T. Gurdziel Questions – Log

1) Removing the Reactor Head Insulation Blankets for Inspection

It has been a problem with me for a number of years now that the NRC did not have authority to require that insulation blankets be removed so that a bigger surface area could be inspected for leakage on the Davis-Besse reactor head. You are the regulator, I don't understand why you couldn't just say: "Do it." With that final Davis-Besse Lessons Learned Recommendation now complete, that should no longer be a problem. However, whether it was complete at the time of the 3 inspections of this reactor head or not, I hope that they removed the insulation each time. Did they?

2) I Don't Like the Davis-Besse (Only) Reactor Head Inspection Process

One of our daughters has a fenced-in backyard and did have a big dog. We have a small dog. We like the dogs to stay in the backyard when we visit. How would we get this done?

Let's try the Maintenance Rule way, (although I do not have a good present knowledge of it.) You would walk around the backyard and see if the fence needs to be repaired, and then repair it before letting the dogs out.

Now let's try the way you presently have operating organizations inspect their PWR reactor heads. First let both dogs out. If you see the little one outside the fence, then look to find the opening. (This also works if I say you see the big one outside the fence.)

Do you see what I am saying? If you are looking for boron residue (for a PWR), FAILURE HAS ALREADY OCCURRED if you find some.

So, what I am saying is that I DO NOT accept the "leak before break" idea for every reactor head FirstEnergy puts on top of its reactor vessel, including reactor head number three. And I do not think you should, either. (But it still might be alright for all the other PWRs.)

3) How Long Does Through-wall Failure Take?

Inspecting for through wall leakage every refuel outage may not be adequate if failure occurs in a shorter period of time. Do we know how fast the cracks occur? Because if it is less than 2 years, 2 years between inspections is too long.

4) A problem of long standing with me is the failure of the FirstEnergy organization to install their Flus leakage detection system on the upper reactor head. This is the situation there, as I understand it.

(First let me point out a possible area of confusion. In the fabrication of a reactor vessel, the part at the bottom is called the bottom head, even though it is not detachable.)

The leakage problems have occurred on the top heads. No leakage has been confirmed on the bottom head. Yet, if you read lines 5, 6, and 7 of the attachment "Numbers of Channels", you will see that they installed the Flus system UNDER the reactor vessel. In other words, they installed the Flus system where the problem is not.

And, would it even be there? As I see it, the problem resulted on the (first) top head because a pool of boric acid formed and continued to eat away at the carbon steel. If liquid boric acid showed up on the outer surface of the bottom head, wouldn't gravity help it to leave (and not pool)?

5) If you look at the dot in area "A" of my sketch, I have represented a defect that will turn into a through wall crack and eventually leak boron residue up the gap to somewhere near "B". (I know the gap is not supposed to exist, however, I think that it may, at least intermittently, at problem nozzles.) Now supposing it is noticed during a visual inspection for boron residue, what action would be taken by FirstEnergy? They can't see the crack there, can they? If the head is still on the vessel, can they do any other type of test?

Do you see my problem here? You can't see the failure, even if you know it is there. Will they then remove the head and inspect it, then repair the nozzle? There is no allowable amount of leakage from the reactor head, is there?

6) Does the present FirstEnergy/Davis-Besse organization have the ability to identify the cause of problems? I recall that, 8 or 9 years ago, they were unable to find a leak of boric acid into their containment. They were able to change the sampling location to one that clogged the sampling filter less frequently. However, I believe that some air ductwork inside containment was completely eaten away (by boric acid). At that time, this was apparently not a sufficient reason to increase the searching. (Nor was the amount of boric acid/residue inside containment: a 0350 meeting transcript was probably the source of the actual number of 5 gallon containers removed during cleanup. I don't presently remember what it was.)

7) I am interested in the method of repair presently being used. If the nozzles are being cut off above the J-welds and then welded to the reactor head, is stainless steel cladding being applied to the carbon steel head now exposed to reactor coolant? And, if the cracks are actually in the J weld, are they, (the J welds), being removed as well?

8) Using Less-sensitive Testing?

From what I have been reading about the present Davis-Besse CRDM nozzle inspection, it appears that one inspection is done by ultrasonic test (UT), then another one is done to find axial oriented defects, and then even another is done to find circumferential defects. Is the first test done by the Time Of Flight Diffraction (TOFD) method of UT? (TOFD is supposed to be more sensitive than conventional UT techniques.) If it is, why would you do the other less sensitive tests?

9) Different Operating Conditions

To me it appears possible that continuing reactor head/nozzle problems at Davis-Besse are the result of unnoticed, yet sufficiently different operating practices. Could Davis-Besse operating crews be observed doing normal evolutions (only) in a simulator by a few B&W plant (but not FirstEnergy) operators? I would think the following might be important: boron concentration/changes; reactor vessel heat up & cool down; or any possible additives to the reactor coolant such as hydrogen, zinc or hydrazine.

10) Flow Induced Vibration

A few years ago, a continuing problem with Electomatic Relief Valve reliability at one of the Quad Cities nuclear plants was found to be what is called acoustic or flow-induced vibration. Basically, energy in a flowing fluid, (liquid or gas), can cause trouble, and did. A company from New Jersey solved this problem for them while studying a 5 foot long through wall crack in their new steam dryer. Has flow induced vibration been studied as a possible cause?

(Acoustic vibration was also the cause of a cracked weld on a Hope Creek recirc pump decon connection.)

11) Resonant Vibration

If the natural frequency of any CRDM & nozzle is close to the frequency during plant operation, trouble may occur.

(During a refuel outage at Nine Mile Point, Unit 2, we had a contractor come in to determine the natural frequency of either a reactor recirculation pump or the flow control valve for it. (I don't remember which.) Apparently, sensors are placed on the machine and it is hit with a hammer when it and surrounding machinery are still.)

I don't know how to measure frequency during plant operation.

12) O-rings

I believe the practice on reinstalling a BWR reactor head is to use new O-rings. (There are 2 required.) The situation may be the same for PWRs.

At the time I was in the BWR operating part of the industry, there was a long lead time in ordering them and, because of their size, they were a problem to ship. So, you need to have extras on hand because it is possible to damage them before use. (We did this at Nine Mile Point, Unit I but had extras on hand.)

Extra O-rings would also be needed if reactor coolant leakage was identified before the end of the planned run and the reactor head had to be removed for inspection and repair.

13) Finally, let's look more closely at the design of the CRDM nozzle penetration through the reactor (upper) head. My reference is slide 10 of 36 of the attached" August 23 NRC Slides". Do you see that both the top and the bottom of the hole through the head is counterbored? This means it has been made larger than the hole necessary for the nozzle: in other words there is a gap (between the nozzle and the head) in both locations. I am sure that this was done so that there would be support evenly, completely around the nozzle at all elevations above the lower counterbore and below the higher counterbore. Today's analytical computer programs may show that the counterbores are not necessary. I think somebody should check this.

There are two vertical thin black lines that show a side view of the gap (on slide 10 of 36). You have to look for them. It is on the right hand side of the upper counterbore and the left for the lower. I have cut two pieces of plastic pipe to approximately show what these volumes, (voids), look like in the "Counterbore Voids" attachment.

One problem I see is that, once the weld or the nozzle is cracked, reactor coolant can travel without any resistance maybe 1/3 of the way to the upper reactor head surface. Then it would have to attack the upper reactor head steel pressing on the CRDM nozzle for about 3 inches or so, and then it is free: there is no more resistance. So, if present calculations assume that the reactor coolant, after attacking the weld or lower part of the nozzle has to further attack 7 inches of steel, they are incorrect.

Another problem I see is that this configuration may not satisfy the design requirement that it is inspectable. Is it?

14) During one year-long (plus) outage when we replaced all "safe-ends" and external reactor recirculation piping at Niagara Mohawk/Nine Mile Point Unit I, I was one of 6 drywell (work) coordinators. In the attached sketch "Preparation for Welding, (Pipe)", I am showing (from my memory) how pipe joints were prepared for welding.

Note that a consumable ring spanned the gap between pieces of pipe. An inert atmosphere was required (behind the weld) until the ring was "consumed" and 3 acceptable passes of weld metal were applied.

In the other sketch, "Preparation for Welding, (Nozzle to Head)", (where I have not shown the J-groove), my interest is in what fills the gap for the first few weld passes and how would an inert atmosphere be provided behind the weld?

15) **Email: April 22, 2010**

First off, I see that the Davis-Besse Lessons Learned Task Force Recommendation information that I was interested in has been brought up to date. Thank you.

Next, I am interested in calculating the relative movement during heat up of both the hole in the carbon steel reactor upper head and the CRDM nozzle. I believe that I can figure out how to do this, at least approximately. Can you tell me the diameter of the hole (not counterbore hole) through the upper reactor head at room temperature? Can you tell me the outer diameter of the CRDM nozzle at room temperature? Can you tell me the type of steel the CRDM nozzle is made of, or, at least, if it is austenitic stainless steel or ferritic stainless steel? And, finally, I think that the last piece of information I need is the usual operating temperature of the second upper reactor head at Davis-Besse.

The purpose here would be to show that, despite the initial shrinking, the nozzle does still remain in contact with the head after heat up, or the nozzle does not remain in contact with the head after heat up (thus providing a gap between both as long as operation continues).

Email: April 23, 2010
Today I tried to see if the CRDM nozzle remains in contact with the upper reactor head after heat up. (Don't worry about the 3 attached sheets: they don't have all my assumptions written down.) What I have tried to do is start off with a 4 inch diameter hole, (2 inch radius), through the upper reactor head at a temperature of 70 degrees, then heat it up to 605 degrees and calculate the new radius using a Linear Temperature Expansion Coefficient for steel of 7.3 x 10 to the minus 6 inches per (inch-degree F).

Then I did the same twice, once for a nozzle made of Austenitic stainless steel and once for a nozzle made of Ferritic stainless steel because I thought the nozzles were made of stainless steel and the first has a Linear Temperature Expansion Coefficient slightly higher than that of ordinary steel, and the second has a Linear Temperature Expansion Coefficient lower that that of ordinary steel.

I found that, after heat up, the nozzle with a coefficient higher than that of the steel (of the upper reactor head) would expand more than the hole in the head (if it were not inside the hole) and thus would remain in contact with the head.

However, I found that the nozzle with the coefficient lower than that of the steel (of the upper reactor head), if starting out just in contact with the hole, would no longer be in contact at operating temperature. This means a gap would appear at operating temperature.

I further calculated, (approximately), that, in this second case the nozzle would be in contact with the head at operating temperature only if it were originally larger than the hole. It would fit (into the hole) at room temperature if it were cooled so that it would be shrunk in size. I figure that the temperature would have to be about minus 100 degrees F for this to work.

So, my suggestion to you is to make sure that the nozzles actually installed in the Davis-Besse second upper reactor head are made of the material they were supposed to be made of. If their coefficient of linear temperature expansion is lower than that of the steel in the reactor head, you should also figure if enough oversized diameter was provided (requiring that "shrink fit"), so that no gap occurs at operating temperature.

17) Two months after discovery, even the color of boron residue on the upper surface of the second Davis-Besse reactor head still has not been revealed to the public. Is there a need for this amount of secrecy by the NRC?

17a) What would be the expected location of the first meeting?

Have you asked somebody like INPO to review your regulatory actions with an eye to identifying any insufficient requirements?

Is somebody reviewing industry group involvement on this matter, or is FirstEnergy all alone?

If leakage of primary coolant through the head/nozzles is a Technical Specification violation, and since this has already happened before, will Enforcement action, (a monetary fine on a per day basis), be announced at the second meeting?

It appears that FirstEnergy will decide when to start up the plant. Doesn't it seem more appropriate that the NRC actually issue an order requiring NRC approval before this plant is started up? Shouldn't all related 2.206 requests and related allegations also be addressed before this plant is allowed to start back up?

18) Accepting that failure of the Midland head occurred in less than 6 years of reactor operation, yet failure wasn't discovered with the original Davis-Besse head until 25 years of reactor operation, you would have to expect some other factor is also important. Could it be the age of the head (without consideration of use)?

Midland (Unrepaired) Upper Reactor Head
Suppose the nozzles were inserted in the head in 1973. From 1973 to 2010 is 37 years. This head was used in reactor operation from 2004 to 2010. That is 6 years. Let us add the two together to get 43.

Original (Unrepaired) Davis-Besse Upper Reactor Head
Assume the nozzles were inserted in 1975. From 1975 to 2002 is 27 years. Assume the head was used in reactor operation from 1977 to 2002. That is 25 years. Add the two to get 52.

Compare the two sums. The head with the larger amount of damage has the higher sum. That makes sense. And, as a first estimator, the sums are not unbelievably far apart.

Perhaps the age of the inserted nozzles is the main factor IF they are also exposed to reactor operation for a minimum of 2 or 4 years.