UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of:

IE TMI INVESTIGATION INTERVIEW

of Mr. George A. Kunder
Unit 2 Superintendent
Technical Support

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

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NRC PERSONNEL:

Dorwin R. Hunter
Donald C. Kirkpatrick
Owen C. Shackleton

SHACKLETON: This is an interview of Mr. George A. Kunder. Mr. Kunder is presently the Unit 2 Superintendent, Technical Support, Three Mile Island with the Metropolitan Edison Company, the time is 5:10 p.m., April 25, 1979. Present to conduct this interview is Mr. Dorwin R. Hunter, Mr. Hunter is an Inspection Specialist, Performance Appraisal Branch, I&E Reactor Construction Inspection with the U.S. Nuclear Regulatory Commission. Also present is Mr. Donald C. Kirkpatrick. Mr. Kirkpatrick is a Nuclear Engineer with the Inspection and Enforcement Headquarters in Bethesda, MD. My name is Owen C Shackleton, I am the Investigator in Region V with the U.S. Nuclear Regulatory Commission. This interview is being conducted in Trailer #203 at the Three Mile Island site just outside the south gate. Just prior to the beginning of this interview on tape, I presented to Mr. Kunder a two page Advisement Document outlining the purpose and scope of this investigation in the authority of the U.S. Nuclear Regulatory Commission to conduct such an investigation and his rights to refuse to be interviewed or to provide any type of statement. On page 2 of this document, Mr. Kunder in writing answered in the affirmative to the following questions. Mr. Kunder do you understand the document that I just described?

KUNDER: Yes, I do.

SHACKLETON: And do we have your permission to tape this interview?

KUNDER: That's affirmative.

SHACKLETON: As I understand you'll like a copy of this tape and the transcript?

KUNDER: I would appreciate that.

SHACKLETON: Very fine, they will be provided to you. Mr. Kunder to assist those persons who will be listening to this tape and learning what transpired at Three Mile Island during those first days of the incident, would you please provide your background and training concerning you work in the nuclear industry.

KUNDER: I graduated from Penn State University with a B.S. in Mechanical Engineering in 1968. I joined Metropolitan Edison Company as a Station Engineer at Tyts Generating Station, which is a small fossil plant in Reading that provided me my initial training in the utility industry, I was assigned there for one year. Assigned to Iller Generating Station in Reading for approximately six months and then I was assigned to the TMI Project Management Group, which was at that time, responsible for the overall control of the actual management of the TMI construction project. I was with that group for approximately two years until around April 1972, where then, I performed reviews of requirement outlines and specifications for Materials Procurement, did some System Design Reviews in the area of my cognizance, I participated in setting up some of the meterological stations that we currently use on and offsite and performed at various junior technical activities in the Reading office. I was assigned then, around April

1972, to come out to Three Mile Island and was assigned to the Engineering group responsible for writing procedures for both operations, for surveillance and emergency procedures. I was assigned cognizance on certain of the Unit 1 systems and was later assigned, just under a year, to work for the Unit 1 Supervisor of Operations as his Engineering Assistant, if you will. From that time til approximately September 1975 I functioned in that capacity and during the process of the startup and testing of Unit 1, I trained for my Reactor Operating License, spent time down at the B&W Simulator in Lynchburg, trained up at the Penn State Triggar Reactor and of course, trained on Unit 1 through my activities in the startup and test program, so I got both practical experience and nuclear technical experience in that fashion. I did receive a Reactors Operator License along with one of the first groups of Operators to be licensed on Unit 1. Then I went into a training program to receive a Senior Reactor Operators License, I can't recall the exact date, but it was approximately prior to my term which ended around 1975 in September. At that time, I was promoted to the Supervisor of Operations in Unit 1 and was responsible for supervising the Operations Department consisting of the Control Room operators and auxiliary operators in Unit 1. I was responsible in this position through the period of the latter part of the first cycle of operations, Unit 1, through the first refueling outage and just prior to the second refueling outage that was in about December 1977 when I was promoted to Unit 1 Superintendent, Technical Support. I functioned in that position until December of 1978 when the Unit 1 Superintendent resigned and had transferred to another B&W plant and the Unit 2 Superintendent, Technical Support, Jim Seelinger, was

promoted to the Unit 1 Superintendent, and I was asked to and elected to move over into Unit 2 as the Unit 2 Superintendent, Technical Support, principally to gain additional experience and broaden my background in the industry by learning another Unit, which is of course Unit 2, so I've been functioning in that position since December 1978, which pretty much brings up to the present.

SHACKLETON: Thank you very much, now I'll turn the interview over to Mr. Hunter.

HUNTER: Okay, George. The information that I would like to start with is the morning of the incident, can you recall when you came onsite, approximately?

KUNDER: I came onsite approximately 10 minutes of 5 and I arrived that by sort of correlating when I left my house which was somewhere around 4:30 and I don't live to far, I came in and dropped off my briefcase in my office and I had noted that the Unit 1 atmospheric relief valves were relieving and wasn't quite certain why and I called the control room in Unit 1 and indicated over the page that the Unit 1 atmosphere dump valves were relieving, just to be sure that they were indeed aware of that, then I proceeded over to Unit 2 control room.

HUNTER: Why did you come in?

KUNDER: I was called by Scott Wilkerson, he was a nuclear engineer on duty at the time in Unit 1 and when the trip of Unit 2 occurred he had gone over to Unit 2 apparently and was asked to call people out, I don't know who asked him to call people out, but I was called and I was told that Joe Logan was also called, he's the Unit Superintendent.

HUNTER: What was the trip, when did Unit 1 tripped?

KUNDER: Unit 1 was not tripped, Unit 1 was in a, I believe, a hot shutdown position at the time.

HUNTER: When Unit 2 tripped then he was...

KUNDER: He was in Unit 1 and he went over to Unit 2.

HUNTER: Unit 1 was in hot shutdown after refueling.

KUNDER: Yes, he was shift to begin the physics test program, as a matter of fact.

HUNTER: Okay, when Unit 2 tripped, then he called you?

KUNDER: That's correct. I was home in bed, he asked me to come right in because they had a trip in Unit 2, no further detail, so I did get up right away, got dressed and went right in.

HUNTER: You know Scott, did he sound like there was a problem?

KUNDER: I don't recall any particular urgency in his voice. He did indicate that Bill Zewe who is the Shift-Supervisor, wanted me in, needed some help. So I just proceeded in. That's the tone I recall.

HUNTER: On the Unit trip, or routine trip would you normally be called in?

KUNDER: I would have, I at the time was responsible for the duty section, that was my week for the duty and normally the Shift-Supervisor calls the Duty Section Head or least the Superintendent of the Unit, informs him of the problem, he will ask for assistance in whatever area he feels he needs in order to, depends on the nature of the trip, if it was a turbine trip he'd try to get the engineers associated with a turbine generators, that typically the routine that we go through, you don't wait till day-shift for instance to start looking. You call people out...

HUNTER: You were the Duty Engineer or Duty Superintendent at that time. When you got to the site and you had in fact made it to Unit 2, what was you understanding at that time, what did you find. How did you find Unit 2?

KUNDER: I found the Unit 1 Shift-Supervisor, Ken Bryan, was in the control room, Fred Shiemann who was the Unit 2 Shift-Foreman at the time and I'm pretty sure there was two operators in the control room were the only people that I recall. I think Scott Wilkerson was in there, but I can't

remember just where he was when we came out of the Shift-Supervisor office or not. At any rate, I came over to the console and inquired what had happened and they indicated that they had a trip. The thing that seemed to be of immediate concern to them was the pressurizer level. Ken Bryan or someone indicated that they had ruptured the drain tank rupture disk. I wasn't that familiar with all the instrumentation in Unit 2 since I only begun my Senior Reactor Operator Cross-License training program and my experience on the panel is very small. So I wasn't quite sure what I was seeing and I pretty much had to ask the Foreman what his problems were and at that point in time the pressurizer level seem to be the main point of concern and the pressurizer level was high or pegged at the time. I recalled that the high-pressure injection had been secured at that point, looking back I was completely unaware this situation, the emergency feedwater system and I was really unaware that til later in the morning or later in the day, to be honest with you.

HUNTER: How did you find out about that?

KUNDER: I think, I had found out about it from the GPU engineers that were looking into this scenario. I recalled the fact it was later much later in the day if even that day, I learned about it when I was, I knew the emergency feedwater pumps had started through my subsequent review of the sequence of the events by now. The pressure came up that discharge the pumps but I was unaware that the valves failed to open or that we weren't getting flow, and I later learned through that group that it was apparent that the BFV 12 A&B

valves were shut at the time. The only thing that was apparent was Bill Zewe had come into the Control Room and I don't recall how long after I got there, it was a few minutes maybe five minutes or so and he had been down trying to secure the water going into the condenser, apparently what had happended on the trip was that the condenser level instrumentation indicated a low-level which called for the hot-well makeup valves from the condensate storage tanks to open and the condenser hot-well filled up and he was trying to secure that problem for fear of it causing problems with the bypass steam being flooded, causing water hammer and that sort of thing. Bill had come into the control room from trying to get that process secured. That was pretty much my immediate impression.

HUNTER: You indicated high-pressure injection, you were discussing with the Foreman, I assumed that Fred Shiemann who was the foreman on shift that morning. What was the condition of high-pressure injection at that time?

KUNDER: When I came in I didn't see it but I understood that the high-pressure injection was secured. Someone mentioned that the letdown was occurring they were trying to reduce the level in the pressurizer. I can't remember if I looked at the high-pressure injection valves, I do know where they are in the panel, to ascertain that for myself or not, I just can't quite remember.

HUNTER: What about the flows, high-pressure injection flows, did you look at the flows?

KUNDER: No, I think they're on the back panel and I know I didn't see those.

HUNTER: Okay. So the rupture disc on the reactor coolant drain tank had blown high pressure injection was minimum or was _____.

KUNDER: It was apparently secured.

HUNTER: Pressurizer level was up, letdown was going...

KUNDER: Right.

HUNTER: Excess. The amount of letdown, trying to get the pressurizer level down. Any other keying items that you looked at, Bill had just come up from...

KUNDER: I did locate the reactor building pressure recorder and I noted that the pressure was up around 2 pounds, 2.2 pounds, in the building. So that made sense to me. I believed that the fact that the rupture disc had blown.

HUNTER: What would that indicate to you, or did it, what did that indicate to you?

KUNDER: Well, it indicated that we did have a pressure rise in the containment which likely had come from the reactor coolant drain tank, rupture disc blowing because I wasn't aware at the time what pressure the rupture disc blew. I'm familiar with the Unit 1 system and our drain tank in Unit 1 is much smaller in size. The pressure rating for the rupture disc is 55 pounds and I later recognized that Unit 2 rupture disc blew about 200 pounds pressure. But any rate, there's a lot energy released through the relief valve and if it blew it's apparent that we either had leakage or something continued to expel steam into the drain tank and cause it to blow. But at that time it wasn't clear to me what had really occurred...in terms of...

HUNTER: Besides the pressurizer level being high, did Fred tell you, you know, indicate to you that he had any other problems, did Bill say or indicate or Ken Bryant even?

KUNDER: No. One conversation I recall with Ken Bryan was that he was looking at the computer temperature for the relief valve discharge line and, I'm judging ten, fifteen minutes after I got there he had noted that the temperature of the discharge relief valves in the pressurizer had come down from what it had previously been earlier, prior to my getting there and he seemed satisfied that the relief valves were not blowing steam anymore or at least it had decreased. That was my perception of how it seemed.

HUNTER: Okay.

KUNDER: And beyond that, what I tried to do, I was trying to figure out for myself what they had had and I was looking at the pressurizer level and they told me that all three channels behaved the same way and it seemed inconsistent with what I've been experienced to on a trip of that nature. And, I recall that I found a uncompensated pressurizer level indicator on the panel 5 or something like that. It's, and when you look at that level and corrolated it using the uncompensated, the uncompensated pressurizer level chart that's posted on that console, it appeared to agree with what they were saying on the LT 1, 2, and 3.

HUNTER: So that gave you four levels that were consistent.

KUNDER: Yeah, but I thought too, at the same time, the uncompensated level probably comes off the same transmitter. Because really in the B&W plants, at least in Unit 1, you have three transmitters. You don't have a fourth transmitter. You get Dp which comes out in the computer. You get the, o course, the compensated level which is on the recorder charts and also in the computer and you can get the uncompensated level which was on this one indicator. So that, that really didn't help me out really. Just told me that everything agreed and that it appeared as if the pressurizer was seeing or the instruments were probably seeing a high level, but there was that element of doubt in my mind and I think in the mind of the operator, my perception of that.

HUNTER: Okay.

KUNDER: It just didn't seem consistent.

HUNTER: Did you recall looking at pressurizer pressure?

KUNDER: I did, I can't recall exactly when, probably wasn't too long after I had gotten there. My perception of that was that I had thought that we took the system solid and we expelled the steam in the pressurizer and that the pressure ended up low because we did not have an adequate bubble at that point. And, that was, that's how I perceived that condition and the fact that they were letting down and trying to reduce the level to get it in range and heaters, you know, trying to build the bubble back up to get pressure back up. It seemed to be what was going on, to me.

HUNTER: At that time, do you recall getting a pressurizer liquid or steam space or surge line temperature?

KUNDER: No.

HUNTER: Did you check to see what the temperature in the pressurizer was?

KUNDER: No. And, I'm not sure that I would have, I doubt if I would have recognized and alarm of that nature because I'm still not that familiar with the layout of the control room and all the instrumentation. That, I

must admit, was one of the most frustrating parts of performing. I just didn't have enough expertise in Unit 2 to interprete everything they were saying because I wasn't able to recognize everything as an operator would. Perhaps if I had had my training program through and had really qualified in the unit...

HUNTER: What's the status of your training program right now?

KUNDER: I began an in house cross license program which first consists of going through what's called a Category For Operators Training Program. The first part of its pretty much of it is self-study effort. The area that I have studied so far was the Secondary Plant System, turbine generator, the auxiliaries for turbine generator, condensate feedwater system and the main steam system. I hadn't had my first oral on the system. The program is split up into six cycles and it's generally intended that you can go through it an excellerated pace in about perhaps 5 to 6 months. Normally, the program is designed to take an auxiliary operator and train him in about 9 month program on a, you know, a more of a routined pace. I'd gotten through the answering all the questionnaires and doing some of the exams on the first cycle which I had been submitting to the training department and I had not had the first oral exam so I hadn't, I didn't have a good feel as to how much in depth I really, you know, knew that first cycle, even. So, I was really only beginning the program unfortunately.

HUNTER: The, you can go to 4, 5, or 6. That would get you 4 from Secondary 5 into the primary and 6th into the license.

KUNDER: Yeah, it would be, you got into Cycle 2, you got into decay heat removal, makeup purification systems and then you start getting more experience on the console. The design of the oral exams are pretty much to get you, really challenged on the console and to verify that you got the depth to see all the alarms and understand what they're telling you and know where all the controls and so forth are.

HUNTER: After the Category 6 and all is that an RO license as a result of your training or an SRO.

KUNDER: No. it would, the SRO licenses is what I was going for, the Category 4 Training Program was one of the vehicles to get you into material, to get you through learning the plant, okay? It was an organized lesson plan, if you will and the part that would pretty much give me the depth and qualification for the SRO portion of the exam would be in a large part, you know, the emergency plan training, knowledge of the administrative procedures and controls, knowledge of 10 CFR 20, and a lot of the more administrative oriented parts of the job and a lot of that I had and the program did cover a review of all those areas.

HUNTER: Okay.

KUNDER: Okay? So I was really going for an SRO cross license. Just merely utilize the elements of the CRO training program to ...

HUNTER: What did you project you'd get through with that?

KUNDER: Well, I was hoping I could get through it by the end of the summer or I was really hoping to get through it by mid-summer but I found that my commitments, I mean, the normal parts of my job prevented me from really devoting the time to the study, you know, to get through the accellerated program. I was going to study at my own pace and typically my training program involved a pretty significant commitment and time on my part and I only really got to start studying some of this stuff in earnest when I got down to the simulator the week prior to this event. I was able to spend some time in the evenings, you know, do some of the review that I just hadn't had the opportunity to do prior to this thing. But with the startup of the plant over our engineering workload was tending to wind down and I was expecting to be able to devote a greater share of my time in the training program which is going to do two things. They get me cross license, but the real intent, of course, is to get...

HUNTER: Cross license you might explain that...

KUNDER: License in the Unit 1...

HUNTER: SRO?

KUNDER: Yeah, that's right. I was required to have that license as a supervisor of operations in Unit 1 when I held that position. I wanted to get the cross license mainly for the benefit of the learning experience in Unit 2. To do my job most effectively in managing the engineering department which is my prime job and also in my function as the chairman of the Unit 2 plant operations review committee an interfacing with the licensee matters with the commission. It, I've always felt that the experience of the licensing process prepares you technically and operationally to do a much more effective job. So I placed value on the license for that purpose and, of course, when I took the job I had been asked if I had any problems in going for my Senior Reactor Operators License and of course I didn't, my question was does the Company have any problem if I do make that kind of commitment and spend some of the time its going to take to get the license. Thats the program I embarked on.

HUNTER: You worked directly for Gary Miller?

KUNDER: No, I worked directly from Joe Logan, Unit 2 Superintendent who in turn works for Gary Miller.

HUNTER: Excuse me, I'm sorry, that's what I was after, you work for Joe Logan who is the Unit 2 Superintendent.

SHACKLETON: We'll end our interview at this point to change the tape. The time is now 5:39 p.m., April 25, 1979.

SHACKLETON: This is a continuation of the interview of Mr. George A. Kunder, time is now 8:33 p.m. April 25, 1979. We discontinued the last meeting inasmuch as Mr. Kunder had another meeting attend and now is back to continue our interview. Continue on please.

KUNDER: One of the things that I recalled also that I had done when I got into the control room and again the timing was I think within about 5 or 10 minutes of arriving and trying to get an understanding of what was going on, since pressurizer level was higher or pegged and we had reportedly ruptured the drain tank rupture dis: I was concerned because of the unusual situation, I did ask Scott Wilkerson to call out additional people, and I specifically asked for Dick Dubiel, my lead engineers, Dick Seeklets and I'm pretty sure I asked him to recall Joe Logan because I wasn't obsolutely certain, although I thought he had said that he had called Joe I wasn't certain that he had. I believe I had asked, because of the fact that the guys were pretty busy with the plant at hand, I had asked them to call out the oncoming Shift-Supervisor and Foreman so we can get additional supervision and experience in there, because we were dealing with something that to me was out of the ordinary in terms of the transient response. Of course at this time there was no indication of any radioactivity or anything unusual with respect to radiation. That I could observe. He did make

those calls, I don't know who he reached but I know Dick Dubiel had come in a little later on and my lead engineers did come in and reported to the Control Room. I do recall, Ivan Porter at least, Ron Warren, Dick Bensil and offhand I can't think of anybody else that reported. Dick Seeklets later came in, perhaps jumping ahead a little bit, but those people were onhand just prior to the time we announced the site emergency. I think that helped.

HUNTER: George, you indicated out of the ordinary, lets key on that for awhile, okay lets key on your here and you've looked at the drain tank and determined that its ruptured, or somebody told you, you look at. What else was really out of the ordinary, you've seen other trips at this plant and also you've seen them at Unit 1.

KUNDER: I don't think I ever seen a trip in progress in Unit 2, I've seen the I don't want to say aftermath, but I've seen the results of previous trips, through the reviewing the reactor trip reports and that sort of thing, I've never seen a situation either in this plant nor in Unit 1 nor the simulator where the pressurizer level was pegged and we had a low pressure in the RCS and in that sense and the fact that we did apparently blow a rupture disk in the drain tank and had 2.2 lbs or so in the reactor building that was the nature of the unusual situation that I was referring to.

HUNTER: Rupture disk blown, couple of pounds in the containment, pressurizer level up, pegged or high offscale?

KUNDER: Yeah, it appeared right up against the top of the chart in a straight line.

HUNTER: And also low pressure, how about giving us your feelings at that time?

KUNDER: The pressure appeared to be, it was about in the range of 1100 lbs and sort of leveling off and my perception in not having gone through the whole thing from the initiating event or not having experienced the whole scenario through the initiating event was that somehow the plant was taken solid and we lost the steam bubble to the extent that we didn't have adequate pressure control, pressure was low, we had a solid system, we didn't have an adequate steam bubble to get the pressure back up and pressurizer heaters, I'm not sure, I didn't, I didn't know if they were on or not, I just presumed they were and they were letting down and trying to get the level on scale and the pressurizer level instrumentation and trying to reestablish the bubble and get the pressure up. I think it took me a little while to really understand what was going on with pressure, I don't think I perceived that initially but I do recall, that I had gotten a call from Gary Miller who was made aware of this thing, I was the one that communicated with Gary Miller and I'm pretty sure I gave him the key parameters, pressurizer level was pegged and that pressure was low and he

decided he best get a call, conference call set up between he and Jack Herbein and Lee Rogers of B&W and try and get some sort of resolution to the problem, you know, understand what was going on and make them aware of the problem.

HUNTER: I'm still, I'm still, we're still pretty earlier in the program timewise.

KUNDER: It was around, I'm guessing, around 6:15 or 6:20 or so when that first phone call was made.

KIRKPATRICK: Was that prior to the time that the primary coolant pump, the last batch of the primary coolant pumps were tripped.

KUNDER: Yes, pretty sure it was, that phone call, yeah.

KIRKPATRICK: You said, you gave to Gary Miller the main parameters which were, I take it, which were pressure and level and temperature.

KUNDER: Levels, and I guess we keyed on level because that appear to be the big concern at that point, the fact that the level was high.

KIRKPATRICK: And he was discussing these parameters with the B&W people.

KUNDER: No, when I told him what the parameters were and that we were in on a condition that I just wasn't sure what was going on and whether we

should believe the indication or not. He decided to set up the conference call between Herbein and myself and Lee Rogers, and he broke off the line and proceeded to set that call up.

KIRKPATRICK: By indication did you mean level indication?

HUNTER: Pressurizer level?

KUNDER: Pressurizer level yeah.

HUNTER: When you, how long did it take you to get the conference call, to get it established?

KUNDER: I'd estimate about 15 minutes.

HUNTER: And that included Jack Herbein, Lee Rogers, Gary Miller, yourself?

KUNDER: Yes, that was it.

HUNTER: That was the first conference call.

KUNDER: There was only, there was two calls made, the first one was myself and Gary Miller when he called in, and the second one was after he had initiated the conference call. At the conclusion of that call Lee Rogers and Gary proceeded into the plant and I'm not sure what happened to Jack Herbein.

HUNTER: What was the general discussion in the conference call.

KUNDER: Well, again the general discussion evolved around what the plant parameters were, what was the pressurizer level, RC pressure and Jack and Lee and Gary were trying to acertain what we had, I think we did talk to an extent about whether the pressurizer level indication was real. I seem to recall, I was asked by, I think it was Lee Rogers, that if the electromatic block valve was closed and I talked to someone in the control room, and I just asked was the electromatic block valve closed and they said yes and came back in and said yes the operator said it was closed. Of course, I told them what the pressure was and I told them the pressurizer level and we seem to all agree that the pressurizer level indication should be believed and so we continue to believe the level indication that it was high. That was pretty much based on the fact that all three level indicators performed similarily they were all high and it just wasn't consistent that they'd all be the same and there be some sort of a common known failure because they are separate transmitters lines off the pressurizer and separate transmitters, there's no, it's a totally independent channels both electrolly and mechanically, so whatever was happening they were seeing a high level. I seem to recall mentioning probably towards the end of the conversation that we had had problems with the steam generator, particular the B generator, I wasn't following the secondary side that closely and I was never really clear in my own mind what had been done to the B generator and again I was unaware of the fact at that point that we were without feed for the first 8 or so minutes which is what I got out of all the curves and soforth that we extrapolated after the fact. But, early ...

HUNTER: You were unaware of that fact, that meant that on the conference call, Gary Miller was unaware of that fact?

KUNDER: Yeah. I would've have said that to him. They were unaware that the BFV 12 A & B valves had to be opened by the operator manually.

HUNTER: They were not aware of that at that time.

KUNDER: That's right, I'm sure they didn't talk to anybody else, so they wouldn't have that understanding at that point. But I did indicate to them that, Bill Zewe and whoever was operating on the secondary side, had noted that the steam generator pressures differed and that the B generators pressure was lower, I seem to recall about 300 lbs lower than the A generator pressure. They thought at first that they may have had a steam leak on the B side and as a result they followed the procedure to isolate the B generator and attempt to see if that had an effect as it was believed that may be contributing to the pressure in the reactor building and I understand that was done, I did not verify with any valve lineman or anything like that, cause I didn't really participate in that side of it, the operation. I believe it was a little later on when that thought was dismissed and I believe thats when Mike Ross came into the Control Room that they, ...I'm trying to think of the parameters that they looked at to determine that it was probably not a leak in the B steam generator and offhand I can't think of what it is now, but there was a relationship between the reactor building pressure and we figured B is probably isn't leaking steam so they did cut

it in. And they did cut it in before the level had dropped very far. I think it was the level hadn't change if I'm not mistaken and

HUNTER: That was the first time?

KUNDER: That was, yeah, that was the first time the generator was isolated and I think that was the parameters they were looking at, same generator levels but I'm little fuzzy.

KIRKPATRICK: The water was staying in the steam generator so they on that basis they eliminated that that is the cause of the pressure in the containment..?

KUNDER: Yeah.

HUNTER: Also this was before the reactor coolant pumps were tripped.

KUNDER: I'm pretty sure that's true. Yeah. Okay. But I recall noting that to Jack Herbein and Miller, so that really occurred before our conversation. Now that conversation lasted, I'm judging another 15 or 20 minutes I would think, cause it seemed that I was on the phone an awful lot.

HUNTER: In the meantime, I'm presuming that others came in, you indicated as your going along you wrapped up the phone call and then there's a group of you available for the plant, to help out with the problem?

KUNDER: I'm trying to put the, when we knocked off the reactor cooling pump in a little bit of perspective. Seems to me that we knock off the first set of coolant pumps prior to ending the conversation with Herbein, Rogers and Miller. And the reasons they knocked off the first set of pumps, was they were afraid they were getting into the pump NTSH curve limitations were just about being violated they were afraid of losing suction, cavitating the pump, so they decided to secure one set of pumps. I recall looking at the curves myself to verify that the pressure and temperature conditions were justifiable to allow securing the RC pump. I remember the pressure was down around 950 to 1000 lbs in that region and the saturation temperature was, I'm sorry, the TC was up in the region of 540° or something like that. But at any rate, the point was on the curve in fact slightly below.

HUNTER: Were you reading the curve on the phone?

KUNDER: No I had come away from the phone. I'm having trouble fixing in my own mind when we secured the first set of pumps, it was either just prior to the conversation or during the conversation when I had come out to the Control Room just take a look at pressures and temperatures again and I looked at the procedure.

HUNTER: B-loop pumps at this point, the first set.

KUNDER: I had thought yeah, I think it was the B loop pumps, because I recalled the flow went down in the B-loop pumps. I believe that they secured the B-loops so that we could still have adequate spray flow and the A-loop gives you more pressure and you get better spray flow, gives you better pressurizer spray control. But at any rate, we finally ended the conversation and Gary and Lee Rogers said they were coming. Joe Logan I think was the first Senior person to come into the Control Room. Best to my recollection we had already secured one set of pumps by the time Joe came in and it was about the same time frame that when, it was either about the time he came in or shortly thereafter that we secured the second set of pumps, because the flow was starting to degrade on the console flow indicator. I seem to recall that it was the flow in the A-loop, two pumps running was up above 60% on the indicator and the flow was degrading and had degraded somewhere I think in the region around 30% so it was clear to me that flow was decreasing and that it was thought we were cavitating. So, the Shift-supervisor secured that set of pumps expecting to go on natural circulation because the pressure was low and we didn't want run into cavitation problems with the pumps. I guess prior to that point I started to get into a different thought process, I had a, Bubba Marshall had come into the control room, and Scott Wilkerson was still there and I had asked to have a shutdown margin calculation performed and I wanted to get the boron concentration from the system. I had asked Bubba Marshall to call the lab and get a boron pretty quick. Again I was sort of concern where this water was coming from but at that point I still felt, it still appeared to me that somehow we other water in the system and I didn't know where it had come

from. Cause the operators had indicated to me that they didn't have high-pressure injection on for that long that it would have filled the system up and we would have gone solid. I didn't understand that. I had a, let me think. Dick Dubiel had arrived and I told him that I had asked for that boron sample and asked if he'd go down and coordinate and make sure we get the boron sample, get the results of them and I guess it was an interim period of perhaps 15-20 minutes or 30 minutes before Dick got back to me. This was probably close to, when I asked Dick to go down and check on getting the sample I believe it was around between 6:00 and 6:15 that sort of thing, so it would have taken them a certain period of time and by that technicians may have been getting a sample cause that had been asked for a little bit earlier. Dick had called up to me, and I believe it was around 6:35 or so maybe 6:40 and he called up the result, and he said the first, I think he said the first two samples indicated 700 ppm boron and he said the next sample he didn't think that was right so they had another sample that was 400 or something, I don't recall the exact numbers but that change all of a sudden really frightened me, because I thought I hope that's a bad sample analysis because I couldn't at that point I started to think my God, maybe were getting demineral water in through some flowpath, I just don't understand.

KIRKPATRICK: This was really only a few minutes after the second set of pumps were cut off, probably around 6:30?

KUNDER: It was to far from that time frame. I didn't know what initial boron was I walked over to the status board and it was a little over a 1000 ppms that was the boron concentration that we should have been at at that point in time, then the thought went through my mind, Oh my God, were deboring the system and I told them you got to get another sample and tell me whats wrong, at that point I asked Bubba Bubba Marshall, that is to start looking at the Unit 2 system and see if there's anyway possible we could be getting demineralized water into the system. Then again the primary side I just was not familiar enough with over in Unit 2 and although the basic B&W system is the same, the interconnections and rad waste system are totally different between Unit 1 and Unit 2 and I had very little feel for the various system the configurations and soforth and how we could be getting demineralized water so I went through my head, maybe we had demineralized water in BWST and somehow we may have this in our sample analysis, but nonetheless Bill Zewe initiated emergency boration at that as a precaution. At that point, I knew something was really, really wrong and at some point in time in that same timeframe I was alerted or I even noticed or somebody mentioned that the NIs were kind of high, I went over a looked at sources ranges instrumentation and the source ranges were reading in the range of about 10^5 counts, intermediate range had come onscale and it was about half a decade to almost a decade onscale. The only thing that was going through mind at that point, is that the reactor had gone critical again. I didn't understand what was really happening, I think I understand now, we think we understood after the fact we seen, but at that point in time I thought my God we've been deboring the system, somehow that's how

we've been getting all the water in the system and we taken the reactor critical, so I started to urge, we got to get high-pressure injection back on, we got to get some borated water, what we thought was borated water back into the system and Mike Ross was in the Control Room at the time. I remember him commenting to me George we got to do something because, there was a, the guys just set there at console and I guess Joe Logan just weren't sure of what the next step was and all I could think of was get that damn high-pressure injection on, that was the only thing I could think of. There was nothing else to do except to get some borated water into the system until we understand what was going on. And so we did initiate high-pressure injection and I seem to recall I even yelled it out, get it on, I don't care, we got to get that thing initiated and now. So that was done, immediately after we asked for it and continued thereafter. Dick called up very shortly thereafter and I heard him screaming over the page George Kunder, George Kunder, line one and I answered. Dick said, George the sample line had just went up up to 600 mR/hr, and at that point I realize oh my god were failing fuel and I yelled at Joe, I said Joe were failing fuel, Dick gots 600 mR/hr at the sample lines and that was right around 6:45 in that region and I said hey were into site emergency, its the real thing and site emergency was declared. I turned around and told Ron Warren and Dick Bensil and who had been in the Control Room, .. oh I think just before that Ivan Porter who's my lead I&C engineer had come into the Control Room and I briefed him on what had happended, on what the plant was doing and I seem to recall, I may have mentioned something about failed fuel, we were getting high activity in the system and that was all pretty much around the same

time frame, but I do recall telling Ron Warren who had been in there and Dick Bensil to get on the phone and start making the phones calls and we went into the emergency procedures and began the emergency response and I don't know, at that time I really started to just starting reacting to the condition and really getting it clear in mind, we were in a real emergency situation and we got to initiate the emergency plan and you know from that point on I was, I don't know how to put it, just keyed up to carry out those emergency plans and keeping the plant in a safe condition. Bill Zewe as I recall pretty much directed his attention to the console and it was around the same time frame that Gary Miller came in, I think he came in, he definately came in after the site emergency was declared, Joe Logan was the Senior guy at the time the site emergency was declared and Gary came in I would estimate 15 minutes or so after the site emergency was initiated and Gary took charge of the emergency as Emergency Director and the emergency teams were formulated. I basically was responsible at that point to work for Joe Logan, carry out any technical activities he needed, make sure communications was established with the State, that was my first concern, to get hold of the Civil Defense and I did put two engineers on it, because through previous emergency drills it just takes a long time to make all the phone calls. The first one of course is to the Civil Defense Duty Officer and maintenance times that goes to get them notified so they could notify the Bureau of Radiological Health and get that part of the plan moving.

SHACKLETON: At this time we'll end this tape, its 9:02 p.m., April 24, 1979 and we come on other tape.

SHACKLETON: This is a continuation of the interview of Mr. George A. Kunder. Time is now 9:05 p.m., April 25, 1979.

KIRKPATRICK: George you were, you had just commented that you had starting making the appropriate calls, Joe Logan was the Senior man on site at that time. Does that make him the Site Emergency Director? And shortly, then, Gary Miller came in. At that time does he assume the ...?

KUNDER: He did. Gary first appraised himself of the plant conditions and what we had and Gary, I thought, very forcefully took over as the Emergency Director. He announced it, and he indicated that he, myself, Logan, I think he said Ross, and I know he said Debiel were the guys that talked to him, to try and establish good clear communications paths with the people in the Control Room. And there was the... communications were being established by someone else between the control room and the emergency control station. In otherwords, between ECC and ECS. I was pretty much making sure that the calls were being made to the offsite people and we got someone... I can't remember who it was anymore... to keep the emergency status board and I wanted to make darn sure that we go the information from the callers, Ron Warren and Dick Bensel, out to the emergency board. That worked fairly well. We had clearly identified who was called at what time. In fact, there was a photograph made of that, so we wouldn't lose that information. That part of the drill got started fairly well.

KIRKPATRICK: Step back a minute, I want to keep the emergency in mind, I want to ask you earlier about the conference call between yourself and Jack Herbein and Gary. Did you keep a log of that or is there a record of your call ...?

KUNDER: No. I did not keep a record, Jack or someone on their end may have kept some notes.

KIRKPATRICK: We're down to the point were the emergency has been declared now. If my sequence is correct, the emergency occurred, you saw radiation increase when Mr. Debiel was down in the lab.

KUNDER: Dick saw the increase down there. When he told me what his problem was, it was within seconds that the alarms in the back panels of the RMS starting coming in. At this time in my training, I'm not familiar with which alarms go to which area, but I saw the alert and the alarm lights coming in and they all started coming in very, very quickly. I knew that there was probably a dome monitor in each unit. I was not aware that there was other monitors in the reactor building. I'm not sure what they did, but the alarms for the area monitors or the atmospheric monitors in the Auxiliary Building or fuel handling building were apparently going off. A lot of alarms were coming in.

KIRKPATRICK: Were you aware they started the reactor coolant pump at that time, or do you recall that?

KUNDER: I was aware that the coolant pump was attempted to be started. I thought it was only started one time. But I learned a little later that they had tried to start one and it didn't work out, but I observed when they started the--let me think, I think it was the 2B pump, if I'm not mistaken. There was one control switch in the far right. They started the pump, the indicating light was red. I looked at the flow indicator, it read zero. And I seem to recall Mike Ross and Zewe wondering if it was really running. They called for someone to go down to the switchgear and check to see if the breaker was closed. And you know they said it was, and they recognized it probably was running, but you know it was just pumping steam up. There was just no water in the pump and that is why we didn't see the flow indication. About this same time by the way, the intermediate range counts dropped off.

KIRKPATRICK: Did that give you any kinda--did somebody report that to you, for instance, or were you watching your intermediate range?

KUNDER: I wasn't watching. I looked at it just after it went down, just to verify that it was going down?

KIRKPATRICK: What does that mean to you? At the time, I mean?

KUNDER: At the time I was sort of relieved, but I still didn't fully understand what we were seeing. I think it was later on when John Kenna, of B&W, had been in the control room that he mentioned that probably was

due to the fact that we had the core uncovered, and that the the neutron leakage output to the out-of-core detectors was greater, and we were seeing the higher count rate. And that all correlated. You know, after the fact you start thinking about this, and then it fowls up your memory a little bit, because you know--I wasn't--you almost think you recognized it at the time but I don't think I really did. I did not recognize why the counts went down.

KIRKPATRICK: During the period the pump was off, somebody...

KUNDER: Excuse me. I think probably what's going through my mind is the high pressure injection was having some effect, but I just can't recall exactly.

KIRKPATRICK: During the time you had the high pressure injection going in at the normal rate, 200 and some gallons per leg.

KUNDER: 250.

KIRKPATRICK: 250, ok. So you felt that would be boron water? Cooling water?

KUNDER: Right, it would be 2270 ppm.

KIRKPATRICK: At the time (this is Kirkpatrick) from the time you got very concerned that there was a serious problem and told them to turn on the high pressure injection, all during this period you had it going essentially at 250 gallons a minute, is that right?

KUNDER: That's right. I didn't see the meters. They initiated high pressure injection. You know I wasn't really part of the operation from the console, so I didn't verify it. It was my understanding.

KIRKPATRICK: But that was, you told them to initiate, and it was your understanding that they did?

KUNDER: Yes sir.

KIRKPATRICK: Do you understand how they initiated it? Was it by the normal, just by switching two makeup pumps? Or was it by actuation?

KUNDER: I don't, I didn't seem them do it. I mean I didn't see them press any particular buttons. I believe they initiated it with the manual high pressure injection push button.

KIRKPATRICK: I see. Okay.

KUNDER:: I'm trying to be very detailed about it. I didn't go back and look. I didn't verify the pumps were on myself. By that time we had Joe

Logan in there, Bill Zewe, Mike Ross. They were the licensed people, and you know I didn't try and track the console to see all that stuff. I was sort of standing back by the operator's desk, and trying to get an overview of what was all going on.

KIRKPATRICK: Sometimes that's a good place to be. An overview rather than being right in the middle of the program. During this time now, somewhere along the line, somebody decided the power operated relief valves, either lifting or open. It was indicating closed as I understand it, and by looking back at the other interviews. But, it was during this time that somebody closed it. Were you aware that it was closed during that time or was that--

KUNDER: No.

KIRKPATRICK: Okay.

KUNDER: All the activities in the PM valves, I wasn't aware what was going on there. Because that's part of the console, first of all, that's one part that I wasn't that familiar with. Okay. There was, it was sprayed valve, vent valve and a couple of other controls, switches and indicating lights, and the way they are laid out, they are all sort of together. So I wouldn't have known exactly what I was looking at, unless I had gone up there and really picked out the appropriate indicators.

KIRKPATRICK: Looking at the events from the time you got in, early 4 something, 4:30 or whatever time you have, and looking down, did you ever, did it ever strike you that you may have had a loss of coolant accident going on all this time?

KUNDER: No, I think my first indication that we probably had a loss of coolant situation, although I didn't perceive it as a loss of coolant accident in the normal sense, it was when we started the pump and didn't get flow and the temperatures in the hot leg were going off scale or they had gone off scale. And it was apparent that we were vapor bound, it was the only thing I could think of. Somehow, we were vapor bound in the core, and I guess that perception became more and more reaffirmed in my own mind as we went along. And this is after we had the high pressure injection initiated.

KIRKPATRICK: Right. Did you have that feeling, apparently not, when you took the first two pumps off?

KUNDER: No.

KIRKPATRICK: And the next two?

KUNDER: No. I didn't have that feeling at all. I thought that we had gone into natural circulation. Again, I never perceived that we'd had a bubble in the core or in the head, and looking back, it is what it appears to me that occurred, of course.

KIRKPATRICK: But basically, well, what was that feeling with, I'm really trying to make sure that we understand when looking at the situation that night, that morning, the pressure was down, the pressurizer level was still up, and I don't want to lead you--but was the pressurizer level the thing that, being full, even though the pressure was down, was that enough to lead you to think that you didn't have a loss of coolant?

KUNDER: Well, I don't think it lead me, I never even questioned that we had a loss of coolant accident. Again, my perception when I first came in was that we were filled up in the system and had lost a bubble and for some reason we wern't regaining pressure control. And they said that, I guess makeup, I don't know if I ever really asked or if anybody really told me that makeup was secured. But they did indicate the high pressure injection was secured and of course I identified with that in the way we do it. You know we have had other trips where, you know, following the trip, the pressure gets down low enough to start high pressure injection and then when the water level in the pressurizer came back up into normal range, they gradually bypassed high pressure injection so they could throttle back on the high pressure injection valves, so that they wouldn't take the system solid and

KIRKPATRICK: What did you feel right then when you walked in and you saw the pressurizer full?

KUNDER: Well, I was confused.

KIRKPATRICK: Okay now, it looked solid?

KUNDER: Yeah, well, it look like it was full. To me, it appeared that the level had gone up and bubbled around a little bit, close to the flow indication. It was full and the operators were keying on that and trying to let it down and couldn't get the level down. My problem was I didn't have enough of a feel for the overall picture because I couldn't pick out all the parameters that quickly. My familiarity with the panel is sort of limited.

KIRKPATRICK: What are Mike Ross's license conditions?

KUNDER: He's cross licensed. He's one and two both.

KIRKPATRICK: Its a long day. I think I even asked him that to make sure. Mike was there all the time?

KUNDER: No, he came in, he was in, Mike was in, it must have been 45 minutes I would say, to an hour after I got in there. Somewhere in that time frame.

KIRKPATRICK: Right. I think he actually came in after the pumps were shut off, is that right? He came in during that time, right? We covered the

nuclear instrumentation and discussed the boron samples, which I was interested in, and we'll key on those as far as time. Natural circulation we keyed on, thats important. Okay. The site emergency, you keyed on the temperatures, high Th, and then the site emergency was declared and Gary Miller was here, I assume right away. Did you recall them initiating the general emergency?

KUNDER: Yeah. The general emergency was initiated about 7--I didn't note the time when they initiated, but based on the log or the status board about 7:24, approximately. I do know that when the general emergency was declared, I immediately went in and told Ron Warren and Dick Bensel that it was a general emergency, recall everybody. By that time, I understood that they had reached just about everybody. In the case of the NRC, I do remember that they could only get the girl who was going to ring the duty officer. Okay? And I don't know what their conversations were specifically. I know Ron had questioned me, you know, the Civil Defense guy wanted to know a litte more information. I said, just tell him it's a site emergency and tell him to make the notifications. Because I didn't want to get into a lot of detail with him, because I think that would have just confused the issue and I wanted him to get off the phone and start making the calls. But anyway, a general emergency was declared, and we immediately went through and started making calls again.

KIRKPATRICK: And you were specifically working in that area, making the calls, making sure that was all done?

KUNDER: Right.

KIRKPATRICK: That's finished, you've made all the calls. I guess I don't know how long it took to make all the calls, but...

KUNDER: Well, what happened, yeah, I guess the calls were made, the second round of calls after the general emergency was declared, they began immediately after it was declared and they continued on. They were probably making phone calls for another 20 to 35 minutes, or something like that. I remember that one call came in on the 944-6017 number, which is the one that they used to tell like the DER to call back on. That's a direct outside line. At least someone answered it and said it was Gerusky. And I got on the phone with Gerusky. He had just got into the office. I told him what we had. We had a general, at that point it was a general emergency. It seemed it was about 15 minutes after the general emergency was announced. I told him that the conditions we had, high radiation, and I am trying to remember if I mentioned that the calculations showed that radiation level in Goldsboro would be 10R, and I was thinking that in line with the dome monitoring was what confirmed that we had a general emergency. And I can't remember if I told them that or not, but at any rate

KIRKPATRICK: Go back to the radiation level, where?

KUNDER: In Goldsboro. After we initiated the site emergency, it took 15 minutes or so til the calculators were able to use the isopleths, and using

the source term from the reactor building dome monitor. They apparently did a calculation and the resultant was that we would be seeing 10R at Goldsboro. I believe that was a whole body dose. And I had thought at the time that was one of the things that led Gary to declare that it was a general emergency. I was not aware of what the radiation levels were in the dome monitor, okay? And I thought initially we just, you know, we had the site emergency because we had more than 1 radiation level in the plant and that was pretty clear. But at any rate, I can't remember if I told him that fact or not. But I do know that there was a team dispatched to go over to Goldsboro, and the intent was to get a State Police helicopter in. Someone else made the initial request and apparently made it in a separate call to the State police. At least I thought that had occurred. I am not sure if it really did. But a little later into the event I had talked to the State police sergeant, and he wanted to confirm just what we needed. And I told him, I didn't really communicate with Gary, but I told him what I thought exactly we needed was a State trooper at the North gate to direct traffic, a State trooper at the South gate, and by that time I was aware that we would be diverting all the people that would be coming into work up to the observation center. So, I am pretty sure I asked him for a guide at the observation center. I said I wanted a helicopter to come in so that we can send some offsite monitoring teams out. I thought the best place for that guy is to come right on site and I told him I would notify security that the helicopter was coming in and we'll have the radiation monitoring team meet you up at the North end of the site. I knew the helicopter had come in here once before, and you know, they can land up there without any

problem. So I told him I need to have that done right away. Whether or not the helicopter was enroute, I'm not sure. The helicopter did come in pretty short order, as I recall, and I had told Dick Dubiel to reconfirm that I had talked to the State police and that they are sending a helicopter down and I called the security sergeant. I don't know who it was, but you know I told them that the helicopter should be landing on the site to pick up the radiation emergency teams. Dick took over making arrangements with ECS to get the emergency team out and meet them and that's all I got involved in that.

KIRKPATRICK: Okay.

KUNDER: I left the phone off the hook so that we could talk to Gerusky, and I was trying to get Dick Dubiel free so that he could come in and give him a better assessment of what radiologically we were seeing because I did not have a good enough handle on that myself. From time to time he did talk to him and I really can't remember how long or just when, but I tried to get him on the phone occasionally to just make sure, hey, we are still here, and just brief him on any changes. I think I probably gave him the wind speed direction at least one time.

KIRKPATRICK: Did you remain in the emergency center there?

KUNDER: I was in the emergency center the whole--yeah, I remained in there til later in the afternoon when I got called up with Gary Miller to the

Governor's office. So my function pretty much through the whole morning was I would say two things: I tried to handle communications for Joe and Gary, and certain amounts of coordination. I think I had called Security to make sure the muster was being taken, to find out if they had a muster yet, sort of the peripheral communications, and also all the offsite communications. Don Haverkamp called back and I had, I think I had--I'm not sure how I had set it up with Don now. He either called back on the one line and I answered it out in the control room and held that open, or he called in and I told him I would call him back at a number, and I just can't remember what I did there. But at any rate, I did have Don on the phone and this was probably 8 to 9 o'clock, in that time frame. I briefed him on what we had and I held the line open and I recall that he had people in the office that were either on the box or they were there and he was keeping them briefed. Basically, the I&E group who had set up a command center. So I did talk to Don on several occasions on the phone, and it was pretty much with respect to telling him where we were with the plant. Trying to give him the scenario as I understood it from the initiating event. I was aware at that time that we tripped because of loss of feed, tripped a turbine, that tripped the reactor. Again, I still wasn't aware that what happened to the feedwater emergency system and indicated that, I am pretty sure in that point in time, that I was aware that we had essentially a let down from the RCS and we had pressure having gone so low was, had formed a steam bubble and exchanged the water from the head of the reactor up into the pressurizer. That was the way I understood the real problem that we were into at that point. That was the first part of my responsi-

bilities that morning, aiding in that respect in the emergency plan. The other area was when Gary got together with, basically myself, Logan, Lee Rodgers and Mike Ross, we discussed pretty much as a team what our next move was with the plant. This was sometime after 8 o'clock. It was 8:30 or 9 o'clock that we pretty much left the emergency to the people that were running it, you know. Gary _____. We were still concerned about the reactor core. I recall we did reaffirm our main concern was the health and protection of the public. We sort of reiterated that as a group, and made sure that we had done everything for the plant. You know, the emergency plan was implemented. We addressed the core, we were still injecting high pressure injection, BWST was coming down, we still had our hot leg temperatures pegged. I hadn't realized that in Unit 2, we had a wide range hot leg temperature which goes to 800 degrees. I found out a little bit later in the morning that they indeed were very high. They were at or above 700 degrees. I remember praying that we somehow would get a real break in the system because we knew we had a bubble in there. Somehow we were vapor locked. There was no way--we recognized we probably had a, the pressurizer was indeed full of water, and we had vapor in the head of the reactor and up in the loops. We were trying to get as much water in there as we could. The pressure was still low. I guess it was still around 1,000 pounds, and we wanted to try and get the pressure up and at that point in time as I recall, we had the electromatic relief valve open and the RCV2 was open because we felt, you know that was the only way we were getting any kind of cooling. Inject high pressure injection and vent off through the pressurizer. After, at one point, we all felt the best thing we could do was to try and

get the pressure in the system up by closing the RCV2, the E.M. isolation valve. And that was done. That was sometime, I estimate, around 9:30 or something like that.

KIRKPATRICK: Excuse me, would you clarify that again? You said the pressure was still down but you were charging water in, but you think it was going out the relief valve? Is that correct?

KUNDER: Yeah, we had, at that point the philosophy as I recall was that we wanted to get the flow through the core, using high pressure injection, and by having the electromatic relief valve and the pressurizer open. We were hoping to get some sort of flow through the core and out that path. The thing is the pressure never rose. Pressure just wasn't going up. We felt that the best thing that we could do to get the pressure back up was close the relief valve and hold pressure at a high value and then continue the venting through the pressurizer. We just sort of felt that we were going to try and collapse that steam bubble that was in there. Get enough water in there to make sure that the core was indeed flooded. We intuitively felt that the core was flooded, but you couldn't prove it. There was no indications that said, yes, indeed, you were indeed covered. Okay? We felt that we were but one of the things that really bothered us badly was the fact that the hot leg temperatures were still very high. And we felt that we still had steam in there. I recall one of my big concerns became that, my God, we are going to put water in the pot and if we're boiling off, we are concentrating boric acid, and I was extremely concerned that we

might be crystallizing boron and get to the point where we don't have enough room for water. Okay? We end up having a slush of boron in the core, and what would happen then? So that's something that really worried me. And I felt by trying to get the pressure up and trying to press the bubble, maybe we can do a more effective job of circulating water through the core by using the high pressure injection.

KIRKPATRICK: We'll cut the tape at this time. It's 9:34, April 25, 1979, and we will resume on another side.

SHACKLETON: This is a continuation of the interview of Mr. George A. Kunder. The time is now 9:36 p.m., April 25, 1979. Please continue.

KIRKPATRICK: George, at the end of your last tape, you were commenting on boiling and--possible boiling of the coolant concentration of the boric acid diffuser. Would you go into that in a little more detail.

KUNDER: Okay. We had been injecting high pressure injection all along. Our temperatures in the hot legs were still--they were pegged on the panel instruments and by that time I was aware that the temperatures were up above or at 700 degrees F. It was my perception that we were somehow vapor locked, that we had a steam bubble at the top of the core and somewhere in the legs, had no way of knowing exactly where. We were concerned that we were not getting adequate cooling. We were fairly confident, intuitively, that we had the core covered, but one of my specific concerns was, if we

are not getting good water circulation, then the cooling mechanism was--we were getting--had the core covered, but it was continually boiling off and we were steaming. And that would or could lead to concentrating the boric acid to the extent, I was afraid, we might be getting a slush of boric acid in the core and ultimately lose the cooling that we had at that time. So, as I recall, the logic for making the decision to close the pressurizer E.M. valve and get pressure up was to try and collapse that bubble. Okay. And see if we can get the level in the system up and try and make a run for filling the loops and getting the natural circulation cooling or something like that. The concept was that we may be able to get more effective cooling using the high pressure injection through that mode. So, we all agreed that the we ought to go that way. I can't recall now whether Lee Rodgers had communicated with Lynchburg to determine if that was the way to go in that particular item, but at any rate, we did do that. The pressure did come up and we seem to be about over a half hour to maybe an hour-and-a-half time period. The pressure got up to above 2,000 lbs, and it was decided by, I guess Gary Miller that we try to hold the temperature between the 2,000 and 2,200 lb band by cycling RCB2, which is the EM block valve. That was done and we were in that mode for a considerable period of time, probably an hour or longer. And they were cycling that valve, which is a motor-operated gate valve, about every couple minutes to maintain that pressure band. I believe the decision was made to widen the band to decrease the amount of cycling on the valve, and based on our experience in Unit 1, that valve doesn't perform very reliably through continued cycling. We were afraid of maybe developing packing leaks or at some point in time the

motor might fail, or something like that. So we wanted to just limit the number of times the valve cycled. We recognized that we hadn't really made much progress by increasing pressure, in the sense that we were still injecting from the BWST and we only had so long to operate in that mode before we would be out of boric acid in the BWST, and our problem was what are we going to do next? We still didn't have indications that confirmed we had circulation in the core. Again, we still intuitively felt that the core was covered and we were getting some cooling, but there was no clear evidence that we were getting circulation and my concern for that crystalization still sort of existed at that point.

KIRKPATRICK: This is Kirkpatrick. At this time were you taking any core temperatures or getting core temperature readouts?

KUNDER: I personally wasn't. Ivan Porter had been, throughout much of this time period, looking at the hot leg temperatures. He had, as I recalled, hooked up a digital volt meter to the hot leg temperature that goes into the RPS on the RPS channels in the control room.

KIRKPATRICK: Up in the hot legs themselves?

KUNDER: Yes, and he used the output of that and correlated it to the calibration curve for that RTD and was able to determine temperature. It did agree fairly well with the wide range temperatures, and it was sometime during the morning, I'm pretty sure, that he or someone else had looked at

the in-core thermocouples. Unit 1 do not have in-core thermocouples, and I was unaware that Unit 2 had them installed. I think Unit 1 probably has the in-core thermocouples but they're just not hooked up, as I recall. But Unit 2 had them hooked up, and I was really unaware of the information that you can get from them, but he had been looking at that and I recall afterwards that they saw very, very high temperatures. They ranged from some value close to what the, I guess, I'm just guessing now, they had some question marks, I know, which meant that it was out of the range of the computer or got a bad signal, but they had high temperatures--up in the 2000° range or something like that. I did not see the numbers, I'm saying that's based on data that I've seen since this event occurred.

KIRKPATRICK: Do you know if any of these temperatures were in the periphery or do you k[illegible] character aspect, you can't characterize it that well?

KUNDER: I can't characterize it that well, and I believed that Gary Miller had specific conversation with Ivan or the people that was getting the data for him, but I didn't participate in that directly.

KIRKPATRICK: The decision then was made to depressurize I presume ...?

KUNDER: Yeah, we talked about that for some length. We felt that probably the one way we can assure that we got water going into the core was to get down in pressure low enough to get the core floodtanks going into the core, and also our thought was at that point, we try to make a run through for

getting on decay heat removal, which means we got to get down to pressure of around 320-325 lbs. We finally agreed that we'll allow--and the other concern of course was we were afraid we were going to damage the block valve--at least the motor, operating on it from cycling it so frequently. So, we decided we would open the block valve, allow the system to depressurize, and try to get core flood initiated into the core. And that was done, and this was somewhere around in the region of 12 or 1:00 something like that. And the pressure did come down, and it came down fairly rapidly at first and tapered off. It did come below the 600 lbs and allowed some water to start to dribble in.

KIRKPATRICK: Were you still running the HPCI at this time?

KUNDER: Yes, we never stopped running high-pressure injection to my knowledge, and Gary Miller made it pretty clear that he didn't want high-pressure injection isolated or stopped for any reason, just to make sure that nobody got the wrong impression out at the console. I think that the flow rate was cut back somewhat to conserve water. I think that it was probably cut, I think I recall that it was cut back to no less than 300 gpm total input to the core. That's a recollection, I never really confirmed that.

KIRKPATRICK: And you started... you got down... and then... you... the core flood tank really wouldn't dump, apparently.

KUNDER: Well, we did move water into the core. It wasn't as much as I was hoping for, I was hoping we could get the pressure down a lot faster and really empty the tanks. That didn't occur, we emptied probably 10 to 20%, and a little bit more, from the core flood tanks and the pressure was down around, oh it sort of bottom out around 450 maybe as low as 440 lbs in the RCS. It was about that time that Gary had indicated to me that he was required to go up with Jack Herbein to the Governor's office, and I didn't like that at all. We were in a situation where I felt we needed the expertise. He asked me to go along because he didn't have all the details of where we were at, and what had happened clearly down on paper or clearly in his mind. He wanted someone technical to back him up, and at that time I did have a lot of the details and the thought processes and what we did. I did in preparation for going up to the Governor's office, I did try to get information from the... all the logs we had gotten zerox's of the sequence of events. I had to go over to Unit 1 to get some of that, because the nuclear engineers, Mike Bensen, was trying to get that information and retain it so it wouldn't get lost. I had to get that from him, so I had to make a trip over to Unit 1 control room prior to going uptown with Gary. I spent probably 10 or 15 minutes trying to gather information and get copies of the printouts in the Unit 2 control room, marking down the status of the plant (pressure, temperatures and so forth), and I made a few notes. Then I went over to Unit 1, got a xerox copy of the sequence of events, and the alarm printout and I got a copy of the communications log that was being kept with the on and off-site monitors. The ECS by the way had been removed to the Unit 2 control room earlier in the day because of higher radiation

levels or higher airborne levels in the Unit 1 control access area. Later on, we had again, high airborne in Unit 2 control room. It wasn't too high, but it was enough that we had to don respirators and it was decided to move the ECS over to Unit 1, so that had transpired before 12:00 noon. So, I went over to get that information and then I met Gary at the service building exit, and we both got into the car and went out to the North Bridge, and there we met Jack Herbein. We stayed in that same car and went up to the Governor's office.

KIRKPATRICK: How long was you gone from the time?

KUNDER: That was--we were gone roughly an hour and a half. At first I thought we had left around 1:30, but after reviewing some of the sequence of events and some of the plant parameters, I recalled when I left the plant the pressure was about 450 lbs. And I had forgotten that the pressurizer level for the first time through the morning had come on scale. It looked like we were starting to get some method of circulation cooling, but then the pressurizer level went up again and they had lost it. That was about the time that I left and that was, after looking back at it again, it was somewhere around 2 or 2:30 in the afternoon. We were offsite for ... went out to the Governors, went up to Bill Scranton's office actually, and we had talked briefly to Herman Kneecamp who was already up there and had spoken to the officials and went inside. I went into an office adjacent to Bill Scranton's office and called back to the plant to establish some communication with them and to see if anything had changed in our absence,

and I held the line for I guess it was 10 or 15 minutes. Meanwhile, Gary and Jack went in and had their conversation with Bill Scranton. I guess we were probably there for at least half an hour, probably 45 minutes, maybe a little bit longer. I do recall when we came back, we tried to pick a route where we didn't have too much traffic, because it was around 4:30 to 5:00, somewhere in that time frame. We got back to the plant, and I believe it was when we got back a decision was made to take the pressure back up, and again attempt to get the loop--at least one loop--filled, and see if we can start a pump. I don't think it was too long after we got back to the plant that that became our goal, and Jack Herbein had ordered that we take the plant, try to take the plant solid, and I guess we were skeptical of our ability to really do that. Any rate we did charge it max flow rate, as I recall. This is a little fuzzy, I'm not really sure what the flow rates were at that point. But we did attempt to charge the system, to get the pressure up, and hopefully fill the loops. The decision was made to try to start the one reactor coolant pump. Lee Rodgers had been on the phone with Lynchburg, I guess, during most of the day. He was checking out with Lynchburg whether it was okay to start the pump. At any rate the pump was started. Initially the pressure was up around 2000 lbs, somewhere close, and pressure initially dropped fairly radically and they secured the pump. I wasn't up at the console really observing this. I really have a hard time recalling what specifically I was doing, but I was on the periphery following the operation on the console. It was apparent that the decreasing pressure was due to the cooling that was occurring when we started to pump and Joe Chwastyk was the Shift Supervisor on at the time. And it was just

a matter of getting the pressure back up and making a second attempt, which was done. I helped to participate in that operation. They put me back behind the panel to close the automatic isolation valve or the valves DHV 8 A & B. This is the outlet of the sodium hydroxide storage tank,s because the first time that they had a pressure drop I believe they had high-pressure injection, which was no problem, except it initiated a lot of other equipment, opened those valves. It was not desired to inject sodium hydroxide into the sytem at that point. I'm not sure what all else occurred when you intiated high-pressure injection over in Unit 2, but I was there to close those valves, and they did make another shot at starting the pump and expecting the pressure to come down. They were going to try and keep it on this time and see how far down it came, and if it leveled off, fine. I don't recall if they established a limit on the pressure drop, but it did come down to somewhere in the range of 1500 lbs, perhaps maybe a little bit lower. But, when we ran the pump at that point, the hot leg temperatures came down into range very close to the cold leg temperatures and shortly thereafter I believe we got flow established in the B loop as well. Of course, at that point we knew then we had flow in the system and, by the way, the one valve, DHV 5 I believe it was, did open. I immediately closed it.

HUNTER: The sodium hydroxide valve?

KUNDER: Yes.

HUNTER: The 8A or 8B valve?

KUNDER: The one valve, I just, I hit them both closed just to make sure they did stay closed or go closed again. I recall assigning Don Berry to take notes to make sure we were keeping a record of what was going on. He was doing this also behind the console with me.

KIRKPATRICK: When would he have started taking notes, during the day or ...?

KUNDER: No, I don't think. It was too early in the day, I just rec... periodically, I recognized that notes were not being taken, because it was a lot activity, and I just seem to recall just prior to that event that I asked them to keep good notes on everything that transpired so that we had a record. Its awful hard for the operators to keep a log on ..

KIRKPATRICK: I notice that, realizing that things were going on ... trying to build a log now, really. After you had the pump on again, did you feel like things were... that you had things fairly stable, then, far as cooling flow and ..?

KUNDER: I think we felt that way. We felt at least we made a major milestone. And we reestablished flow and it was stable flow, and we had control of pressure, the pressurizer level was still rather high, but it was on scale and TH came into close proximity to TC on the A loop, and it was very

shortly thereafter that same thing occur on the B loop. And for the first time, I think we all felt pretty relieved.

KIRKPATRICK: Was the pressurizer level on scale, you said down to indicate...?

KUNDER; It was on scale and as I recall somewhere around 300 ...

KIRKPATRICK: Was that from the pressurizer heaters and actual steam bubble on the pressurizer, or was it just there?

KUNDER: Well, we, I think we felt we had steam bubble. I know earlier in the day the pressurizer heaters were not very effective. We apparently had lost a number of them due, presumably to the moisture conditions in the reactor building. But from the time we stopped venting from the pressurizer, the pressure had come down and presumably some of the condensation, some of the moisture, permitted the heaters to dry out sufficiently, so we could reset them and we were getting a little bit more performance out of the heaters.

KIRKPATRICK: Okay. We've been through the complete event, and I think we got your position through the whole event, and we can keep that and take points for the radiological people to talk with you on the health physics aspects of that. If we need more details we've got ... pick areas to talk specifics to you. I'm saying that we will be talking with you again, I'm sure. We will schedule you in again next week, or whatever. Don, do you have any questions?

HUNTER: No I believe I don't have any at this time.

KIRKPATRICK: It's getting late and there's no sense going on. I'm finished for now, and I appreciate your time. Do you have any comments that you like to put forth? As I say to everybody, is there any area that we need specifically to make sure we do get involved in, that we don't overlook anything, because again we're coming in trying to rebuild this thing.. We have a fairly decent sequence, and we're putting everything together, but it's going to be. We don't want to overlook anything, because we're here to find out why you were presented with what you were presented with.

KUNDER: A feeling that sort of pervaded the control room was that, and it bothered me, was that we didn't have the ability to control what we had, we didn't have the ability to vent off the system. Like I said, I was at one point just praying that we didn't blow a reactor cooling pump seal, or something we could blow off the top. That way, we could vent off the steam and assure that we were getting flow through the reactor. It was more than a frustrating feeling. It was sort of a futile feeling, that we weren't able to get flow through the system at that point in time. Of course, we were thinking of all kinds of design changes that we'd love to see to allow us to go for that situation. I've got some recommendations, probably more generic recommendations, that I've already taped and given to Gary Miller and he's compiling those recommendations along with those of other people in the plant to present to Senior Management, and so forth. No. I don't think I've any other comment.

KIRKPATRICK: Thank you. Think about--think about what we can talk about again. If something comes to mind, make sure you jot it down, 'cause when we do talk about these areas at the time the block valve was closed, oh yes, by the way, that's when the source range did something whatever you, ... recall somebody saying something. Try to think along that line and don't hesitate to jot something down, and we'll try to make sure that we cover all the aspects of this thing, that we feel and you feel are necessary for us to be covered to make sure we get the answers. We are not ever going to have this chance again. And we didn't expect to have it this time, but since it is here, we're going to try to find out what happened.

KUNDER: Now, I certainly want to see that.

SHACKLETON: Okay, thank you very much Mr. Kunder, the time is now 10:03 p.m. April 25, 1979, and we'll end this interview.