprudence?" Answer would need to be carefully crafted and reviewed, but would indicate that, we don't know and it's not our role to review or judge that, nor do we endeavor to have the expertise to decide such matters; are inspections are not designed to obtain the necessary information or perspectives to judge such matters.

Thanks for the chance to comment; these are important Q/A's; perhaps others can comment as well.
randy

>>> David Lew 07/26 12:44 PM >>>
Attached are a summary, Q&As and communications plan. Please provide any comments to Mike Modes.

Also, a preview of the letter is attached. I will follow up with the final version when it is signed by Wayne Lanning.

CC: Bill Bateman, Brian Holian, Elinor Adensam, James Wiggins, Leanne Harrison, Richard Crlenjak, Wayne Lanning, William Raymond(...)