Tuesday Afternoon Session

June 11, 1985

3:20 o'clock p.m.

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(Present: Messrs. Burns, Rossi, Bell, Beard, Lanning, Shafer, Jackiw, Kosloff, Roles and O'Connor.

MR. ROSSI: What we are going to do now is just discuss the feedwater system, the auxiliary feedwater system and the main steam system, and the Steam and Feedwater Rupture Control System just to get a better understanding of how the systems work at the Davis-Besse plant. That's what we want to do. And you have given us three or four drawings here and you can make some comments on what these drawings are so that that will be on the record.

MR. O'CONNOR: Let's everybody --

MR. LANNING: May I interrupt you a second. Would you state your name first and give us a little background as to your position.

MR. O'CONNOR: My name is Bill O'Connor. I'm the operations superintendent. I have been at the station for about eleven years. I have been the operations superintendent since last September.

Prior to that, I was the operations engineering supervisor for several years. I was the operations training supervisor for about a year and a half. I was a training instructor before that.

I was a reactor operator, auxiliary operator, equipment operator, came up through the ranks while through that time I was going to school, got my degree and all that, then moved on into the office engineering positions.

I was in the Navy before that. In fact, I met Larry in the Navy. We worked together for a while at S1C. I was surprised to see him when he walked in today.

MR. LANNING: Thanks very much.

MR. O'CONNOR: I do have a senior license. I had an RO license before that. I have been licensed for about, oh, since 1978.

Let's look at the main feedwater drawing first, the one that says Main Feedwater System, Figure 1, the official drawing number if you have a set of P&ID is M-006B. In other words, if you are wanting to get great detail and you get a real P&ID, it looks like this one, but this is a simplified

drawing showing the major flow paths.

I would like to describe the flow path of the main feedwater system and the startup system first, and then we will talk about the auxiliary feedwater system and then the main steam system. So we will go through each of these drawings in some detail to explain our flow paths at Davis-Besse.

MR. BEARD: Before you get into the drawings, are these drawings made up for training purposes?

MR. O'CONNOR: Yes. These are simplified training drawings.

MR. BEARD: Do you have a strong feeling, do they really reflect the plant? There has been some problems that training documents don't really reflect the plant.

MR. O'CONNOR: I feel these drawings adequately reflect the major flow paths, and I don't expect to find any major errors -- there may be some of the valves that are shown normally open here and normally closed, that may not be necessarily 100 percent true. But I don't think that there is any glaring errors in these.

Let's start out with the main feed system. We have two main feedpumps at Davis-Besse. They are turbine-driven pumps. On one end of the turbine is connected the shaft of the turbine which is connected to the main feedpump. The other end of the turbine shaft connects to a gear reducer to the booster feedpump.

In other words, on your drawing you have got a main feedpump and a booster pump, they are connected to the same turbine, one is on one end and one is on the other. The booster pump, however, does have a gear reducer. It's about a 2.8 to 1 reduction.

The main feedpump turbine receives its steam supply at full power from the cross-around steam to the moisture separator reheaters. We will get to that a little bit later, but there is also supply from the main steam system.

In other words, when you start the turbine up, initially on the main steam, as we build up cross-around pressure in the turbine, then the high pressure control valve will end up not in control. The low pressure control valves will take over.

I don't know if you want to go into the specifics?

MR. BELL: Who makes these turbines here?

MR. O'CONNOR: GE.

MR. BELL: Do they have an electrohydraulic control system or a control --

MR. O'CONNOR: No. We have what is called an MDT 20 system. It's an electronic control system. It's not -- we use a speed pick-up for the signal and then it controls a secondary operating piston to the actual valve covering.

MR. BELL: Then is the EHC system used to operate that piston?

MR. O'CONNOR: Not in the term you want to use EHC system. That's a high pressure fuel system.

MR. BELL: Not off the turbine EHC.

MR. O'CONNOR: No.

MR. BELL: Okay.

MR. O'CONNOR: It's driven off the main oil pumps for the turbine -- for the feedpump turbine, and it's not an electrohydraulic control system separate to the turbine.

Normal flow rate through the main

feedpump turbines at full power is about six million pounds per hour nominally. The feedpumps discharge through two nonreturn valves, their FW-488 and 491 shown on your drawing, right on the discharge of the pumps.

Up through there is a cross-connect header at that point that joins the two feedwater -- high pressure feedwater heaters together. Our two high pressure feedwater strings through our four, five and six feedwater heaters down each train, then the piping joins back down together again for about ten or fifteen feet of pipe when it branches off to the two control valve networks for the individual steam generators.

We have minifeed valves, FW-44 and 139 shown near the top of your drawing, these maintain the minimum 32 gallons a minute required for the feedwater nozzles to insure that they always remain full and we don't thermal shock the nozzles. So they are always throttled to 32 gallons a minute. Actually it's a little -- that's the minimal. They are typically 40 to 50 gallons per minute.

Immediately below them is the startup control valves, SP7B and SP7A. These valves would

be during a startup the first ones that we would open, and they would control up to around 15 percent power.

MR. BELL: These valves are the valves used primarily to hold you on the low level limit when you are starting it.

MR. O'CONNOR: Yes. These valves will control on low level limits.

MR. BELL: SP7B and 7A, okay.

MR. O'CONNOR: They are air operated control valves from the integrated control system.

MR. BELL: And manual control station's in the control room?

MR. O'CONNOR: Manual control in the control room.

MR. BELL: Okay, sir.

MR. O'CONNOR: Below that we have SP6A and 6B, which are the main feedwater control valves which as the startup valve gets to 80 percent full open, it will send a signal to open the block valve to the main feed control valves, which would be 780 and 779, the two valves with the circle and the M shown as a motor operated valve, they automatically open when the startup valve gets to about 80

percent open to put the main control valve in service.

So now during a startup we would have the minifeed's throttle at about 40 gallons a minute, the startup valve would end up being full open and the main valve taking over as control at about 80 percent open on the startup valves.

MR. SHAFER: For the record, SP7A is the one that failed on the feedpump?

MR. O'CONNOR: Yes. We were not able to reopen immediately after the trip. It has a blocking function to allow overriding the Steam and Feedwater Rupture Control closure, but it did not open immediately. We were able to get it open several minutes later when we got an I & C tech in the back, and I'm not sure of the details of what he did at this time, but he was able to successfully get it blocked.

Downstream of these three valves which are in parallel is a check valve on each side, No. 147 and 156. This is immediately outside the containment and next to the containment isolation valves 612 and 601.

612 and 601 are the large motor operated

feedwater stop valves that isolate immediately outside the containment building. These valves are automatically closed on Steam and Feedwater Rupture Control logic and Safety Features Actuation logic.

MR. BELL: Automatic closure signals to SP6 and 7 are just the Steam and Feedwater Rupture Control.

MR. O'CONNOR: Control.

MR. BELL: And you use that to backup the closure on 612 and 601?

MR. O'CONNOR: Yes, sir. The logic -- we will get into that when we do the SFRCS, but they close on opposite sides to assure any single failure will always assure feedwater isolation.

MR. BELL: So maybe 612 comes off channel chain --

MR. O'CONNOR: 601 and 612 are on opposite channels, as 6A and 6B.

MR. BELL: 612 6B and 7B would be opposite channels?

MR. O'CONNOR: 612 and 7B are on the same channel and 601 and 7A is on the opposite side channel. When we get to that one drawing that shows all of them, I will go through which channels

they operate off of. I think it might be easy to explain that.

MR. O'CONNOR: Downstream of 612 and 601, the piping just goes into the containment and enters the feedwater nozzles. That takes care of the discharge side of .he feedpump. Let's move back over to the suction side.

MR. BEARD: Before you go there, since the question has already arisen about this SP7A valve that apparently failed to reopen, that's the one where you tried to radio a startup pump and feed and that valve kept you from using that valve.

MR. O'CONNOR: To that steam generator.

MR. BEARD: Could you show us just quickly where the electric startup pump feeds into this diagram?

MR. ROSSI: He's getting to that, I believe.

MR. BEARD: I was just trying to relate this before we get too far away from this.

MR. O'CONNOR: If you look at the bottom of your chart are the motor driven startup feedpump and coming out the left side of that pump and following the arrow up, it ties to FW-106 into the

common feedwater header downstream of FW-45, which is a manual isolation valve.

MR. ROSSI: Okay. So it comes in upstream of the heaters.

MR. O'CONNOR: Yes, sir.

MR. ROSSI: Okay.

MR. O'CONNOR: I guess we can start with the startup pump next before we go to the suction of the pumps. The startup feedwater pump is an electric driven feedpump. It's rated at 300 gallons a minute. It is used on normal startups up to about one to two percent power. That's all it's capable of supplying feedwater, the capacity of it. We have a problem in our startup --

MR. ROSSI: What's the megawatt thermal rating of your plant?

MR. O'CONNOR: 2772.

Our Startup Feedpump piping is not seismically qualified and it passes through the Aux Feedpump room, so we have to maintain this piping isolated during power operation so that when the Startup Feedpump, when it is in service on a startup, we have to maintain an operator in the room such that if the piping were to break, he can

stop the pump and isolate the piping so it can affect the Aux Feed pump system.

MR. ROSSI: And where does that isolation take place on that piping?

MR. O'CONNOR: What's required on the isolation is on the suction side we have to maintain the suction FW-32 shut, which is the suction from the deaerator, we have to maintain the discharge side shut with FW-106, which is up by the feedwater heaters, we have to maintain the cooling water supplies shut, which are not shown on this drawing. They are cooled from the turbine building cooling water system. In other words, the pump is isolated from the system so that it doesn't count as a high energy line break.

MR. ROSSI: FW-32, is that the one right here and that goes back to the deaerator?

MR. O'CONNOR: Yes. If you go back right here, I'll find a spot on the drawing where that is located. Right here where it has got an A right next to this FW-85, that's the other end of the Startup Feedpump. If you connect this A and this A together, that's the other end of that pipe.

MR. ROSSI: Okay.

MR. O'CONNOR: Which is off the deaerator cross-connect header.

MR. ROSSI: Okay.

MR. BEARD: But the valves that would be closed during normal operation or the ones that this person down there would close in the event of a problem, would they be 106, 91 and 32?

MR. O'CONNOR: And the cooling water isolation valves, CW --

MR. BELL: Which there are none shown.

MR. BEARD: But the ones that are on this diagrams would be those three?

MR. O'CONNOR: Yes.

MR. BELL: Now, the other one you used to startup the feedwater pump building, where was it getting its suction produced?

MR. O'CONNOR: When they lined it up the other night, it was getting the suction from the deaerator. They lined it up to FW-32. That did cause, in other words, if this was lined up in standby, they would have been able to start it immediately from the control room. But since we have to keep it isolated, this is a recent requirement, starting up from this refuel, we had

to keep this pump isolated. Prior to this filling it was normally in standby and you could start it from the control room.

MR. BELL: So you are saying had it not been for compliance with the seismic -- nonseismic qualifications of this pump, this pump would have been immediately available?

MR. O'CONNOR: Immediately available, yes.

MR. ROSSI: Well, to put it into service, you had to open up FW-32 and FW-106?

MR. O'CONNOR: And the cooling isolation valves.

MR. ROSSI: And that cannot be done from the control room?

MR. O'CONNOR: They were all manual valves.

MR. BELL: 12-, 14-inch lines?

MR. O'CONNOR: Yes. It's about - I think the suction lines is a ten or twelve, and the discharge lines is a six or an eight.

MR. ROSSI: And that started this last refueling.

MR. O'CONNOR: Yes. We used to have the pump in service with FW-32 open and 106 open.

MR. BELL: Adequate suction pressure can be maintained on the startup pump from just the head in the deaerator storage tanks?

MR. O'CONNOR: The deaerator storage are in the top of the turbine building and the pump is in the basement. So I don't know exactly how many feet, a hundred feet plus the pressure in the deaerators.

MR. SHAFER: For the record, if I may, the rationale for keeping the startup feedpump isolated because the lines are not seismic is basically because those lines pass through the auxiliary feedwater pump.

MR. O'CONNOR: I said that in the beginning.

MR. BEARD: High energy line.

MR. SHAFER: That's right.

MR. BEARD: Has this electric startup pump been in the plant design since day one?

MR. O'CONNOR: Yes, sir.

MR. BEARD: It hasn't been added.

MR. O'CONNOR: It's been there since day one.

MR. BELL: And your normal feed path and

startup you normally feed through the feed nozzle, then right up through the six or seven?

MR. O'CONNOR: Yes.

MR. BELL: Would it be the sevens, because the sixes would be isolated?

MR. O'CONNOR: Right. Once we get up to about two percent power, then we put a main feedpump on, shut down the startup pipe and isolate it.

MR. LANNING: Is that a manual operation now you are talking about?

MR. O'CONNOR: Yes, sir.

MR. LANNING: It's all manual.

MR BEARD: So you don't use Aux feed startup?

MR. O'CONNOR: No, sir.

MR. LANNING: When do you switch over to automatic control of feedwater?

MR. O'CONNOR: Feedwater control on the valves is put into automatic prior to lifting off what we call low level limits. In other words, all of the valves would be in full automatic control.

We typically do not put our main feedwater pumps in automatic until we get the flow

rate up over three or four million pounds per hour. They don't like to control at low flows in automatic. You just -- they are not available.

MR. BELL: But to amplify your answer, you can startup with startup control valves in auto?

MR. O'CONNOR: They are in auto.

MR. BELL: You startup with Aux standby maintaining you at your low level limit?

MR. O'CONNOR: The valves are in automatic, the pumps are not. Once we get up off of low level limits is when we put the pumps in automatic.

Now, let me clarify that a little bit. Based on some of the problems we have had with our feedpump oil control systems over the last few months, we have been -- we recently changed our startup procedure to maintain one of the main feedpumps in manual control at all times, because we have had some spurious trips in automatic and we fully added extra instrumentation to the No. 1 main feedpump, we are running it in automatic and No. 2 in manual control in hopes to isolate this spurious problem that was not able to be fully -- you know, we weren't sure we could fully solve that or had

found the root cause to that problem.

MR. BEARD: Could you say again, Bill, what that problem was?

MR. O'CONNOR: We were having spurious trips of the main feedpump following a reactor trip and were not able to isolate a cause. We would go in and check all the pressure switches, run the pumps up and down, reset them, trip them and could not duplicate the trip. So what we did following our last trip, that would have been I think on the 2nd or the 3rd, we fully instrumented the No. 1 main feedpump, we went into places in the oil system, we went across all of the trip contacts in the electronic trip circuitry so that we could -- and put strip charts on all these things so we could isolate it to a particular fault if it tripped again.

MR. ROSSI: Then you put No. 2 --

MR. O'CONNOR: Then we ran No. 2 in manual control.

MR. BEARD: It seems the trips were associated only if it was in automatic.

MR. O'CONNOR: Yes.

MR. ROSSI: Do you have experience that

indicates that that's the case?

MR. O'CONNOR: Every trip we had was in that mode. And while we were doing the testing shutdown, we were not able to cause it to trip in manual.

MR. ROSSI: Okay.

MR. BELL: But you were able --

MR. O'CONNOR: We were able to cause it to trip when it was under ICS control. So we put it in manual control in hopes that we could keep one pump and verify that the rapid feedwater reduction system, which I will get to a little later, wasn't interjecting something and causing the feedpump to step change too fast and trip it.

MR. BELL: Okay. Now, there are feedpump speed controls, is it a function of the delta P across the feed valve network up here?

MR. O'CONNOR: Yes. The one next is the feed delta P across feedwater control valves and feedwater demand.

MR. BELL: And the other is feedwater demand.

MR. O'CONNOR: Yes.

MR. ROSSI: From the ICS.

MR. O'CONNOR: Yes.

MR. BEARD: One of the things I heard -- and it may not be accurate -- but you had some problem with governors. And I don't know whether that is a situation on the main feed or the Aux Feed.

MR. O'CONNOR: Both.

MR. BEARD: I don't want to get into it in great detail.

MR. O'CONNOR: We changed the speed pump controls during this last outage.

MR. ROSSI: The main?

MR. O'CONNOR: Main and one of the Aux. The old system was what I want to call the rev zero GE system with all the levers and springs, and I don't know a real name for it, but we disassembled the entire old governing system and put in a new electronic governing system for the main feedpumps.

MR. BEARD: That was this outage.

MR. O'CONNOR: Yes, sir.

MR. BELL: And these trips didn't show up until you had the new turbine governor system in place?

MR. O'CONNOR: Right.

And we have had the vendor in here numerous occasions and he's made adjustments to like the thrust wear pressure switches and turbine control oil pressure, trying to isolate it to a particular fault.

MR. ROSSI: And that vendor is?

MR. O'CONNOR: From General Electric.

MR. BELL: You don't -- when you have a reactor trip that trips the turbine, taking a turbine off, the turbine trip will not result in a feedpump trip, will it?

MR. O'CONNOR: It should not. We have had several spurious trips, and that's one of the problems that we are trying to solve.

MR. ROSSI: Let's see. When you trip the turbine then, does the steam flowing to the main feedpumps revert to the main steam header?

MR. O'CONNOR: To the main steam header, yes. It's just a function of there is a high pressure control valve and five low pressure control valves, and initially the low pressure valves open, but there is no low pressure steam since the moisture separator reheaters have no steam in them at that point.

As the last low pressure valve opens, it opens up the high pressure stop valve to allow the high pressure control valve to start control over the mainstream. As you start building a cross-pressure, as that pressure builds up, the first thing it does is the governing mechanism sees this pressure increase and the speed starts to increase, the first valve it closes down on is the high pressure valve, and as we get more and more cross-around pressure, it presses down on the LP valves to control.

MR. JACKIW: Bill, do you know if GE made the modifications at other plants?

MR. O'CONNOR: I'm not familiar with whether GE made the modifications. I believe that they did, but I can't say for sure.

MR. JACKIW: You don't know if other projects are having the same problems with tripping?

MR. O'CONNOR: I know SMUD had some problems when they changed out, but they didn't go to the exact same system we did. They went to a similar system but not the exact same one.

MR. LANNING: This feedpump is instrumented presently; is that correct?

MR. O'CONNOR: No. 1 is.

MR. LANNING: No. 1 is. So there are data available during this transient feedwater pump No. 1?

MR. O'CONNOR: Yes. The data that we saw immediately after the trip, none of the electronic trips had picked up. The only thing that had picked up was a mechanical trip on overspeed.

And our flow data shows and our speed data shows that the pump did trip on overspeed, and what we are theorizing now, since we haven't been able to go into the cabinets because we have a stop work essentially, is that the speed pickup to the electronic circuit opened up. In other words, it's sensing speed off a magnetic pickup.

If it sees a zero speed signal, it tells the turbine controls that the turbine is not turning any more and says speed up. If it gets a zero input, it will tell the valves to open just as fast as they can go and would give an overspeed trip. GE told us that in our training also.

MR. BELL: But isn't there more than one speed pickup?

MR. O'CONNOR: There is two pickups, yes.

But they come together in a parallel path. If it failed at the last point up to -- in other words, if I open the wire after the speed pickups come together, in other words, when it leaves the MDT-20 cabinet to the governor control system, anywhere in that circuit, it would be a zero input. If it failed at the turbine, then the other one will still come in.

MR. BEARD: Have you had any experience of failures of that type?

MR. O'CONNOR: No, sir.

MR. BEARD: So there is no reason to believe that that is the cause other than speculation?

MR. O'CONNOR: Other than we had an overspeed trip and no other contact showed trip.

MR. BEARD: But your history doesn't show that.

MR. O'CONNOR: No.

MR. BELL: Isn't there an electronic overspeed trip on that pump too?

MR. O'CONNOR: No.

MR. BELL: There is not.

MR. O'CONNOR: Not to my knowledge. All

there is is a mechanic. There is high speed stops and everything that if the speed goes up, it's not supposed to let it go over like 105 percent of rated speed.

MR. BEARD: That's what I don't understand as to why your high speed systems didn't come in.

MR. O'CONNOR: Even GE in our training following an outage said a zero speed signal will not be protected by a high speed stop, it will go to overspeed. They said the change is too fast to be caught by anything.

MR. BEARD: Are we about at the end of the main feed storage?

MR. O'CONNOR: I would like to go back to the six for a minute. The normal suction for the feedpumps is from the deaerator storage tank. We have two large tanks of sixty-four thousand gallons each which provides suction to the feedpumps, and these are normally cross-connected through two valves, FW-423 and FW-84, so either feedpump can take suction from either deaerators, and both deaerators stay at the same level during normal operation.

Now, feed into the deaerators is from the condensate system. So unlike other systems, if we were to trip all our condensate powers, our feedpumps still have a suction, and there is about four to five minutes of water there on a loss of condensate for our plant.

So we could turn all of our condensate pumps off and still have water to the feedpumps for about five minutes. And our integrated control system has a runback associated with the deaerator level, if you get to four feet in the deaerator, it will run the plant back to 55 percent in anticipation of a loss of a feedpump.

MR. BEARD: Okay. With regard to how this system performed during the event, I don't really think we intended to get into it this hour. Maybe you can clarify, the question has come up in my mind, the failure of the No. 1 main feedpump is what we are now calling the transient initiator and then somewhat later the No. 2 tripped out I guess on loss of steam.

MR. O'CONNOR: I didn't trip out. It costed to a stop because it had no head steam to the turbine

MR. BEARD: So you ended up with one out immediately at the onset and the second one coasted down after about five minutes, so you had still main feed in the plant for about five minutes after transient stop?

MR. O'CONNOR: Its post-trip response was normal. It calmed down to low level limits, everything looked normal. Came into a normal post-trip TF condition. It was at that point that things started going away when the MSIVs went closed an that.

But there is enough steam when the turbine trips and closes the valves, that the moisture separator reheaters, and the water in their drain tanks flashing off, there is quite a bit of steam trapped in there and the main steamlines to run the main feedpump turbines, and the main feedpump turbines are essentially under a no load condition at this point because when our reactor trips, we have a rapid feed reduction system which immediately jams the main feed valves closed and the startup valves to a target position of about 20 percent open. That's equivalent to about 4 percent K heat load, 4 to 5 percent, where

is where it should be targeted to coast it right in on low level limits

MR. BEARD: Is part of that control system also something that would tend to speed up the turbine in anticipation of pumping it against the high pressure?

MR. O'CONNOR: Yes, sir. Part of that system sends a target speed signal to the main feedpumps -- their normal speed at full power is somewhere between four thousand and forty-four hundred rpm. Each one is a little different. And after the trip, it targets that speed up about two hundred more rpm.

MR. BEARD: It's about a 5 percent increase roughly.

MR. O'CONNOR: Yes, sir.

MR. BEARD: So your control system is telling the turbine to speed up.

MR. O'CONNOR: Valves to close.

MR. BEARD: And I heard rumor, and I'll characterize it as purely rumor, and the reason I bring it up now is to set the record straight and at least get me straight. Have you had problems on the main feedwater side of the balance of that

system turning, if you will, to the control aspects of this speeding up the turbine side and closing down the vaive, and I guess there is a speed governor involved in that.

MR. O'CONNOR: We have had some difficulty making all of the things come together at the same time. The target speed adjustment, what is done there is it's a pure minus ten to plus ten volt ramp, and the speed is supposedly linear so they pick off, it should be at 8.2 volts or whatever and it should be forty-six hundred rpm. That voltage, however, they found later to be too high and our feedpump was actually going to a much higher speed.

MR. BEARD: So it was nonlinear.

MR. O'CONNOR: So it was nonlinear, if you would like to call it that. They found some other signals that were getting to it affecting that voltage and made further adjustments following the trip we had a week ago to the rapid feedwater reduction system to put this speed back down to where it was supposed to be. We didn't get a chance to check it because the feedpump tripped.

MR. BEARD: Okay. The last thought or

question I had in this line here is that have you had these problems since you put in this now I guess governor, if you can call it that, in here in this last outage, or have these problems been over a longer period of time?

MR. O'CONNOR: We have experienced some problems with the rapid feedwater reduction system since its inception several cycles ago.

MR. ROSSI: It's a separate system from say the ICS.

MR. O'CONNOR: It's part of the ICS.

MR. ROSSI: It is a part of the ICS.

MR. O'CONNOR: It's a separate subsystem to the ICS.

MR. ROSSI: But you haven't always had it in the ICS?

MR. O'CONNOR: No. I can't remember what refueling we added to it. It seems to me it was at the end of cycle three I want to say, but it may have been -- I think it was cycle three.

MR. ROSSI: Let me ask you this. During the event, main feedwater pump two as far as you have been able to determine up until now worked the way it should have worked?

MR. O'CONNOR: Yes.

MR. ROSSI: Okay. And the rapid feedwater reduction system after the trip worked the way it was supposed to work.

MR. O'CONNOR: Yes.

MR. ROSSI: The problem with the main feedwater pumps that's known now was that something went wrong with main feedpump No. 1 and initiated the transient. But as far as main feedwater pump No. 2 is concerned, and I don't know how much in looking at it you have done up to now, its controls and everything worked the way you would expect them to work?

MR. O'CONNOR: Is normal, yes, sir.

MR. ROSSI: It being in manual?

MR. O'CONNOR: Yes, sir. The operators did raise its speed up. In other words, when the main feedpump No. 1 tripped, the plant starts an automatic runback to 55 percent power based on a loss of a feedpump. In other words, they got the ICS reactor power limited by feedwater alarm runback in effect and they raised up No. 2 feedpump to pump some more water with it, which is what the ICS would have done also.

The plant was running back normally, and this is one of those triggers that for us, if we are up above 85 percent power, it's a 50/50 chance we will make the runback. If we are below about 80 percent, it's guaranteed you usually make it.

So that being the case, they ran up No. 2 feedpump, everything was kind of all right, but at 30 seconds we didn't make it. We tripped up high reactor cooler pressure. In other words, one feedpump can only pump a little over seven million pounds per hour, and the feed flow you need at that point is around eight our nine for the power level they were at and the power was ramping off, the turbine was ramping off, but they just didn't make it. We were on a cross-limit, but they didn't make it.

MR. BELL: Your reactor was cross-limiting feedwater?

MR. O'CONNOR: Yes.

MR. BELL: What was your initial rod position?

MR. O'CONNOR: The rods, I can't tell you the exact percent, they were about 92, 93 percent with drawing group seven.

MR. BELL: We are getting more into incidents than we are systems.

MR. ROSSI: Okay.

MR. O'CONNOR: That pretty well takes care of the main feedwater system. I would like to defer the Aux Pumps which are down at the bottom of the drawing until we get to another drawing.

MR. BEARD: Can we take a two-minute break and go down and pick up some coffee or something?

MR. ROSSI: Okay. We will take a break of four or five minutes then.

(Thereupon, a brief recess was taken.)

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MR. O'CONNOR: I redrew the drawing called Figure 41, SFRCS Components. There is one error on the auxiliary feedpump to discharge line where it says PDS 2685. Delete that from the drawing and move it straight down to the next pipe on the main feed drawing.

MR. BEARD: This is on the top half of the drawing we are talking about?

MR. O'CONNOR: Yeah, on the top half of the drawing. In other words, this -- well, it

would be this one. This DP on your drawing was shown right here, move it down here.

MR. BEARD: Where the initials that go with that, I assume that's an instrument, should that be PDS or FDS?

MR. O'CONNOR: PDS, pressure differential switch. These are training drawings and if the real numbers and everything, the valve numbers are okay, but the switch numbers, like I say, this is a training drawing. It's not officially controlled from the book that I got it out of.

MR. BEARD: I'm not criticizing you.

MR. O'CONNOR: It should be PDS, pressure differential switch.

All right. This shows the feedwater valves that are controlled by the Steam and Feedwater Rupture Control System. What I would like to do now is show the valves in a condition that they would have been prior to the event and discuss what valves move by the Steam and Feedwater Rupture Control System.

MR. ROSSI: Okay. You will differentiate which ones do certain things on level and which ones do certain things on pressure.

MR. O'CONNOR: Yes.

MR. BEARD: So you are going --

MR. O'CONNOR: I'll draw it in a full power line to begin with.

MR. BEARD: All right.

MR. O'CONNOR: Probably that's the easiest thing to do.

MR. BEARD: Why don't you do it outloud so it will go on the transcript.

MR. ROSSI: Say the position of each valve as you --

MR. O'CONNOR: FW-780 is open, FW6B is open, FW7B is open -- I left out a valve. This is 612, FW-612 is open. That's on the main feed line to Steam Generator 1. The same or the complimentary valves on Steam Generator 2 FW-799 is open, FW6A, FW7A and FW-601 are open.

One thing to keep in mind here, just as a little "Oh, by the way," the valves labeled B go to No. 1 steam generator, which isn't logical but that's the way it is, and the valves labeled A go to No. 2 steam generator. And that is consistent through the plant. In other words, this when we get to the steam drawing, you will see it also.

like ICS 11B goes to No. 1 steam generator and A goes to No. 2.

When you get to our reactor protection system, if you get into that, you will find the breakers don't go A, B, C, D, 1, 2, 3, 4. They go B, A, D, C. So it's a little confusing if you haven't been here.

MR. BEARD: On the Aux speed system, I take it the 608 and 599 would normally be closed?

MR. O'CONNOR: No. On the Aux system, 608 is normally open, 599 is normally open, 3870 is closed, 3869 is closed. I forgot the other two. I forget which one goes to No. 1. 3871 and 3872 are both closed.

MR. BEARD: So all four of those cross-over valves are closed, feed and cross-over?

MR. O'CONNOR: Yes. Let's go to the bottom part of your drawing and mark it up so we get our normal lineups. On the steam side, the flow pass from right to left here, the atmospheric dump valve, ICS 11B, is normally closed. The steam generator steamline warmup drain, MS-394 is normally closed. The main steam isolation valve 101 is normally opened. The by-pass valve 101-1 is

normally closed. The nonreturn valve, that's just a check valve, and it's obviously normally opened.

On the other steam generators, Steam Generator 2, ICS 11A is normally closed, the atmospheric dump on that side. The warmup drain MS-375 is also normally closed. The main steam isolation valve on Steam Generator 2 MS-100 is normally opened. Its by-pass 100-1 is normally closed, and the nonreturn valve is also normally open.

Now, this section of the header continues on to the main turbine stop valves and other components downstream in the main steam system. For the auxiliary feedpump turbines, their steam supplier for all four valves, MS-106 is normally closed. 106-A is normally closed, 107-A is normally closed. 107 is normally closed.

The next valve is -- that is not labeled on your drawing immediately downstream of these steam valves -- this is actually a dual valve. There is a trip throttle valve, and it is normally opened. Downstream of that not shown is the governor valve, it also is normally open when the turbine is shut down. So there is another valve in

here called the governor valve, which is normally open also.

MR. BEARD: There is a label on the drawing in that area that says auxiliary governor. Is that the area you are talking about?

MR. O'CONNOR: Yes. I think on your drawing it shows it -- yeah, where it says auxiliary governor, that's actually two valves, to be technically correct. There is a trip throttle valve and a governor valve right in series. We will get into those in just a couple of minutes. So everyone understands the normal lineup?

All right. Let's go back to the feed system. Before we get to that, I would like to list the trips on the Steam and Feedwater Rupture Control System. The first one is low steam generator level, and the setpoint for that is twenty-six and a half inches. The second one is steam-to-feed differential pressure, and the setpoint of that is 177 psid. In other words, if the feed pressure is less than the steam pressure by 177 pounds, the Steam and Feedwater Rupture Control System will actuate.

MR. ROSSI: Feed less than steam.

THE WITNESS: Yes.

MR. O'CONNOR: The third actuation is low main steamline pressure, and the setpoint for that is 612 pounds. And the forth trip and the final trip is loss of all four reactor coolant pumps. So there is four actuation signals for the Steam and Feedwater Rupture Control System.

MR. BEARD: On that loss of reactor coolant.

MR. O'CONNOR: It's monitors -- it senses the same thing as the reactor protection system. In other words, it's that dual current transmitter. If the current -- you have got a normal current, if it's high or low, the pump contact monitor circuit senses the loss of forepumps. Same thing as the reaction protection system.

MR. ROSSI: Pump motor currents.

MR. O'CONNOR: Yes. It's the Bailey dual current sensor, black box; okay? Any questions on the four actuation signals?

For ease of discussion, the low steam generator level or the steam-to-feed differential pressure do the exact same things to these components. So we will discuss what these two

signals do to the Steam and Feedwater Rupture Control system first. In other words, we will go through those components one by one and see how they move for these two signals, then we will talk about the difference in a low pressure -- in a loss of low pressure and loss of reactor coolant pumps.

On a low steam generator level or a steam-to-feed differential pressure trip, the main feedwater block valves, 780 and 779, will go closed, the main feedwater control valves, 6A and 6B, will go closed -- I don't know if I can mark this up here.

MR. ROSSI: SP6A and SP6B on here.

MR. O'CONNOR: How about if I put a little mark above these for where they go during the trip?

MR. BEARD: If they are open, they are going to go to the opposite direction.

MR. O'CONNOR: Yes.

MR. ROSSI: They close, okay.

MR. O'CONNOR: The startup feed control valves go closed, 7A and 7B. The containment isolation valves 612 and 601 go closed. The auxiliary feedpump discharge valves 3870 would go

open, 3869 would remain closed. 3872 would open, 3871 would remain closed. In other words, the auxiliary feedpumps No. 1 would line up to No. 1 steam generator, No. 2 would line up to No. 2 stean generator.

The containment isolation valves 599 and 608, they are already open but they receive an open signal. In other words, they are sent an open signal, even though the valves are normally open. So the feedwater side of the system, we isolate fully the main feedwater on both steam generators and line up the auxiliary feedwater so that the complimentary pump feeds its steam generator. In other words, No. 1 lines up to feed No. 1 steam generator, No. 2 Aux Feed lines up to feed No. 2 steam generator.

This is a normal response, assuming all four Steam and Feedwater Rupture Control channels function normally. On the steam side, the -- we are still talking about a low steam generator level and steam-to-feed differential pressure, the atmospheric dump valves. ICS 11B and 11A are closed and receive a closed signal.

I shouldn't say -- they may be open

blowing steam, but when the trip comes in they get a close signal. The steam generator drain valves 394 and 375 or the main steam valves get a closed signal. The Main Steam Isolation Valves MS-101 and 100 get a closed signal.

The main steam isolation by-pass valves 101-1 and 100-1 get a closed signal. The auxiliary .eedpump turbines line up to steam from their respective steam generators. MS-106 will open, 106-A will remain closed, 107 will open, 107-A will remain closed.

In other words, they will be steaming from their own steam generator, No. 1 from No. 1, No. 2 from No. 2, remembering they are also feeding their own steam generator. That's a normal response for the Steam and Feedwater Rupture Control System on level or differential pressure.

MR. LANNING: The main feedpump turbine is not tripped?

MR. O'CONNOR: No. The main feedpump turbine is not tripped, but when the Steam and Feedwater Rupture Control System actuates, the main turbine receives a trip signal; all right? When the main turbine trips, also with the MSIVs closed,

there is no steam for the main feedpump turbines, so they just wind down. They stay reset, but they have no steam, so they just coast to a stop.

There are two other valves not shown on here, on your simplified drawing. There is two steam generator drain valves -- I'm trying to remember the number of them -- 611 -- I can't remember -- 603 and 611, and I don't know which, they also receive a closed signal. I'll write it this way, but these may be reversed, the numbers. It will be on your real P&ID. They were added last outage and this drawing has not been updated on this simplified drawing. But there is two other valves that are the drains off the steam generator that also receive a closed signal.

In addition, the Steam and Feedwater Rupture Control System goes to our anticipatory reactor trip system, so if we get a Steam and Feedwater Rupture Control trip, it also goes over and opens control rod drive breakers.

MR. BEARD: What's that acronym?

MR. O'CONNOR: ARTS, ARTS system, Anticipatory Reactor Trip System. So it also goes to the ARTS.

Now, this ARTS trip will come in from any of the four trips except for a loss of fore or aft cooler pumps. In other words, any of these three will cause an ARTS trip. The loss of fore does not --

MR. BEARD: That doesn't imply you don't want the trip to react.

MR. O'CONNOR: The trip has always tripped on many other things. The purpose of the ARTS system, which was added after TMI, was to shut the reactor down on things like temperature and pressure pumps and things like that.

Now, as a quick review, if we get a trip of the Steam and Feedwater Rupture Control System on level or DP, you get full feedwater isolation, full steam isolation, a turbine trip, a reactor trip and auxiliary feedwater running to their own steam generators. No. 1 from No. 1 and from No. 2 into No. 2. Any questions on that?

All right. Let's go back to a low pressure trip. It's a little different. On each of the main steamlines in your little drawing, you will see an indication that says pressure switch. There is actually twelve pressure switches on each main steamline. It would be on the bottom part of

your drawing a little thing that says PS. These go to the Steam and Feedwater Rupture Control System for the trip logic and the low steam pressure block logic.

Eight of the switches on each steamline are used for trips. Four of them are used for blocking functions on normal cool down so you don't get a trip.

Now, for the sake of discussion, it's easiest to look at a particular point and break a steamline off to show what happens on a low pressure; all right? And let's say for the sake of discussion that I break off No. 1 steamline upstream of this MSIV. In other words, for some reason the 36-inch steamline broke in half and all the steam is running out this hole.

The steam pressure in this steam generator, instead of going down to the turbine, all runs out the hole and the pressure immediately starts to decrease. All the steam that was coming out of this steam generator which was supplying half the steam to the main turbine, the turbine valves are still in their same position, so the steam going out of here is now feeding a hole twice

as big as it used to be. So the pressure in this steam generator also drops. And what happens is both steam generators blow down to less than 612 pounds. Does that make sense to everybody, why that happens?

MR. BEARD: What's normal system pressure?

MR. O'CONNOR: Normally system pressure is about 920 in the steam generators and 870 on the turbine header.

Now, as soon as the Steam and Feedwater Rupture Control System trips, the first thing it does is cause a full isolation, just like we talked about before. Main steam isolates exactly the same way. In other words, the MSIV 101 and 100 go shut, the by-pass 101-1, 100-1 go shut. The atmospheric vent valves 11B and 11A, the steam generator drains 394, 375 all go closed. We will skip Aux Feedwater for a second.

On the feedwater side, the same valves that went shut before go shut now: 780, 6B, 7B, 612, on the other side 779, 7A, 6A and 601. So right now we are sitting there with steam fully isolated and feed fully isolated. And we haven't talked about Aux Feedwater yet. Does everybody

understand that? So steam is isolated, feed is isolated.

Now, when the MSIVs go closed, what's going to happen in the pressure in this steam generator? It turns right around and comes back up because these bottle up while there is still steam in the generator. The MSIVs close in less than five seconds.

So with these closed, that is repressurized immediately. This steam generator however doesn't. It still has a hole in it.

MR. BELL: It repressurizes if the RCS is high enough to repressurize it. But if the cool down has caused its pressure to drop to 612 it won't.

MR. O'CONNOR: Our analysis is it will pressurize above 612 based on the time SR senses it and establishes it. It will pressurize above 612. You are right though, later if it would continue to blow on down, obviously you can't repressurize or if you blow all the water out of it first, but our analysis shows that this occurs in a time frame that that will repressurize.

Now, this steam generator repressurizes

above the trip setpoint, so it's the good steam generator. The Steam and Feedwater Rupture Control logic senses this steam generator repressurizing and lines up both Aux Feed pumps to steam from that one and feed that one.

MR. BEARD: Hold it. Point of clarification: Is there actually a network that senses the return to pressure and identifies one steam generator as being good versus logic that really says the other one is bad so -- or one is bad so go to the other one?

MR. O'CONNOR: Okay. The network that is used is the same pressure switches that sense the low pressure now clear.

MR. BEARD: They are self-resetting then?

MR. O'CONNOR: Yes. In other words, the pressure switch is tripped, the pressure switch is reset. That's all it is, and it senses this steam generator has pressure now and this one does not.

MR. BEARD: All right. Is the logic such that it will really go to the one for which pressure has returned?

MR. O'CONNOR: Yes.

MR. BEARD: Or will it just go anyway

from one which there is no pressure?

MR. O'CONNOR: It will go to the one that returns. If neither return, then it requires action of the operator.

MR. ROSSI: What if the break were downstream of the MSIVs and so both return?

MR. O'CONNOR: Car I get to that after we finish this one?

MR. BEARD: Let me stay on this first one first. This morning or some time prior to noon we had a discussion of what took place during this event and how the plant responded and et cetera. And I don't even remember who the gentleman was, but someone explained to us that the Rupture Control System senses a loss of pressure on both of them during this event, because there was a manually inputed actuation, because neither returned for at least a few seconds, and because of that it did all the switch-overs as if both channels were trying to assume the other steam generator was good.

And so I raise the question then about how the system actually works versus the theory of how you want it to work, and I have got a little

different response between there and now. And that's why I'm puzzled.

MR. O'CONNOR: The reason the system responded differently is the two buttons the operator pushed were the two channels for low steam pressure for both steam generators, and what it did based on just the two he pushed going to the output logic was cross-connect the Aux Feed pumps such that 106-A opened and 107 opened.

You have to get into the logic drawing and see the two buttons he pushed and where they enter the system. That's not like the pressure switches picking up. It's not the same.

MR. BEARD: In other words, the way the system, the Rupture Control System responds on the manual input may be a little different from the way it would respond for a hypothesized steamline break?

MR. O'CONNOR: Right.

MR. BELL: Is it fair to say that the two buttons are downstream, the pressure switch contact inputs?

MR. O'CONNOR: Say that again.

MR. BELL: The two push buttons are downstream, the pressure switch inputs, and because

they are pushed they could never see the pressure switches were reset?

MR. O'CONNOR: They go directly to the output logic.

MR. BEARD: If we disregard this one area I was questioning in, still the output of the Rupture Control System, the effect is it senses steam generator is kaput and therefore tries to switch over to what is presumed to be a good steam generator even though the signals to it indicate it may not be good. You see my dilemma?

MR. O'CONNOR: No. I'm a little --

MR. SHAFER: What you need is a steamline break on Steam Generator 2 same as this to get the same effect that the operator gave.

MR. O'CONNOR: Except if he would have pushed all four low pressure buttons, then it would have done what you wanted it to do. It would simulate a double break here.

MR. BEARD: We are getting more into the event than understanding the system, but I was a little confused as to the way the system works.

MR. MYERS: Bill, if you would, the key idea that didn't get across was there is a

difference, the system thinks differently if you only push the top two than if you push all four of the top ones.

MR. O'CONNOR: That's what I was going to get to. The operator pushed these two buttons, and the way -- the channels go to different valves and the combination that he pushed allowed the cross-over valves to open.

MR. ROSSI: But not the Aux Feed valves.

MR. O'CONNOR: Right. It shut 599 and 608 though.

MR. MYERS: Now, if you pushed all four, the cross-over wouldn't have opened.

MR. O'CONNOR: Would not have opened. If he would have gone over all, the cross-overs would have stayed closed too.

MR. ROSSI: Then all of the Aux Feed would have been -- on both steam side and --

MR. O'CONNOR: Steam side, everything, all the valves we just talked about would have been closed if that occurred.

MR. BELL: Let's get back to normal a minute. We got a break in No. 1 -- let's look at the water side. That steam side is not that hard.

MR. O'CONNOR: All right. Does everybody understands why this repressurized and how it lines up the steam to steamoff the good one?

MR. BELL: Yeah.

MR. O'CONNOR: Let's go to the water side. We haven't finished it yet. The water side will line up to feed the good steam generator also. In other words, Aux Feedpump one will come down through 3869 and 599 to Steam Generator 2, and the Aux Feed 2 will line up to feed Steam Generator 2 through 3872.

Now, the only thing is low pressure closed 599 and 608 when both of them went less than 612. Something has to open them back up. When this steam generator repressurized and cleared the low pressure trip immediately behind it with the MSIV shut, there is a DP trip that comes in because the feedpumps went away and a low level trip because no water is going in.

So those trips subsequently come in within a second or so to allow the system to realign and reopen the good steam generator isolation valve, 599 or 608.

MR. ROSSI: But only for the good one.

MR. O'CONNOR: Right. Only the side that repressurized.

MR. ROSSI: So for the case you described, 608 stays closed. 599 --

MR. O'CONNOR: Yes, sir. If both of them repressurized, then both of these would reopen automatically due to the low level or the DP trip coming in.

MR. BELL: But since we had two erroneous low pressure signals, both 608 and 599 remained closed?

MR. O'CONNOR: Yeah. Until they undid the low pressure and pushed the low level, they stuck closed, but they were getting an open signal.

MR. BELL: There was pushed the low level actuation?

MR. O'CONNOR: Yes.

MR. ROSSI: When you pushed the buttons, the pressure just being high didn't automatically clear it. He had to clear it manually.

MR. O'CONNOR: No matter what the pressure was in the steam generators, you were telling the system it was low.

MR. ROSSI: And it stays low until he resets

something?

MR. O'CONNOR: It could have gone to wherever it wanted, and as long as it was told that it had low pressure by the operator, it was going to stay in that condition.

MR. BEARD: So let me see if I got this straight. When he pushed the two buttons, that low pressure caused 608 and 599 to close.

MR. O'CONNOR: Yep.

MR. BEARD: And had it been a real thing rather than -- I mean, an automatic thing versus manual and Steam Generator 2 had been good, its pressure would have come back up, which would have subsequently caused 599 to reopen?

MR. O'CONNOR: Based on another trip coming in, a DP or a low level.

MR. BEARD: Well, I was thinking just to return to pressure point.

MR. O'CONNOR: That will not reposition any valves. Just returning to pressure does nothing other than clear the low pressure trip. It does not reposition any valves. Another trip must be present to reposition valves.

MR. BEARD: I see. They stay isolated.

MR. O'CONNOR: Yes.

MR. BEARD: So the valves would have both stayed in the closed position had the operator not taken subsequent action to undue what he had done?

MR. O'CONNOR: Yes. If he had never unblocked the low pressure trip or undone that trip, they would have stayed shut.

MR. BEARD: All right. Good.

MR. O'CONNOR: Just his undoing that, the level trip came up, was in already, and it would have opened them anyhow, even if he hadn't pushed low level.

MR. BEARD: And during the event, I don't want to get too much into it, he did go through that sequence and the valve should have opened. But part of the event was they didn't.

MR. O'CONNOR: Right.

MR. BEARD: Okay. Thank you.

MR. O'CONNOR: Another thing, keep in mind -- I didn't bring this out yet. Pressure trip overrides all trips. Low pressure supersedes any other trip that's in.

In other words, you could have all the other three trips present and you give it a low

pressure, and it takes precedence. In other words, it will isolate a steam leak first since that's the most serious, the overcooling.

Now, any questions on a steamline rupture? If you go back through it the other way, we could break the other steamline and do the same thing. If we break it downstream, the only difference is both of them will repressurize, and once they both repressurize, as soon as the low level of their DP comes in, each Aux Feed pump will realign to its own steam generator instead of just this one since they are both good. Does that make sense?

MR. BEARD: So they don't stay in the crisscrossed arrangment?

MR. O'CONNOR: No. Once you get -- if both of them repressurize, the subsequent trip on DP or level will realign them to their own steam generator. All right?

Now, loss of forereactor cooler pumps is very simple. It doesn't need to isolate feed, it doesn't need to isolate steam. All it needs to do is put auxiliary feedpumps on. So we pump water in the top of the generator to promote natural circ, so all the loss of forepump does is open MS-106,

MS-107. That's the normal steam supplies from their own steam generator and opens the discharge valves to their own steam generators 3870 and 3872.

So the Aux Feed pumps just start on their own sides, spray the water in the top of the steam generator and promotes natural circulation. That's all that happens on the loss of forereactor.

MR. ROSSI: The Aux Feed pumps always spray from above?

MR. O'CONNOR: Yes, sir. They can only feed the top nozzles.

MR. BEARD: On Davis-Besse as compared to other B & W plants, is it -- did the Davis-Besse plant steam run high --

MR. O'CONNOR: Yes.

MR. BEARD: -- or low? You have high steam levels.

MR. O'CONNOR: For those of you who aren't familiar with other plants, our reactor sits essentially at the bottom of the system. The hot leg comes out and goes up into the steam generators and the pumps come out the bottom, so our steam generator sits above the reactors.

We have what's called a raised loop plan.

The other B & W plants if you transpose the steam generators down so they sit essentially alongside the reactor, that's a lower loop plant.

MR. BEARD: So you have the raised loop steam generators, but you have the low head high pressure injection pumps?

MR. O'CONNOR: Yes.

MR. BEARD: So that's the uniqueness?

MR. O'CONNOR: Yes. We need very little water in our steam generators to natural circ. We can natural circ on low level limits. We typically or we automatically control them at about 46 inches, which is a little bit above our low level limits, but we can natural circ just fine on low level limits.

MR. BEARD: Is that 35?

MR. O'CONNOR: 35. The other plants have to raise their level up to 50 percent on the operator range or higher depending on the conditions they are in.

MR. BEARD: Is Davis-Besse the only one with the high loops?

MR. O'CONNOR: As far as I know, the only 177.

MR. BEARD: This plant is unique in two respects, raised steam generator loops and the low head pumps for high pressure safety injection.

MR. O'CONNOR: Yes.

MR. MYERS: Those are two of the areas.

MR. BEARD: There may be more.

MR. MYERS: I think makeup separation from LPI/HPI is another area we are separate.

MR. O'CONNOR: They have three makeup pumps, one makeup -- two HPIs -- they are all the same. We have two makeup pumps and two HPI pumps.

MR. BEARD: One of the reasons this tutorial session is so important from where I come from, I deal with not only you folks and Westinghouse plants, but I have got to be concerned with the Ranchos and everything else. And it's very easy to get them mixed up. And it's important in this kind of a situation to try to get it straight.

MR. O'CONNOR: I did not give you a drawing of the emergency core cooling system pumps.

MR. BEARD: I didn't need that.

MR. BELL: When you say low pressure/ high pressure pumps, what is the shut off?

MR. O'CONNOR: The high pressure injection shutoff heads is 1650, the low pressure injection pumps is about 190 to 200 pounds.

MR. BELL: That 1650 is with BWSI tech section pressure?

MR. O'CONNOR: If we have the LPI discharge, we can get up to about 1850. Did that adequately cover how the Steam and Feedwater Rupture Control System works and how the feed and steam systems hook together for that?

MR. MYERS: JT, is that a little better than Fred's?

MR. ROSSI: I think he covered it fairly well. We may want to come back and ask some more questions about what the buttons do. The buttons are clearly a significant part of the event.

MR. O'CONNOR: One thing, if we can get them a copy of the Steam and Feedwater Control panel, they are all explained in the back and there is a logic drawing back there.

MR. BEARD: S[illegible]one has already suggested that's important fo[illegible] get.

MR. O'CONNOR: It's got a little logic network and shows you exactly what valves move when

you push what buttons.

MR. BEARD: Can we get that before we leave today? Off the record.

(Discussion held off the record.)

MR. O'CONNOR: Now, what did you want to do next?

MR. BELL: I would like to go home.

MR. ROWLES: We would like to get into the list of equipment.

MR. BELL: Do you want him to terminate one thing and start another?

MR. O'CONNOR: I will be here tomorrow and will be around here all day. I will make myself available in this building.

(Thereupon, a recess was taken at 4:50 o'clock p.m.)

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Page	Line	Correction or change and reason therefor
77	6	Name "Roles" should be "Rowles"
81	15	"fuel" should be "oil" (steno error)
82	3	"their" should be "they're" (steno error)
88	1	"can" should be "can't" (steno error)
91	13	"rooms" missing after "pump" (steno error)
92	8	"pipe" should be "pump" (steno error)
96	10	"speed" should be "feed" (steno error)
101	14	"storage" should be "story" (steno error)
102	22	"I" should be "It" (steno error)
102	23	"costed" should be "coasted" (steno error)
108	8	"up" should be "on" (steno error)
108	12	"our" should be "or" (steno error)
112	8	"speed" should be "feed" (steno error)
115	9	word "pumps" missing (steno error)
115	15	"fore pumps" should be "four pumps" (steno error)
120	2	"fore or aft" should be "four reactor" (steno error)
120	3	"cooler" should be "coolant" (steno error)
120	4	"fore" should be "four pumps" (steno error)
137	4	"BWSI tech" should be "BWST tank" (steno error)

Page No. 77-138 DATE 6/22/85 SIGNATURE W. C. Rowles

Page	Line	Correction or change and reason therefor	
78	10	change "office" to "operations"	incorrect
81	15	change "fuel" to "oil"	incorrect
93	23	change "--" to "identified"	word left out
103	7	change "calmed" to "came"	incorrect
103	9	change "TF" to Tave	incorrect
103	24	change "K" to "% of full"	incorrect
108	24	change "withdrawing" to "withdrawn"	incorrect
111	4	change "line" to "lineup"	incorrect
113	15	change "supplies" to "supply"	incorrect
115	7	I would like to document that I fogot to mention the High Steam Generator Level Trip at ≈ 92% (384"). This was not left out of the transcript, I just forgot to include it in the discussion.	
120	11	change "pumps" to "transients"	incorrect
123	16	change "is" to "says"	incorrect
133	19	change "fore" to "four"	incorrect
134	24	change "plan" to "plant"	incorrect
135	19	change "operator" to "operate"	incorrect

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