UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of:

IE TMI INVESTIGATION INTERVIEW

of Mr. Joseph B. Logan
Unit 2 Superintendent

Trailer #203
NRC Investigation Site
TMI Nuclear Power Plant
Middletown, Pennsylvania

May 9, 1979
(Date of Interview)

June 30, 1979
(Date Transcript Typed)

182, 183, 184
(Tape Number(s))

NRC PERSONNEL:

Mr. Dorwin R. Hunter
Mr. Tim Martin
Mr. Anthony Fasano
Mr. John R. Sinclair

SINCLAIR: The following interview is being conducted of Mr. Joseph B. Logan. Mr. Logan is the Unit 2 Superintendent at the Three Mile Island Nuclear Power facility. The present time is 6:07 p.m., eastern daylight time. Today's date is May 9, 1979. The place of the interview is trailer 203 located immediately outside the south gate of the Three Mile Island site. The individuals present for the interview will be interviewers Dorwin R. Hunter; also present Mr. Tim Martin; and Mr. Anthony Fasano. All gentlemen are inspection specialists with the Performance Appraisal Branch I&E Reactor Construction Inspection. My name is John R. Sinclair. I'm an investigator with the Office of Inspection Auditor, U. S. Nuclear Regulatory Commission. Prior to the interview being recorded, Mr. Logan was provided a copy of the document explaining his rights concerning information to be obtained regarding the incident at Three Mile Island. In addition, Mr. Logan was apprised of the purpose of the investigation, it's scope and the authority by which Congress authorizes the Nuclear Regulatory Commission to conduct the investigation. On the second page of advisement document Mr. Logan has answered three questions. The questions and Mr. Logan's responses will now be recorded as part of the interview. The first question Mr. Logan, did you understand the documents?

LOGAN: I understand the documents.

SINCLAIR: The second question, do we have your permission to tape the interview?

LOGAN: You have my permission.

SINCLAIR: The third question, do you want a copy of the tape?

LOGAN: I desire a copy of the interview.

SINCLAIR: Alright, thank you. At this time I would ask Mr. Logan to provide some information concerning disappointment in training in the nuclear industry.

LOGAN: Prior to becoming employed by Metropolitan Edison, I spent approximately 20 years in the navy in nuclear power, in the nuclear power field in the submarine branch progressing to various engineering assignments to the executive officer, commanding officer, division commander, and assistant chief of staff of training to Readiness submarine force of the Pacific fleet. After retiring from the Navy I became employed by Metropolitan Edison and entered approximately a one year training tour, if you will, to become familiar with the plant at Three Mile Island Unit 2 and to obtain a Senior Operator's License. This training involved self study of the various systems, tracing of systems, training sessions with the training department at Three Mile Island, periods at the simulator at the Babcock and Wilcox facility in Lynchburg, Virginia. This colminated in the later part of 1978 which I took the license examination and passed.

SINCLAIR: Okay, thank you. At this time we will turn the questioning over to Mr. Hunter.

HUNTER: Okay, Joe. Couple of things just to talk, get back into the program again and make sure we're talking in the same, along the same line. You indicated in a previous interview that you were called at approximately 4:00 a.m., the morning of the 28th by someone in Unit 1. Subsequent to that had you looked at the again at that time and can you give us more detail on when you were called and by whom?

LOGAN: I looked at what time, I of course couldn't look at what time I was called, it was sometime after 4:00 however. I normally get up at 4:00 and I was having a cup of coffee when they called me. I checked at the gate to see what time I arrived here and they tell me it was at 0545. Um, Mr. Wilkerson, the nuclear engineer for the station, one of the nuclear engineers for the station was the individual who contacted me.

HUNTER: Okay, Joe. And Mr. Wilkerson was working in Unit 1 at that time?

LOGAN: He called me from Unit 1, yes.

HUNTER: As I understand it Unit 1 was at hot shutdown doing control rod drive testing in preparation of startup and Mr. Wilkerson was I guess involved in that testing program.

LOGAN: I would imagine he would be I don't know that that was what he was specifically engaged in that evening, however.

HUNTER: Okay. You arrived onsite, excuse me, what status was given to you by Mr. Wilkerson at 5:00 when he called or was any status given?

LOGAN: Just that the turbine and the reactor had tripped.

HUNTER: And after that contact then you proceeded to drive to the plant?

LOGAN: That is correct.

HUNTER: I understood from a previous interview that you live 70 miles from the site.

LOGAN: Not quite, no. Not quite 70, it's more like 50.

HUNTER: 50, okay. And do you arrived here then at 5:45?

LOGAN: Right.

HUNTER: Ah, at that time then who did you who was your first contact?

LOGAN: I proceeded to the control room in Unit 2 and the control room individuals who were at the who were on duty were engaged in operations to control the plant. Mr. Kunder, the Unit 2 Superintendent of Technical Support was in the control room at that time. I proceeded to observe the panel indications and which were somewhat were abnormal and then proceeded to the supervisor's office where Mr. Kunder was going over the trip, after trip indications from the computer.

HUNTER: Okay, Joe. Two things. The first that we'd like to cover is can you give us a brief on the actual conditions as you saw them that morning and try to relate any of the unusual conditions and what they meant to you at that time realizing again, it's been awhile.

LOGAN: It has, and my recollection here is somewhat clouded by things that happened. I don't recall...some of these may have occurred after I got there, I don't know. However, as I recall we either had pumps, coolant pumps, reactor coolant pumps were either secured or several of them were secured. I don't recall if all of them were secured or if two of them were secured when I arrived. However, the pressurizer level was high, pressure was low which was abnormal as I recall the shift supervisor who was Mr. Zewe told me that he had isolated the B steam generator because he suspected a leak. ...I can't think of anything right at the moment that I observed other than that although I'm sure there are probably were but right at the moment I can't recall.

HUNTER: At that time were there any radiation alarms that you recall seeing or were there any brought to your attention?

LOGAN: Not at that time as I recall. I know I didn't at that time I didn't anticipate that we had a leak I mean that we had a problem other than perhaps a primary to secondary leak in the steam generator but as I recall Bill Zewe didn't indicate that he had picked up an alarm it was a pressure differential in the steam generators that I believe gave him the indication that we had a leak in the steam generator.

HUNTER: Okay, Joe. The pressurizer level being full and the pressure being down can you give us a little information what that meant to you at that time?

LOGAN: Well, it was somewhat...it's not a normal situation when we have a plant that is hot. To have that high a level and not have a high pressure also because you would anticipate with a bubble up there that the pressure would be high. At the time something you know didn't ring a bell. There was something that was wrong there at the time and I didn't, I couldn't identify what it was. The fact that the pumps were off certainly was you know abnormal. The shift supervisor was busy trying to get the plant squared away that's why I went to ask George Kunder, you know, what had happened, what was his assessment of this problem because he had been there for sometime and perhaps he could fill me in on some of the information. As I recall the informa-

tion he gave me concerning the pumps was that they had fluctuation in the discharge flow or flow indication on the discharge of the pump and I believe he also said that the amperage had dropped on the pumps indicating that they were not pumping water.

HUNTER: You at this time had personally were talking with George Kunder in the shift supervisor's office?

LOGAN: Yes.

HUNTER: And you had discussed the pumps. Did you discuss the pressurizer pressure and level problem?

LOGAN: I don't, I can't recall that I did. I think the thing that really hit me was the fact that the pumps were off and we were still hot you know and that to me you want to maintain flow and that's the thing that stuck in my mind. There's a tremendous problem I am real serious ....

HUNTER: You are saying Joe that the pumps were off. Ah, two pumps or all four pumps?

LOGAN: I don't recall right now how many were off.

HUNTER: Okay.

LOGAN: Abnormal pump configuration and normally you would want to maintain as much flow as you could through the core to remove the heat.

HUNTER: I understand that. I tried to ascertain if you recall then after coming in and maybe talking with Bill with looking the charts over in the control room and then talking with George Kunder do you recall the two more pumps being secured while you were there within the first few minutes?

LOGAN: Right now I can't recall whether that happened before or after I got there.

HUNTER: Did you spend some time Joe with Bill Zewe that morning you know when you came in discussing the plant conditions?

LOGAN: I didn't have much of an opportunity because when this... My first intention was to see that the calls had been made, this was an abnormal situation, and I wanted to make sure that one, Miller had been called and informed of the situation. I walked back out Zewe was having problems trying to get this thing under control because of the abnormal indications and my mind is kind of hazey right now as to what went on at that particular time you know trying to decide what we

should do. I do recall we tried to start a pump. I can't remember if it was shortly after I got there or not but we had received a report sometime shortly after I got there of a boron sample which indicated a low boron content and as I recall we were concerned whether we were getting an accurate sample. The results were I think were around 700 ppm when we were running at that time around slightly over 1000 ppm so the concern here was that an accurate sample or not. As I recall we also had an indication about that time of an increase on our source and intermediate range meters. George Kunder I know had was concerned that we might actually, that could perhaps have been an accurate indication and as I recall I believe we reinitiated, or we initiated emergency injection they had initiated this before and secured it. I might point out in previous reactor trips we had initiated high pressure injection and subsequently corresponding with that high pressure injection we have the you know sodium hydroxide injection also and this has caused us considerable problems of course in removing the sodium from the plant and they secured the high pressure injection ... I'm getting this ... from .... Talks that I had with them after this occurred of course, they had secured that when the pressurizer started filling up you know. That indicated that they certainly had enough water in there and they didn't want to put anymore sodium hydroxide in the plant and they secured both the sodium hydroxide and the BWST, the high pressure injection.

HUNTER: Okay. When you had discussed with George Kunder earlier you indicated you had discussed the reactor coolant pumps, the problem with the pumps, do you recall any other specific areas that you and George had talked about? net potitive suction pressure curve, pin compression limits, I'm trying to key on anything that you may have discussed. It's looks like at 5:45 you logged in at the gate. It's looks like at 5:45 that all the pumps had been secured.

LOGAN: I couldn't remember whether they had or not alot of this is you know kind of hazey.

HUNTER: Okay. Well that's a ... power source range and intermediate and the low boron concentration you mentioned also during that time frame they had after securing the pumps. Apparently the power operated relief valve had been closed finally, after that length of time. Do you recall discussing that particular evolution or how the conclusion was obtained that the valve was opened or and then closed?

LOGAN: pause

HUNTER: If you don't recall just ...

LOGAN: I'd honestly say I'm trying to think. I can't honestly say that I recall discussing that. That was closed at what time?

HUNTER: It was closed 2.3 hours into the event. That would be approximately 6:20. You had been there probably a half hour or so. The pumps by the way were secured at the B pumps were finally tripped at 5 something which you got there at 5:45. The power operated relief valve was closed somewhere in the range of 6:20.

LOGAN: I honestly right now don't know I don't recall that I'm sure I was probably aware of it at the time but I don't recall that right now.

HUNTER: Might a touch a base with you in a general way at that time, when you came in were you under the assumption or was it your understanding that George was in charge of the plant, the senior man in charge of the plant additionally to Bill Zewe, of course being the shift supervisor.

LOGAN: Well, yes in the sense that he was the senior man there but it was very apparent Bill Zewe was in charge of the control room. George had taken the computer printout and was looking at it to analyze you know I suppose what had happened first of all and I after seeing the condition I think he was perhaps trying to relate any parameters on the printout that might help to identify why we had these abnormal conditions of a low pressure, a high pressurizer level, and I'm not sure the relation there to the pump could be you know obviously we have, nothing would tell us we had a bubble in that loop or the loops

or anything and in hind sight when you go through these things you say well did you look for that or did you look for this you know well of course you don't. I recall looking at the printout initially to see what caused the trip initially.

HUNTER: You did look at the computer printouts with George?

LOGAN: Yeah. I, yeah right.

HUNTER: Then you went through to see what caused the trip initially?

LOGAN: Right.

HUNTER: Was there anything that surprised you at that time as you looked at the reactor trip sequence, the turbine trip reactor trip sequence?

LOGAN: I can't recall anything that was a surprise except the first thing that was on there was a condensate pump trip and I was trying to figure out what would have caused it of course and you had to realize that at this time these other things were going on out in the ....

HUNTER: Then you didn't worry too much about the condensate pump trip at that time?

LOGAN: Well, of course, yes because I was wondering what caused it you know that was why we were there you know so obviously I was but all it says is that the pump tripped you know it didn't tell you why.

HUNTER: Okay. Was there any other items on there that would specifically keep your interest? Were you looking for something?

LOGAN: Well, yes I was looking for something but you know the sequence the condensate pump trips, the sequence of pumps, your booster, your feedwater pump, then your turbine, and then your reactor and they did what they were supposed to.

HUNTER: Do you have a printout on the reactimeter available to you at that time?

LOGAN: No.

HUNTER: It's available subsequent to the event.

LOGAN: The reactimeter is down in the cable room, in a relay room, and I don't recall when that was brought up. We have the computer ... these were the readings from the computer down in the control room.

HUNTER: Yes, I understand. Would the, is the reactimeter printed it out in a form which you could use at that time or is it a magnetic tape or a recording?

LOGAN: At that time I think we had a recorder in.

HUNTER: Okay.

LOGAN: I didn't think of the reactimeter frankly.

HUNTER: Alright, okay. Now, talking with George Kunder and looking at the plant when you came in, can you describe what the condition of the control room as far as the actual manner in which the fellows were conducted themselves. Did you see anything unusual, I assume you came in on other trips and you've seen what the control room is like. How were the fellows conducting themselves?

LOGAN: If this has been a normal trip when I came in I would expect things to be much calmer than things were when it had tripped at 4:00 and I got there 1 hour and ½ later. There was concern about the level, pressurizer level and pressure and I say this because, you know, people were concentrated...they were trying to...and Zewe was back and forth...the steam generator as I recall was secured when I got there and I'm I would have to characterize the actions of the people there as active as more active, if you will than I would have had expected under a normal trip, in other words things were not really under control, those pumps, you know, that were all...the temperatures were abnormal because you had of course no flow in one loop or reduced..., well at this time, both of them or all full four

of them off also ... your loop temperatures were different. It was an abnormal situation and the people were concerned so consequently...not a...I don't want to say that they were extremely aggitated but there was concern there because they didn't understand the situation.

HUNTER: Okay Joe, looking at the...still looking at the computer ah printout was there anything else available or did you look at anything else besides the flow sequence of events trip?

LOGAN: No I didn't look at...you mean printed material?

HUNTER: Alarm material alarm printouts anything, you know, anything...any other material to review to determine the status of the plant at that time or try to determine the status of the plant?

LOGAN: Not at that particular time. As I say I...realizing we had a problem that was certainly abnormal, I thought the first thing we should do is get, notify Miller who was the Station Superintendent of the situation and to try to assess the situation by going out and observing, which I did. Zewe, I felt was a very and still do, a very competent Shift Supervisor, and as I do all the Control Room Operators that were there at the time. I certainly at the time, did not equate the fact that the pumps weren't running with the bubble in there. I knew there was something wrong, but the idea of having a bubble in the loops did not occur to me.

HUNTER: Okay...Tim.

MARTIN: Mr. Logan ah early that morning there was a conference call setup for a Mr. Miller, Mr. Rogers, Mr. Kunder and others. Were you involved in that conference call?

LOGAN: No I was not.

MARTIN: Did you know it was going on?

LOGAN: I didn't know...I had told George Kunder to call Gary and apprise him of the situation. I went out into the control room to see if I could assist or provide some direction in to what they were doing. I was not aware that the conference call was set up. I did ask him if he had called, I suppose after the conference call was over, cause I called and asked if he had gotten a hold of Gary and he said yes. I had asked him if he had called Herbein also Jack Herbein, and I believe he told me he could not reach Jack...I don't...its kind of vague in my mind whether he said he did or he did not.

MARTIN: Mr. Logan at any time during this morning were you aware of samples taken on the steam generators looking for activity specifically?

LOGAN: At...you mean when I got there had they taken...

MARTIN: Yes

LOGAN: I don't recall if they told me they had taken a sample then or ordered one and I'd have to say...at this particular time I didn't know that a sample had been taken. The reason for securing the steam generator had been a pressure differential and level differential between the two steam generators. That was the reasons Zewe gave me as suspecting a leak in there.

MARTIN: Alright Mr. Logan. Shortly after your arrival apparently the electromatic valve was shut. We saw a more rapid decrease in the reactor building pressure ...it was inferred at that point that we had found the source of increasing reactor building pressure that it had in fact been a leaking EMOV. At that point the ah B steam generator no longer was suspect for a secondary to containment leak. Was the B steam generator then unisolated?

LOGAN: No I think we left that steam generator isolated, I believe. Cause I think we still felt that that steam generatorwas had a leak. Now whether that was whether, we had ordered a sample, and got the results I don't recall.

MARTIN: Alright Mr. Logan once the EMOV was shut the wide-range pressure trace shows a general increasing trend in pressure. Was this the result of an overt decision to a pressurize the reactor using high pressure injection to your knowledge?

LOGAN: I would have to tie that to one of two things, either we had received the sample results of the boron on it, you know, from the primary system, if so then I would say yes. Without looking at the graph and saying that we had injected I...if we did inject...obviously it was an overt action. Whether it was shutting of the of the EMO immediately caused it to increase which I expect it would...I can't say. In other words I don't know what the...I'd have to look at the sequence.

HUNTER: Joe, the auxiliary feed water system had in fact initiated but the flow was not available due to the apparent...apparently the EFV12 isolation valves to the A and the B one to each generator were closed. In your discussions concerning the status of the plant, were you aware that that the emergency feedwater had not functioned properly?

LOGAN: No I was not

HUNTER: ...When did you become aware of that fact?

LOGAN: I'm trying to remember if I was told of that or informed of that that day or the next. Things were happening very fast and Zewe was extremely busy and, you know, his duties were trying to control the plant and I do not believe he told me that those valves had been shut or found shut. I know that I...he didn't tell me immediately when I got there. And as I say when I got there he was busy I didn't

want to interrupt him he was taking care of the plant...George was there...George did not mention that to me either and I don't know if he was aware of it at that particular time.

HUNTER: Okay Joe. You indicated that you went to the control room to attempt to assist and maybe provide some direction to the fellows. Who was in the control room at that time besides Fredericks, Faust, Zewe, Fred Scheimann was there...was Ken Bryant from Unit 1 there also?

LOGAN: I don't believe he was when I went out there...again you get kind of hazy here when these people showed up...I don't believe he was though.

HUNTER: You indicated you went to the control room can you recall any specific parameters that you observed or reviewed at that time or at any or at any specific activities that you observed, operator actions or when you went out and tried to assist?

LOGAN: I don't recall specifically. I do recall...again my concern was the fact that we didn't have pumps running and why we couldn't get them running. And I don't recall if we tried to start the pump then or not.

HUNTER: Did you review the status of the plant such as the hotleg temperatures, coldleg temperatures?

LOGAN: Well I'm sure I did because that's the normal parameters you look at but to try to tell you what they were I don't know.

HUNTER: Okay and did you look at...do you recall looking at pressurizer level at that time?

LOGAN: I don't recall looking at it but I'm sure I did cause as I recall Fred Scheimann was standing almost there I mean on top of it. That was one of the probably the most...one of two most disconcerting things was the fact that the high level, the low pressure, and we couldn't get pumps running. Those three things were extremely abnormal.

HUNTER: Were the fellows in the control room appear to you and yourself even, were they keyed up about those those particular items?

LOGAN: Yes I'm sure...yes they were I'm sure they were...I can't, you know, recall that they were jumping around...we were...those are all abnormal conditions, you know, and the fact that we couldn't do anything about it was the disconcerting part.

HUNTER: Okay Joe. Looking at the high pressure injection system and trying to key your and jog your memory do you recall looking at the

high pressure injection system when you came in that morning or at that time...and or were you informed of the high pressure injection flows at that time?

LOGAN: I don't recall being informed...I don't think...let me rephrase that...at the time I got there we were not injecting. I recall vaguely that Zewe had told me that we had an injection and that they had secured it.

HUNTER: Okay. To pursue that, the operators two minutes into the event had an engineered safeguard features actuation initiating safeguards system actions which included tripping the B make-up pump and putting on the normal A and C make-up pumps in the high pressure injection mode, the sixteen valves came open injecting water for a period of time and very soon at 3 plus minutes the high pressure injection was apparently bypassed...it...by the operations group okay, can you clarify for us the...again by the procedures, if I'm reading the procedures correctly can you give us a little background on the bypass of the the safety injection or the emergency injection... and also try to key on the fact that the pressurizer pressure at that time...a few minutes into the event...

HUNTER: Is below sixteen hundred pounds...it has it has...you've had the injection?

LOGAN: Right

HUNTER: The pressure in fact did come up some due to the injection then tailed off very quickly and within just a few minutes headed back to level out at about 1350 or so but definitely below the below the injection pressure or the set point of the emergency injection system.

LOGAN: Alright to put the...to try to put the thing into perspective ... the injection into perspective and why there actions were as they occurred, you have to look back at the...you had several injections in Unit 2 during the pre commercial period as a result of several things, but as I mentioned earlier in each of these injections, we had experienced...they were normal injections by that I mean the pumps came on the valves opened the water went in along with the sodium hydroxide we shut down we went through agonizing periods of trying to determine the effect of the sodium on the primary plant. The cleanup that was required afterwards in order to proceed back to a critical state and back to an operational state if you will. These things were in the operator's minds I'm sure. They had bypassed ah the injection at other times when they were sure that the plant was in a safe condition by that I mean level was in the pressurizer, pressure was normal, conditions were normal therefore when this occurred I'm sure thos thoughts were going through their minds. One, the effect of continued injections once they had retrieved level, you know, sufficient level indications. We had never experienced the pressure, low pressure

condition and a high pressurizer level. Never had this particular accident been presented I might add at the simulator. Therefore, this was certainly an abnormal accident if you will. These operators go down to the simulator they go through rigorous training down there. Accidents that are that were analyzed in the FSAR are presented to them on the simulator under pretty realistic simulation. This one we had not gotten into unfortunately, therefore, I think there actions were predicated on prior trips that we experienced. When the injection commenced and they saw level increasing in the steam generator they felt that the injection system had accomplished its purpose, that they had the the event under control. The pressure I don't know why ... what their reaction was to low pressure because I wasn't there. It would be an anomaly to say hey we've got level coming back up but pressure isn't coming back up now there's something screwy, you know. If you had a full pressurizer for instance and your pressure was very low two minutes after a trip something is very strange and as I say we had never looked at this particular accident as a possibility.

HUNTER: Okay. Tony.

FASANO: I have a one or two questions here. You mentioned the concern about the sodium hydroxide getting in, now that was earlier during the pre-commercial operation you say in maybe February or April. Did you know there.

LOGAN: Excuse me it much...we had other trips other than February or April all. I can't give you every one we had we had trips in of after...we had significant outages you may recall we replaced all the main steam reliefs and we had trips after that after we came up

FASANO: Well I don't remember...clear my mind here...did we get on this actuation did we get sodium hydroxide also?

LOGAN: Yes we did

FASANO: So the logic still is to put sodium hydroxide in at the time you get an engineered safety

LOGAN: You get it, it's not immediately, you get it, I forget how many feet as you come down you do get an injection of sodium hydroxide. Our analysis, the last sample as I recall was reading around 700 ppm sodium in the plant.

FASANO: Thank you.

HUNTER: Okay Hunter speaking. Looking at the high pressure injection being bypassed by the operator and looking at the, you know, looking at the reasoning behind the high pressure being bypassed by the operator, in this plant there's a difference between an apparent difference between reactor building initiation of the high pressure injection

system and the low pressure initiation of the high pressure injection system or the ESF. In the logic for the initiation from low reactor coolant pressure, that logic has a bypass feature associated with it and in the reactor building logic there's no bypass feature if in fact you you must, you must absorp a high building pressure initiation. That that will occur and there's nothing the operator can do about it.

LOGAN: Right.

HUNTER: Except block pumps out to prevent flow but there's nothing he can do about it...if he sees it approaching 4 pounds he's going to get that A and you had an A building insulation occur and there was nothing he could do about it except watch it occur and then react to after it occurred. In the case of the pressurizer low pressure...pressurizer ...reactor coolant system low pressure initiation the logic had the ability to defeat or to actually bypass that sequence for normal cooldown and the reasoning behind that logic is it's become apparent so that they can cool a plant and not get a low pressure or high pressure safety or an ESF signal. I'm still, I'm still little, you know, I'm still not quite sure I can follow why an operator or why the operators would block the instrument safety features, why safety features when we were still below 1600 pounds

LOGAN: Okay let's look at what the purpose of the high pressure injection is. Basically it's for a loss of coolant accident when you

got a leak, rupture or something like this. We had no indications of that...we had no...we had a loss of pressure, okay, which would you would expect to happen if you tripped and your cooling your removing heat from the steam generators. If you had a loss of coolant accident you would expect other indications such as a reactor building radiation monitor alarm some high sump levels low, this type of thing. None of these conditions xisted. Every and I keep going back to the previous history of trips that we have experienced were similar conditions everything happened except this pressure problem, you know, it didn't come back up. That's the only difference in this case. The only difference in the symptoms to the operator was one; that the pressure stayed down, see. He did not have a reactor building radiation alarm, he did not have a high sump level at this particular time...two minutes you say after that...

HUNTER: Yes

LOGAN: The injection

HUNTER: Go ahead Dick

LOGAN: What I am saying is that the to them what had occurred was a normal reactor trip, turbine trip, reactor trip, heat being removed by the steam generators, normally the pressure should go down. They reached the point where injection occurred, the purpose there is to

maintain the level, keep the core covered, which is indicated by the pressurizer level, their training had been if you keep water in the pressurizer you got water in the core, that's what they did.

HUNTER: Okay the definition of securing high pressure injection and you know better than I do okay, I hope you don't that what the definition of securing high pressure injection, would that mean to the operators to bypass bypass high pressure injection and throttle in order to and in would bypass include throttling the high pressure injection valves to maintain pressurizer level and to your knowledge is that what they were doing at that time?

LOGAN: No ... I didn' get there when this occurred.

HUNTER: But I...the system excuse me I know you've gotta go the injection had occurred

LOGAN: Yah.

HUNTER: The plant pressure has continued or is continuing to run low and we're out right in this particular time frame basically it was at saturation one can talk like that now okay, it was at saturation conditions and pressurizer level was in fact up, would it normally be the...would the operators seeing a low pressure and and seeing a high pressurizer level would they appear...they would keep at a high pressurizer

level rather than a low pressure and throttle the high pressure injection.

LOGAN: Without the analysis of this particular accident that we've had I would say yes. I would say if you had at any of the B&W plants of this design if you had talked to anybody and they'd say hey if you hit anybody with this accident those conditions without the detail that was going into this one...and if you said hey you had this injection, you had this trip, not going into the fact that you had steamed the generator dry, but you had had the accident the...you had a low pressurizer I mean a low RCS pressure and a high pressurizer level what would you do with your RCS? I think the initial response would have been to secure the sixteen.

HUNTER: In secure Joe do you mean

LOGAN: Maintain your tech spec level in the pressurizer.

HUNTER: Okay. Would they ..you mentioned that when you arrived that the high pressure injection was secured. Would they in fact maintain any high pressure injection flow at that time or do you know, yes or no whether they were or not.

LOGAN: No I do not know...I don't think that they were feeding the the pressurizer at that particular time. It was high and I don't think they were they shouldn't have been.

HUNTER: Okay so that would be your understanding that if it was high they wouldn't be they wouldn't be using normal make-up or the B valve for the high pressure injection valve which is normally your alternate path under a trip condition. Let me make something clear in my own mind you have had a number of trips where you in fact had an extremely low pressure of at least a low pressure adequate to get you to the engineering safeguard features initiation.

LOGAN: I say a number I enough to make me familiar with them and I.

HUNTER: Okay and you said then that the difference was that the pressure didn't they weren't able to recover pressure even though they did very definitely recover pressurizer level at very shortly after ... the trip?

LOGAN: All the previous ones the pressure this abnormal low pressure continuence was not present in other words they kept the level back pressure came up and everything.

HUNTER: And when you came in again, I want to make sure because I we're going to have to go through this again and look at the again and again and I hate to repeat but I that's just the way it is. When you came in B steam generator isolated due to a delta P.

LOGAN: Okay.

HUNTER: I understand that and they isolated and that's you still got another steam generator which is there the steam generator levels at that time were normal apparently that that you know that was just a item. Pressurizer level being high and pressurizer pressure being down were the key issues at that time and when you came in, had they in fact, or were you informed by George Kunder or was he aware that they, that at that time, they had in fact ruptured a rupture disc on the reactor coolant drain tank. Do you recall that or any conversation concerning the drain tank?

LOGAN: I don't recall when I first got there that that was discussed. Sometime during the morning and I don't recall just when I was made aware of it though.

HUNTER: And along the same line, sometime later in the morning that they they had in fact had a high sump level, and the sump pumps had been turned off were you made aware of that?

LOGAN: Yes. We had a, because we had a aux building sump level, a high level, and I don't recall when I discussed this with Bill Zewe but...

HUNTER: You did discuss it with Bill Zewe?

LOGAN: Sometime during the morning.

HUNTER: Okay.

LOGAN: And he told me that he had secured the reactor building pumps ... now that must have occurred early I'd say early in the accident, probably when they had ruptured the you know the RC drain tank and the water from the RC drain tank went into the into the reactor compartment. He told me that he had secured that because and I forget just exactly when we discussed it I don't know if it was after we had received the radiation alarms in the aux building or not. I remember the conversation and...

HUNTER: During that conversation Joe was the conversation such that the ruptured disc on the reactor coolant drain tank had lifted, had been ruptured as a normal occurrence, as an unusual item or as something that might be expected.

LOGAN: Well it was unusual to me for it to occur. I would not have anticipated it, that it would rupture. It's designed of course to protect the tank but under normal circumstances I wouldn't expect it to rupture.

HUNTER: How did, what did you get the impression, what kind of impression did you get from Bill when he's telling you about it and that it did rupture.

LOGAN: He was very vague. I'll have to surmize that it was when we were probably discussing the electromatic relief valve operation. If it stuck open, you know, and you continue to steam into it, it's not designed for that I don't believe.

HUNTER: Did at any time you go around behind the panels and look at the reactor coolant drain tank behind the upright panels and see the conditions of that tank?

LOGAN: I don't recall, probably, when he told me it ruptured I probably did, but I can't recall doing that.

HUNTER: Okay.

MARTIN: This is Tim Martin, at 6:54 the computer indicates that a reactor coolant pump was started. Are you aware of any problems that they had in starting that reactor coolant pump?

LOGAN: We tried to start, and I presume this is the time...several times we tried to start the pumps that day...we tried to start a pump...we got a hundred amp...around a hundred amps I recall...hundred

amps indication on a pump that normally runs approximately 600 amps...which was telling us that it wasn't pumping. I think we tried all four pumps and if this is the time I don't think we got a pump on.

HUNTER: Hunter speaking, at the time you were attempting to start the reactor coolant pumps, was the people there, you and George Kunder, and Mike Ross was he there at that time?

LOGAN: I'd have to say Mike probably was even when I look back at some things that I have looked at now, but I don't recall

HUNTER: Was it like you and Zewe and Kunder

LOGAN: Yah right.

HUNTER: At that time looking at the pump. Did you have the were you using the minimum temperature pressure relation curve at that time looking at the pressure and temperature relative to deciding whether or not to start that pump?

LOGAN: Personally at that time no, my interest was in getting water circulating I wouldn't have cared what the relation was...my concern there was getting water circulating in the core.

HUNTER: Okay.

LOGAN: It wouldn't have bothered me what the pressure was down to

HUNTER: Did you know if George Kunder had the curve or Zewe and had been looking at it?

LOGAN: The curve is right on the panel.

HUNTER: Were they looking at it?

LOGAN: The operators were I would be sure.

HUNTER: Were they plotting anything on the curve? Were they tracking their path down the curve as far as temperature pressure similar to what you do on a cooldown or heatup. Did they know where they were?

LOGAN: I can't swear that they were I don't recall that, at that particular time. The situation was so unusual I don't recall that they were plotting that particular item. George...as I recall this was in about the time we received the results of the boron sample if I'm not mistaken. I do know that George was very concerned about the low boron which I was too, but I felt that we needed...that we didn't have representative sample for one thing. The pumps were not had not been running and that coupled with the fact obviously we needed to

remove heat from the core was the thing that was in my mind as far as getting the pumps running.

HUNTER: Okay.

MARTIN: Joe, Tim Martin, were we in a site emergency when we started that reactor coolant pump?

LOGAN: We declared a site emergency about that time. I, it seemed to me around 6:40 to 6:50 somewhere in that time frame.

MARTIN: So was this before the reactor coolant pump was started or after?

LOGAN: It's difficult for me to recall.

HUNTER: Hunter speaking. What when you obviously you're interested in starting the reactor coolant pump...if I was there I certainly would have been watching as the man turned all the switches

LOGAN: Um uh

HUNTER: All four of them...I am sure you were I would assume that you were ... when the pumps started what was the...besides the pump went amp current going up and coming back to a hundred amps which you

mentioned and it didn't have flow what was the most significant event that happened at that time or was there anything significant besides the pumps that happened at that time?

LOGAN: I'm trying to recall whether we saw any flow at all on the Gentillie indication and I'm not even sure that the amperage really came up, you know, maybe it just came to a hundred and I don't can't remember right at the moment. We subsequently did this again and I'm trying to correlate which time what happened is vague in my mind. As far as the site emergency, whether that report came up before or after the starting of this pump, I, again it's vague in my mind. I recall the report coming up that they had a high reading and I forget whether Dubiel came in the room...Dick Dubiel the Supervisor of Radiation Protection...came into the room and said that or whether he called that up. That he had a high reading at the hot machine shop which is...the sample line runs by there. I don't remember...to answer your questions specifically where in the sequence of events we did this. It seems to me that perhaps it was after the report though.

MARTIN: Joe, Tim Martin again, what keyed the site emergency what event? What event?

LOGAN: The report from the Health Physics Supervisor.

MARTIN: Relative to the radiation level in the hot machine shop or the activity - radiation level from the sample of the primary coolant?

LOGAN: I don't recall which we got first, frankly. I think it was his report and I again right now I'm a little hazy as to whether we had received the area the area alarm or not. I think at that time we may have received an area monitor alarm but I wouldn't swear to that.

HUNTER: This is Hunter speaking. Who did, who declared the site emergency?

LOGAN: When we got the report, George said we should declare it, I agreed I told him to declare a site emergency.

HUNTER: And subsequent to that conversation George declared a site emergency.

LOGAN: No I told him to declare it. You might say it was a coordinated function. George when we got the report in, or maybe George received that report I can't recall right now whether it came over the...I in the back of my mind I think it came over the speaker, George may have received that and came out and said that they got the that this level was reported and recommended a site emergency. I told him to declare a site emergency at that time.

HUNTER: And who made the announcement on the site emergency Joe?

LOGAN: I don't know if it was Zewe...I don't think it was Zewe. It was one of the operators and whether it was Faust or Frederick or...I honestly don't remember which one.

HUNTER: Okay.

LOGAN: Alright.

HUNTER: The plant status that you came into again looking at the general at the big picture and again concentrating on the minimum pressure temperature curve...earlier apparently...right apparently not too far back from where you came in...they had concluded to take the plant to natural circulation and secure the...this included the securing of the last two reactor coolant pumps which in fact would have put them in natural circulation or was supposed to have put them in natural circulation. Did you and George talk about that particular activity?

LOGAN: I'm sure the fact that the pumps were secured we discussed. I can't recall what the conversation...now my question I'm sure was why the hell are the pumps off, you know, and as I recall it seems to me that he told me that the...and again I can't remember if this occurred during this conversation or subsequently, but the sequence was they got a irratic indication on the flow indication...the Gentillie indication

there for the first two I believe and the second one was...I think as I recall in subsequent conversations they had secured the second two because of the pressure temperature relationship.

HUNTER: Okay ah Mike lets take a break.

SINCLAIR: Yah. Sinclair. The time is 7:11 p.m. we are going to have to break here to change the tapes.

SINCLAIR: The time is 7:13 p.m. we are now continuing the interview with Joesph Logan.

HUNTER: Joe, when the last two reactor coolant pumps were secured, this in the, in this B&W type plant in any pressurized water reactor would obviously place you in natural circulation, you have a procedure of that discusses natural circulation in the prerequisites for natural circulation, one of the items in the procedure points out that the minimum pressure temperature curve should be used to determine whether or not you could establish natural circulation and secondly it acts, it provides you specific pressure temp hotleg relationships that should be ah obtained prior to going or being, or going into natural circulation, did George Kunder or you discuss that procedure that morning at all?

LOGAN: No, we didn't as we indicated earlier the pumps were secured when I got there, the pumps were not secured predicated on a preplan and natural circulation evolution, they were secured in accordance with the operating procedures that says you secure the pumps if you get below the operating curve, now you got a dichotomy here, I don't think they had planned the natural circulation evolution, if you follow me?

HUNTER: Right, I want to make sure you understand, it was your understanding that they secured the pumps due to the significant pump problems that were occurring, such as vibration that, rather than really, rather than, I'm trying to visulize that the low pressure which they had pushed them out, placed them outside of the minumum pressure temperature limits for operating the pump and they secured the pump, based on that problem...

LOGAN: Let me clarify a couple things that I think may have gone through their mind. This is speculation, but if you get down below the operating curve you can, as you say, get exessive vibration in there leading to perhaps a seal failure or complete failure of the pumps, seizure of the pump even. At the time they secured the pump, to the best of my knowledge, they had no indication of leakage, a LOCA type of incident going on. I think the thing in there mind they had been taught to follow operating procedures and the pumps are critical components of the coolant system and there are very cognizant

of the operating limits for that pump when they got down to that limit. I'm sure the first thing that went through their mind was that limitation on the pumps. They cannot explain the low pressure, they had a pressurizer level which to them I think indicated that the core was covered, a very abnormal casualty, if we could put it that way.

HUNTER: Joe, you mentioned that they did not have a LOCA situation. Up until this time and then at the time that you walked out to the Control Room and then were looking at some of the parameters had...was there any indication or had anybody discussed the lost of coolant accident at that time?

LOGAN: No.

HUNTER: George Kunder had not discussed it with you or did it cross your mind at that time, based on your experience that you have a condition...

LOGAN: No, we had none of the classic indications of a LOCA, i.e.: the radiation alarms in the comparment, had none of those, we had a pressurizer level it wasn't decreasing, in fact as a matter it is going up, as I say the sump, I don't recall any, I don't know whether they had pumped that sump at this time, I supposed they had by now but that was not discussed with me, I don't feel in my mind that they felt they had a LOCA, I certainly did'nt at that time feel...

HUNTER: Was the initiation Joe of the emergency safeguards system then keyed to a normal reactor trip?

LOGAN: In our experience, yes, a normal reactor turbine from 100% power, I think it's been established you'd probably get a trip, excuse me, you would get a trip if you tripped the turbine and it had been our experience that we would sustain an HPI.

HUNTER: If you came in and asked the operators what they had sustained after a 100% turbine trip, reactor trip on high pressure, cause that's the sequence if you get a turbine trip that's whats gonna happen, nothing was abnormal to you if you came in and he had had a ES initiation and had in fact reestablish the pressurzier level?

LOGAN: I would not of considered that abnormal based on my limited experience in this plant from the past trips that we have had.

HUNTER: Have you spent significant time reviewing the previcus trips in training?

LOGAN: Yes, and in the test program one of the last things we did in the test program was to do a trip from 92% power I think, we tripped and we maintained the reactor only which everybody felt was somewhat unusual trip the turbine and we maintained the reactor on the line which was considered somewhat unusual.

HUNTER: Joe, maintaining the reactor on line, you mean pressurizer level stayed within the...

LOGAN: We did, we did not trip the reactor plant.

HUNTER: Right, you maintained the reactor on the line after the turbine trip used, I would assume then that you did'nt go out on high pressure and the power operated relief valve operated properly, spray operated, pressurizer heater may have been cut off to the low level but the level did in fact recover.

LOGAN: Well I'll have to say that as I recall we have elevated the pressurizer level a little bit before we did this.

HUNTER: Also along that line do you recall any special preparations made or special instructions to the Auxiliary or the main feedwater Control System on the operator monitoring that particular activity during that trip, was there any special preparations made at that time concerning feedwater to the steam generators or was it allowed to operated it automatic, as normal?

LOGAN: To the best of my knowlege everything was in automatic, we obviously made special preparations, we had extra people in, the only parameter that perhaps was not normal as I recall was that we had a slighly higher than normal pressurizer level because we expected the

level to go down, I might point out that we had, in one of the trips that we've experienced, and I think it was when the steam release failed we had lost indication on the pressurizer level all the way down, we did not, by substant analysis it had not emptied the pressurizer level but it had gone out of our local indication, I have to say this, you got to realize that alot of these trips occurred when I, in the spring of the year when I first got here, I, so I wasn't you know in the Control Room or did'nt understand some of the things that were presented to me at the moment you know as what had happened the latter that was more familiar with having familiarized myself with the plant having been to the simulator and witnessed the, accidents that they present to you down there on the simulator it was, another words I was able to as simulate what the devil was happening later on.

HUNTER: Ok, the trips that you were familiar with again, where they presented to the operators in training and retraining at your request or Gary Miller's request or is that a routine presentation at this point?

LOGAN: That's a routine presentation, I did not take over the plant until after I recieved my license which was essentially when it went commerical I was in strictly a training capacity up until that time and really not given any responsibility other than, other than learning the plant and preparing for the license examination.

HUNTER: Joe did you go through those previous trips in your training, were they presented to you as a package of trips that this plant has responded to you or has it encountered?

LOGAN: Not in the matter in which your presenting it, the going through with the training, the foreman that I dealt with on training, I had a kind of one on one arrangement with two of the training foreman they were taking me through, we go through systems, the training program is broken down into components where you take systems which include operating and casualty procedures and there to a period of in my case approximately a year these are presented, the casualties at that time are presented you know as examples of what occurred but to answer your questions specifically, no I was not presented a package of trips that had occurred in Unit 2.

HUNTER: You did not review them as a specific package?

LOGAN: No, I did not.

HUNTER: Ok, lets...I guess I wanted to key on the issue that the normal type trip from 100% power, is normal to plants are analyzed for these, they must be, there not and you know it's, the normal type high pressure trip, reactor trip from a turbine trip then would in fact, had in fact included the initiation of the emergency injection system before at Unit 2 which you were aware of secondly you indicate that

during that special test and we could go back and look if you don't recall and we will, I'm sure I can assure you but you indicated that the pressurizer level was above normal, do you recall how much was, are you know, a small amount or a significant amount?

LOGAN: I would say it would be a significant amount, were still in Tech Spec but it was significant amount where we would normally opera ., I can't recall exactly what or we could find out very easily.

HUNTER: Ok no problem, let me ask you concerning that type trip, are you aware that night that the pressurizer sprays were in manual and the heaters were in manual and the plant was being operated in that condition due to an apparent relief valve safety valve leakage problem?

LOGAN: Yes, we had a experienced a relief valve leakage for sometime within the Tech Spec limit, but we had experienced in fact that we're having a problem in identifying which of the three was leaking, whether it was the electromatic or one of the two code safetys, the thermacouples located downstream of these valves, they all tie into a common line and at various times we have speculated it with various valves, the eletromatic relief being the most suspect and in fact had identified a spare in the, in the warehouse a spare relief valve that that we had, were making plans if we could identify which specific valve was leaking that we would put in on the first oportunity.

HUNTER: Ok.

LOGAN: Now the, I lost my train of thought...

HUNTER: The next thing was I said Ok, the spray valves are on manual and the heaters are in manual and that's not a normal operator condition for this particular Unit, due to this concentration of boron in the pressurizer by the leaking valves, safety valves or relief valves, do you recall or were you aware of the actual leakage that had been attributed to those valves at that time?

LOGAN: Yes, the amount of leakage, right.

HUNTER: Yes.

LOGAN: We had calculated it, it was ah little over one GPM I forget exactly the value that we had calculated, estimated I should say, the problem of course being with the boran concentrating in there as your leaking through and we had, trying to surge it in and out if you will to try to get a good mixture, so it did'nt concentrate in the pressurizer.

HUNTER: During the 100% power trips that were done or were previously occurred or testing, do you recall that the pressurizer heaters were in manual and the spray valves on?

LOGAN: In manual?

HUNTER: Right, in manual.

LOGAN: No I do not, I don't think it was, either.

HUNTER: Ok, another question concerns the spray valve, have you observed any specific trips at this plant, yourself?

LOGAN: You mean been in...

HUNTER: Being in the Control Room and observed a trip testing or otherwise?

LOGAN: The one that we had for the, the planned one.

HUNTER: Did the operators at that time when the plant tripped place the spray valve in manual override and open it to limit the pressure increase, in parallel with the power operated relief valve open?

LOGAN: Not, I don't believe for the test that we did because part of the test was determined that the plant could take care of itself, if you will, I'm trying to think if I had been there for any others and I...

HUNTER: Have you ever had to discuss the particular use of the spray valve in the manual override condition or position during the trip as far as operators routinely using that valve to parallel the power operated relief valve to minimize pressure increase?

LOGAN: I'm not sure of what you mean, discuss it in the operation of the pressurizer system.

HUNTER: Of the system operation at this point.

LOGAN: I have certainly, certainly considered the operation of the spray valve but that is no different that any other reactor system as far as using the spray valve to control pressure.

HUNTER: The spray valve on a pressure increase, would in fact open.

LOGAN: That's right.

HUNTER: That's correct.

LOGAN: If it doesn't open by itself obviously the first thing you want to do is try to open it.

HUNTER: I understand that, if it in fact has opened I understand there's a limit on it as far as the amount that it will open.

LOGAN: That's right, normally if, if automatically open, normally it goes 40%, as I recall, open.

HUNTER: And my question I guess was have you in dicussions with the operations group or training report committee discussed the use of the spray valve above 40% to the minimize the pressures surge ah increase during a trip?

LOGAN: I have not specifically, as I recall, ever discussed that although the fact that if you want, you know you could open it wide if you wanted to and the, we, well I do recall one time if that thing stuck open we, cause I believe they had done this in Unit 1 there was a discussion at one time I recall a hot and heavy discussion as to weather you know your heaters could come on and sustain that, if it were failed open and where you would level out but that was the extent of any discussion that I can recall ever having on it.

HUNTER: Ok, one other question and then I would like to rest awhile, I'm sure you would for a minute and then we will let Tim have a couple questions, also. The plant is, its at 5:45 you have come in, you got a status, granted the conditions are not normal, but the reactor is there it has just tripped from 100% power, there is a certain amount of decay heat associated with this plant. It's part of the program that were involved in, the hot leg loops were high, the cold leg loops were down, all about that time, by the time you saw, by the time you

got in to look at the program, did you or did you and Zewe or Kunder any of the group discuss the removal of the decay heat from that plant by any mode or mechanism and tell me what you discussed and what your conclusion was?

LOGAN: I was trying to get the point across I guess throughout here, my concern was getting those pumps moving to remove decay heat from the plant.

HUNTER: And I understand that, let's go back and let's look at it from the standpoint that when you came in there were no pumps and what was your mode of decay heat removal and without pumps was the fact that decay heat was being generated without pumps discussed and was, and what was the thought or the frame of mind concerning decay heat before the pump was put back on, I understand the decision to try to get the pump on to circulate the water, I don't think that's, that's, this particular I'm a not keying on, the point being one key that I want you to key on and to give us the thought frame, is what was discussed concerning the removal of decay heat from the plant at that time when you were sitting on natural what was supposed to be natural circulation and it came very obvious due to the lack delta T's and the interviews we had that the natural circulation was in serious jeopardy, at best you may have been transferring a small amount of heat at the surface areas of the tubes steaming over the bubbles were probably in the loops, what was the thought train at that time?

LOGAN: My thought train was to get a pump going and trying to figure out how, my first _____ came in or my first thought was why aren't the pumps on, why were they secured, the rationale given was we have some screwballs indication on that Gentilli, we had had problems with the Gentillis before, in fact that was one of the reasons we were not at 100% power because of the one Gentilli had never, was indicating slightly less that the other. I therefore had some suspicion of Gentillis in general as to whether that was a valid indication but when one both Gentillis ware I think they said both Gentillis were fluctuating to me, I suppose that was rational decision to secure two of the pumps, the other on the pressure temperature indications when they secure them I can't fault that but at the same time in retrospect you got to get circulation in there was my thought. And I don't know how long when you say discussed it, I don't think there was much of a discussion, my feeling were we had to get a pump started. how long this took, it was 6:40, time goes pretty damn fast I guess when your in there, your trying to determine what caused the trips, what condition are you in, we had several abnormalities you'll have to appreciate in that condition, one, the indications of a high pressurizer level, a low pressurizer pressure, no pumps running, an isolated steam generator, you know, your hit with this the first thing in the morning when you come in, I came in thinking it was normal. , I should say I would find a normal reactor trip, turbine trip indications there and to run into this, to say the least disquieting. I don't recall specific discussions, quote no removing decayed heat. I think that always goes through your

mind. You don't sit down and say how are we going to remove decay heat, you say how are you going to get the pumps going, you know. I had not considered going into natural circulation until we proved we could not run those pumps. And when it, to me, the fact that we had a pressure temperature curve limitation that would not restrict me from operating a pump.

HUNTER: I understand that.

LOGAN: And that was my concern was getting a pump going.

HUNTER: I guess, again I'm trying, were looking at this thing in retrospect were trying to understand that the steam generators were set there and basically they were not steaming, what little bit they were steaming was just minor amount not feeding because they were not steaming, basically sitting on the ll valves. Really the steam rate is so small that he's had to actually isolate one generator to try to keep heat off to keep the level from coming down it was leaking through and then he made the decision, hey, this thing may be leaking. The steam rate was very small, the decay heat that was being generated was in fact having to be removed in some method other than ambient losses across the pipes and I, looking back, looking at this situation, was the high pressure injection flow rate discussed, specifically that this is the mechanism which we are in fact cooling core, it is the only thing left because we now have steam generators which are not

seeing the reactor core temperature, we have reactor coolant pumps which are for whatever the reason inoperable because we, in fact, have gone below the net positive suction head pressure curve and are taking a chance on loosing them, it may be creating a LOCA and I understand that you know we have a seal failure that that could place the plant in jeopardy, but then backing into the third issue, the third level of protection that we had backed down 70 degree boron, recovery storage tank water and a hight pressure injection system that would put out 2900 pounds if needed at 500 gpm plus and that cool water would be the ultimate level of providing core cooling at that time, was that particular area even discussed or did it cross your mind at all?

LOGAN: No.

HUNTER: Did George Kunder to say anything about high pressure injection flow or at that time, do you recall, you know looking at that time frame?

LOGAN: I don't recall a discussion, were talking about now the time frame of the time I got there till we started the pumps, I don't recall any that, or tryed to start the pumps, I don't recall any conversation of that nature.

HUNTER: At the time you started the pumps, have you looked at the high pressure injection flow?

LOGAN: No.

HUNTER: To see what they were.

LOGAN: I don't even recall the high pressure injection was occurring at that particular time, it doesn't ring a bell in my mind.

HUNTER: It may or may not have been occurred.

LOGAN: That's right.

HUNTER: You did'nt really look at it.

LOGAN: I don't think it was but now when you say, now, you mean with the...

HUNTER: Not ESF, but the makeup pump putting in "X" gallons per minute of water to that core, did you look at the flows are they normal?

LOGAN: No, I did look at the flows but I can't say we were not putting water in there.

HUNTER: That's right, well with a high pressurizer level Joe, if I understand it right, the makeup valves, the 17 valves on high pressurizer level in automatic, would be closed.

LOGAN: That's right.

HUNTER: The flow path, then, in order to maintain injection flow of some type, the sealwater injection to the pump is on because the guys were sensitive to that area also, the other path would be through the 168 valve, the injection valve or A and B or any combination but you did not look at that particular flow?

LOGAN: No.

HUNTER: Ok.

LOGAN: My concern then was trying to get a pump going and the confusion if you will of the situation that existed in with the multiple casualties that occurred, I don't, I can't recall that the 16s were open, we had a high level and I, if someone had asked me if they were open I would of said no they weren't at that particular time.

HUNTER: Ok Joe, thank you at this time I'm...

MARTIN: Alright I'd like to continue, alright as we've point out before approximately 3 hours into the event we had started a reactor coolant pump, we operated a reactor coolant pump for approximatly 19 minutes, why was that pump taken off the line, was it tripped by a operator or did some automatic system take it out?

LOGAN: As I recall, if that, and I suppose we did get a pump started at that time obviously, I think it may have, I'm trying to recall whether we actually saw 100 amp it dropped down to 100 amp or not, if so, it was an operator action that took it off, and I don't recall a pump tripping other than an operator tripping it, the entire time I was there, so I would say if I recall properly, we would of tripped it.

MARTIN: Do you remember any specific action that the operators took when that pump was tripped off the line, such as a changing makeup flow, going to high pressure injection, emergency borating whatever.

HUNTER: Or manually main initiating high pressure injection.

LOGAN: Sometime during the morning we did do that and again trying to equate this to specific time I'd have to look at the sheet and see if we did, we did do it sometime but I don't recall.

MARTIN: You referred to a sheet, what sheet are you referring to?

LOGAN: No, the curves from the recorders.

MARTIN: Shortly after that pump was shut down, apparently Mr. Miller arrived on site and sometime after that Mr. Rogers arrived, the think tank people arrived, were there any subsequent starts of reactor coolant pumps?

LOGAN: Yes I don't know what time this occurred, at one time I recall Rogers, Miller, myself, Shift Supervisor-Zewe, and Mike Ross starting the pump we had. Rogers as I recall was in communication with Lynchburg at that time. I think his conversation was keyed to starting the pump and letting it run for a limited amount of time as I recall the conversation going and then securing it, waiting a period of time and starting another one, this was predicated by then, I believe we had determined that we had an air a bubble in the loop and we were attempting to sweep it out, I suppose would be the best description.

MARTIN: Is this in the morning Joe, are we talking about like 7:45, we know he made a call approximately at that time?

LOGAN: That's were my mind is hazzy as to when that particular action occurred...

SINCLAIR: Let's break here, 7:44 p.m. were gonna have to break to change the tape.

SINCLAIR: The time is 7:45 p.m. were continuing the interview with Mr. Joseph Logan.

MARTIN: You remember at least one start, do you remember any additional starts, did they try one in each loop to your knowledge?

LOGAN: At some time and I don't recall if this was the 7:30 attempt we tried more than one pump and I don't know if we tried all four, at one time we tried all four but I don't remember which attempt it was.

HUNTER: Joe what was the problem with the pumps that they would'nt start?

LOGAN: The amperage no, we tried to start, nothing happened, we tried to start, the pump just would'nt start.

HUNTER: Do you recall any investigation at that time, was that, determine whether they had some type interlock that was preventing it to start.

LOGAN: I know we checked, as you know these pumps, the lift pumps, there is a series of pumps that come on before the pump starts, and I know we checked to see that because we had no indication of the oil lift pump bearing, the lift pump and the bearing pump didn't come on, and I recall we checked but right now it alludes me as to what we discovered.

MARTIN: Did we ever get one started and running at a 100 amps?

LOGAN: At a 100 amps.

MARTIN: Approximately 100 amps indication.

LOGAN: If we did we tripped it and it seems to me we did and did trip one as I recall.

MARTIN: Alright Joe, from 8:00, let's make it 7:30 to 10:00, do you have any feel for what was going on during that period, an idea at all?

LOGAN: Yes and no, we, when Gary Miller arrived he took charge, we have as you know an emergency procedure that we follow which involves a series of events including not only the communications aspect of informing various and sundry people but establishing our ECS to vector people out to take samples and this type of thing. Gary had put me in charge of seeing that that aspect of the emergency plan was being conducted, and at the same time we were discussing the conditions of the plant. The bubble that we had finally accepted, I guess if you will as being there, how to get rid of it, the fact that we were having tremendous problems in trying to collapse the bubble to, the idea of course was to try to get the bubble out of the, into the pressurizer where it belongs, this type of thing, the use of the electromatic relief, the fact that we were concerned of it's failure it had by experience in Unit 1, they had, had at least one failure that electromatic relief over. There continued use of it was of concern that it might fail, also. I would have to say, yes, I was

aware of the problems that we were experiencing and trying to shut the plant down safely.

MARTIN: Alright Joe, somewhere during this period of time the general emergency was declared, do you have a feel for when that happened and what might be the key event?

LOGAN: The reactor building, reactor dome alarm hitting it's high limit is of course one criteria, I forget whether that's what stimulated us to got to the general or whether it was the two alarms, the alarms gone off in more than one building, both of those were criteria for us to declare a general emergency and I can't remember at the time which one caused us to, I think it was the two alarms though, alarms in various buildings that went off, the reason I say that, is the dome subsequently did certainly go into high alarm status and remained there for several, a long period of time and still there.

HUNTER: Joe was there any discussion of problems with the pressurizer heaters at this time and did you have a sufficient number to...

LOGAN: No, we had failures of the heaters and I don't remember how many that we had on at this time, whether, we had, I might add prior to this accident had to have some problems with heaters tripping and we had a program underway to try to ascertain the identification of which specific ones, not which specific ones cause we knew which ones

tripped, but to try to ascertain if it was a temperature problem in the coil itself that was tripping them or just what the problem was, the heaters that failed and I again I can't recall just how many grounded, I presume because of the temperatures, the humidity that we experienced in there. I was aware that we had heater problems.

MARTIN: Joe, somehwere in this event it was decided to increase steam generator level to approximately 90%, what was the basis for that decision and what did that gain?

LOGAN: At this time, again this one is hazzy as to when we did it and the reason I can, I would have to say we probably discussed natural circulation to try to provide a driving head to high, to start it, frankly I don't recall that particular aspect.

MARTIN: Approximately 9:15, 9:20 in the morning a pressure trace showed that marked increase in pressure heading up toward a pressure of 2000 to 2200, obviously some decision had been made, something was being done here by the plant operators, what was that decision and what was the tatic being used?

LOGAN: I think they decided to, the idea was to try collapse the bubble if we could and go solid and collapse the bubble wherever it was.

MARTIN: What lead to that obvious change in direction of the plant? Up to this point from 7 to 9:30 pressure had meandered around generally had a downward trend.

LOGAN: You mean how did we get the pressure up there?

MARTIN: Now so much how you got pressure up there but I'm trying to understand from about 7:30 to 9:30 what was the tactic that was being used then, why were we letting pressure slowly tail off?

LOGAN: I can't recall when we, prior to this I believe we had isolated that the, the electromatic relief block valve, I believe. We had initiated high pressure injection at sometime after Gary got there and I don't know if it was at this particular time or not, I just don't recall.

HUNTER: You indicated you initiated high pressure injection after Gary Miller and I assume the Superintendent arrived, what was the discussion before initiating or the and reasons for initiating high pressure injection, do you recall?

LOGAN: I can't specifically because at this time we had gone into the general emergency phase and of course in a I was kind of involved in trying to get the monitoring teams out and this type of thing and my, I was in and out on these things, I would presume that we had decided

by this time that a bubble existed in there and we wanted to insure that we were putting water in there as a means of removing heat, I think at that time we were cycling the electromatic as a means of providing some flow through the system.

MARTIN: At approximately 10:00 we increased pressure to 2000 pounds and examining the wide range pressure trace we see a saw-tooth pattern in pressure, can you explain that pattern?

LOGAN: I don't know if we were opening that valve or not, the electromagnetic, at that time I can't, unless that's the reason, obviously the pressure is...

MARTIN: Let me lead you, based upon some other interviews, we were told that directions were given to the operators to control pressure 2000 to 2200 cycling something on the pressurizer, do you know what they were cycling?

LOGAN: I don't know at this time whether we were cycling the spray valves, I don't think we were solid at this time, cycling spray valve are the...

MARTIN: Since we did'nt have reactor coolant pumps.

LOGAN: Oh, ok, yeah, it must have been the electromagnetic.

MARTIN: The electromag or it's block valve?

LOGAN: Well...

MARTIN: Or was it the pressurizer vent?

LOGAN: When did we go to the vent, I don't know right at the moment, I can't recall.

MARTIN: Did you ever use the pressurizer vent?

LOGAN: We have used the vent and I'm trying to remember if it's after we came all the way down or whetner it was during this period, I don't really remember, from the indication there it's probably wasn't the block valve that's, the block valve would be a little more eratic but we did use, I know we used the block valve but I don't remember if it was at this time?

MARTIN: Let me help you a little further, approximately 11:30 in the event we see an increase in the range of the pressure spikes and we're told that that has some, based upon some managment decision, do you understand why that was done, why is the operator now being allowed to control in a wider range of pressure and that might key you to what there using.

LOGAN: I think that that was when we decided that the block valve could fail or might possibly fail so we probably were using the block valve and had decided to lengthen from the intervals in which we were cycling it, I know that was a concern in our minds that the failure of that thing could cause us additional problems.

MARTIN: Alright by 11:30, excuse me Joe, by 11:30 we obviously arrived at another decision point, can you explain the basis for shifting gears again, taking new tatics, this case we see a drop in the reactor coolant pressure, obviously something new was being done?

LOGAN: Yep, I'm trying to think in my mind what we did at that particular time, what we trying to do is get the bubble in the pressurizer which I think partially explains that drop in pressure, I'm trying to remember how we did it, at that time I believe we started a pump if I'm not mistaken.

MARTIN: Reactor coolant pump

LOGAN: I think so.

HUNTER: Let me, let me, I have to feed him some information, this is not, if we were here two days ago I'd get upset, I can't, I won't, at this point it appears that the plant was going to be depressurized to this level and the mechanizm for depressurizing the plant, the decision

was to depressurize the plant to a low level, apparently, if you follow the sequence out, at where did we go, we went to about 12:00 or so we would see, we would see, at 12:30 or so, we would see a core flood tank alarm that says core flood tank just let me give you the number 13.3 feet that type of alarm.

LOGAN: We were trying to establish again level to determine whether we actually had the core flooded, we felt if we could put the, drop the pressure down put the core flood tanks to see how much water went in we could determine the level from the drop in the core flood tanks if we in fact did have the core covered and I believe that was the decision, again when these decisions were made I wasn't really participating in that, I might point out that I really have not had opportunity to go over these.

HUNTER: We probably would rather that you had had an opportunity to go over these.

LOGAN: I had looked at them once but I...

HUNTER: Ok, that's alright but you, the decision to depressurize to below core flood tank, were you involved with Gary and Kunder and Miller?

LOGAN: Not directly, I knew when they put the core flood tanks on what they were attempting to do but as far as a decision, Rogers I'm sure was heavily involved in this, Kunder, Seelinger might have been over there at that time, Jim has been here an extensive period of time in the construction of Unit 2, I don't know if Jack Herbein, I'm sure he was perhaps involved in that decision also he was not in the Control Room but I'm sure he must have been involved in that decision.

HUNTER: Joe, a question along that line, not being directly involved in that, one thing comes to mind is that your position there being a Unit 2 Superintendent and falling on some of the emergency planning type program, what was your position relative to the think tank, were you available to it, inside it at the edge of it or did you jump in the middle and kick somebody in time or I mean were you free to state what you thought, you know what was the posture at that time?

LOGAN: The quote "think tank" if you remember was in the, it moved around but it was generally in the Shift Supervisors office, we had to set up the ECS on the outside of that on some tables that we had set out for plotting and direction of the teams and that was out in back of the computer table, if you will, in there that's where our actions were mostly coming to, Gary was conducting the quote "think tank" if you will, with assistance from Jim, Mike Ross, Rogers and I'm sure on conversations with Jack on the phone and he was constantly on the phone. My contributions were certainly I'm sure welcome, I don't

think that I offered much in this particular situation, they were, people that were there were much more experienced that I both in the construction of this plant and the operation because of the similarity in Unit 1. I was not excluded from it, but at the same time Gary felt that somebody had to direct the ECS and we had gone through two drills just, you know very much like this in the previous year, latter part of previous year and my job was primarily to get that thing moving.

HUNTER: Ok, Joe and being at the side line do you recall any high pressure injection flow discussions at that time, are you aware of any, what that injection flow was during the actual event?

LOGAN: The actual flow rates, no, I couldn't, I can't recall.

HUNTER: That the injection was in progress or that, minimum or...

LOGAN: I, quantatively I can't say how much the flow rate was, the fact that we did have high pressure injections at various times, yes I was aware of that.

HUNTER: Along that line Joe, when they, at any time was a report made to you as the Unit 2 Superintendent specifically by anyone as far as where you were, what the conditions at, were when they either obtained some stable condition or apparent stable condition so that you were aware of what the plant condition?

LOGAN: Not specifically to me, I was there in the Control Room and I was aware as these things occurred you know but as far as somebody turning around and saying we're at such and such a level, no, no such report was made, there was no question as to who was in charge of the Unit and that was Gary, by that I'm trying to point out that your in a situation like that, you know if they secure a pump your there watching it, they don't turn around and say we secured the pump, for instance, I was aware because I was there at what was going on.

MARTIN: During this period of time were you aware of that we were steaming to the atmospheric steam dumps?

LOGAN: Yes, we put people up on the roof, well I remember at one time we started to put them up then pulled back, and then subsequently we put them up there to monitor any releases that we might have out of it, we did not of course think that "A" steam generator was leaking but we wanted to try to varify that because we you know it was a potential source.

MARTIN: Joe were you aware of a sample that was taken on the A and B steam generator earlier that morning?

LOGAN: Before the accident?

MARTIN: No sir, sometime probably after that additional reactor coolant pump was run, when you arrived.

LOGAN: At sometime and I don't know if it was that day or not, I was aware that we had taken a reading on the generator, the B generator cause that one was of concern, now wheather we took on the A that might have been reported to me also and in fact I would of have expected it now that I think about somebody probably did report to me that we had taken a sample.

MARTIN: But you don't remember the results of the sample.

LOGAN: I, no if we got one I know that I'd, we did'nt have any indications or nothing sticks in my mind that we had any indications that it was leaking.

MARTIN: What was the source of feed for the A steam generator at approximately 11:00, 12:00 in that range do you have any feel?

LOGAN: Source you mean that...

MARTIN: Where was the water coming from, you were using, initially, the emergency feed early in the game, are you still on emergency feed now or are you using some other source?

LOGAN: I don't recall, I would think that we were probably still on the emergency, I don't recall anybody at the time I arrived, going down to lining off the feed pump but I, I can't say.

MARTIN: Joe when was the atmospheric steam dumps secure, do you have any feel for that time?

LOGAN: I think we were, it must have been around, somewhere around noon or shortly thereafter, as I recall we were, that occurred I think when Gary went to, he left the site to visit the governor and I think he called back and said secure them, I think, that thought goes through my mind, I could be mistaken but...

MARTIN: Were you in the Control Room at approximately 2:00?

LOGAN: I was in the Control Room from the time I got there for 30 hours.

MARTIN: Did you receive a report that the reactor building sprays had actuated?

LOGAN: No I did'nt and I was standing there I think when it happened, there was a group of us, this happended in looking back around 1:30, 2:00, when that happened we heard a noise and I recall asking what it was, somebody reported it was the ventilation system and it could of been never having heard the...

MARTIN: Did you hear the noise?

LOGAN: Uh.

MARTIN: Did you hear the noise yourself?

LOGAN: Yes, I presume it was that noise but it could of been a ventilation.

MARTIN: Do you remember something like Mr. Miller saying what was that?

LOGAN: Yeah, well I, yeah.

HUNTER: Joe is that what you said?

LOGAN: Yeah, I think I asked him if I'm not mistaken, but anyhow somebody said, I remember somebody saying it was the ventilation system, now that's when the spray pumps must of come on there was a group of us there though I don't think anybody, I don't recall anybody saying the spray pumps took off, I presume they must have but in what was going on because we were doing something else, I forget whether it was trying to start the pump again, I guess it was, trying to start a pump again at that particular time, for some reason I know we were all right in the vicinity of the panel, the control panel.

MARTIN: We are at approximately 500 pounds, do you believe that we were trying to start a reactor coolant pump at this time?

LOGAN: We were doing something, I'm trying to remember just what.

HUNTER: Was there any discussion continuing and trying to put in core flood tanks or was at that time your understanding that you were stable on the core flood tanks and that that's, that was as far as you, as far as you, as far as you intended to go, was there any discussion of going down to the decay heat at that time?

MARTIN: Something like opening an eltromatic relief at that point.

LOGAN: It was further down here I believe, down here wasn't it.

HUNTER: This is the, that spike is concurrent with the, yeah 8 hours, 9 hours, 10 hours, this is the spike at almost, well it turned out right at 1350, whatever, this spike occurred but the power operated relief valve in fact, in the pressurizer heaters which has very little probably, it could of been that but the power fail operated valve appears to have been opened at that moment.

LOGAN: Your right it was, something that could of caused the you know a spark in there and I think it was the pump, now refreshing my memory I believe we did operate that, I'm trying to, I don't recall right now why.

HUNTER: Ok, you don't have any reason, you don't remember why it was being operated at that time?

LOGAN: No but there were, it was planned I remember because we went over there and I'm trying to remember why though.

MARTIN: Were we operating the pressurizer vent system during this period.

LOGAN: I don't I don't remember.

HUNTER: At 1400 there is a substantial pressure increase 550, 560 after sitting at this level and then the decrease, do you have any, was there any discussions for the pressure change at the time of the coolant spray pumps, having the containment spray pumps operating or...

LOGAN: At the point it would have occurred.

HUNTER: At the power operated relief valve at that point being operated, do you recall any discussion of a pressure change in the reactor coolant system or do you recall increasing or decreasing any high pressure injection flow that would of caused that type of pressure change?

LOGAN: I don't recall anything, no.

HUNTER: Do you recall Joe in the discussion of decay removal, or when was decided that we are not going to decay heat or that we can't get to decay heat, do you recall any discussions concerning that?

LOGAN: No, I do not recall any discussion on decay heat.

HUNTER: There is a point that, Tim, is not, that Gary in fact then was called at noon apparently was indicating of hey we want you to go to the Lieutenent or Governor's office, and somewhere around 2:30 in that range Gary left and was, went to the observation center, was picked up by Jack and then they proceeded, who took Garys place at that time, Joe, did you take Garys place at that time?

LOGAN: Yeah, I took his place.

HUNTER: Ok, and what was the plant condition at the time you took his place?

LOGAN: We were quote "stable if you will."

MARTIN: Stable by definition meaning to you what?

LOGAN: Stable you could be in this condition, there wasn't any changes we were, the flood tanks, we were sitting on the flood tanks, no pumps operating, we were steaming the A generator, we had been sampling in various places for offsite, onsite readings, at that time I think our major concern was the releases that were occurring and trying to protect people, our own and others, I can't remember the exact time that we made a decision as to move people from various locals from within the site and again all this is kind of hazzy, as to when we made these decisions whether Gary was still there. As I recall some of those decisions we made while he was absent as a result there's some indications that we had of radiation levels within the, within Unit 1 or close to Unit 1 on the periphery.

MARTIN: Joe, Tim Martin here.

SINCLAIR: Let's break here, the time is 8:17 p.m. we are going to take a break here to change tapes.

HUNTER: Following a short intermission, we are continuing the tape of Mr. Joseph Logan. The present time is 8:25 p.m.

MARTIN: Joe, it appears that approximately 2:30, we believe that Mr. Miller has left the site. You are now in charge, and we note that from there on we see a steady, very slow increase in pressure. Was that a result of something you were doing? What was the status of the

makeup system? Were we still on high pressure injection, if so, how many pumps?

LOGAN: I don't really recall, I would presume we were on one at this particular time, if we had a pump on injecting into the loop. We obviously had a, we kept a pump, one pump on, of course, for seals, but I don't think we had more than one on.

MARTIN: Alright, during this period of time there was some discussion of a maneuver that was utilized to hopefully condense then thought to be steam bubbles in the candy canes. Are you aware of the maneuver and how was it executed?

LOGAN: You'll have to refresh my memory a little bit...

MARTIN: I believe it had to do with the operation of the high pressure injection system and certain valve operations.

LOGAN: I'm a blank with that. If you could prompt me a little bit more I might recall it.

HUNTER: ... let me prompt you a little bit more. Was there discussions that you were involved in to, let's go back a step. The thought at time apparently was that there were steam bubbles, vapor, in the hot legs exiting the core, the reactor vessel which in fact go up and turn

down into the top of the steam generators. More commonly known as candy canes, so that we'll know what we're talking about, and during this time with one high pressure injection pump on, apparently, and then possibly starting a second pump and turn it off, and start and turn it off, not necessarily that being the important part, do you recall any discussion of utilizing a flow path through the spray valve, the first issue? Do you recall that at all?

LOGAN: Without a coolant pump running?

HUNTER: Right. Any auxiliary spray flow, anything along that line?

LOGAN: You're not ringing a bell.

HUNTER: Okay. Any use of the pressurizer vent line at that time?

LOGAN: I don't recall that.

HUNTER: Okay. What about the four safety injection valves, the 16 A, B, C, and D. What about, any talk about of shutting, maintaining high pressure injection flow, or varing flow, and closing two, and flowing through two specific valves, closing two and flowing through two specific valves and operating the flow paths in that manner.

LOGAN: At this particular time I don't recall that discussion.

HUNTER: Okay. You said at this particular time.

LOGAN: When Gary was gone.

HUNTER: Okay. Do you, in fact, recall that discussion before Gary left or possibly later in the evening?

LOGAN: We tried many things and there were many discussions, you know, on, addressing the problem of trying to get rid of that, the bubble that was in there, in those legs. To be specific about it, I can't recall the discussion right now. If you continue I may all of a sudden the light may come on, I may recall it, but I don't right now.

HUNTER: No, there were some specific activities apparently to slosh the water, if you will, in the legs in an attempt to, I guess, in the attempt to possibly condense, maybe, the steam in the loops somewhat. They had, I believe there is an indication on the hot legs at that time. At least it came down as a result of possibly getting some water into the core causing some boiling or causing some action in the legs or whatever, and possibly circulating some steam. Again, Tc at that time is very low, if I recall my curves right, and Th is still up high. You still delta T of many, many degrees fahrenheit which would indicate the low flow or no circulation or convection ... heat removal

by convection if there was any heat removal. Do you recall at any...a time during this activity when there was a discussion concerning increasing high pressure injection flow and maintaining high pressure injection flow above a certain number in the early afternoon or the middle afternoon, do you recall a discussion concerning that? Did anybody bring to you some information from Unit 1 control room stating it has been recommended by someone that the high pressure injection pumps be placed on or the high pressure injection flow be increased to a certain level and maintained above that level?

LOGAN: A recommendation from Unit 1?

HUNTER: A recommendation delivered by Unit 1 by a Unit 1 person or by the hot line recommending...

MARTIN: Mr. Hitz, specifically?

LOGAN: It could have been. I don't recall.

HUNTER: If you didn't get the message, Joe, who would have intercepted that or who would you have had as you right hand man in charge of that plant who would or should, who should have intercepted that information and utilized it? Would that be Mike Ross?

LOGAN: Mike Ross was in, you know, direct charge of the operations there, but I'm sure he wouldn't have done it without telling me. I just don't recall the conversation. He, you know, he could have but...

HUNTER: To give you some background just what we or what I'm understanding is the point being, that some words, did come in and since as you were well aware of Unit 2 control room may not have been as available for communication as it could have been, the method to give information at times was by Lee Rogers from somebody's house. Okay? And then long distant to Lynchburg, and but also possibly calling you, some outside people calling Unit 1 and indicating to Unit 1 people at the supervisory level, Mr. Hitz is an example, to specifically relay information to the Unit 2 management and do you recall anything like that...?

LOGAN: I recall Greg Hitz coming over, coming in there.

HUNTER: Do you recall, where did he go or what he did?

LOGAN: Right now I don't. You mentioned Hitz, and I remember now, I picture him coming in but still kind of hazy. We did go ....

HUNTER: Did he go talk with Mike Ross or Zewe?

LOGAN: I don't know. I don't remember. I remember, it seemed to me that Gary had sent word while he was gone to do certain things, and I can't remember what those were. I may have been that, it seemed to me that he sent word though to secure the dumps, for one thing.

MARTIN: Joe, how long did you stay in charge of Unit 2, specifically, in Gary's absence? How long did you specifically, or did you remain in that position the remainder of your 30 hours?

LOGAN: No, Gary came back, Gary came back and took charge.

HUNTER: Did Greg Hitz possibly go talk to Gary, was that the time frame, was Gary back at that time?

LOGAN: I'm a blank. You hit me on a blank. I don't recall the instance that you're referring to.

HUNTER: I'm trying to recall now, see, when Gary back and I had apologize, I should have had that ....

MARTIN: Assuming that Mr. Miller left, do you have any feel for the length of time Mr. Miller was gone? We've heard various estimates of like an hour and a half.

LOGAN: Time meant nothing to me during that period.

MARTIN: Assuming that he actually left the control room at approximately 2:30, that would put him back to the control room around 4:00, do you have any feel for how long after he got back before the decision was made by or the direction was given by Mr. Herbein to repressurize the primary system.

LOGAN: I have no time correlation as to that sequence.

HUNTER: Do you recall that discussion ... repressurizing the primary system and get a pump on or repressurizing...

LOGAN: During the entire period of this incident, Gary was on and off the phone. There were discussions back and forth, recommendations, consultations, calls to Lynchburg, calls to Jack, back and forth, and I'm sure that, if I set long enough and enough instances were recalled, I would remember...

HUNTER: Are you indicating to us then, Joe, that when Gary was there that he was in fact getting the information and it would be that he was in charge, that he would make the decision to repressurize rather than say you... based on information that you know?

LOGAN. No. I'm sure that Gary made that decision after consultations or direction if you will.

HUNTER: It did not occur while you had, while you were in charge of the activities while in Gary's absence. He was back at the time when the decision was made to repressurize.

LOGAN: I would say yes. I don't recall when we went solid, frankly.

HUNTER: When Gary came back, Joe, where did you go? What was your next activity that you were involved in?

LOGAN: Well, I was still in the ECS...

HUNTER: You ended up back on ECS?

LOGAN: Well, let me say that when he came back, of course, things were somewhat better organized than at the start of this...and I'm not sure that I went back to that function as a sole thing, in fact, I don't believe I did, the more I think about it, except in a overseeing role, if you will. By then we had quite a few people up there. It was, I wouldn't say running in automatic, but it was, we had enough people up there where we were more into our, and I don't say normal, organization but we were better organized by this time because people had come in and taken over their functions that they were assigned to.

HUNTER: And then what, you may have been observing that activity that you indicate, but were you observing other activities all along?

LOGAN: Yes, yes. My main function at that time, I felt, was to keep Gary informed of really what was going on in the entire sequence; the ECS, the plant, if I saw something that was going on that I wanted to make sure he was aware of.

MARTIN: So prior to the direction being given to repressurize the plant, I believe the control room was having, or believed they were having some success in quenching the bubble in the A loop. I think that there was some belief that the plant was stablizing, the level of pressurizer had finally returned on scale. Do you remember any discussion relative to repressurization and why it might not be advisable?

LOGAN: We had conversations, I remember, particularly with Lee Rogers, in trying to surmise what would happen when we lit off one of those pumps and that the bubbles should sweep into the pressurizer, how low it would go, things of this nature. I don't know if that's what you're referring to.

MARTIN: Let me take you to one other point which is very interesting to me. Once we had repressurized, we got up to approximately 2300, 2305, or something like that, and you don't see the saw tooth pattern that is typical of the block valve on the EMOV. You obviously found some other way to control pressure and I'd like to know what that was.

LOGAN: Well, I can't really tell you what it was. Maybe the vent valve. I don't remember what we were using.

MARTIN: Okay.

HUNTER: Hunter speaking. Joe, will the spray valves in this plant operate with one reactor coolant pump running? Will they deliver flow through the pressurizer?

LOGAN: I never tried it, but I assume they would. Certainly on the A loop...

MARTIN: This is Tim Martin. After we have reached pressure again, we held fairly constant pressure until approximately 1945 when we finally had completed or solved our problems with starting the reactor cooling pump. Can you enlighten us on what those problems were and in what you experienced when they finally bumped that reactor coolant pump?

LOGAN: I think our level came down and we removed part of that bubble, or put a good part of the bubble, I should say in the pressurizer. The, let's think what did we do with the, to start the pump, whether we jumpered out something. Let me see whether we jumpered out all the interlocks or part of the interlocks and to my recollection we jumpered some contacts and I can't remember which ones, to start it.

MARTIN: Joe, could you identify a person that might able to assist us in understanding how they were able to get the reactor coolant pumps started?

LOGAN: In the control room at that time we had quite a bit of help. Specifically, Rogers was there. Before we started, I believe he was on the phone with Lynchburg. Now, had any number of people in there that, are you asking who went in to do it?

MARTIN: Who would know the specifics of the problems that were encounted in starting the reactor coolant pump and how they got around them.

LOGAN: Zewe was certainly aware, and I'm trying to think who else would, Gary was.

HUNTER: This is Hunter speaking. The names again, Joe.

LOGAN: Gary Miller, Bill Zewe, Lee Rogers.

HUNTER: I'm like Tim, I'm still intrigued by this particular aspect of the pressure curve where at one point it was very obviously a gate valve open and closed type operation in an area where the pressure was very closely controlled. I, prior to starting, prior to starting the reactor coolant pump, at which time, I asked at that time, could the spray pump, spray valve be used and you said yes, with the pump on. At this time there was no pump on, apparently.

LOGAN: No, not at that point.

MARTIN: Tim Martin again. We bumped the pump. Do you remember approximately how many seconds it was run?

LOGAN: No, we had a, it seemed to me it was 15.

MARTIN: Okay, a very short run.

LOGAN: Yeah, I remember because we were counting and then there was a time delay, I guess that's the time I'm thinking about, when Rogers was on the phone, we, a time delay in between when he would, he recommended securing one and starting the other, maybe that was the interval between time, I forget now the sequence. But it was a short time interval that we ran the pump and then sometime we waited, and then we started another pump, I forget whether we started the same pump or started another pump, but...

MARTIN: Joe, were there any precautions that you were observing when you started this pump. Obviously that actually did work. We have some concerns here.

LOGAN: Yeah. We were concerned about several things: (1) the starting, the running current where it would drop down indicating that we weren't pumping the Gentille flow, trying to establish criteria for saying,

yeah, we had flow, pressurizer level, cause we anticipated that it would drop if we washed this thing in there, pressure itself, these were all concerns and, in fact, we posted an individual at each place, you know, to watch those indications, those criteria.

MARTIN: Did you get an ES, as a result of starting that pump? Was ES bypassed at this time?

LOGAN: I think ES was bypassed. We were, I don't know whether we bypassed, had it bypassed at that time or whether we anticipated we would get an ES and did bypass it, I don't recall that specific thing.

MARTIN: After waiting, the required or suggested 15 minute time delay in starting the reactor coolant pump and running it. What new precautions did you now observe in starting the pump?

LOGAN: Would you restate that now? Because I'm trying to think it seemed to me we did have, it seemed that Ed Frederick we put over on the ES panel, now that I think in the back of my mind, who was standing where.

MARTIN: I'm looking for some specific precautions that were provided your operators, actions they were told to take if certain things occurred, that you utilized during the startup of the reactor coolant pump the second time.

LOGAN: Well if we want if we didn't, the pump dropped down to 100 amps, we secure it, if we saw the, didn't see a flow indication of the Gentille we would stop it, and I'm not sure if we addressed any other, we probably did address other considerations, but those are two that I recall. I was standing over by those, I was watching those two things, myself. Primarily as a positive indication, to me at least, that the pump was running, you know.

MARTIN: Joe, during this period of time, you started this reactor coolant pump and you again restarted it. Did you have seals on those pumps? Seal injection? Was it not secured earlier?

LOGAN: I'm trying to remember when we did secure seals and I believe at some time we secured seals to all but one pump. Trying to remember just when that occurred. And I think they were secured because I think I had asked Rogers, Rogers or Stan Menge. I'm trying to remember which day this was occuring in. What would happen, what would be the effect if we lit that pump off? No. What would happen if we secured the seal water while the pump was running? We can run this way, you know that is a acceptable operating condition, but you don't like to. And I remember asking him to get a report from Lynchburg and, of course, they procrastinated a little, maybe didn't want to say right off the bat. I don't remember if that was this particular time or not, but we did have the seals secured to all but one pump and I don't know if it was this particular time or not.

MARTIN: When the seals were secured and there was some concern about starting the reactor coolant pump, wasn't there some discussion about ceramic material being introduced into the seal area and wiping the seals?

LOGAN: When we secured the seal water to it? I don't recall that conversation.

HUNTER: Joe, change the cadence a little bit, during the daytime there were a number of things going on. But during your period of being associated directly with the decisions being made, indirectly by being aware and/or interested or just present in the control room, do you recall any discussions concerning the letdown flow system and/or the lack of or problems with that system? Could you elaborate somewhat in that area?

LOGAN: Yeah, I again, because of the time since this occurred I'm not sure that that was when it first started. Letdown flow decreased. We speculated it was because of boron buildup. And again I in trying to determine just when this occurred, I had had no idea if it had been during this incident or if it was after sometime afterwards but letdown flow decreased and we took various actions to try to increase it by bypassing the filters, bypassing demineralizers, and tried to increase the temperature on it with varying degrees of success each of these endeavors.

HUNTER: Okay. One more thing now, and I'm...and I am basically finished with my questions for now. Do you have any areas that you feel like that we need to specifically cover. We have a lot of area to cover, we in fact may overlook an area. Is there any concerns that you have that you think should be looked at? Specifically, or do you have any suggestions that you would like us to look at? Specifically, or anybody else to look at?

LOGAN: Well, yeah, certainly I have a lot of areas that I think should be looked at as a result of this accident, I think everybody does. But I think you probably have most of those from Gary and other people, the design to permit venting from such a situation. That was our biggest problem and our main concern during the entire event with how to get rid of that bubble. It would have been so simple to have eliminated the entire god damn problem if we had had a capability of venting that system. The design of the candy cane, if you will, the pressurizer, the size of the pressurizer, which is recognized certainly before this incident happened is inadequate, take the various casualties that require in surges and out surges. But if we just had some means of venting that pressure off, we would have gotten out of this thing without any problem. As you mentioned yourself, and its obvious when you're up there, the human engineering aspect of this plant is lacking, having come from a naval reactors where you got mimick buses that are easy to follow, you know, designed for an operator, these aren't. The instrumentation there is not designed for somebody to read in a hurry,

you know, you can't, you know, daily instrumentation was not designed with the operator, quick reaction in mind, you know, if you're trying to get specific readings off the thing. You're talking about gross indication, yeah, they're alright, but, you know, its not designed for that type of thing.

HUNTER: Joe, Hunter speaking. What about any instrumentation that you felt like the operators could that the key problem that they had in any instrumentation that might assist them to recognize the problems that you had.

LOGAN: Well, certainly if initially they had known that a bubble existed in the core, I think they would have gone ahead and pressurized and tried to collapse that bubble. I don't think they recognized, and I certainly didn't when I got there, that we had a bubble in the core, you know, on top of the core. If instrumentation were provided, and that's not that difficult to do, you know, provide that type of instrumentation, they say, "hey, you got something other than water in there." This incident would not have occurred. If the two valves that were shut, if there had been and alarm type of instrument, you know, attached to these things so when they're out of there "normal position" that would have been an obvious audible alarm or computer alarm prints out or something of this nature, you know, it wouldn't have happened. These are all simple things that, and its easy to say "hey, why didn't we have it," you know, hind sight is the greatest thing going.

MARSH: Joe, break please.

SINCLAIR: The time is 8:56 p.m. We're gonna have to reverse the tape.

SINCLAIR: The time is 8:57 p.m. We're continuing the interview with Mr. Joseph Logan.

HUNTER: Joe, Hunter speaking again. One key item besides the low pressure, which we've discussed to some degree, was also the fact that the power for the relief valve on the pressurizer was open for a period of approximately 2.3 hours and general and well almost to a person, no one was able to pick up on the fact that it was open, it indicated electrially, the electrical signal indicated closed. But it was, in fact, blown apparently, at least the majority of that time. Can you elaborate on that particular problem?

LOGAN: I can only surmise what may have gone through people's minds. When the incident occurred and the relief valve lifted with the subsequent rupture of that rupture disc the indications that you would get in there is a high sump level, which they had, which they read, apparently secured the pump, so the high level existed in the, the pumps weren't pumping which gives you an indication that you've got water in there, the compartment. They had not received the area radiation alarm in the compartment at that time, which again would key them to "hey,

you've got water coming into that compartment." Why, I mean these would have been checkpoints that say "hey, you've got water coming in there from someplace," you know. What avenues exists? Why they didn't catch it, I presume because of the abnormal things that were going on, captured their attention.

HUNTER: Okay, Hunter speaking. Joe, more so what type of instrumentation or what type of indication would you say would have helped these fellows close that valve more expeditiously.

LOGAN: Well, I think there could be several improvements. A level, sump level indicator in there that would give you a high level alarm with, you know, actual level indications from the sump. The relief valves itself indication, you know, you get a signal, what they're showing is a signal to the valve and that's been a series or it has had a series of modifications on the lights in that valve that have been confusing to people. The two lights that exist. The, I think maybe th· ve itself, of course, has a thermocouple downstream of the relief valve. That in itself alarming, but of course that would alarm once the valve had lifted and a guy seeing that alarm would say "well, hell, that's from the.." Plus, we had suspected a leaking relief valve, anyhow. So that would not assist ascertaining, you know, the fact that the valve was still open. A flow majoring device certainly would assist somehow. I hadn't thought about it. I could sit down, I think, and come up with a fairly simple way of saying the

damn valve were open, but a position indicator on it, certainly. Many simple, and I think it should be simple, anything they do down there should be very simple mechanism that they put on it.

HUNTER: Okay, Joe. I don't have anymore questions. I thank you for your time and trouble. It's been a long interview ....

LOGAN: Let me add a few more recommendations .... Obviously the accident itself should be provided a simulation training as a thing that can happen and did happen, you know. Other aspects, I think, of the accident should be addressed in our own training session. There are things that, looking back in the navy, my navy experience that perhaps should and certainly I will take action to see it's done here, is a checkoff list for critical valve positions on a shift basis to see that this type of thing at least wouldn't go past a shift, you know. When you design something that humans operate, you gotta accept that mistakes can be made. That's just some things that I have thought of and I haven't gone to great detail in listing them.

MARTIN: That's all I have.

SINCLAIR: Okay. Thank you, Mr. Logan. The time is presently on and over 3:00 p.m. and at this point we will conclude the interview.