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BEFORE THE FACT FINDING TASK FORCE

OF THE NUCLEAR REGULATORY COMMISSION

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Re: :

Davis-Besse event :

of June ', 1985 :

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P R O C E E D I N G S

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Proceedings before the Nuclear Regulatory Commission Fact Finding Task Force in regard to the aforementioned event, held at Conference Room 210, Davis-Besse Nuclear Plant, Oak Harbor, Ohio, commencing on Tuesday, June 11, 1985, at 12:30 o'clock p.m.

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PRESENT:

J. T. Beard (NRC)

E. Rossi (NRC)

Wayne Lanning (NRC)

T. L. Bell (NRC)

W. D. Shafer (NRC RIII)

Don Kosloff (NRC RIII)

I. N. Jackiw (NRC RIII)

Stephen Burns (NRC OELD)

Steve Wideman (TED-Senior Licensing Specialist)

John K. Wood (TED-Fac. Engrg. Gen. Supr.)

Ted J. Myers (TED-Nuclear Safety and Licensing Director)

M. E. O'Reilly (TED-Staff Attorney)

William T. O'Connor (TED-Operations Superintendent)

Jacque Lingenfelter (TED-Technical Superintendent)

Stan Batch (TED-Technical Projects Supervisor)

Terry Murray (Assistant V.P. Nuclear Operations)

W. C. Rowles (TED-Assistant to the V.P. Nuclear)

I N D E X

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Tuesday Afternoon Session

June 11, 1985

12:30 o'clock p.m.

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P R O C E E D I N G S

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(Present: Messrs. Rossi, Bell, Beard, Lanning, Kosloff, Schafer, Rowles, Myers, O'Reilly, Batch, Lingenfelter, Murray, Wideman and Wood.)

MR. ROSSI: This is going to be the Licensee's briefing and overview of the summary of the event that occurred on June 9th. And we will have a record transcribed so we can review what was said and it will be there for everyone to look at later.

And I don't know that anything more needs to be said on that. We will have the Region people present to hear what is said but they will not participate in the discussions. Any member of the Fact Finding Team can ask questions at any point in time and get clarifications or whatever, and I will make sure that the things stay orderly so we don't have three people asking questions all at the same time and that any one person who asks questions can

kind of proceed with his train of thought until that's completed.

So with that, we will turn it over to the Licensee. You can begin to tell us what you want to tell us.

MR. BEARD: Off the record.

(Discussion held off the record.)

MR. ROSSI: Why don't you state your names also just so -- well, he's got the seating chart so maybe we don't even need to do that.

MR. LINGENFELTER: I want to ask a question before we start. The presentation we are making is based on our, Stan Batch's and myself's, evaluation of the events as we took them off of the delogging information from the plant computer systems.

We are not planning to cover any details in terms of any specific individual actions or what is behind anybody's minds. We are dealing with the actual events as we have them recorded in terms of parameter information, what happened when, so forth.

If you have got other additional questions on that, you can ask them. If we can answer those, fine. We are looking primarily at

the very specific sequence of equipment events is what we are going to deal with.

MR. ROSSI: Okay. We would appreciate it, I assume in this sequence of events, you will cover things like operator actions that were taken as opposed to things that occurred automatically?

MR. LINGENFELTER: Certainly.

MR. ROSSI: And the other thing that would be of value to us is where equipment worked the way it was designed to work, tell us that, and if it worked in some way that you either believe it not to have been designed to work that way or it malfunctioned, let us know that as much as you can too.

MR. LINGENFELTER: Okay.

MR. BATCH: This is also fairly preliminary here and we have additional clarifications. As we review this data more, it may turn out some of this may change. But this is our best understanding at this point in time.

MR. ROSSI: I understand.

MR. BATCH: Okay. The plant was originally at approximately 90 percent of full power. No surveillance test was in progress. We

were at full automatic control except for the No. 2 main feedpump which was at manual. We had that main feed pumping manual due to some problems we had previously with the main feedpump.

At time 01:35 in the morning, 00 seconds, the No. 1 main feedwater pump tripped on overspeed due to a control failure. The ICS at Davis-Besse runs back at the plant at a loss of feedwater automatically. This runback was initiated by the ICS. With the No. 2 main feedpump in manual, the ICS could not control the No. 2 main feedpump. The operators attempted to increase its speed. It didn't get high enough for the plant to make the runback.

So without adequate feedwater for the runback to occur, we ended up tripping the plant out on high pressure at approximately 80 percent of full power when the high pressure reactor trip occurred. And the turbine of course trips when the reactor trips. The actual reactor trip occurred at 1:35:29 hours, so it was about 30 seconds or so, 29 or 30 seconds after the main feedwater pump trip that the reactor tripped on high pressure.

At 1:35:31 hours, the Steam and Feedwater

Rupture Control System's Channel 2 had a spurious half trip. This occurs at the time, essentially when the reactor trips, the secondary side pressure increases quite rapidly, and at this point in time they are getting the spurious half trip in one Steam and Feedwater Rupture Control channel. This is sensing a low level, but it is not a desired actuation and it is not a real actuation on low level but it's a half trip.

MR. BEARD: Excuse me. Can I ask you, when you say half trip, are you talking about no actuation, but one of the coincident channels has been tripped?

MR. BATCH: That's about half right. When one coincident channel trips, it will actuate the main steamline drains which are already closed, it will make sure that one stays closed and it will make sure the MSIE by-pass is closed. It actuates some equipment that really doesn't affect the plant on a half trip.

MR. BEARD: So some actions do occur, but the majority on the actions on this Rupture Control System doesn't really happen until a second channel trip?

MR. BATCH: That's correct.

MR. BELL: What are the input signals into this thing?

MR. BATCH: It senses loss of fore-reactor coolant pumps, low steamline pressure, low steam air level.

MR. BELL: Off on what channel? Startup range or --

MR. BATCH: Startup range is what it senses.

MR. BELL: But at 30 seconds in the trip, you are not even --

MR. BATCH: We had plenty of water level at this time.

MR. BELL: Why does this occur when the plant trips?

MR. BATCH: I don't think we know yet.

MR. BELL: Does it happen every time the plant trips?

MR. BATCH: It happened just these last several trips.

MR. LINGENFELTER: Last two times prior to this.

MR. BELL: This is the third occurrence

of this steamline rupture?

MR. LINGENFELTER: That's correct. In all three cases, the water level that was actually there was substantially above normal.

MR. BELL: You started out pumping about 60 percent of the operating range, somewhere around there. And by this time you are not off the operating range yet.

MR. LINGENFELTER: That's correct. We have seen levels of 100 inches. There appears to be -- you know, this is speculation. Some sort of a response to a pressure, a rapid pressure increase on the secondary has some effect on one channel of this. The channel itself has been tested following these other events and it responds to a normal low level as required. But there is something about that particular transient that sets that thing off.

MR. ROSSI: Is it one steam generator only or --

MR. LINGENFELTER: We believe that to be the case. One -- we think it is one transmitter.

MR. ROSSI: For one steam generator?

MR. LINGENFELTER: That's correct.

MR. BELL: And I would like to, if it's

all right with you, back up to your Item No. 1 here. You say a runback is initiated by the ICS. What power level do you normally runback to in loss of feedpump and what's the runback?

MR. BATCH: 50 percent level, 55 percent of 50.

MR. BELL: 55 percent at 50 percent per minute, if I understood correctly?

MR. BATCH: Yes.

MR. BEARD: Is that correct?

MR. BATCH: Between 55 or 60.

MR. ROSSI: You mean you run it back 55 or 60 percent at 50 percent per minute?

MR. BATCH: That is the runback rate that is initiated in the ICS. The plant can't runback at 50 percent unless --

MR. BELL: In a percentage it could.

MR. LINGENFELTER: Possibly, it could.

MR. BATCH: That's the rate it tries to runback at.

MR. BEARD: How much -- I guess you runback 10 percent before you got the trip; right?

MR. BATCH: Roughly.

MR. BELL: Had the other main feedpump

been on automatic, would you have rode the runback out?

MR. BATCH: Quite possibly.

MR. LINGENFELTER: We have in the past.

MR. BELL: It's your experience in the past you are able to run it out with loss of feedwater pump?

MR. LINGENFELTER: We want to point out that the pump was in manual. We had in the past had some difficulties with the main feedpumps tripping following a reactor trip, and it appeared to be that that tripping following a reactor trip had something to do with one of the pumps or having to do with the pumps being on automatic.

And we placed, for a precautionary reason this time around, we had one in automatic and one in manual. So that if we had a reactor trip, the one that was in manual would not be lost.

MR. BELL: Okay. Now, excuse me. When this pump is in manual, is there any effort to keep either pump speed matched or pump flow rates matched?

MR. LINGENFELTER: Yes.

MR. ROSSI: So at 90 percent power, you

were sure it was supplying 45 percent of the feedwater.

MR. LINGENFELTER: That's the intent. And the operator, when the transient occurred, recognizing that he had to try to take the place of the automatic aux, tried to run the thing up, tried to run the feedpump up but was unsuccessful.

MR. BELL: Okay. Thank you.

MR. BEARD: So far in the event as you have gotten -- we haven't let you get very far -- but basically what I would like to understand is that with the history of a few frequent half trips on the Steam and Feedwater Rupture Control System and the spurious tripping of the No. 1 feedpump, everything to this point has progressed pretty much as, quote, normal, unquote. I mean, there are no big surprises.

MR. LINGENFELTER: That's correct.

MR. BEARD: Okay.

MR. BATCH: The half tripping of that Steam and Feedwater Rupture Control channel does not cause any particular problems in the plant either. I don't know whether I made that clear, but it's not a significant problem to the plant

when that does half trip. The tripping itself is a safe condition, so it's not like it's becoming inoperable at that point in time.

MR. BEARD: I'm just trying to keep separate in my mind what is, quote, within the range of normal and where do we begin to get some interesting things.

MR. BATCH: Okay. We got through the half trip of the SFRCS channel.

At 1:35:36 and 37, the No. 1 and 2 Main Steam Isolation Valves closed. I guess this is deviating from what we would have expected at this point in time. There is no apparent reason for the MSIVs to begin to close at this time. MSIVs at this plant are closed by a full Steam and Feedwater Rupture Control System actuation, but there should not have been one present at this time.

MR. ROSSI: Is that the only signal that would automatically close the Main Steam Isolation Valves?

MR. BATCH: The SFAS, Safety Features Actuation System.

MR. ROSSI: SFAS?

MR. BATCH: Right.

MR. ROSSI: Okay. So it's those two signals that would normally be automatically closing the MSIVs?

MR. BATCH: Right.

MR. BELL: Is there any reaction between SFRCS Channel 2 and Channel 1? Is there, like in Channel 2, since it is a trip condition, does it let Channel 1 know it sensed a trip signal?

MR. BATCH: Signal.

MR. BELL: And is there any way the trip in one channel could isolate these Main Steam Isolation Valves, this half trip? Is there any reaction there that can cause these MSIVs to shut?

MR. BATCH: One actuation trip of the Steam and Feedwater Rupture Control System closes both MSIVs, so it only takes one channel.

MR. BELL: So Channel 2 actually could have closed these MSIVs if it were a full trip?

MR. LINGENFELTER: In other words, actuation of either channel of SFRCS, one or two, could -- would close both MSIVs provided it were a full trip. Now, we don't -- the timing of this particular closure on the Main Steam Isolation Valves would appear to be coincident with this half

trip. However, no other expected acts of equipment occurred. And past experience would lead us to believe again on this spurious trip that only a half trip probably did occur. So right now we think that a half trip occurred which may have influenced the MSIVs. It should not have.

MR. BELL: But it may have.

MR. LINGENFELTER: Yes.

MR. BEARD: Let me get a point of clarification here. I'm getting a bit confused. I want to make sure I don't get confused.

We are talking about instrument channels, we are talking about Rupture Control System channels and half trips, things of this nature. And it seems to me -- let me throw out what I think it is and see if it is right. A channel of the Rupture Control System may involve the coincident tripping logic of two or more instrument channels. For example, an instrument channel would be one transmitter on say low pressure, so there is channels upon channels upon channels is what it comes down to.

MR. LINGENFELTER: Right. The terminology is a little different, but I think you

got the right idea.

MR. BEARD: Yes. But what occurred here is actually one instrument channel had tripped.

MR. LINGENFELTER: Right.

MR. BEARD: Which did a half actuation of one logic channel, if you will, in the Rupture Control System.

MR. LINGENFELTER: Right.

MR. BEARD: And other than the minor actuations you talked about earlier, you wouldn't have expected full actuation of any MSIVs.

MR. LINGENFELTER: That's correct.

MR. BEARD: Thank you. I hope I can keep that straight.

MR. LANNING: For this sequence of events you are talking about, would you tell us what the source of the information is?

MR. BATCH: This is a combination of interviews with operators in a meeting we had Sunday morning, the Sequence Of Events printout, the alarm type printout, the computer information that we have available, in an effort to try to make it all as understandable as possible. You want me -- many of these things were covered in many of those

sources.

MR. LINGENFELTER: Are you looking for specific names of sources that you might want to have later or what is your direction?

MR. LANNING: Obviously the time schedule is what the computer put out. That's the alarm printer.

MR. BATCH: Some of those "Approx. 1:41s" are approximate range of times there. They may have been a combination of alarm printout and operator interview.

MR. LANNING: Is there other printouts from alarm printers?

MR. LINGENFELTER: Yes.

MR. LANNING: From what source are they?

MR. LINGENFELTER: We have part of the emergency response network which establishes by computer the system down, the Technical Support Center, which logs a great deal of analogue data at a high frequency. We use that for looking at how the parameters responded.

MR. BEARD: Is this referred to as the SPDS?

MR. LINGENFELTER: No. It provides an input

to the SPDS. It's part of the same computer network which drives the SPDS, but it's not a part of it.

MR. BEARD: I guess for the record I think SPDS means Safety Parameter Display System.

MR. ROSSI: This computer system that's in the Technical Support Center, what is that referred to as, it's name?

MR. LINGENFELTER: That's Acquisition Display System or ADS. I will try to use that name.

MR. ROSSI: Okay. And that's an analogue recording?

MR. LINGENFELTER: Analogue. It is a digital system, but the major source of information we are getting here was from analogue-type information. There is also digital information, contact inputs and so forth.

MR. LANNING: Is this a continuously recorded storage of system parameters?

MR. LINGENFELTER: Yes. Approximately one hundred major parameters are stored at a rate of approximately once a second, and there is a great deal of additional information that is stored at lesser rates.

MR. LANNING: During all modes of operation?

MR. LINGENFELTER: Power operation, yes.

MR. BATCH: It's a constantly rotating file.

MR. LINGENFELTER: We keep a 24-hour file.

MR. BEARD: Maybe we better let you get on with the summary. I think we are getting off more on details rather than the optimum use of this first meeting.

MR. BATCH: Okay. From the time then 1:35 until 1:40, we had fairly normal post-trip equipment operations such as the auto transfer of housepower to the startup transformers that occur during the normal post-transient, post-trip transient. No. 2 main feedpump continues to supply normal feedwater, and it takes two, two and a half minutes to boil steam generators down to low level limits where you actually start calling for additional feedwater, and that main feedpump supplied feedwater until approximately 01:40 hours when there was not enough steam in both our moisture separator reheaters storage tanks or the main steam lines to keep the main steam pumps

supplied.

So the steam generator's water levels decreased at that point, approximately 1:41 hours, to the Steam and Feedwater Rupture Control System low level trip setpoint, which is twenty-six and a half inches at this point in the steam generator.

MR. ROSSI: About twenty-six and a half inches.

MR. BATCH: Right. We can go into a lot of detail at this point in the actual sequence that happens in the next few seconds.

MR. LINGENFELTER: Do you want me to talk about that?

MR. BATCH: Probably.

MR. LINGENFELTER: I'll try to address what happened with the SFRCS, Steam and Feedwater Rupture Control System at this time because a number of things occurred that provides some confusion, and I'm sure we will have to discuss this later in additional detail.

Again, using your analogue or your analogy of instrument channels and the actuation channels, two-instrument channel of one SFRCS actuation channel sensed low level on one steam

generator at this time. That full trip of that actuation channel then initiated the start of the No. 1 Aux Feedpump Turbine and a number of other valve actuations. I won't go into all of them at this point.

The normal difference in instrumentation accuracies between the steam generator level sensing channels permitted a time delay between the double actuation, the two-instrument channel actuation in one SFRCS channel, that allowed that channel to actuate before the second channel actuated by approximately ten, eleven seconds.

In between those times, the operator in the control room who was concerned about SFRCS actuation and what he had seen, that's all I know, decided that a manual initiation of SFRCS should occur, and he attempted to manually initiate SFRCS.

He went to the panel where the manual actuation buttons are located and pressed two SFRCS manual actuation buttons. There are a total of ten. There are two sets of fives, one set of five actuation buttons for each actuation channel.

The buttons that he pushed, he decided to pick the -- or he picked, I should say, the top two

buttons in both strings. It turned out that those two actuation buttons were manual actuation of Channel 1, SFRCS Channel 1, low steam pressure on Steam Generator 1, that's one button, and the second one was actuation -- SFRCS Actuation Channel 2, low steam pressure on Steam Generator 2.

So he had put into the system information that let the SFRCS think -- one channel thought Steam Generator 1 had low pressure, main steamline rupture, which essentially tells the SFRCS that that steam generator is no longer available for operation, and the other channel was told that the other steam generator was unavailable for operation.

MR. BELL: May I interrupt you one moment?

MR. LINGENFELTER: Sure, please.

MR. BELL: This first steamline break protection, right?

MR. LINGENFELTER: That's correct.

MR. BELL: So the system looks at if one steam generator pressure is lower than the other. It doesn't look at a differential between the steam generators. It's strictly a pressure-based system.

MR. LINGENFELTER: Right.

MR. BELL: Then there are no provisions

for a downstream break in this system or a break on any common line anywhere where both steam generators would be low to allow emergency steam provisions, if I understand what you are telling me correctly. If I had a large downstream break, both steam generator pressures would be low and equal, right?

MR. LINGENFELTER: Right.

MR. BELL: But yet I could feed neither steam generator because this SFRCS system would prevent the addition of auxiliary feedwater.

MR. LINGENFELTER: That is correct.

MR. BATCH: The one generator would be pressurized.

MR. ROSSI: Or both, if both MSIVs worked, then both generators would be pressurized.

MR. MYERS: If you get one to generate, it clears itself.

MR. LINGENFELTER: It clears itself.

MR. BELL: But if both pressures are low and stay low, then it is not permitted to generate.

MR. LINGENFELTER: That's correct.

MR. BEARD: Until there is some override type action, if that's possible?

MR. LINGENFELTER: That is possible.

MR. BEARD: Let me back up one more step and make sure I understand it. The low pressure senses what it thinks is maybe a rupture of the steam generator and therefore, to avoid feeding it, it isolates basically that steam generator.

MR. LINGENFELTER: Uh-huh.

MR. BEARD: So is it roughly analogous to a feed-only-good-generator system that was energized for both of the only two steam generators in the plant, so that basically whether it is right or wrong, the buttons in effect actuated this system which caused both steam generators to be fully isolated?

MR. LINGENFELTER: Yes. Yes. Now, there is a slight difference in that now where if you had actually had really both steam generators with a low condition, low pressure condition, both sensing -- both actuation channels would sense low pressure on both generators.

Here we had a condition where only one channel, one channel saw one generator, the other channel saw the other generator. So this channel, Channel 2, thought Channel 1 was still good, and

Channel 1 thought Steam Generator 2 was still good.

MR. BEARD: Now are you talking in terms of the instruments that it saw or the input it received via the operator pushing the manual actuation buttons?

MR. LINGENFELTER: The buttons that the operator pushed made the SFRCS think that. There is no instrumentation. There is no real low pressure at this point.

MR. BEARD: Okay. Maybe I'm getting confused again, but it seems to me that the instruments fed in a signal that spuriously said low level in one of them, I believe, if I haven't got that part confused.

MR. LINGENFELTER: That's correct.

MR. BEARD: Then the operator inputted to the system low pressure signals, one for each steam generator. So the system as a whole, the Rupture Control System I mean, believed that there was low pressure in one steam generator, and low pressure in that same steam generator plus in the other steam generator. It thought it had inputs that said low pressure.

MR. BATCH: Yes, and low pressure has

priority.

MR. BEARD: Same thing for both, pressure level low on one, pressure low on the second.

MR. LINGENFELTER: Right.

MR. BEARD: And it bottled up both steam generators.

MR. LINGENFELTER: That's correct.

MR. ROSSI: It does that by closing valves in the auxiliary feedwater lines. Is that how it bottles them up?

MR. LINGENFELTER: Main steam water, Main Steam Isolation Valves.

MR. ROSSI: So it bottled the Aux Feed and main steam from both generators?

MR. LINGENFELTER: Now, Aux Feed is only isolated when the system senses low pressure, and low level isn't a problem.

MR. BELL: But had it been an OSGTA, a generator at normal pressure and the other steam generator at low pressure, would it feed the steam generator with low pressure had it been an actual actuation rather than a manual initiation?

MR. LINGENFELTER: That's correct. And in fact, what the systems attempt to do is to take

both auxiliary feedpumps and feed the good steam generator. So what you will find when you review the events, using again your example, if one -- if the actual -- if there was an actual low pressure in one generator and the other steam generator saw a normal pressure, the auxiliary feedwater pump associated with the bad steam generator would be lined up to draw steam from the good steam generator and provide water to the good steam generator. So you have two pumps supplying it.

MR. BELL: Okay.

MR. LINGENFELTER: Now, we are in a situation where the SFRCS channels again, one channel sees one steam generator bad but thinks the other one is good. The other actuation channel sees the opposite steam generator bad or sees its own steam generator's bad and says the opposite one is good. So they attempt to try to take their own pumps and where possible cross-feed one another. All right?

The valves that should have moved to do that did indeed do that. They functioned the way they should have. However, with the individual channels sensing that its own steam generator was

bad, it shut the steam generator isolation valve, the Aux Feed Isolation Valve just upstream of the steam generator to prevent any water from either pump entering.

So that effectively cut off all feedwater to both generators in that situation, although the two Aux Feed pumps are now still trying to feed the opposite generators.

MR. BELL: Now, you have got may we call them A and B steam heaters. Is that a fair terminology? Now, the one channel will try to open the steam supply to the auxiliary feedwater pump turbine from the steam generator that it thinks is good, is that what you said, and close the steam supply to the auxiliary feedwater pump turbine on the steam generator it says is bad? So in that case those valves had two conflicting signals, one to shut, one to open?

MR. LINGENFELTER: That's right.

MR. BELL: Which took priority?

MR. LINGENFELTER: Whatever happened first.

MR. BELL: It's a relay race then.

MR. LINGENFELTER: Right. In the case of

the No. 1 Channel -- well, wait a second. You are talking about -- you were talking about the valves having conflicting signals. There were no conflicting signals from the low pressure signals. Those things are covered by different, what do I want to say, different actuation channels.

MR. BELL: How about the water valves then, the supply valves on the feedpump discharge? Are we in a situation where, for example, the Aux Feedpump supplies to a steam genenerator without it being opened and closed?

MR. LINGENFELTER: Let me back up and say -- go through the sequence again. The first thing that happened on SFRCS Channel 1 was that it sensed a low level, and certain valves started to move on that actuation. The only place where there was a conflict was when the operator pushed the buttons for low pressure.

Low pressure having priority, it now gave signals to some of those same valves to close. And so what happened is -- and that occurred four seconds after that low level. So for four seconds, those valves were on their way opened or closed, and then a couple of them turned around as soon as

they were all the way open, turned around and went back to match the demands of the low pressure. Okay?

There are no conflicts that I am aware of. When the guy pushed the two buttons, there should be no relay racing going on with respect to the low pressure. Okay?

MR. BELL: Okay.

MR. ROSSI: Low pressure just takes precedence over low level?

MR. LINGENFELTER: That's correct.

MR. BEARD: Are the actuation channels, are we talking about Channel 1 and Channel 2, are they in direct correspondence to the two steam generators? In other words, earlier you indicated something about Channel 1 senses low level on Steam Generator No. 1. I'm trying to associate -- I think what we are saying is Channel 1 had low level and manually inputted low pressure. Channel 2 had only manually inputted low pressure.

MR. ROSSI: No, I think by this time they had low level on both because you had real low levels.

MR. LINGENFELTER: That's six seconds

later.

MR. ROSSI: You haven't got there yet.

MR. LINGENFELTER: But we are close. You are very close. A quick rundown on the actuation channels themselves: The instrumentation that feeds into the actuation channel logic comes from both sides. It's not an Actuation Channel 1 is for Steam Generator 1 and associated loops. It looks at both sides of the systems, both actuation channels look at both sides of the system.

MR. BEARD: Are they fully redundant in that sense?

MR. LINGENFELTER: In a sense, yes. In terms of what they actuate, no, with the exception of certain valves, of course. You can't make it easy.

The Main Steam Isolation Valves are both closed from both channels. Startup feedwater control valves and I think -- anything else? In general, though, the actuation channels themselves actuate the associated loop, if you will. In general that's a true statement. Okay. Now --

MR. BEARD: Before you go on to the next step, just to detail, you said the operator went

over and intended to actuate the Rupture Control System. I'm not sure whether I am reading into it more than what you said or not, but I think you were implying that he intended to do it on low level but at any rate he did it on low pressure.

MR. LINGENFELTER: That's correct.

MR. BEARD: And you say the low pressure actuation buttons are the top two in two rows of five buttons each. Could you tell me where the two buttons are that he intended to use, the low level buttons?

MR. LINGENFELTER: Fourth down I think.

MR. BEARD: Forth down?

MR. LINGENFELTER: On both.

MR. LANNING: Was the operator's actions confirmatory in nature or anticipatory in nature?

MR. BATCH: He thought they were anticipatory. It ended up they were actually by four seconds.

MR. LINGENFELTER: Afterwards. He thought he was doing it himself, but it would not have been required had he not touched the buttons. Everything would have worked as required. But he thought it was necessary to do that, so he did it.

MR. LANNING: Based on the level.

MR. BATCH: I think the MSIV being closed also.

MR. LINGENFELTER: You have to ask him what their thoughts were. There are a lot of confusing aspects. The MSIVs being closed, which would be a normally expected SFRCS occurrence. There was considerable confusion.

MR. BATCH: If you really want to understand SFRCS, it probably would be worthwhile to have a regular lecture.

MR. BEARD: It's very complicated. I looked at it several times over the years and a week after I got myself up to speed on it, it's sufficiently complicated that unless you use it almost daily, you can get it mixed up very quickly. But I have used it daily and got mixed up. It's a very complicated system.

MR. BATCH: There was one more input -- I didn't finish my statement. There was 177 pound DPE input that also feeds in SFRCS. I stopped describing SFRCS before. But there is a differential steam pressure that's also input to the SFRCS, and SFRCS channels do get both steam

generators inputting to the channels but they basically control their own Aux Feedpumps.

MR. BELL: Did I hear you correctly, had the operator either pushed the low level buttons or not pushed any buttons, all the rest of this would be a blank sheet of paper?

MR. LINGENFELTER: That's uncertain. That's uncertain.

MR. MYERS: The plant should have proceeded.

MR. LINGENFELTER: It should have proceeded, and it is uncertain. We believe there is a probability that that is the case had he not pushed those buttons. I am going to get into that a little bit further here. Okay?

Now we have had one channel with low level actuation and both channels with a low pressure actuation. The No. 1 actuation channel tried to start or started the auxiliary feedwater pump on that low level signal. The No. 2 actuation channel, still again sensing that only one steam generator was bad, thought that the No. 1 steam generator was good and in turn started the No. 2 action feedwater pump to try to feed the No. 1

generator.

So the second Aux Feedpump was started by the low pressure manual actuation. In either case, about, I think it's what, six seconds later, the second channel of low pressure, the second actuation channel was received. The SFRCS channel showed the low level -- excuse me, saw the low level on the second actuation channel, that came in, it registered as an alarm, it did nothing again since it doesn't have the priority.

All indications that we can tell up to now are that all the valves actuated as required. Everything moved in the direction it's supposed to.

MR. BEARD: Before you get to the second page I have a question. Are you there?

MR. LINGENFELTER: Yeah.

MR. BEARD: Okay. You mentioned several times that when an actuation channel senses low pressure on a given steam generator, it apparently is configured in some logical manner that it convinces itself that that steam generator is bad and it figures that the other steam generator is good.

What I'm trying to understand is does it

actually have some input that tells it the other one is good or does it just switch away from the bad one?

MR. LINGENFELTER: Until it is told that the other generator is bad via a low pressure signal, it assures it is good.

MR. BEARD: But it is an assumption. There is no input to it that tells it the other one is good. It's switches to the good one as well as it avoids the bad one.

MR. ROSSI: But it gets pressure information from the so-called good one.

MR. LINGENFELTER: It still gets pressure information from the good generator.

MR. ROSSI: And because of the lack of a low pressure steam generator, that's what it uses to make the assumption it is a good steam generator.

MR. LINGENFELTER: That's true.

MR. BEARD: In this case, the operator simultaneously pushed the two low pressure actuation buttons.

MR. LINGENFELTER: Let me describe it. He pushed the top two. The next two down are No. 1 actuation channel, low pressure on Steam Generator

2, and No. 2 actuation channel, low steam pressure on No. 1 generator. So to get both generators to be recognized as bad, the operator would have had to push the top two and the next two down.

MR. BEARD: So the two he did push were related to one steam generator?

MR. LINGENFELTER: No. The two he did push were related to opposite steam generators. So again one actuation channel thinks the one is good, the other actuation channel thinks the other is good, considerably different than a real -- there you go. This, by the way, is not the first human engineering discrepancy we found in our control room design.

MR. BELL: That went on prior to this incident?

MR. LINGENFELTER: Yes, scheduled to be changed.

MR. MYERS: I'm not sure if I haven't got them --

MR. LINGENFELTER: You have done them backwards, but the idea is good.

MR. MYERS: Low pressure 2 for --

MR. LINGENFELTER: The top one would be 2

in that case. It's the same numbers. That's for Channel 1. You have got Actuation Channel 2 now on the left and Actuation Channel 1 on the right.

MR. ROSSI: If we are going to talk about what's on the board --

MR. LINGENFELTER: That's why I haven't drawn anything.

MR. ROSSI: -- we have to have something. One possibility is you draw it on a piece of paper.

MR. LINGENFELTER: We can give you a drawing of it.

MR. ROSSI: Put it on here. Then we have it.

MR. BATCH: Why don't we get the records here. We may end up with it labeled wrong.

Let's get the FCR view of those buttons.

MR. LINGENFELTER: '84 -- it's later than that.

MR. BATCH: We will supply those to you.

MR. BEARD: I think the thrust of what I was trying to understand is that the buttons that were pushed, one was a redundant actuation. One channel thought one steam generator was at low pressure, a different actuation channel thought the

other steam generator had low pressure.

MR. LINGENFELTER: That's correct.

MR. BEARD: But -- okay. So now one channel wants to switch away from what it thinks is the bad steam generator, and the other channel wants to switch away from what it thinks is the bad steam generator. So in the switching processes, they block each other out.

MR. LINGENFELTER: Essentially, yes.

MR. BEARD: Okay.

MR. BELL: Has there been any discussions of perhaps putting a steam pressure differential of steam generator pressures into this logic?

MR. ROSSI: I really think we ought to refrain from directing that question now. We are here for information on what happened.

MR. BEARD: It's hard enough to understand what really happened. If you get me one step beyond, it's --

MR. ROSSI: We have to refrain from that.

MR. BATCH: Are we on page two?

MR. BEARD: You are right, that 01:41 time was a killer. It took a long time to get through.

MR. ROSSI: I don't know whether you can clarify. I think we skirted around the question and you may have even answered it a couple of times on where you are getting two signals telling a valve to do the opposite things, which of these valves will do whatever comes first and which of them have a different action regarding which comes first, you know, where it is overridden. I gather when you are talking about shutting off the auxiliary feed to the steam generators, if you have low pressure in the steam generators, regardless of what other valves I have, I shut off the auliliary feed by shutting the valve in the auxiliary feed line into the generator.

MR. LINGENFELTER: Right.

MR. ROSSI: But I gather when you are talking about valves that feed steam to an auliliary feedwater pump, that there what the valve does may depend on what signal gets there first?

MR. LINGENFELTER: Well, actually there are four steam valves, okay, the way it is set up?

MR. LANNING: These are steam emission valves of the Aux Feedwater Pump.

MR. LINGENFELTER: Correct. Off of each

steam generator is one valve to each Aux feedpump turbine; okay? When the low level actuation occurred, the steam generator supply valve from No. 1 generator to No. 1 turbine opened, as it should have.

When the low pressure signal induced by the operator was input to Channel 1, the signal to close that valve was given. It was already on its path open, it went all the way open and had gone all the way shut. At the same time that channel opened the -- I think that's right -- did that channel do it or the other channel did it? That channel did it. Opened the supply valve from the other steam generator to the No. 1 turbine. Okay?

MR. ROSSI: So the pressure really took precedence, the fact that the guy even opened the steam valve lines up, the pressure took precedence over the level and told the steam valves to do what they would always do for that pressure signal.

MR. LINGENFELTER: That's correct.

MR. ROSSI: Regardless of what kind of levels you get.

MR. LINGENFELTER: That's correct.

MR. ROSSI: So the pressure really took

precedence.

MR. BATCH: It always takes precedence.

MR. ROSSI: So there wasn't a race here. The pressure just took precedence.

MR. LINGENFELTER: That's correct

MR. BATCH: Except some of those valves have to stroke completely full open before they will be allowed to stroke closed through the circuitry.

MR. ROSSI: Other than that, the pressure took definite precedence and set the valves up to do what they would always do with the pressure signals.

MR. BATCH: Right.

MR. BEARD: Some valves have to complete their initial motion before they turn around on the priority system.

MR. BATCH: That's right

MR. BEARD: Does that imply that some other valves reverse in midstream?

MR. BATCH: Some of them didn't have signals.

MR. BEARD: I see. In summary, where we are is you have got the two Aux Feedwaters

cross-blocked each other, so to speak, if I can make up that term, and where do we go from here?

MR. LINGENFELTER: Okay. This prevents any kind of feed to either steam generator. Both Aux Feedpumps are attempting to come up to speed to provide flow, if they can. Steam is provided.

I'm not sure. I would have to go back and think about it. I think you would find if you had an actual low pressure on both steam generators, I would think you supply steam to -- but in this particular case, there was steam going to both turbines. They came up to speed and went out on overspeed, both turbines.

MR. BEARD: Now, this going out on overspeed is an off-normal situation.

MR. LINGENFELTER: Absolutely.

MR. BEARD: Just to set the record straight on events. This is off normal.

MR. LINGENFELTER: Absolutely off normal.

MR. ROSSI: Even for the case when their discharge -- feed discharge valves are closed and they are pumping against closed valves and they have steam and are being told to come up to speed, is it abnormal for that, or do you know?

MR. LINGENFELTER: We are not sure. We feel it should be, but I quite frankly -- we are not certain that we have ever been in this precise situation. It's very confusing.

The testing we normally provide or run on these things sets up a sequence, but it doesn't produce these results, obviously. We are trying to understand. We don't understand enough about how the governors on the turbines function. I don't know I can explain what this is. We simply don't understand it yet. We need a lot more information.

MR. BEARD: Would it be your best judgment that you would not have expected this overspeed tripping even for this configuration?

MR. LINGENFELTER: That's correct.

MR. BEARD: Even though it is not backed up by testing?

MR. LINGENFELTER: That's correct. We don't think it should have happened at all.

MR. BELL: When you start this pump, like if you are doing surveillance on either one of these pumps to power, the valves you are talking about are normally closed valves, aren't they?

MR. LINGENFELTER: Yes.

MR. BELL: And yet when you do the surveillance midstream to the turbine, it doesn't overspeed; is that correct?

MR. LINGENFELTER: That's correct.

MR. BELL: Is not the same recirc path available in this condition as the pump recirc path?

MR. LINGENFELTER: That's correct.

MR. ROSSI: So the operation of the pump during the event is not known to be different than the operation that may occur during surveillance tests with respect to having no auxiliary feed flow, but having feed flow and a signal to crank it up to speed?

MR. LINGENFELTER: That's correct. At this point, it is pure speculation in regards to some potential difference that may exist in the fine detail of how the governor works that might possibly explain it. I can't say anything more than that. We need to do a lot of looking. That's the major area of concern.

MR. BEARD: Just to make sure I understand the plant status, do both of these pumps -- correct me if I'm wrong here -- both of the pumps were considered operable at the time of the event

and have passed their most recent surveillances, et cetera, et cetera?

MR. LINGENFELTER: Yes.

MR. BEARD: And on Aux Feedpump, how frequently do you typically start it up? Is that a monthly thing?

MR. BATCH: Both these have been started a week before.

MR. BEARD: So they did the week --

MR. BATCH: They were tripped the week before.

MR. LINGENFELTER: Tripped the week before, and we had testing subsequent to that.

MR. BEARD: But basically the equipment was operable.

MR. LINGENFELTER: Yes.

So given the events that have occurred up to this point, up to where the pumps have oversped, we have not uncovered any peculiarities in the response of the SFRCS, in response of any of the valves, other than the overspeed tripping of the pumps. That's the only thing we have identified at this point is a concern.

MR. ROSSI: You've had two equipment

things that apparently either were not at the time or maybe still are not understood. One of them is this spurious half trip thing of Channel 2, and the other one is the tripping on overspeed of the auxiliary feedwater pumps. The rest of this stuff in here all worked the way you would expect it to work for the signals that --

MR. BEARD: I don't think so.

MR. ROSSI: What else do you think?

MR. BEARD: I thought we talked about earlier closing the MSIVs were not proper.

MR. ROSSI: That's right.

MR. LINGENFELTER: Those items -- I should rephrase what I said; it was a bad choice of words. With regards to the events from the time of about 01:41 there, everything that happened in regards to the expected SFRCS response given what happened up at 1:35 appeared to be normal.

MR. BEARD: I think in that context, you are right.

MR. LINGENFELTER: Okay. There we go. At 1:42, I believe it's 1:42 even, the operator or maybe an operator corrected the input error by resetting the trips, the low pressure trips. In

other words, they figured out what the problem, what they had done was incorrect and reset at the same switches those trips, which basically takes the low pressure trip out of the SFRCS, it clears it. Just like, you know, in a real event, had the pressure dropped down and then come back up again, the pressure switches would be set. SFRCS now thinks that both steam generators are indeed good.

MR. ROSSI: Okay. That's one minute basically after he pushed the switches in the first place.

MR. LINGENFELTER: Yeah. Right.

MR. ROSSI: The low pressure problem.

MR. LINGENFELTER: That's right.

MR. BELL: Only auxiliary feedwater valves are in position, right?

MR. LINGENFELTER: Right.

MR. BELL: The Main Steam Isolation Valves would not reopen.

MR. LINGENFELTER: Would not reopen, that's correct. And to the best of our knowledge all the valves required to realign to go to the normal feed situation did move with the exception of two valves, the steam generator isolation valves

AF-599 and AF-608. Those were the last two valves on the Aux Feed line into the steam generators. They did not reopen. They stayed in the closed position.

MR. ROSSI: The names of those valves are -- the Aux Feed, what are the names of the valves or what are their numbers then?

MR. KOSLOFF: AF-599.

MR. LINGENFELTER: And AF-608.

MR. ROSSI: AF-599 and AF-608. And are they in an auxiliary feedwater line?

MR. LINGENFELTER: They are in the auxiliary feedwater lines, the last valves up to the steam generator.

MR. BEARD: And the expected response is these valves should have reopened when the actuation signal was reset and the abnormality was they stayed closed.

MR. LINGENFELTER: That's correct.

MR. BEARD: Did the operator have valve position indication in the control room on these two valves? In other words, did he know these two valves had not responded properly?

MR. LINGENFELTER: At some time he did.

MR. BEARD: I don't mean did he look, but was the information available?

MR. LINGENFELTER: It's available. It's available. Some time he figured it out because they ended up both being opened.

MR. BELL: Okay. One more question. Are alarms supplied in the control room that the operator does know these two auxiliary feedwater pumps are tripped?

MR. BATCH: Yes.

MR. BELL: So he knows from his enumerators, realizing there are two hundred of them in alarm right now, but these are available?

MR. BATCH: Yes. That's correct.

MR. BELL: And has anyone been dispatched down to the room yet to reset the trips at this point in time, 1:41, 1:42?

MR. BATCH: It was dispatched quickly. You would have to ask the operators that.

MR. LINGENFELTER: We know what time they started rolling again, but I can't tell you that. There is speed indication and obviously flow.

MR. BEARD: Going back, since we were interrupted anyway, did the operator ever attempt

up to this point to push some sort of a reset that would have caused the spurious closure of the MSIVs to be overridden and therefore reopen those? Was that ever in the ballgame?

MR. LINGENFELTER: No. You can't do that, no.

MR. BELL: So now we are up to four different discrepancies, four things happened that you wouldn't expect to have happened: The spurious trip, the two MSIVs closing, and two Aux feedpumps tripping, and the final thing I have here is the 599 and 608 not repositioning.

MR. LINGENFELTER: That's probably a good count, yes.

MR. BELL: Okay.

MR. BEARD: We are up to five, is that what you said?

MR. BATCH: At this point in time. You will have to discuss with the operators where they were sending people, but they tried to reestablish a Startup Feedpump and an auxiliary feedpump and without main or auxiliary feedwater. They are still cooling the RCS, and at 1:45 the RCS was starting to feed up to 562 up to that point at 1:45.

The operators' action at this point in time, I would rather you talk with them directly.

MR. BEARD: I wouldn't try to probe that area. I just thought, you know, the operator did go to a panel and do something. I was trying to establish it was something unrelated to the MSIVs.

MR. ROSSI: Okay. What can he do from the control room? Can he at this point from the control room reset the auxiliary feedwater pump trip on overspeed?

MR. BATCH: That's done locally.

MR. ROSSI: That has to be done locally. How about opening these auxiliary feedwater isolation valves? Does he have a switch that can do that from the control room?

MR. BATCH: They weren't working with the motor operator, but he has a switch.

MR. ROSSI: He has a switch, and you don't know whether he tried to use it or not?

In any event, they didn't open, either at least automatically and maybe not manually either, but you don't know about the manual.

MR. BATCH: They did crank them off the seat.

MR. LINGENFELTER: Manually with a switch he means. Manually with a switch. From the control room they did not open, if they tried it.

MR. ROSSI: If they tried it.

MR. LINGENFELTER: We don't know that.

MR. ROSSI: Okay, fine.

MR. BELL: 01:45, it says there are 12 or 13 inches of indicated level in the steam generators. When do you people consider the steam generators to be dry?

MR. BATCH: There are several things in the nature of the generator. If it loses steam pressure, if you lost all your feedwater and your steam pressure is down, it's 960 or eight inches --

MR. BELL: Or steam pressure is dropped?

MR. BATCH: 960 and a loss of all steam water. If you go dry, you will be depressurized soon, so it gives you a choice there.

MR. BELL: Does this come from B & W or is that Toledo Edison's?

MR. BATCH: It's our log pressure. I think eight inches may be from B & W. I'm not sure the 960 was our choice or theirs.

MR. LINGENFELTER: I believe it's a

combination, but it's a major variance.

MR. BEARD: Point of clarification. When the operator reached the manually inputted low pressure signals and caused the feedwater isolation, the Aux Feedwater Valve should have reopened and apparently did not. What about the main feedwater valves? Should they have reopened?

MR. BATCH: No.

MR. BEARD: They were intended to stay closed, and they did stay closed?

MR. LINGENFELTER: Yes. The low level trip is still in; that continues. In other words, the low level trip that had initially occurred on No. 1 generator or No. 1 actuation channel and then followed up on No. 2, those were still in. Him resetting those low pressure trips did not affect the low level trips.

MR. BATCH: Okay. Then from time 1:45 to 1:51 we had RCS Tave increasing due to lack of primary and secondary heat transfer. RCS pressure was increasing due to this and heating up of the primary water. RCS pressure increased, due to the water we were putting in the pressurizer, went up to the Power Operated Relief Valve setpoint, 2425

pounds, and the Power Operated Relief Valve cycled a total of three times, relieving pressurizer pressure to the Quench Tank. And the Quench Tank did accept all the relief off the Power Operated Relief Valve. The rupture disk, we did not get up to the rupture disk setpoint.

MR. BEARD: What was the capability to makeup the primary system at that point? You said you had two makeup pumps.

MR. BATCH: Both makeup pumps. We have pressurizer level at this time, so it would have been shut off.

The third time the Power Operated Relief Valve opened, it didn't appear to reset at the proper pressure and the operator closed the block valve. Later they opened the block valve and the power was received. As a precautionary measure he closed it.

At 1:51 hours, the operators placed the Startup Feedpump in operation, and we are supplying the No. 1 steam generator with it. This steam generator pressure had reached a minimum of about 750 pounds at the time he started feeding it, and repressurized to approximately 900 pounds from the

startup feedpump.

MR. ROSSI: Now, the 750 pounds is one of the criteria for saying that under these circumstances you have an empty steam generator; is that correct?

MR. BATCH: Anything less than 960.

MR. ROSSI: So that would tell you this steam generator was empty at that point?

MR. BATCH: Yes.

MR. LANNING: What's the difference between a startup feedwater pump and an auxiliary feedpump?

MR. BATCH: Our startup feedpump is a electric motor driven pump, which is in the auxiliary feedpump room. It does not have an automatic signal from our Steam and Feedwater Rupture Control System. It's used mainly for startups and shutdowns after our main feedpumps are not being used up to about one percent power is all we use them for.

MR. LANNING: So it's normally not used in a safety capacity?

MR. BATCH: It is capable of being used in a safety capacity.

MR. LINGENFELTER: The operator had guidance in the emergency procedures to use the Startup Feedpump in this capacity at that point.

MR. LANNING: Do you take credit in your analysis for this startup feedwater pump?

MR. MYERS: I can answer that. In the post-TMI loss of all feedwater conditions for B & W power plants, we take credit for the electric nonsafety-related Startup Feedpump and it is provided with capability to operate without off-site power available. It is not in the original design of the system in the FSAR stage taking credit for the original design analysis.

MR. ROSSI: But it can be operated without any off-site power.

MR. MYERS: That's correct. It's proceduralized as a result and accepted under the post-TMI B & W loss of all feedwater conditions.

MR. LANNING: Is this pump added as part of the first TMI requirement?

MR. MYERS: No. It was an installed pump. It was modified, power supplies were modified as a result, being able to be fed from on-site power.

MR. ROSSI: Is it covered by requirements

in your technical specifications? Are there LCOs and that kind of thing on this pump?

MR. MYERS: I don't believe it is.

MR. ROSSI: It's not included in the technical specifications.

MR. BEARD: Do you consider it to be a safety-related piece of equipment?

MR. MYERS: It's not designed for that.

MR. BELL: That startup feedwater pump, is it powered from nonvital AC or from vital AC?

MR. MYERS: Non that can be fed back from vital AC.

MR. BELL: So if a real loss of off-site power occurred, the operator would have to interrupt the bust this was supplied from and supply the bust from the DC?

MR. MYERS: I'm not sure of the procedure.

MR. LINGENFELTER: That's correct.

MR. BELL: And that's why it was backfitted. It was just a procedural change?

MR. MYERS: That's correct.

MR. LINGENFELTER: Another problem that occurred prior to this, I believe, just sequential point, SP7A, the startup feedwater valve on the --

for the No. 2 generator would not open or could not be blocked, is that right? They had trouble -- they had tried, the operators had tried to open the startup feedwater valve to the No. 2 steam generator to use the Startup Feedpump to supply No. 2 generator, and the valve either could not be blocked or wouldn't open. But in any case it wouldn't open and so they decided to feed No. 1 generator. That is also something we are working on.

MR. BEARD: So that's another equipment problem you are working on.

MR. LINGENFELTER: Right.

MR. BEARD: While we are at this point, about the time you get the start feedpump running, I would like to get to the position where you have heat removal capability. Can you back up just a bit and tell us what the conditions were in the primary system in terms of heat temperatures and saturation or margin to saturation or anything along that line?

MR. BATCH: Max Th we had seen was approximately 593 degrees, in that neighborhood. Primary pressures got up to the PORV setpoint,

which was around 2425 pounds. All four reactor coolant pumps were on at high RCS, but with the subcool margin, we didn't have to shut off our reactor coolant pumps. The Th's and TDs should have been roughly the same at 592.

MR. LINGENFELTER: The thermal couple registered six hundred.

MR. BATCH: Their accuracy was probably less.

MR. BEARD: Would you say the core cooling condition was such you had a substantial margin before you got saturation?

MR. LINGENFELTER: Yes.

MR. BATCH: At 1:52, the No. 2 auxiliary feedpump was returned to operation, fed the No. 2 steam generator with that.

MR. BEARD: Excuse me. What was involved in getting the No. 2 feedpump into operation? It seemed like, as I remember you saying, it earlier tripped out on overspeed and people were dispatched to the area.

MR. BATCH: Local resetting of the auxiliary speed pump had to be done, and you should probably talk to the operators that were in the

room to get exactly what steps they took. There is a valve and it has to be manually cranked down and a trip mechanism reset and cranked back open.

MR. BEARD: Okay, but basically would it be a fair description to say that the procedure that was followed was if the trip had been spurious and the system was basically reconfigured to a normal configuration following a spurious trip and then a start was attempted and then this start was successful in the sense it did not trip out an overspeed again, or am I mischaracterizing it?

MR. BATCH: They had some problems getting it back right away. I don't know.

MR. LINGENFELTER: Maybe I think I can touch on your question. To get the pump restarted again, the steam valves which were configured by the SFRCS were still in the opened position. The only problem with the turbines, the reason they weren't running was that this trip throttle valve right at the turbine itself, which is not actuated by SFRCS, it tripped to close on overspeed. So what they had to do was go down and manually crank that thing open. Since everything else was already lined up, their act of cranking it open then

induces steam into the turbine. It's not like they put it all the way back and pushed the button.

MR. BEARD: I see.

MR. BELL: Is this No. 2 action turbine returned under operator control or under automatic control?

MR. BATCH: It was manual control.

MR. BELL: Manual control. And that's another thing that wouldn't have been done normally.

MR. LINGENFELTER: Let's back up. No. 1 Aux Feedpump turbine, both of them went out on overspeed trip. The operators attempted to reset both of them locally, and again the exact sequence you are going to have to talk to them about. But they had some troubles resetting I believe it was the No. 2 --

MR. BATCH: I'm not sure.

MR. LINGENFELTER: -- turbine. I'm guessing now, but they had some troubles resetting at least one of the turbines. When they finally got them back up and running, the No. 2 turbine was being controlled from the control room in manual, which is a normal activity, the reason being that on a normal actuation of the pumps and an autonatic

control, the control is a cyclic level control, on/off strictly, and that is not a desirable, doesn't have a desirable impact on the operation of a steam generator. So they are used to, once the thing comes up to its normal feedwater level, taking manual control of the pump and controlling it. In this particular case, they took manual control from the control room of the No. 2 feedpump and dealt with it at that time.

MR. BELL: But before the steam generator was at its normal level.

MR. LINGENFELTER: That's correct. In that sense it's unusual.

MR. BELL: So in that sense it's unusual.

MR. LINGENFELTER: That's correct. The No. 1 pump could not be controlled for some reason from the control room, either automatically or manually, and they ended up controlling it at the local station with a throttle valve controlling the speed with communications to the control room.

MR. BELL: Who makes these auxiliary feedwater pump turbines?

MR. BATCH: Terry Turbine Company.

MR. MYERS: Do you want to mention the

governors systems are different as installed?

MR. ROSSI: You mean the governors systems for the two pumps are different?

MR. LINGENFELTER: That's correct. We are in the process of trying out one pump on an electronically controlled governor. I don't know enough of the details about it.

MR. BEARD: Why are you in the process of trying a new governor?

MR. BATCH: Increased reliability.

MR. BEARD: Is it because you experienced governor problems in the past?

MR. LINGENFELTER: Some types, yes. Nothing quite like this.

MR. BEARD: I don't mean related to this event. I was trying to get the background of why you have a different governor set up.

MR. MURRAY: Let me add a little to that. We had some problems. The vendor had said they would get a new improved version, suggested this use, and in light of past problems in support of I think it was even being phased out as not being a current model, obsolescence, various reasons there, we decided to go to a newer version of the Woodward

governor. And that's why -- and before we just put them on both machines, we thought we will put one on now and run through one cycle and then replace the second one. So we are in that intermediate area right now. So we have a new one on No. 2 and an old one on No. 1.

MR. BEARD: Is the application of this governor, this new one, something I think you said was in at the suggestion and certainly with concurrence with the vendor?

MR. MURRAY: Yes.

MR. BEARD: Okay.

MR. MYERS: A special testing program and everything was developed.

MR. BEARD: Are we drawing to the end of this event?

MR. ROSSI: There is another --

MR. BEARD: At a rapid pace here.

MR. ROSSI: I think we have some questions on subcool margin, if you happen to know what they were using to get that. Maybe that's more appropriately addressed to the operators as to how they --

MR. BATCH: They have redundant TSAT

meters in the control room.

MR. ROSSI: And they were using those throughout this?

MR. BATCH: You can ask the operator what they were using, but they knew they had adequate subcool margin. The pressure up as high it was, that really wasn't a concern.

MR. BEARD: If we are at the end of it. I think for me personally, I would be very interested in just reviewing this thing and going through it and getting a count that we can agree to as to the initiator of the transient and the number of equipment anomalies and the number of people anomalies we can all agree to as a count.

MR. ROSSI: Yeah, I think that would be useful.

MR. BEARD: And if nobody objects, it would seem like the tripping of the No. 1 main feedpump due to a control failure at 1:35:00 in the morning is I would prefer to call the initiator of the transient on the plant and count subsequent things as other failures and other anomalies or other assumptions. Maybe we could just go down through it and count them as we go.

Seems like spurious half trip on the Rupture Control System Channel No. 2 at 01:35:31 is an anomalous situation. It may not be of great significance, but that is an equipment misbehavior, failure, if I may use that term.

MR. LINGENFELTER: Yes.

MR. BEARD: And the spurious closure of two MSIVs seems to be either Item No. 2, or No. 2 and 3 depending on how you want to count it.

Maybe you can give us a feel as to whether or not the controls and actuation of the MSIV at this plant are such that you would consider this one event or two separate events?

MR. LINGENFELTER: I think we think it was two, two separates.

MR. BEARD: Two separates, okay.

And then I guess the way I see it, the next thing I see on the paper here was the operator action which manually inputted low steam pressure into the Rupture Control System as I don't want to call it a failure but an item of interest.

MR. LANNING: So that's four.

MR. BEARD: According to my count it's four subsequent to the initiator problem.

And then I guess five and six become each of the Aux Feedwater Pump trips.

MR. ROSSI: Wait a second. The valve not opening came first, didn't it, or did it?

MR. BEARD: No. I think the valves not opening is at 01:42, and what I'm talking about is 01:41.

MR. LINGENFELTER: That's correct.

MR. BEARD: So the way I count it, if we are up to the point where both Aux Feed Pumps are tripped, we count six? There is six interesting things so far.

The two Aux Feed valves failing to reopen appear to be seven and eight.

The PORV appearing to reset I think may be one, may not be one. I don't know at this time. Maybe we should count it as one right now, just to make sure it gets adequate attention later and if it turns out to be appropriate, take it off the list.

Do you have any feel -- let me finish the count.

I think the next item would be I think you said a valve from the startup feed pump to the

No. 2 steam generator experienced some type of problem, SP-7A?

MR. LINGENFELTER: SP-7A, yes.

MR. BELL: That's alpha, 7-alpha or 7?

MR. LINGENFELTER: 7-A.

MR. ROSSI: SP-7A, right?

MR. LINGENFELTER: Yes.

MR. BEARD: The next one according to my count was at 01:55 when I believe you indicated that for the No. 1 Aux Feedpump, that either an automatic or control room manual of the Aux Feedpump could not be controlled and had to be done locally, local to the equipment. That would be the next one. Is that the end?

MR. BELL: No. I have got one more, and that's that Manual Aux Feedwater Control of No. 2 Aux Feedwater Pump Turbine was initiated before it would normally have been initiated. It was initiated before the steam generators were at the correct level, if I heard you right?

MR. LINGENFELTER: Yes.

MR. BATCH: That's a separate item.

MR. LINGENFELTER: That's a separate item from what you said. That's an additional one.

There may have been --

MR. BELL: So number eleven by my count is that No. 1 AFW pump turbine did not operate correctly, had to be controlled manually with a trip throttle valve which is different from the manual control room.

MR. LINGENFELTER: That's correct. And your item was No. 2 Aux Feedpump was manually -- controlled manually instead of automatically, that was --

MR. BELL: At a point where it would not have normally been in manual.

MR. LINGENFELTER: That's correct.

MR. ROSSI: That was from the control room.

MR. LINGENFELTER: It was from the control room is where they controlled it. I'm not clear on that point, there may have been some problems with the automatic control. I don't recall.

MR. BEARD: Let me count them up here. I have got the initiator plus one, two, three, four, five, six, seven, eight, nine, ten, eleven, twelve question areas.

MR. LINGENFELTER: That we have discussed right now.

MR. BEARD: That we have discussed right now.

MR. LINGENFELTER: Now, there are other things additional to this that were other odds and ends. Do you want to go through all of our list or --

MR. BEARD: I don't think so. I'm not sure I'm up to it. I think just a summary of it is that in this event, there was a plant initiator and twelve interesting aspects if someone asked me to summarize it, and there probably are others but I presume those are more minor in nature.

MR. LINGENFELTER: Relatively minor.

MR. BEARD: I would suggest a break. Have we finished?

MR. BATCH: Would you like a copy of the transient traces?

MR. BEARD: Yes, very much.

MR. BATCH: We have two copies available for you. If you have any questions or need an explanation, please come see me. They are not totally self-explanatory but with a few minutes of --

MR. BEARD: Could you tell us from the record where these came from? There are generated from the analogue-type computers where it keeps a 24-hour record?

MR. LINGENFELTER: Correct.

MR. BELL: It's not an analogue computer.

MR. ROSSI: With analogue inputs.

MR. LINGENFELTER: Correct.

MR. LANNING: Is it possible to get the data that goes with these plots?

MR. LINGENFELTER: Yeah.

MR. LANNING: Can we get a copy of that?

MR. LINGENFELTER: If you need two -- we can get you one.

MR. LANNING: Let's discuss it.

MR. BATCH: One-second data for a half hour is that thick. We have it, but --

MR. ROWLES: You also want the alarm printouts.

MR. LINGENFELTER: You are going to make up a list of those.

MR. BEARD: We have been working with Bill on things.

MR. BELL: May I ask one more question?

You had a trip last week?

MR. LINGENFELTER: Uh-huh.

MR. BELL: What, can you give me a date?

MR. LINGENFELTER: The 2nd.

MR. BELL: So you tripped 6-2-85. And when did you restart after that trip? The same day?

MR. LINGENFELTER: I forgot.

MR. MURRAY: Tuesday I believe. I believe it was Tuesday.

MR. KOSLOFF: It would have been the 4th. Tuesday is the 4th.

MR. MURRAY: Let me look it up. On the 4th.

MR. BELL: The reason I ask, it affects the KE level.

MR. MURRAY: On the 4th we were critical at 02:47 on the 4th.

MR. BELL: Why weren't you at 100 percent power. Why 90?

MR. ROSSI: The 90 percent -- do you have a limited 90 percent right now for some reason?

MR. MURRAY: We are holding to not greater than 90 percent because of some noise signal -- some noise on our RCS flow signal which

will pick up the trip in the flux, delta flux flow portion of our delta PS. So until we get the noise filtered out, we are staying down low enough so the peaks don't hit the trip point.

MR. BEARD: Personally I would like to say this break, if we can call it that, this discussion has been extremely enlightening. I know there have been some hard spots because it's difficult because equipment is very complex to get through it, but I have learned a lot and feel like I have at least a good authoritative feel for what happened.

We had some information before we left D.C., and I feel like now we got very authoritative information as to what took place.

MR. MURRAY: It's our plan to continue providing information and being 100 percent cooperative in your investigation.

MR. ROSSI: Let's see. We are going to break now. Why don't we discuss a little bit after the break whether we want to ask them any more questions that we think about before we go on to the next item, because we may think of something. Presumably we may not want to talk to you. We may

want to come back to you later on, but we will talk during the break and see if there is anything more we want to ask right now.

MR. MURRAY: Okay.

MR. ROSSI: If not, we will go on to the next item in our agenda. Thank you.

(Thereupon, a recess was taken at 2:05 o'clock p.m.)

- - - - -

SEQUENCE OF EVENTS SUMMARY

June 9, 1985

The following is a summary of the Sequence of Events that occurred at Davis-Besse on June 9, 1985. The plant was originally at approximately 90% of full power. No surveillance testing was in progress. The plant was in full automatic control except for the #2 Main Feedpump which was in manual.

| Time | Event |
|---|---|
| 01:35:00 | The #1 Main Feedwater Pump (MFP) tripped on overspeed due to a control failure. Automatic plant runback initiated. Due to the reduced feedwater flow available, Reactor Coolant System (RCS) temperature and pressure increasing. Plant ran back to approximately 80% of full power. |
| 01:35:29 | Reactor tripped on high RCS pressure (2300 psig). |
| | Turbine trip from reactor trip. |
| 01:35:31 | The Steam & Feedwater Rupture Control System (SFRCS), Channel 2, spuriously half tripped. |
| 01:35:36 | Main Steam Isolation Valve (MSIV) #1 closed. |
| 01:35:37 | MSIV #2 closed. |
| 01:35 to 01:40 | Normal post trip equipment operation, such as the auto transfer of housepower to the startup transformers, etc. The #2 MFP continued to supply normal feedwater until approximately 0140 hours, when there was not adequate steam to operate the MFP turbine due to the closure of the MSIV's. |
| Approx. 01:41 | Steam Generator water levels decreased to the SFRCS low level trip setpoint. The SFRCS actuated. The Control Room Operator at this time also actuated the SFRCS manually, however, he incorrectly actuated the SFRCS on low steam pressure instead of the desired low steam generator level. |

| | |
|---|---|
| 01:41:31 | The #1 Auxiliary Feedpump (AFP) tripped on overspeed. |
| 01:41:44 | The #2 AFP tripped on overspeed. |
| 01:42 | The Operator corrected his error by clearing the manual SFRCS actuation on low steam pressure. However, since the AFP's were tripped, no feedwater was supplied by the AFP's. |
| 01:45 | Both Steam Generators had steamed down to approximately 12-13 inches of indicated level.<br><br>RCS Tave approximately 562°F. |
| 01:45 - 01:51 | RCS Tave increasing due to lack of primary to secondary heat transfer. RCS pressure increasing due to decreasing density in RCS water and increasing pressurizer level. RCS pressure increased to the Power Operated Relief Valve (PORV) setpoint (2425 psig). PORV cycled a total of three (3) times, relieving pressurizer pressure to the Quench Tank. |
| 01:51 | Operators placed the Startup Feedpump (SUFP) in operation to supply the #1 Steam Generator. The #1 Steam Generator pressure had reached a minimum of approximately 750 psig. The #1 Steam Generator repressurized to approximately 900 psig from the startup feedpump. |
| 01:52 | #2 AFP returned to operation by operators to supply the #2 Steam Generator. Maximum RCS temperature had reached approximately 592°F. Steam Generator #2 level restored. The #2 Steam Generator had reached a minimum of 920 psig. |
| 01:55 | #1 AFP returned to operation by operators to supply the #1 Steam Generator. Steam Generator #1 level restored. |
| 01:58 | Tave restored to normal post trip temperature. |

Additional Notes:

Adequate subcooled margin was available throughout the transient. The Reactor Coolant Pumps remained in operation. The Quench Tank contained the discharges from the PORV. Makeup/High Pressure Injection cooling of the RCS was available as a method of core cooling at all times.

This data is preliminary and additional clarifications or corrections may be necessary after a detailed analysis of the event.

SNB:nlf
6/10/85

CHRONOLOGICAL SEQUENCE OF EVENTS

| TIME | EVENT |
|---|---|
| 1:34:21 | MAIN FEEDWATER (FW) FLOW INCREASES |
| 1:34:28 | REACTOR POWER BEGINS TO INCREASE DUE TO COOLING OF REACTOR COOLANT SYSTEM (RCS) BY INCREASED FW FLOW |
| 1:35: 0:355 | MAIN FEEDWATER PUMP (MFP) TURBINE #1 TRIP |
| 1:35:01 | UNIT BEGINS RUNBACK TO 55% POWER |
| 1:35:22 | LOW FEEDWATER (FW) FLOW ALARM (TRBL) |
| 1:35:29:995 | RPS CH 2 REACTOR COOLANT SYSTEM HIGH PRESSURE TRIP |
| 1:35:30:145 | REACTOR TRIP CONFIRMED |
| 1:35:30:310 | MAIN TURBINE TRIP |
| 1:35:31 | STEAM AND FEEDWATER RUPTURE CONTROL SYSTEM (SFRCS) STEAM GENERATOR (SG) LOW LEVEL HALF TRIP (SOE RECORDER SHOWS THIS AS A FULL TRIP AT 1:35:30:935) |
| 1:35:33 | SFRCS SG LOW LEVEL HALF TRIP CLEARS (SOE SHOWS THIS AS AN SFRCS FULL TRIP CLEARING AT 1:35:34:70) |
| 1:35:36 | MAIN STEAM ISOLATION VALVE (MSIV) #2 CLOSES |
| 1:35:37 | MSIV #1 CLOSES |
| 1:40:20 | LOW FW FLOW ALARM |
| 1:41:03 | SFRCS SG LOW LEVEL TRIP, CHANNEL 1 (SEE 1:41:04:345) |
| 1:41:04:345 | SFRCS FULL TRIP (SAME AS 1:41:03) |
| 1:41:08 | MANUAL SFRCS TRIP, LOW STEAM PRESSURE, BOTH CHANNELS |
| 1:41:10 | AFW TO SG ISOLATION VALVES START TO CLOSE |
| 1:41:13 | SFRCS SG LOW LEVEL TRIP, CHANNEL 2 |
| 1:41:31 | AUXILIARY FW (AFW) PUMP TURBINE #1 OVERSPEED TRIP |
| 1:41:44 | AFW PUMP TURBINE #2 OVERSPEED TRIP |
| 1:42:00 | MANUAL SFRCS TRIP, LOW STEAM PRESSURE, RESET |
| 1:45:50 | AFW PUMP TURBINE #2 OVERSPEED TRIP RESET |
| 1:46:32 | #1 AFW PUMP STARTS |
| 1:47:48 | AFW TO #2 SG ISOLATION VALVE OPEN |
| 1:48:49 | PORV OPEN (2432.8 PSI ACTUAL, 2425 PSI SETPOINT) |
| 1:48:52 | PORV CLOSED (2376.7 PSI ACTUAL, 2375 PSI SETPOINT) |
| 1:49:29 | AFW TO #1 SG ISOLATION VALVE OPEN |
| 1:50:09 | PORV OPEN (2434.1 PSI ACTUAL) |
| 1:50:12 | PORV CLOSED (2369.4 PSI ACTUAL) |
| 1:51:18 | PORV OPEN (2435.3 PSI ACTUAL) |
| 1:51:21 | #1 SG LEVEL DROPS BELOW 8" |
| 1:51:23 | STARTUP FW PUMP ON TO FEED #1 SG FROM DEARATOR |
| 1:51:42 | PORV ISOLATION VALVE CLOSED BY OPERATOR AT 2141.0 PSI |
| 1:51:43 | #2 SG LEVEL STOPS DROPPING AT 9.8" |
| 1:51:44 | #1 SG LEVEL STOPS DROPPING AT 7.3" |
| 1:51:49 | PORV CLOSED (2112.9 PSI ACTUAL) |
| 1:51:54 | #1 SG PRESSURE STOPS DROPPING AT 749.6 PSI |
| 1:51:57 | #1 SG LEVEL STARTS INCREASING |
| 1:52:03 | #2 SG PRESSURE STOPS DROPPING AT 910.2 PSI |
| 1:52:06 | #2 SG LEVEL STARTS INCREASING |
| 1:52:21 | #2 AFW PUMP PUMP STARTS |
| 1:52:25 | #1 SG LEVEL RAISED ABOVE 8" |
| 1:53:20 | MAXIMUM INCORE TEMPERTURE REACHED, 601.5 F |
| 1:53:25 | AFW FLOW STARTS TO #2 SG |
| 1:53:31 | MAXIMUM Tavg REACHED, 592.3 F |
| 1:53:35 | MAXIMUM Th REACHED, 593.5 F |

| | |
|---|---|
| 1:53:56 | PORV ISOLATION VALVE OPENED BY OPERATOR |
| 1:54:33 | AFW FLOW STARTS TO #1 SG |
| 1:58:21 | HPI PUMP #1 ON |
| 1:58:30 | LPI PUMP #1 ON |
| 1:58:37 | HPI FLOW BEGINS |
| 1:58:40 | #1 AFW PUMP SUCTION TRANSFERS TO SERVICE WATER |
| 1:59:06 | HPI FLOW STOPS |
| 2:00:37 | #1 AFW PUMP SUCTION TRANSFERED BACK TO CONDENSATE ST |
| 2:09:21 | HPI PUMP #1 OFF |
| 2:09:24 | LPI PUMP #1 OFF |

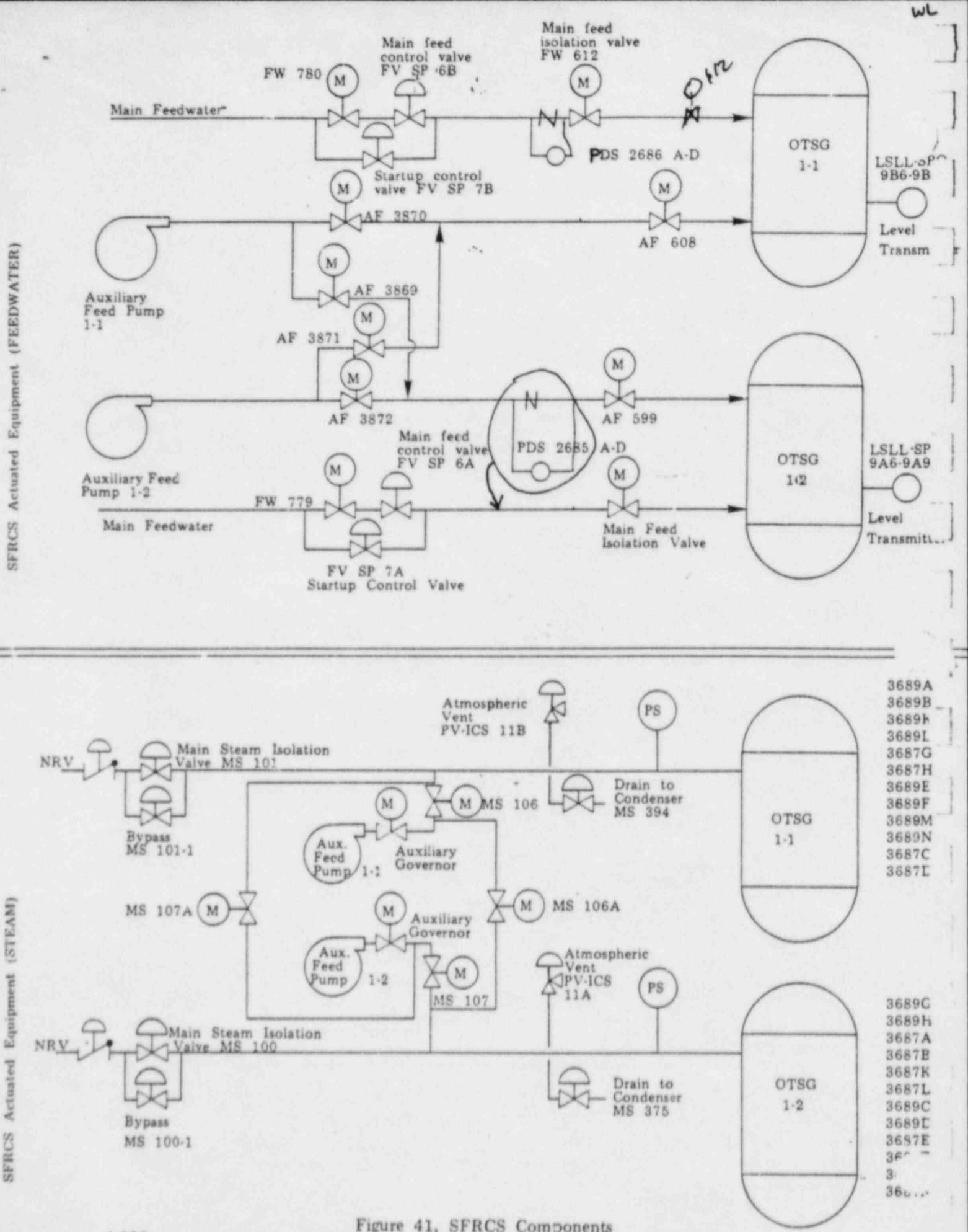
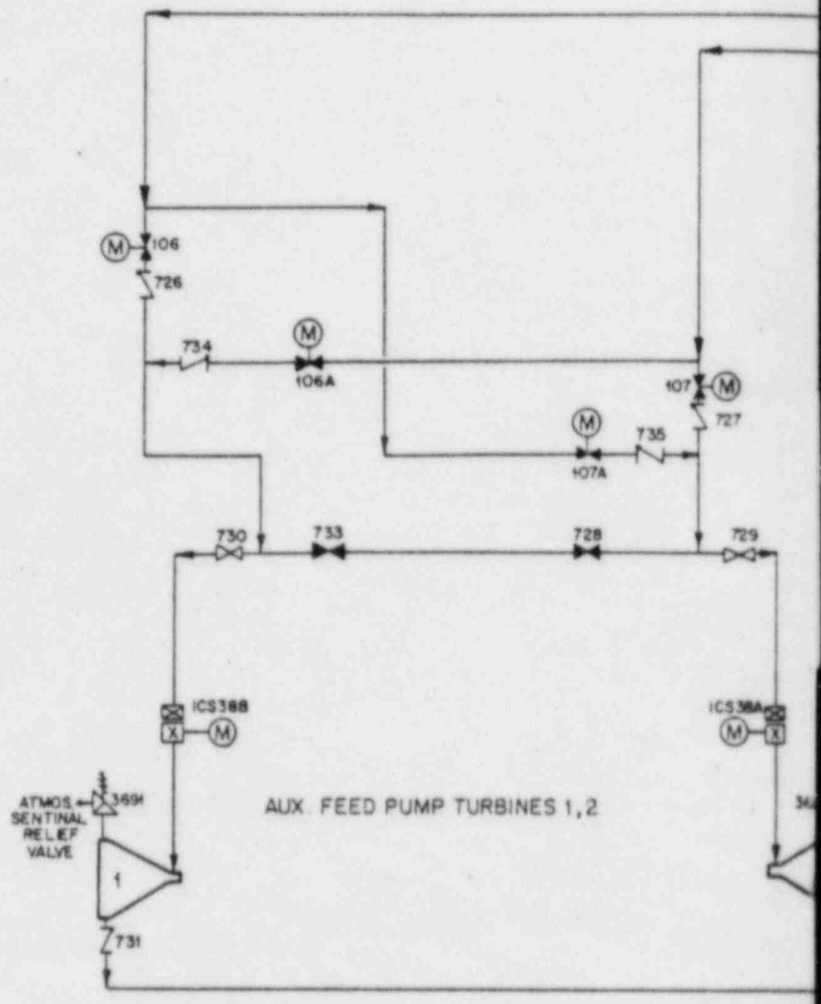
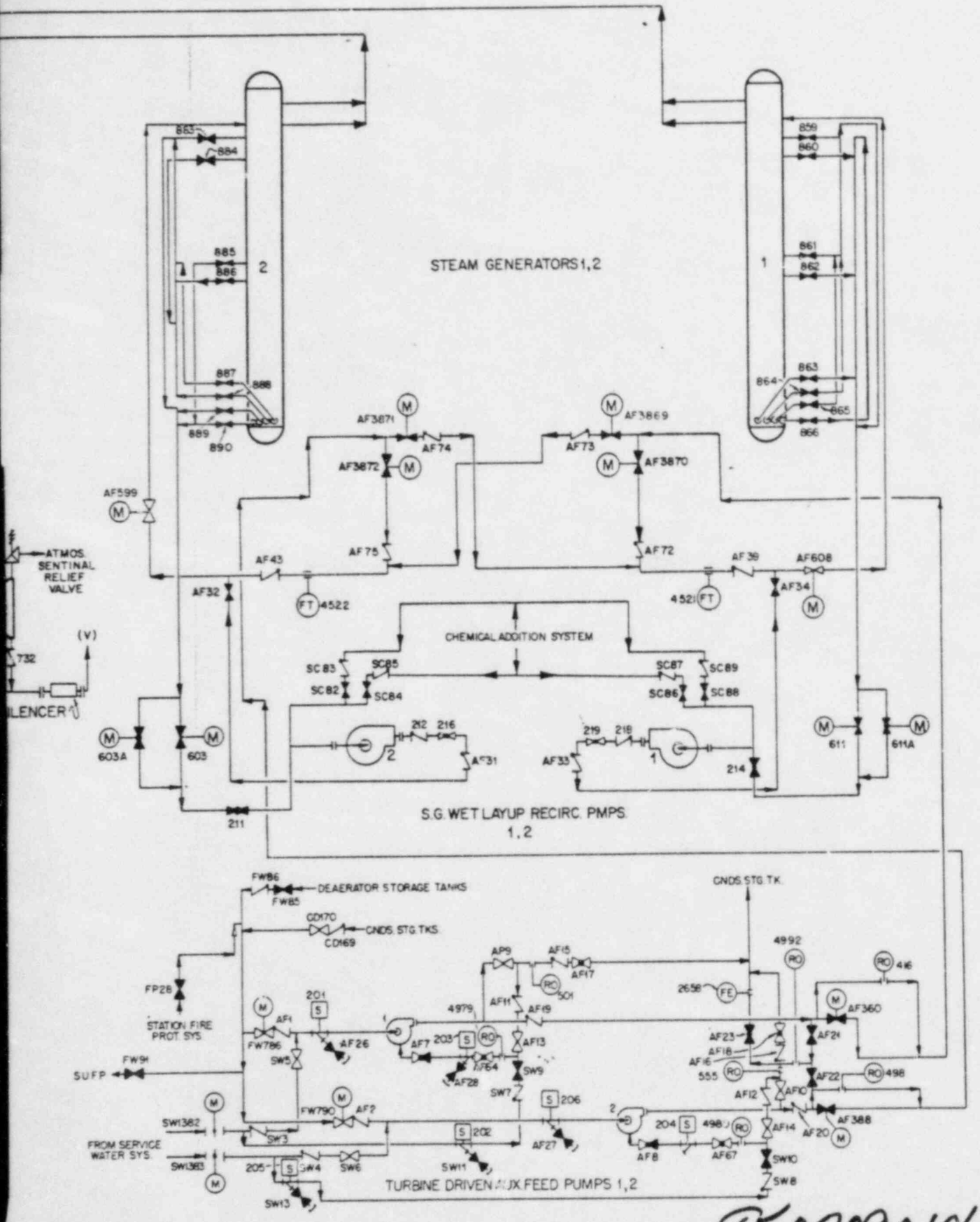



Figure 41, SFRCS Components




NOTE: VALVES HAVE PREFIX "MS" UNLESS OTHERWISE NOTED

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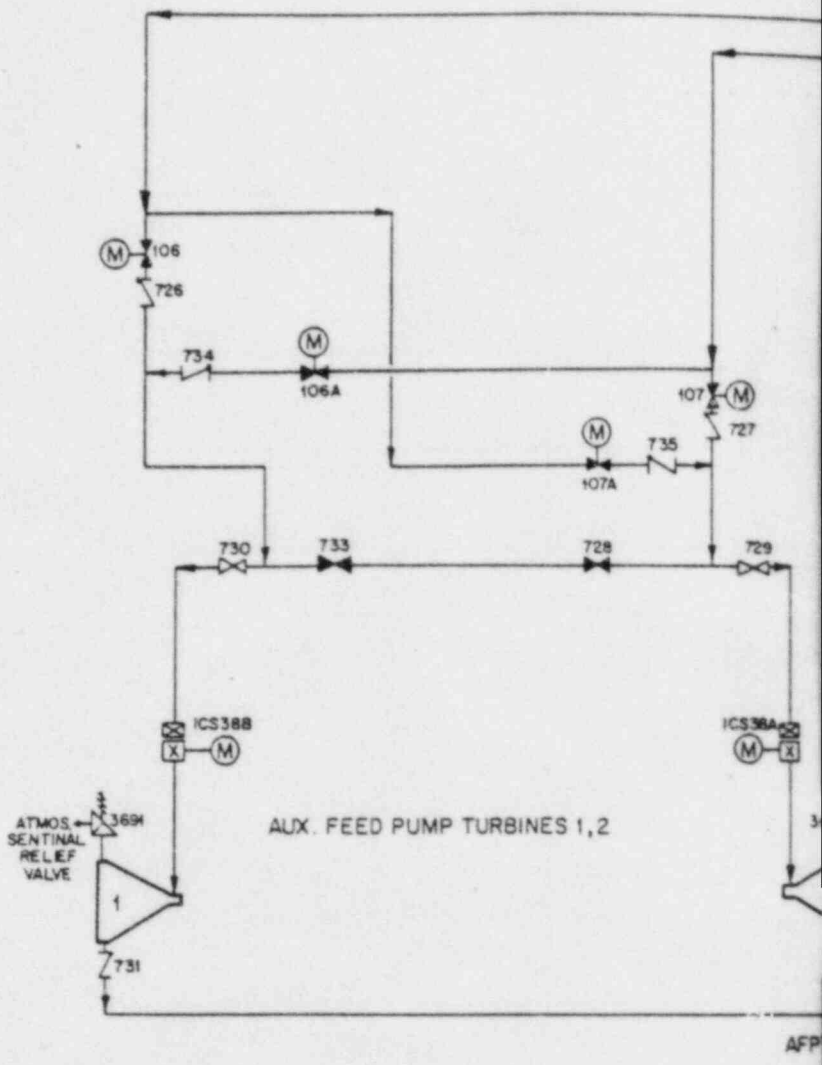
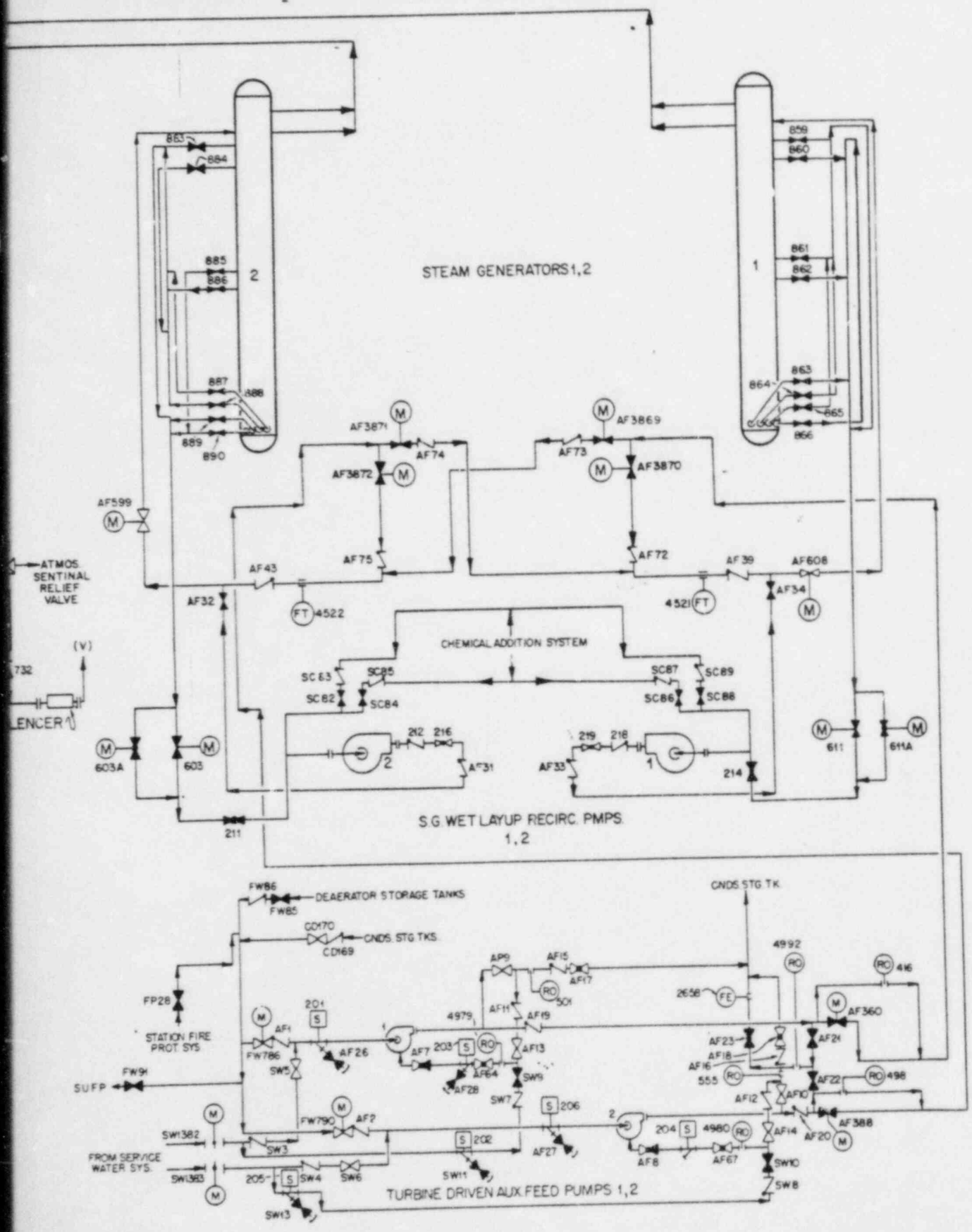
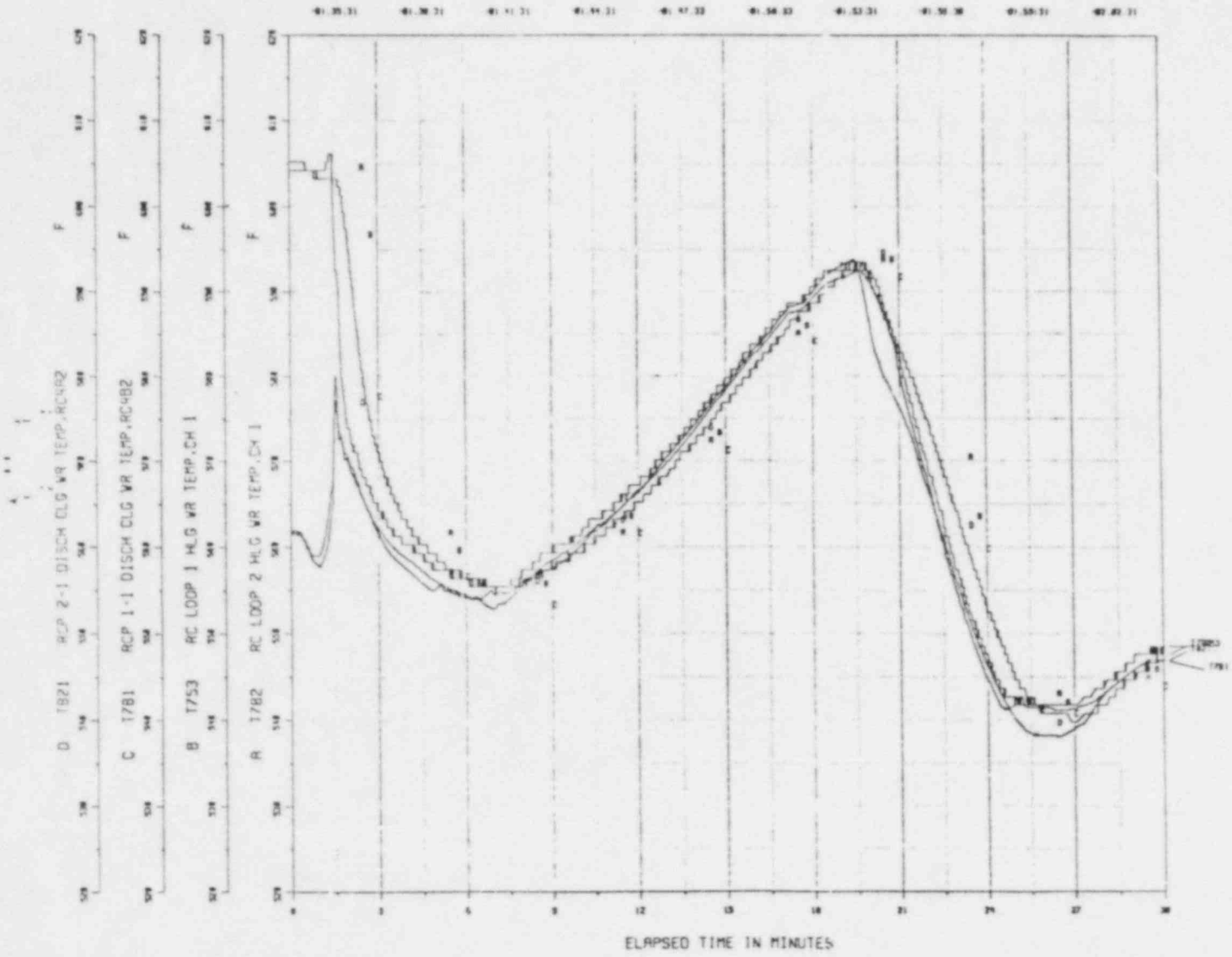
| AUXILIARY FEEDWATER SYSTEM | |
|---|---|
| FIGURE 1 | P & ID M-0068 |

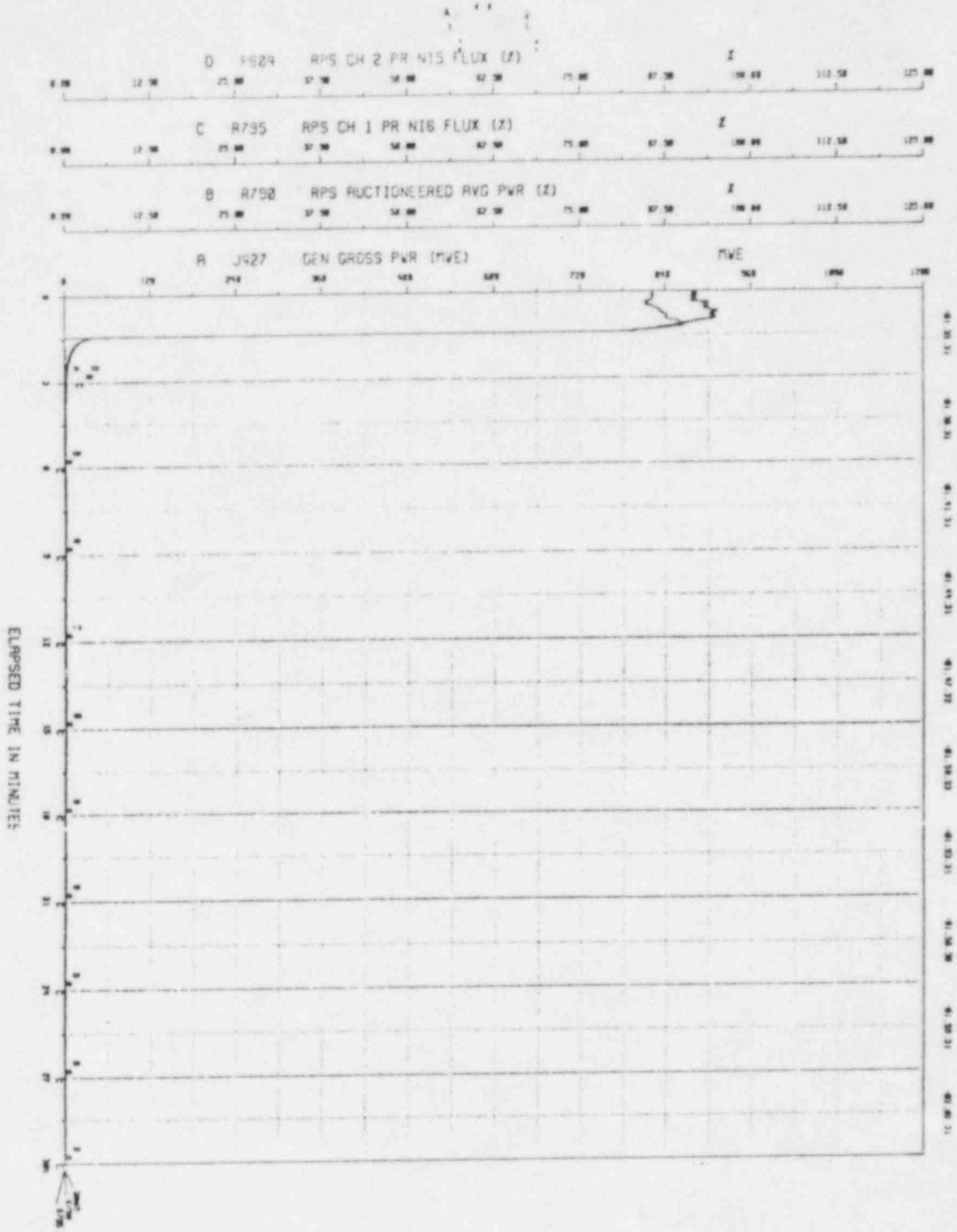


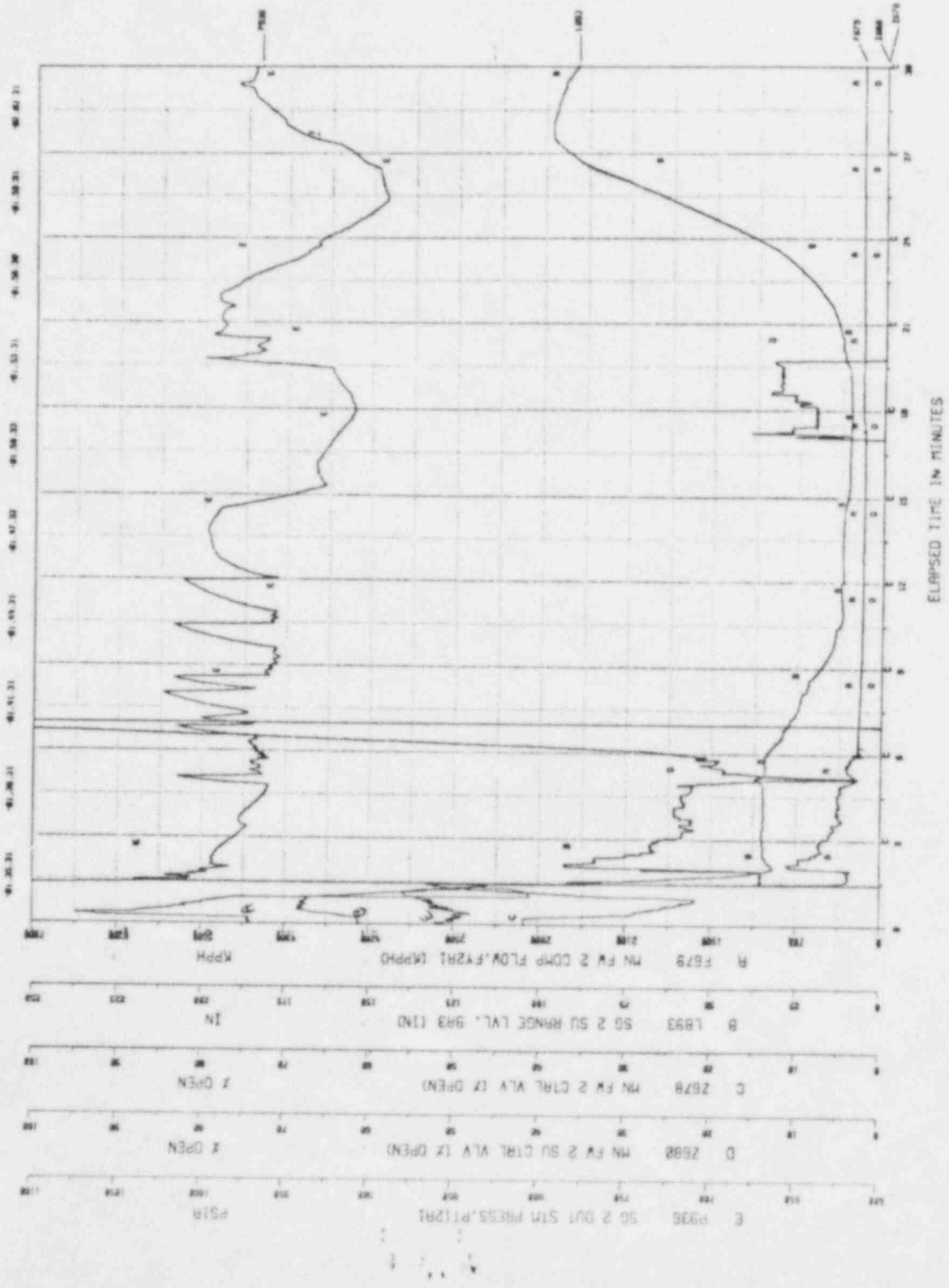

NOTE: VALVES HAVE PREFIX "MS" UNLESS OTHERWISE NOTED

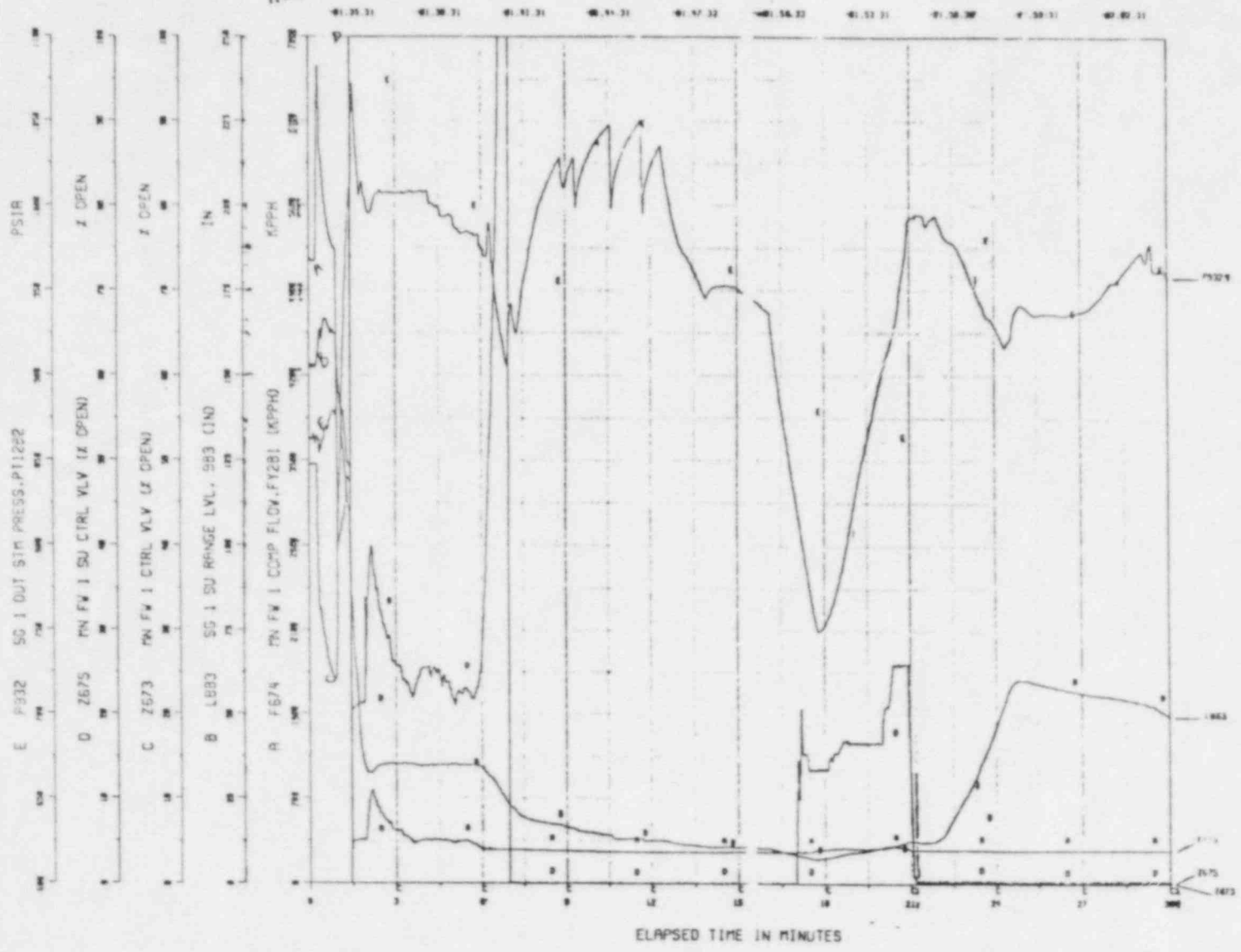


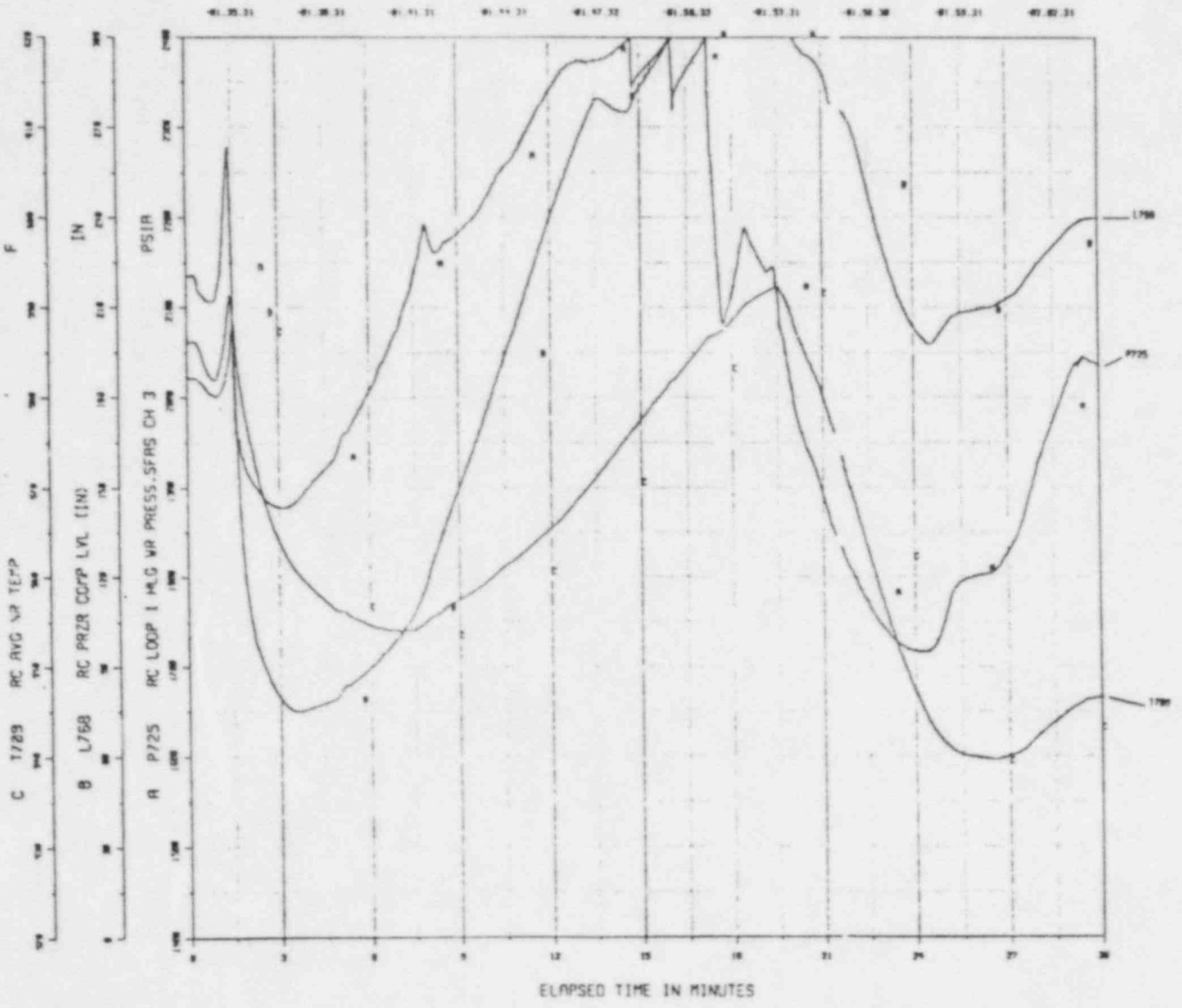

| AUXILIARY FEEDWATER SYSTEM | |
|---|---|
| FIGURE 1 | P & ID M-0068 |


D 1821 RCP 2-1 DISCH CLG WR TEMP,RCW82
C 1781 RCP 1-1 DISCH CLG WR TEMP,RC482
B T753 RC LOOP 1 HLG WR TEMP,CH 1
A 1782 RC LOOP 2 HLG WR TEMP,CH 1
F
ELAPSED TIME IN MINUTES

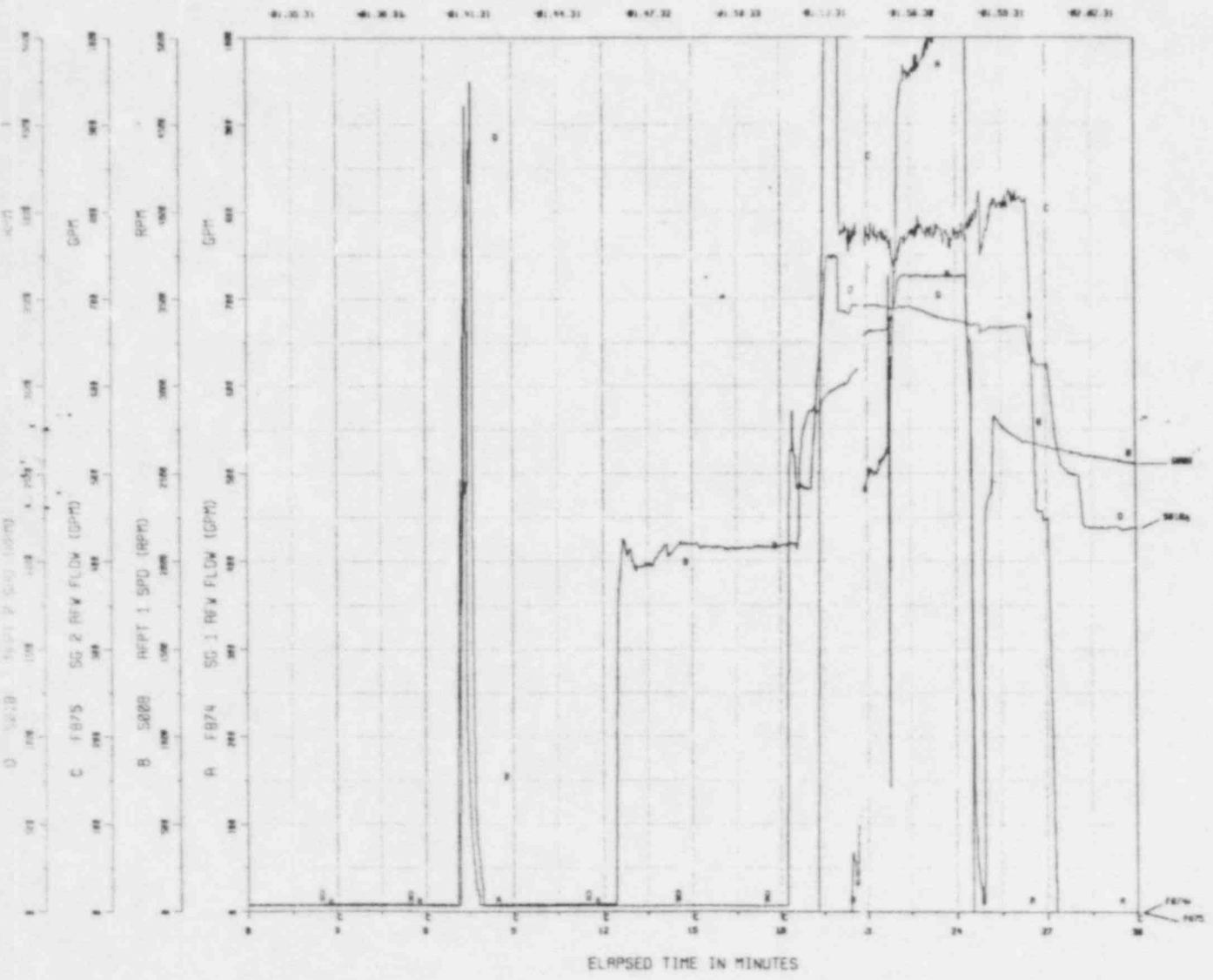

D J924 RPS CH 2 PR NIS FLUX (Z)
C R795 RPS CH 1 PR NIB FLUX (Z)
B R798 RPS AUCTIONEERED AVG PWR (Z)
A J427 GEN GROSS PWR (MWE)
MWE
ELAPSED TIME IN MINUTES


ELAPSED TIME IN MINUTES
KPPH
IN
% OPEN
% OPEN
PSIA


E P332 SG 1 OUT STM PRESS.PT122 PSIA
D Z675 MN FW 1 SU CTRL VLV (% OPEN) % OPEN
C Z673 MN FW 1 CTRL VLV (% OPEN) % OPEN
B L883 SG 1 SU RANGE LVL, 883 (IN) IN
A F674 MN FW 1 COMP FLOW.FY281 (KPPH) KPPH
ELAPSED TIME IN MINUTES


C T709 RC AVG VP TEMP F
B L768 RC PRZR COMP LVL (IN) IN
A P725 RC LOOP 1 HLG WR PRESS.SPDS CH 3 PSIA
L768
P725
T709
ELAPSED TIME IN MINUTES

Aux Feedwater Pump



| Page | Line | Correction or change and reason therefor | STENO ENCL |
|---|---|---|---|
| 6 | 24 | "TEST" TO "TESTING" | e |
| 7 | 1 | "AT" TO "IN" | e |
| 7 | 2 | "AT" TO "IN" | e |
| 7 | 3 | CHANGE TO "MAIN FEEDPUMP IN MANUAL DUE TO SOME PROBLEMS WE | e |
| 7 | 5 | CHANGE TO "AT TIME 01 35:00 IN THE MORNING" | e |
| 7 | 8 | CHANGE TO "RUNS BACK THE PLANT FROM A LOSS OF FEEDWATER" | e |
| 7 | 21 | REMOVE "29" (CLARIFICATION) | |
| 7 | 22 | REMOVE "OR 30 SECONDS" (CLARIFICATION) | |
| 8 | 9 | CHANGE "IT'S" TO "IT IS" | e |
| 8 | 17 | AFTER ONE ADD AUV | e |
| 8 | 18 | CHANGE "MSIE" TO "MSIV" | e |
| 8 | 19 | REMOVE "IT" INSERT "A HALF TRIP" (CLARIFICATION) | |
| 8 | 20 | DELETE LINE 20 (CLARIFICATION REDUNDANT) | |
| 9 | 5 | CHANGE FORE- TO FOUR | e |
| 9 | 6 | "AIR" TO "GENERATOR" ADD THREE DOTS ... AT END OF SENTENCE | e |
| 10 | 1 | COMMENT — NOT THE QUESTION THAT WAS ASKED — | |
| — | — | MY SUGGESTION IS TO CHANGE TO READ "SPURIOUS ACTUATION" | |
| — | — | INSTEAD OF "STEAMLINE RUPTURE" | e |
| 10 | 4 | REMOVE "NORMAL" INSERT "THE NORMAL TRIP SETPOINT" (CLARIFICATION) | |
| 11 | 5 | CHANGE TO "55 PERCENT LEVEL AT 50% PER MINUTE" | e |
| 11 | 16 | AFTER PERCENT ADD "PER MINUTE" (CLARIFICATION) | |
| 11 | 17 | NOT THE QUESTION HE ASKED — | |
| 12 | 12 | CHANGE 2ND "THAT" TO "THE PUMP" (CLARIFICATION) | |
| 12 | 14 | CHANGE "ON" TO "IN" | e |

Page No. 1 DATE 6/25/85 SIGNATURE Stan Gold
ALSO REVIEWED FOR Jacque Lanza Gold

| Page | Line | Correction or change and reason therefor | |
|---|---|---|---|
| 13 | 6 | CHANGE "AUX" TO "SIGNAL" | e |
| 13 | 23 | STRIKE "EITHER" | e |
| 14 | 14 | STRIKE "TO BEGIN". | e |
| 14 | 22 | ADD "CAN ALSO CLOSE THEM." TO END OF SENTENCE | e |
| 15 | 9 | ADD "NO DIRECT" IN FRONT OF SIGNAL | e |
| 16 | 1 | CHANGE "ACTS" TO "ACTUATION" | e |
| 17 | 23 | Delete You WANT ME - - - | e |
| 18 | 24 | CHANGE TO "MANY OF THESE THINGS COVERED WERE FROM THOSE SOURCES" | e |
| 18 | 16 | WE HAVE (AS) PART ADD | e |
| 18 | 18 | AFTER "DOWN" INSERT "IN" REMOVE ? | e |
| 18 | 19 | "ANALOGUE" SHOULD BE "ANALOG" | e |
| 19 | 9 | CHANGE TO "THE DATA ACQUISITION" | e |
| 19 | 10 | CHANGE "ADS" TO "DADS" | e |
| 19 | 13,15 | "ANALOGUE" TO "ANALOG" | e |
| ~~20~~ | ~~12~~ | ~~AFTER HAD INSERT A~~ OK | |
| 20 | 15 | DELETE "POST-TRANSIENT," | e |
| 20 | 16 | START SENTENCE WITH THE | e |
| 20 | 17 | AFTER FIRST TWO, CHANGE TO "TWO TO TWO AND A HALF" | e |
| 20 | 20 | PERIOD AFTER FEEDWATER, CHANGE "AND THAT" TO "THE" | e |
| 20 | 24 | CHANGE "STEAM PUMPS" TO "FEEDPUMPS" | e |
| 21 | 2 | "GENERATORS" TO "GENERATRS" (delete ') | e |
| 21 | 21 | Delete "ANALOGUE OR YOUR" | e |
| 21 | 23 | CHANGE "CHANNEL" TO "CHANNELS" | e |
| 22 | 21 | CHANGE "FIVES" TO "FIVE" | e |

 DATE 6/25/85 SIGNATURE Stan Beck

| Page | Line | Correction or change and reason therefor | |
|---|---|---|---|
| 23 | 16 | NOT WHAT MR BELL ASKED | ? |
| 33 | 19 | AFTER ACTUALLY ADD "CONFIRMATORY" | CLARIFICATION |
| 34 | 21 | "DFE" SHOULD BE "DP". | e |
| 35 | 24 | CHANGE "AUTO" TO "AUXILIARY" | e |
| 38 | 12 | CHANGE "NOT" TO "ONE OF" | e |
| 38 | 13 | CHANGE "DISCREPANCY" TO "DISCREPANCIES" | e |
| 38 | 17 | CHANGE TO "YES, IT ~~WAS~~ WAS CHECKED TO BE" | e |
| 38 | 21 | delete "DONE" | e |
| 74 | 7 | QUESTION BY NRC WAS MISSED ENTIRELY | ? |
| 49 | 7 | CHANGE "SET" TO "RESET" | e |
| 51 | 12 | CHANGE "ENUMERATORS" TO "ANNUNCIATORS" | e |
| 51 | 18 | CHANGE "IT" TO "THEY" | CLARIFICATION |
| 52 | 22 | CHANGE "WITHOUT" TO "RESIDUE" | CLARIFICATION |
| 52 | 24 | CHANGE "FEED" TO "HEAT" | e |
| 52 | 24 | ADD °F AFTER 562 | (CLARIFICATION) |
| 52 | 24 | DELETE "UP TO THAT POINT AT 1:45" | (NOT CLEAR - REDUNDANT) |
| 53 | 1 | START SENTENCE WITH "FOR" | CLARIFICATION |
| 54 | 11 | DELETE "N" INSERT IN THAT SAT "TO UNDERSTAND OF" | (CLARIF. CHA... |
| 54 | 14 | AFTER 960 ADD PSIG | (CLARIFICATION) |
| 54 | 16 | AFTER 960 ADD PSIG | (CLARIFICATION) |
| 54 | 16 | CHANGE "STEAM" TO "FEED" | e |
| 54 | 21 | DELETE 1ST SENTENCE - MUMBLING | (CLARIFICATION) |
| 55 | 1 | CHANGE "ITS A" TO "THERE IS NO" | e |
| 55 | 19 | ADD "THE" IN FRONT OF LACK | (CLARIFICATION) |

Page No. 3 DATE 6/25/85 SIGNATURE [signature]

| Page | Line | Correction or change and reason therefor | |
|---|---|---|---|
| 56 | 1 | CHANGE "FORMS" TO PSIG | e |
| ~~15~~ 56 | 11 | ADD "Hi" TO BEGINNING OF LINE | e |
| 56 | 17 | CHANGE "POWER" TO "PORV" | e |
| 56 | 17 | CHANGE ~~RESETS~~ "RECEIVES" TO "RESTARTS" | e |
| 56 | 20 | CHANGE "THEM" TO "IT" | e |
| 61 | 2 | Delete "AT HIGH RCS" | e |
| 61 | 4 | CHANGE "TD's" TO ~~TC's~~ "Tc's" | e |
| 61 | 6 | AFTER ~~ISCO~~ "THEY" ADD INCORE | e |
| 61 | 15 | AFTER COMMA, ADD "THEY" | e |
| 65 | 10 | CHANGE "INCREASED" TO "TO INCREASE" | e |
| 67 | 6 | START THE SENTENCE WITH "WITH". | e |
| 74 | 7 | CHANGE "FORGOT" TO "FORGET" | e |
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Page No. 4 DATE 6/25/05 SIGNATURE [signature]

| Page | Line | Correction or change and reason therefor |
|---|---|---|
| 7 | 3 | "pumping" should be "pump 1 in" (steno error) |
| 7 | 8 | word "at" (first occurrence) delete (steno error) |
| 9 | 5 | "fore-" should be "four" (steno error) |
| 10 | 1 | Word "trip" missing after "rupture" (steno error) |
| 13 | 6 | word "aux" should be "control" (steno error) |
| 19 | 9 | "That's" should be "Data" (steno error) |
| 19 | 10 | "ADS" should be "DADS" (steno error) |
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Page No. 1 DATE 6/24/85 SIGNATURE W.C. Rowan

| Page | Line | Correction or change and reason therefor | STENO ENCL |
|---|---|---|---|
| 6 | 24 | "TEST" TO "TESTING" | e |
| 7 | 1 | "AT" TO "IN" | e |
| 7 | 2 | "AT" TO "IN" | e |
| 7 | 3 | CHANGE TO "MAIN FEEDPUMP IN MANUAL DUE TO SOME PROBLEMS WE | e |
| 7 | 5 | CHANGE TO "AT TIME 01 35:00 IN THE MORNING" | e |
| 7 | 8 | CHANGE TO "RUNS BACK THE PLANT FROM A LOSS OF FEEDWATER" | e |
| 7 | 21 | REMOVE "29" (CLARIFICATION) | |
| 7 | 22 | REMOVE "OR 30 SECONDS" (CLARIFICATION) | |
| 8 | 9 | CHANGE "IT'S" TO "IT IS" | e |
| 8 | 17 | AFTER ONE ADD AUV | e |
| 8 | 18 | CHANGE "MSIE" TO "MSIV" | e |
| 8 | 19 | REMOVE "IT" INSERT "A HALF TRIP" (CLARIFICATION) | |
| 8 | 20 | DELETE LINE 20 (CLARIFICATION REDUNDANT) | |
| 9 | 5 | CHANGE FORE- TO FOUR | e |
| 9 | 6 | "AIR" TO "GENERATOR" ADD THREE DOTS ... AT END OF SENTENCE | e |
| 10 | 1 | COMMENT - NOT THE QUESTION THAT WAS ASKED - | |
| — | — | MY SUGGESTION IS TO CHANGE TO READ "SPURIOUS ACTUATION" | |
| — | — | INSTEAD OF "STEAMLINE RUPTURE" | e |
| 10 | 4 | REMOVE "NORMAL" INSERT "THE NORMAL TRIP SETPOINT" (CLARIFICATION) | |
| 11 | 5 | CHANGE TO "55 PERCENT LEVEL AT 50% PER MINUTE" | e |
| 11 | 16 | AFTER PERCENT ADD "PER MINUTE" (CLARIFICATION) | |
| 11 | 17 | NOT THE QUESTION HE ASKED | |
| 12 | 12 | CHANGE 2ND "THAT" TO "THE PUMP" (CLARIFICATION) | |
| 12 | 14 | CHANGE "ON" TO "IN" | e |

Page No. 1 DATE 6/25/85 SIGNATURE Stan Gold
ALSO REPORTING FOR Jacque Lewis Goldfarb

| Page | Line | Correction or change and reason therefor | |
|---|---|---|---|
| 13 | 6 | CHANGE "AUX" TO "SIGNAL" | e |
| 13 | 23 | STRIKE "EITHER" | e |
| 14 | 14 | STRIKE "TO BEGIN". | e |
| 14 | 22 | ADD "CAN ALSO CLOSE THEM." TO END OF SENTENCE | e |
| 15 | 9 | ADD "NO DIRECT" IN FRONT OF SIGNAL | e |
| 16 | 1 | CHANGE "AUTS" TO "ACTUATION" | e |
| 17 | 23 | Delete "DO WANT ME - - - | e |
| 18 | 24 | CHANGE "MANY OF THESE THINGS (WHEELS) WERE FROM THOSE SOURCES" | e |
| 18 | 16 | WE HAVE (AS) PART ADD | e |
| 18 | 18 | AFTER "DOWN" INSERT "IN" REMOVE ? | e |
| 18 | 19 | "ANALOGUE" SHOULD BE "ANALOG" | e |
| 19 | 9 | CHANGE TO "THE DATA ACQUISITION" | e |
| 19 | 10 | CHANGE "ADS" TO "DADS" | e |
| 19 | 13,15 | "ANALOGUE" TO "ANALOG" | e |
| ~~20~~ | ~~12~~ | ~~AFTER HAD INSERT A EX~~ | |
| 20 | 15 | DELETE "POST-TRANSIENT," | e |
| 20 | 16 | START SENTENCE WITH THE | e |
| 20 | 17 | AFTER FIRST TWO, CHANGE TO "TWO TO TWO AND A HALF" | e |
| 20 | 20 | PERIOD AFTER FEEDWATER, CHANGE "AND THAT" TO "THE" | e |
| 20 | 24 | CHANGE "STEAM PUMPS" TO "FEEDPUMPS" | e |
| 21 | 2 | "GENERATOR'S" TO "GENERATORS" (delete ') | e |
| 21 | 21 | Delete "ANALOGUE OR YOUR" | e |
| 21 | 23 | CHANGE "CHANNEL" TO "CHANNELS" | e |
| 22 | 21 | CHANGE "FIVES" TO "FIVE" | e |

 DATE 6/25/15 SIGNATURE Stan Gosch

| Page | Line | Correction or change and reason therefor | |
|---|---|---|---|
| 23 | 16 | NOT WHAT MR DECK ASKED | ? |
| 33 | 13 | AFTER ACTUALLY ADD "CONFIRMATORY" | CLARIFICATION |
| 34 | 21 | "DFE" SHOULD BE "DP". | e |
| 35 | 24 | CHANGE "ALTOS" TO "AUXILIARY" | e |
| 38 | 12 | CHANGE "NOT" TO "ONE OF" | e |
| 38 | 13 | CHANGE "DOCLEPANY" TO "DISCREPANCIES" | e |
| 38 | 17 | CHANGE TO "YES, IT ~~HAS~~ WAS CHECKED TO BE" | e |
| 38 | 21 | Delete "DONE" | e |
| 74 | 7 | QUESTION BY NRC WAS MISSED ENTIRELY | ? |
| 49 | 7 | CHANGE "SET" TO "RESET" | e |
| 51 | 12 | CHANGE "ENUMERATORS" TO "ANNUNCIATORS" | e |
| 51 | 18 | CHANGE "IT" TO "THEY" | CLARIFICATION |
| 52 | 22 | CHANGE "WITHOUT" TO "RESTORE" | CLARIFICATION |
| 52 | 24 | CHANGE "FEED" TO "HEAT" | e |
| 52 | 24 | ADD °F AFTER 562 | (CLARIFICATION) |
| 52 | 24 | DELETE "UP TO THAT POINT AT 1:45" | (NOT CLARIFICATION REDUNDANT) |
| 53 | 1 | START SENTENCE WITH "FOR" | CLARIFICATION |
| 54 | 11 | DELETE "W" INSERT IN THAT SPOT "TO UNDERSTAND OF" | (CLARIFICATION) |
| 54 | 14 | AFTER 960 ADD PSIG | (CLARIFICATION) |
| 54 | 16 | AFTER 960 ADD PSIG | (CLARIFICATION) |
| 54 | 16 | CHANGE "STEAM" TO "FEED" | e |
| 54 | 21 | DELETE 1ST SENTENCE - MUMBLING | (CLARIFICATION) |
| 55 | 1 | CHANGE "ITS A" TO "THERE IS NO" | e |
| 55 | 19 | ADD "THE" IN FRONT OF LAKE | (CLARIFICATION) |

 DATE 6/25/85 SIGNATURE

| Page | Line | Correction or change and reason therefor | |
|---|---|---|---|
| 56 | 1 | CHANGE "POWER" TO PSIG | e |
| ~~15~~ 56 | 11 | ADD "H:" TO BEGINNING OF LINE | e |
| 56 | 17 | CHANGE "POWER" TO "PORV" | e |
| 56 | 17 | CHANGE ~~ACCEPTED~~ "RECEIVED" TO "RELEASED" | e |
| 56 | 20 | CHANGE "THEM" TO "IT" | e |
| 61 | 2 | Delete "AT HIGH RCS" | e |
| 61 | 4 | CHANGE "TD's" TO ~~"TC's"~~ "Tc's" | e |
| 61 | 6 | AFTER ~~USED~~ "THE" ADD INCORE | e |
| 61 | 15 | AFTER COMMA , ADD "THEY" | e |
| 65 | 10 | CHANGE "INCREASED" TO "TO INCREASE" | e |
| 67 | 6 | START THE SENTENCE WITH "WITH" . | e |
| 74 | 7 | CHANGE "FORGOT" TO "FORGET" | e |
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Page No. 4 DATE 6/25/05 SIGNATURE [signature]

| Page | Line | Correction or change and reason therefor |
|---|---|---|
| 7 | 3 | "pumping" should be "pump 1 in" (steno error) |
| 7 | 8 | word "at" (first occurrence) delete. (steno error) |
| 9 | 5 | "fore-" should be "four" (steno error) |
| 10 | 1 | word "trip" missing after "rupture" (steno error) |
| 13 | 6 | word "aux" should be "control" (steno error) |
| 19 | 9 | "That's" should be "Data" (steno error) |
| 19 | 10 | "ADS" should be "DADS" (steno error) |
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Page No. 1 DATE 6/24/85 SIGNATURE W.C. Rowan

| Page | Line | Correction or change and reason therefor | STENO ENCL |
|---|---|---|---|
| 6 | 24 | "TEST" TO "TESTING" | e |
| 7 | 1 | "AT" TO "IN" | e |
| 7 | 2 | "AT" TO "IN" | e |
| 7 | 3 | CHANGE TO "MAIN FEEDPUMP IN MANUAL DUE TO SOME PROBLEMS WE | e |
| 7 | 5 | CHANGE TO "AT TIME 01 35 00 IN THE MORNING" | e |
| 7 | 8 | CHANGE TO "RUNS BACK THE PLANT FROM A LOSS OF FEEDWATER" | e |
| 7 | 21 | REMOVE "29" (CLARIFICATION) | |
| 7 | 22 | REMOVE "OR 30 SECONDS" (CLARIFICATION) | |
| 8 | 9 | CHANGE "IT'S" TO "IT IS" | e |
| 8 | 17 | AFTER ONE ADD AUV | e |
| 8 | 18 | CHANGE "MSIE" TO "MSIV" | e |
| 8 | 19 | REMOVE "IT" INSERT "A HALF TRIP" (CLARIFICATION) | |
| 8 | 20 | DELETE LINE 20 (CLARIFICATION REDUNDANT) | |
| 9 | 5 | CHANGE FORE- TO FOUR | e |
| 9 | 6 | "AIR" TO "GENERATOR" ADD THREE DOTS ... AT END OF SENTENCE | e |
| 10 | 1 | COMMENT — NOT THE QUESTION THAT WAS ASKED — | |
| — | — | MY SUGGESTION IS TO CHANGE TO READ "SPURIOUS ACTUATION" | |
| — | — | INSTEAD OF "STEAMLINE RUPTURE" | e |
| 10 | 4 | REMOVE "NORMAL" INSERT "THE NORMAL TRIP SETPOINT" (CLARIFICATION) | |
| 11 | 5 | CHANGE TO 55 PERCENT LEVEL AT 50% PER MINUTE | e |
| 11 | 16 | AFTER PERCENT ADD "PER MINUTE" (CLARIFICATION) | |
| 11 | 17 | NOT THE QUESTION HE ASKED | |
| 12 | 12 | CHANGE 2ND "THAT" TO "THE PUMP" (CLARIFICATION) | |
| 12 | 14 | CHANGE "ON" TO "IN" | e |

Page No. 1 DATE 6/25/85 SIGNATURE Stan Gold
ALSO REVIEWING FOR Jacque Lanza-Goldy

| Page | Line | Correction or change and reason therefor | |
|---|---|---|---|
| 13 | 6 | CHANGE "AUX" TO "SIGNAL" | e |
| 13 | 23 | STRIKE "EITHER" | e |
| 14 | 14 | STRIKE "TO BEGIN". | e |
| 14 | 22 | ADD "CAN ALSO CLOSE THEM." TO END OF SENTENCE | e |
| 15 | 9 | ADD "NO DIRECT" IN FRONT OF SIGNAL | e |
| 16 | 1 | CHANGE "AUTS" TO "ALMATION" | e |
| 17 | 23 | Delete "You WANT ME - - -" | e |
| 18 | 24 | CHANGE TO "MANY OF THESE THINGS COULD WERE FROM THOSE SOURCES" | e |
| 18 | 16 | WE HAVE (AS) PART AND | e |
| 18 | 18 | AFTER "DOWN" INSERT "IN" REMOVE ? | e |
| 18 | 19 | "ANALOGUE" SHOULD BE "ANALOG" | e |
| 19 | 9 | CHANGE TO "THE DATA ALOMATION" | e |
| 19 | 10 | CHANGE "ADS" TO "DADS" | e |
| 19 | 13,15 | "ANALOGUE" TO "ANALOG" | e |
| ~~20~~ | ~~12~~ | ~~AFTER HAD INSERT A EX~~ | |
| 20 | 15 | DELETE "POST-TRANSIENT," | e |
| 20 | 16 | START SENTENCE WITH THE | e |
| 20 | 17 | AFTER FIRST TWO, CHANGE TO "TWO TO TWO AND A HALF" | e |
| 20 | 20 | PERIOD AFTER FEEDWATER, CHANGE "AND THAT" TO "THE" | e |
| 20 | 24 | CHANGE "STEAM PUMPS" TO "FEEDPUMPS" | e |
| 21 | 2 | "GENERATORS" TO "GENERATORS" (delete ') | e |
| 21 | 21 | Delete "ANALOGUE OR YOUR" | e |
| 21 | 23 | CHANGE "CHANNEL" TO "CHANNELS" | e |
| 22 | 21 | CHANGE "FIVES" TO "FIVE" | e |

Page No. 2 DATE 6/25/85 SIGNATURE [signature]

| Page | Line | Correction or change and reason therefor | |
|---|---|---|---|
| 23 | 16 | NOT WHAT MR BELL ASKED | ? |
| 33 | 18 | AFTER ACTUALLY ADD "CONFIRMATORY" | CLARIFICATION |
| 34 | 21 | "DFE" SHOULD BE "DP". | e |
| 35 | 24 | CHANGE "AUTO" TO "AUXILIARY" | e |
| 38 | 12 | CHANGE "NOT" TO "ONE OF" | e |
| 38 | 13 | CHANGE "DISCREPANCY" TO "DISCREPANCIES" | e |
| 38 | 17 | CHANGE TO "YES, IT ~~WAS~~ WAS CHECKED TO BE" | e |
| 38 | 21 | Delete "DONE" | e |
| 74 | 7 | QUESTION BY NRC WAS MISSED ENTIRELY | ? |
| 49 | 7 | CHANGE "SET" TO "RESET" | e |
| 51 | 12 | CHANGE "ENUMERATORS" TO "ANNUNCIATORS" | e |
| 51 | 18 | CHANGE "IT" TO "THEY" | CLARIFICATION |
| 52 | 22 | CHANGE "WITHOUT" TO "RESIDUE" | CLARIFICATION |
| 52 | 24 | CHANGE "FEED" TO "HEAT" | e |
| 52 | 24 | ADD °F AFTER 562 | (CLARIFICATION) |
| 52 | 24 | DELETE "UP TO THAT POINT AT 1:45" | (NOT CLARIFICATION - REDUNDANT) |
| 53 | 1 | START SENTENCE WITH "FOR" | CLARIFICATION |
| 54 | 11 | DELETE "N" INSERT IN THAT SPOT "TO UNDERSTAND OF" | (CLARIFICATION) |
| 54 | 14 | AFTER 960 ADD PSIG | (CLARIFICATION) |
| 54 | 16 | AFTER 960 ADD PSIG | (CLARIFICATION) |
| 54 | 16 | CHANGE "STEAM" TO "FEED" | e |
| 54 | 21 | DELETE 1ST SENTENCE - MUMBLING | (CLARIFICATION) |
| 55 | 1 | CHANGE "ITS A" TO "THERE IS NO" | e |
| 55 | 19 | ADD "THE" IN FRONT OF LAKE | (CLARIFICATION) |

 DATE 6/25/85 SIGNATURE Stan Gatt

| Page | Line | Correction or change and reason therefor | |
|---|---|---|---|
| 56 | 1 | CHANGE "FOUND" TO PSIG | e |
| 56 | 11 | ADD "H." TO BEGINNING OF LINE | e |
| 56 | 17 | CHANGE "POWER" TO "PORV" | e |
| 56 | 17 | CHANGE ~~RESERVE~~ "RECEIVER" TO "REHAIER" | e |
| 56 | 20 | CHANGE "THEM" TO "IT" | e |
| 61 | 2 | Delete "AT HIGH RCS" | e |
| 61 | 4 | CHANGE "TD's" TO ~~T.C's~~ "Tc's" | e |
| 61 | 6 | AFTER ~~INTO~~ "THE" ADD INCORE | e |
| 61 | 15 | AFTER COMMA, ADD "THEY" | e |
| 65 | 10 | CHANGE "INCREASED" TO "TO INCREASE" | e |
| 67 | 6 | START THE SENTENCE WITH "WITH". | e |
| 74 | 7 | CHANGE "FORGOT" TO "FORGET" | e |
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Page No. 4 DATE 6/25/05 SIGNATURE [signature]

| Page | Line | Correction or change and reason therefor |
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| 13 | 6 | word "aux" should be "control" (steno error) |
| 19 | 9 | "That's" should be "Data" (steno error) |
| 19 | 10 | "ADS" should be "DADS" (steno error) |
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Page No. 1 DATE 6/24/85 SIGNATURE W.C. Rowland