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ORIGINAL

OFFICIAL TRANSCRIPT OF PROCEEDINGS

Agency: Nuclear Regulatory Commission
Incident Investigation Team

Title: Nine Mile Point Nuclear Power Plant
Interview of: BOB CRANDALL

Docket No.

LOCATION: Scriba, New York

DATE: Thursday, August 22, 1991 PAGES: 1 - 23

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ERRATA SHEET

ADDENDUM

Page	Line	Correction and Reason for Correction
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23	1	CHANGE "IN" TO "SINCE

Date 10/3/91 Signature [signature]

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

INCIDENT INVESTIGATION TEAM

- -

Interview of :

BOB CRANDALL :

(Closed) :

- -

Conference Room A
Administration Building
Nine Mile Point Nuclear
Power Plant, Unit Two
Lake Road
Scriba, New York 13093
Thursday, August 22, 1991

The interview commenced, pursuant to notice, at 2:18 p.m.

PRESENT FOR THE IIT:

Frank Ashe, NRC

Jim Stoner, Duke Power, INPO

PROCEEDINGS

[2:18 p.m.]

MR. ASHE: My name is Frank Ashe and this is an NRC interview with Mr. Bob Crandall.

Bob, could you give us a little spiel as to your name and also your employment history with Niagara Mohawk.

MR. CRANDALL: My name is Bob Crandall. I am a System Engineer in System Engineering with Niagara Mohawk.

I was an electrician for nine years with Niagara Mohawk. I then became a test engineer during startup and test during initial construction, startup, and now I'm a System Engineer for the last four years.

MR. ASHE: Could you explain your involvement with the UPS power supply which apparently went down during the event? Prior to, prior to -- prior to -- your involvement with the specific UPS that went down during the event.

MR. CRANDALL: Being a System Engineer, I follow that system.

MR. ASHE: When you say "follow the system," could you just describe some of your normal routine duties that you would do in just your day to day activities in working with that system?

MR. CRANDALL: I have been involved with some of the training that's gone on, on the systems, with Operations and Maintenance. I follow closely the maintenance that goes

on, on the units.

I have assisted in startup, shutdowns of those equipment. When things break I usually go out with the maintenance staff to assist them in the troubleshooting and repair.

At time during that maintenance we have also done some checks, preventive maintenance types of things to make sure certain things were working the right way. If we found something wrong in one unit we'd make sure, you know, those kinds of thing weren't going on in other units. We were trying to preclude the same kind of things on other units.

MR. ASHE: For the event, as best you can recall, could you explain your involvement in restoration of the inverters or at least describe your involvement as best you can recall in the restoration of the inverters after they were lost?

MR. CRANDALL: Yes, I was called into the technical support center to give technical support. Found out that five units had gone down, that they had been restored to maintenance and I was requested to go out on the damage control team to assist operations and I&C to restore those to normal, which we attempted to do.

MR. ASHE: Can you be more specific and give us more details as best you recall those?

You arrived on site -- you went down to 237

elevation -- you had the room -- you observed this or that, those types of things.

Could you do that as best you can recall?

MR. CRANDALL: Sure. The initial thing was they requested that I assist in the recovery so I got an I&T tech and electrician. We got tied in with Operations. We went down to 237, normal switchgear.

What we instructed the TSE that we would do would be to go through down to each unit, assess basically the condition they were in, basically determine if there was any outward damage, obvious damage that, you know, would preclude us from starting them. We did that.

We went to 237 first and looked at those four units, radioed back that there didn't appear to be any damage to any of the units. It appeared like we would be able to recover them.

MR. ASHE: Okay. Now when you say "looked" at the units, could you be more specific? What did you look for when you looked at the units or did you look to assess damage to the unit?

MR. CRANDALL: Primarily operational condition, to see position of breakers. We were on maintenance supply. I looked at the alarm indications, just a quick through, call it a cursory view I guess. I didn't at that time mark down alarms. I just took a quick glance to see if there were

obvious things like fuses blown and things like that that would give us indications of some inward damage. There was no alarm indications to indicate that there was anything inherently wrong with it, anything specifically wrong with it.

There were trip signals in on all of them, which we expected to find. Didn't actually open the units up at that time and actually look inside. We merely went by each unit. We were trying to do it as quickly as we could in order to be able to get normal AC power to the units.

MR. ASHE: Could you go through the units that worked on your initial startup as best you recall and the ones perhaps that didn't.

MR. CRANDALL: Let me give you a little more first. We did that on normal switchgear 237 elevation, then instructed the control room TSC that we would go down to the other unit, which was on 214 control building, assess that one and then we'd call back and ask them for their requested sequence for recovery, which they came back and gave us.

the first unit was up on 237 so we proceeded to go up to there.

MR. ASHE: Okay. Now you were involved with the restoration of the three units that were put back on the inverter?

MR. CRANDALL: Yes -- we actually attempted all

five.

MR. ASHE: Okay, all right, now could you explain what happened to the two that you were unable to re-establish?

MR. CRANDALL: Can I refer to this?

MR. ASHE: Sure.

MR. CRANDALL: I am reading from the notes that I made that day from that particular event.

We were instructed to start UPS 1C first, 1-Charlie. What we did was we marked down all the alarms that were in on the unit--

MR. ASHE: Excuse me one second. Do you know why you were instructed to start 1C first?

MR. CRANDALL: Three of our units you could consider to be critical to plant instrumentation. Two of them are plant instrumentation; one of them is a computer.

Because of the situation we were in, really didn't know what they went through, and I agreed with this, we went to 1-Charlie because it fed lights and some communication things that are not as detrimental if we lost them on a short term basis.

That one had minimal impact if we found something that was going to take the power away and indeed we did, on the startup of that particular unit. So to speak, we learned on that one in order to make it that much more

smooth on the other four.

MR. ASHE: So you started at 1-Charlie and you were about to describe what happened.

MR. CRANDALL: Started with 1-Charlie. We recorded all the alarms that were indicated for use for troubleshooting later on, and reset all of those alarms. So that we did not lose the load on the startup, there is a plug on the maintenance supply breaker that we pulled so that that would be maintained, closed the AC input breaker, started the unit.

The unit came up and ran and everything was good. Typically that would be if there is no obvious damage to it, which is when we open the doors, there was no, you know, parts or whatever or no obvious type distortions and there was no reason to suspect any problem so we merely started the unit up.

It went up. It ran. It synced to the maintenance supply. Everything looked good. Closed in CB2. When we went to reinstall the plug for CB4 the operator opened for CB4. We removed the operator, closed that back in.

I'm sorry I have to clarify that because that's not in my notes. I am not positive that unit did that.

MR. ASHE: Okay. Could we just go back from the beginning? It appeared as though 1C was brought back up?

MR. CRANDALL: Yes.

MR. ASHE: But it seems as though there was another problem there. Could we just focus on that to the best you recall what the problem was?

MR. CRANDALL: One of the units, and I'm not saying in my notes, one of the units when the P6 block was put back on there was a closed signal still within the logic, or I'm sorry, an open signal which is not unusual on starting it up, that the logic will get a miscue and has to be reset sometimes, but one of the breakers, and again I am not sure it's 1-Charlie, one of the breakers opened on us, CB4, losing the load. That particular one we pulled the operator, put the breaker back up in, and then put the operator back down.

No, let me rephrase that -- pulled the operator up, closed the breaker. With it in that position, we then shut the unit back down, turned the logic power off, the DC control power, reclosed the DC control power, restarted the unit back up without a problem.

For some reason there was an off signal there, okay, which we -- basically from there we put the operator back down, transferred the unit, the load, over to UPS power successfully.

MR. ASHE: Okay. This process was repeated and obviously you may or may not recall the sequence; if you

do --

MR. CRANDALL: I do.

MR. ASHE: -- you know, I would appreciate it in terms of the --

MR. CRANDALL: It was One Charlie, One Alpha.

MR. ASHE: Okay. But obviously two units -- you were not able to restore two units?

MR. CRANDALL: That's correct.

MR. ASHE: I wonder, could you describe those activities that you might have participated in?

MR. CRANDALL: Okay.

MR. ASHE: Regarding those two that you were unable to re-establish?

MR. CRANDALL: We went to -- One Charlie was first. Then we went to One Delta, was next. That one was restored successfully. We went to One Alpha and upon closing the AC input breaker we heard the -- the way it's described is the bump of the T-3 transformer in there. Which is not unusual, the saturation current going into that transformer. We went to start the unit, it wouldn't start, and then I looked up and noticed that the AC power to the unit wasn't there. The breaker is on the same level. We went over into that panel and that breaker had tripped.

We knew it tripped at the point that we closed CB-1 on the unit, because had it been open during the event we

wouldn't have gotten any saturation current into the transformer.

So, we opened CB-1, I asked the operator to reset the breaker, we attempted one more start; on that start we got no bump, the breaker tripped again; I told him to leave it and we went on to the next unit. And I then radioed the control room and the TSC -- or the control room and asked them to relay to the TSC that that unit -- there is something wrong inside the AC part of that unit. It was staying on maintenance and we proceeded on.

MR. ASHE: Okay. That was the 1-A unit?

MR. CRANDALL: That's the 1-A unit.

MR. ASHE: Okay. And the next unit, did you proceed?

MR. CRANDALL: It was 1-B.

MR. ASHE: One-B.

MR. CRANDALL: That unit -- same -- same process we went through; started the unit up, successfully got it started, everything looked fine, we went to transfer it over to UPS power and the motor operator moved to the odd position but it didn't -- the breaker obviously didn't close. We lifted the motor operator off of the breaker and the breaker was tripped -- in a trip position. We reset the breaker and tried it again, same result.

Previous to this time, and there was already some

work documents in process and we were waiting for an outage on the particular downstream loads, that breaker had failed. We knew we had trouble with it in the past. Sometimes we could get a closure on it. Sometimes it would take a few times to do it, but after the second or third time of attempting it, we couldn't even reset the breaker.

So, we -- again we told the control room to relay to the TSC that that one is on solid on maintenance, unable to recover at this time and we went to 1-G.

Down on 1-G the exact same process, recorded all the alarms and everything, started the unit up, or attempted to start the unit up. I closed CB-1 -- no, let me rephrase that. Initially going down there because of the problem we had on One Alpha, the first thing we were doing was looking at the AC input meter. And we had voltage on that. I closed the breaker and I looked at it again and I didn't have voltage. And it tripped the upstream breaker. We reset the breaker in the UPS and I sent an operator to close that back in, which he did. He called back down and said it was done. We reclosed CB-1 and then proceeded to start the unit up successfully and transferred to loads over.

MR. ASHE: Okay. So as to 1-G, you were able to reestablish the loads back on main --

MR. CRANDALL: Yes.

MR. ASHE: Okay.

MR. CRANDALL: One C, D, and G were successfully started. A and B we were unable to.

MR. ASHE: I wonder, could you describe for us why you feel that none of the units were able to transfer over to the alternate source during the event? Your personal opinion, that's --

MR. CRANDALL: My personal opinion and it's not solidly -- you know, we're not solidly finished testing, we know that the DC logic control power within the units are on -- are off of maintenance supply. The maintenance supply in the units are fed right from utility power that feeds directly back to -- basically ties right into the grid.

We had verified electrically, in two units, that the B phase of the maintenance power feeds the DC power supplies within those units; through some of our testing we have approximated some things that appear to indicate that the circuitry given a low voltage or low voltage with a transient can drop the DC power within those logic supplies to trip the units.

MR. ASHE: Okay. Once the unit isolated though, why -- why wouldn't it have transferred over to a telephone supply? What do you feel is one possible explanation for that?

MR. CRANDALL: On a number of units, and I think it's two. Yeah, on two of the five units we found an alarm

standing in that's a voltage difference alarm. That alarm will only come in if there's a voltage difference across CB-4. If there's a voltage difference across CB-4, there is a permissive within the circuit that will not allow that breaker to close. And it is -- you have know way to know for sure. It is my opinion that because there was a low voltage condition on the B phase of the maintenance supply that the UPS sensed that, couldn't make that -- make up that permissive and therefore CB-4 was locked out from closing, per design.

MR. ASHE: Why do you feel that the low voltage alarm wasn't on the remaining three units? Do you have an opinion about that?

MR. CRANDALL: The voltage difference alarm?

MR. ASHE: That's correct.

MR. CRANDALL: I have an opinion, but coming from an outside representative as I understand it, that the voltage difference alarm is not an alarm that locks in. It's there while the voltage difference exists. While there's voltage across CD-4, but it will clear itself once the condition clears.

Under the circumstances we have the alarm actually shouldn't be there because it should have cleared once they closed CB-4 and had voltage across it. It's my opinion, that based on the transient that went into the DC power

supplies that there was a -- not the right technical term probably, but a logic lockup that didn't allow that -- that latched that alarm for us, in two units. It is conceivable, I mean -- and I would have expected that the alarm came in on all five units at some time, partially because CB failed to close and we have, through testing, verified, on all units -- no, I can't do it on the two that are down.

On three of the units we were able to transfer successfully, so that says the operator is working on those units. On two of the units we have tripped back and forth multiple times and proven that circuitry, so the only possible explanation is that we were -- we had a voltage difference to the maintenance supply, so they were locked out.

MR. ASHE: Is it in your opinion possible that the units could have lost this comparative circuitry such that the permissive was not made prior to the actual transformer failure?

MR. CRANDALL: Are you asking if they were able to transfer prior to this event?

MR. ASHE: I guess what I'm asking is, in your opinion is it possible that the synch signal could have been lost prior to the unit isolating?

MR. CRANDALL: I would expect that that is true. If the signal was received afterwards, there's every reason

to believe that they would have transferred, though that's conjecture, because we don't know what occurred.

MR. ASHE: Now, the class 1E inverters, as we understand them, were not lost. Do you have an opinion as to a reason why you feel that those would ride through this type of transient and in fact five units would not?

MR. CRANDALL: A transient on the AC input to any of the inverters -- to all 10 -- all 10 of them will react to it and ride through it and be unaffected by it. The difference between the five that failed and the five that didn't is that the five that didn't don't take their DC control power from maintenance supply; they take that from the DC supply that supplies the inverter sections of each unit, each of the five that didn't fail.

Because those five units rode through the transient on the AC side, the DC would not have even known that there was a -- it would not have seen it; it wouldn't have been reflected on the DC portion of the units, and therefore the DC logic supplies wouldn't have seen any transient.

MR. ASHE: Based on your analysis of the five that were lost in this event, could you explain to us as best you understand it now changes that are currently being considered with regard to design, with regard to preventative maintenance, and any other items you might

have, to preclude this event from reoccurring?

MR. CRANDALL: Let me give you my opinion on how it can be prevented, rather than saying we're committed to a certain design change that isn't approved yet. If the DC power supplies within these five units -- if that DC logic is fed from inverter output rather than maintenance supply then they would not fail in this scenario. They would be unaffected by any disturbances on the maintenance supply, and any disturbance on the AC input side, they'd ride through it and not know it.

MR. ASHE: What about any type of preventative maintenance being considered -- revision, modification, additions, any items in this area of being considered for revisions or additions? Is there anything that you know about in that area?

MR. CRANDALL: Previous to this, preventive maintenance was done on a less formal basis, as I mentioned. A lot of times we would go out and do preventive maintenance in order to preclude problems. In April I identified that there was not enough preventive maintenance on any of our 10 UPS's and wrote a document to outline what kinds of programs I thought should have been instituted. In July that was approved, and the process had started. It's a broad-based program, say, on all units. Our safety-related's much more frequent that the non-safety-related.

MR. ASHE: As a result of these event, is that going to change the documentation, or is it going to actually accelerate a program that was already in place?

MR. CRANDALL: I would expect that it will accelerate it. My personal opinion is that the preventive program we had going was adequate up to now and that the program we're putting in will definitely be an enhancement for the long term.

The one issue around control batteries that has come up: If the DC power supplies are fed from inverter output, any preventive maintenance on those control batteries becomes a moot point. The control batteries, in and of themselves, are not designed to help us ride through this type of transient; though they may have mitigated it some, it's speculation to say they would have prevented it.

If we're fed from the inverter power supply, in actuality I can take the batteries out of the unit and lose no reliability. The batteries will give our plant some troubleshooting assistance if we lost the total inverter and maintenance power; it would allow some lights to stay on in order to repair the unit down the road, and that's their main design function, not to ride out transients.

MR. ASHE: Prior to this event, were there any anomalies that you were aware of? If so, could you describe those anomalies? Prior to the occurrence of the event, any

anomalies, first of all, that you might have been aware; and, if so, could you briefly describe them for us?

MR. CRANDALL: I'm not sure I understand the question.

MR. ASHE: Okay. Prior to the event, the inverters, all five, were operating, as I understand it.

MR. CRANDALL: Correct.

MR. ASHE: To your knowledge or as best as you can recall, were there any things that you knew, that you were aware of, that were what I would consider abnormal? Did you have any maintenance orders on them? Did you have a work order to do something? Were you going to replace a light? Were there any types of abnormalities or off-normal conditions?

MR. CRANDALL: The only work request we had was on the one unit, 1-Bravo, for the breaker.

MR. ASHE: Could you describe that work request for us? What was wrong with that particular breaker?

MR. CRANDALL: The breaker would not always reset. If it didn't reset, we had difficulty getting the unit from maintenance supply over to normal supply. Sometimes we got lucky and it would reset and we'd be able to go over. Sometimes we had to try and reset it two or three times. Up until now, we had always been able to reset it. It might take two or three times trying to reset it, but we would

always be able to get it over to normal supply. Because of the equipment that it fed and the impact to the plant, we did not immediately want to take the unit down, because of that impact to the plant, but it was in the works to be done.

MR. ASHE: Okay. So the inability to reset a breaker on at least one of the units precluded you from closing that particular breaker; is that what you're saying?

MR. CRANDALL: That's correct.

MR. ASHE: Okay. And what was the --

MR. CRANDALL: But the fact that, prior to the event, we were on normal supply, so we have three sources of power to the unit, the inability to reset it, as long as you could go to normal supply, did not reduce the reliability of the unit, because reliability is based on AC in and DC backup power with the maintenance to fall back on if for some reason something went in the unit. So we felt the unit was reliable in that condition. That's why it wasn't any type of urgency to go out there and get that breaker. It was more important to keep the plant loads intact.

MR. ASHE: But in fact, had something gone wrong with the normal supply, the ability of that breaker to close would have been in question.

MR. CRANDALL: If we'd lost the normal supply, we would have gone on DC as designed.

MR. ASHE: So the backup DC was still there and still reliable?

MR. CRANDALL: Correct. The only way that breaker, that doesn't compromise it, but the only inability we had is once we -- if we lost AC and then lost DC and then went on maintenance and wanted to come back.

MR. ASHE: Let's see if I can do this now. So the real problem was not so much in opening the breaker but rather if the breaker is open the problem would be trying to reclose it?

MR. CRANDALL: Correct, which the only time you expect to be in that condition is under a maintenance situation.

MR. ASHE: But once the breaker is closed, then in fact there is really no problem?

MR. CRANDALL: Correct. There was no problem with any type of premature tripping or with the breaker closed it was reliable. It would latch. It would stay latched in. We weren't the least bit concerned about that.

MR. ASHE: Could you briefly describe now what's involved in repairing such a failure?

You said the breaker was unable to reset. Could you go with that and sort of describe it in the repair?

MR. CRANDALL: What we have to do? Take the unit totally out. We have to kill all loads off the unit, remove

the breaker, and put another one in.

MR. ASHE: Okay.

MR. CRANDALL: It's a replacement. It's not a repair.

MR. ASHE: Okay.

MR. CRANDALL: That's why there is a -- you have to make a judgment as to whether it is better to continue to go along, continue in your vital loads until there is a convenient -- I don't want to use the word "convenient" loosely -- an appropriate time to remove those loads, appropriate to the condition of the plant to make a breaker repair, versus giving up the ability to reclose it.

That wasn't in question really anyway until this particular time. There wasn't an urgency to do that because it was more important to keep the level loads intact.

MR. ASHE: As a result of the event and this occurrence, do you feel there will be changes in operating procedures, in the operating procedures, restart procedures, any type of operating -- have you learned anything that you might wish to consider to modify, revise or change the terms of procedures that describe how to operate the equipment?

MR. CRANDALL: There will be a revision to the one operating procedure to describe the way to close in CB4 with this type of failure. In fact, over the week, week and a half, we have been doing some informal training with every

operator that has been assisting us to show them exactly how that is done.

Ironically, a week before the event I sat down with the Operations Supervisor and requested and he agreed that we would take the operation procedures and have Training go through each, both the licensed and non-licensed operators and yearly go through those operation procedures at the unit, showing the operators where all of the control are and how to manipulate the UPS's as best they could doing mock transfers on that if necessary to get them better familiar with those units.

That, you know, was another thing that was in process. Part of that would have been that lifting of the motor operator to manually close the breaker?

MR. ASHE: How often have you seen any of these units produce a total trip like they did to totally isolate themselves let's say on a per year basis?

Is it once a year, twice a year? I realize that no exact number, but would you say that it's usual that that happens or is it very unusual for the unit to completely isolate itself?

MR. CRANDALL: I would -- I know of one definite. I would guess of two others since startup where there has been a total loss. One of those events was a personnel error. Another, a fourth event, was due to a maintenance

practice, so I would say of all five units in startup, four events probably total.

MR. ASHE: Is there anything, other information that you would like to provide that may be helpful in understanding or analyzing this event? Do you recall anything?

Are there any questions that you feel I should have asked that I didn't ask?

MR. CRANDALL: Not that I can think of.

MR. ASHE: Jim, do you have anything?

MR. STONER: No.

MR. ASHE: Okay. This completes the interview.

[Whereupon, at 2:55 p.m., the taking of the interview was concluded.]

REPORTER'S CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission

in the matter of:

NAME OF PROCEEDING: Int. of BOB CRANDALL

DOCKET NUMBER:

PLACE OF PROCEEDING: Scriba, N.Y.

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Ian Rothrock

IAN ROTHROCK

Official Reporter
Ann Riley & Associates, Ltd.

07-110B-91

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Jim Stoner, Duke Power, INPO

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MR. ASHE: My name is Frank Ashe and this is an NRC interview with Mr. Bob Crandall.

Bob, could you give us a little spiel as to your name and also your employment history with Niagara Mohawk.

MR. CRANDALL: My name is Bob Crandall. I am a System Engineer in System Engineering with Niagara Mohawk.

I was an electrician for nine years with Niagara Mohawk. I then became a test engineer during startup and test during initial construction, startup, and now I'm a System Engineer for the last four years.

MR. ASHE: Could you explain your involvement with the UPS power supply which apparently went down during the event? Prior to, prior to -- prior to -- your involvement with the specific UPS that went down during the event.

MR. CRANDALL: Being a System Engineer, I follow that system.

MR. ASHE: When you say "follow the system," could you just describe some of your normal routine duties that you would do in just your day to day activities in working with that system?

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MR. CRANDALL: Yes, I was called into the technical support center to give technical support. Found out that five units had gone down, that they had been restored to maintenance and I was requested to go out on the damage control team to assist operations and I&C to restore those to normal, which we attempted to do.

MR. ASHE: Can you be more specific and give us more details as best you recall those?

You arrived on site -- you went down to 237

elevation -- you had the room -- you observed this or that, those types of things.

Could you do that as best you can recall?

MR. CRANDALL: Sure. The initial thing was they requested that I assist in the recovery so I got an I&T tech and electrician. We got tied in with Operations. We went down to 237, normal switchgear.

What we instructed the TSE that we would do would be to go through down to each unit, assess basically the condition they were in, basically determine if there was any outward damage, obvious damage that, you know, would preclude us from starting them. We did that.

We went to 237 first and looked at those four units, radioed back that there didn't appear to be any damage to any of the units. It appeared like we would be able to recover them.

MR. ASHE: Okay. Now when you say "looked" at the units, could you be more specific? What did you look for when you looked at the units or did you look to assess damage to the unit?

MR. CRANDALL: Primarily operational condition, to see position of breakers. We were on maintenance supply. I looked at the alarm indications, just a quick through, call it a cursory view I guess. I didn't at that time mark down alarms. I just took a quick glance to see if there were

obvious things like fuses blown and things like that that would give us indications of some inward damage. There was no alarm indications to indicate that there was anything inherently wrong with it, anything specifically wrong with it.

There were trip signals in on all of them, which we expected to find. Didn't actually open the units up at that time and actually look inside. We merely went by each unit. We were trying to do it as quickly as we could in order to be able to get normal AC power to the units.

MR. ASHE: Could you go through the units that worked on your initial startup as best you recall and the ones perhaps that didn't.

MR. CRANDALL: Let me give you a little more first. We did that on normal switchgear 237 elevation, then instructed the control room TSC that we would go down to the other unit, which was on 214 control building, assess that one and then we'd call back and ask them for their requested sequence for recovery, which they came back and gave us.

the first unit was up on 237 so we proceeded to go up to there.

MR. ASHE: Okay. Now you were involved with the restoration of the three units that were put back on the inverter?

MR. CRANDALL: Yes -- we actually attempted all

five.

MR. ASHE: Okay, all right, now could you explain what happened to the two that you were unable to re-establish?

MR. CRANDALL: Can I refer to this?

MR. ASHE: Sure.

MR. CRANDALL: I am reading from the notes that I made that day from that particular event.

We were instructed to start UPS 1C first, 1-Charlie. What we did was we marked down all the alarms that were in on the unit--

MR. ASHE: Excuse me one second. Do you know why you were instructed to start 1C first?

MR. CRANDALL: Three of our units you could consider to be critical to plant instrumentation. Two of them are plant instrumentation; one of them is a computer.

Because of the situation we were in, really didn't know what they went through, and I agreed with this, we went to 1-Charlie because it fed lights and some communication things that are not as detrimental if we lost them on a short term basis.

That one had minimal impact if we found something that was going to take the power away and indeed we did, on the startup of that particular unit. So to speak, we learned on that one in order to make it that much more

smooth on the other four.

MR. ASHE: So you started at 1-Charlie and you were about to describe what happened.

MR. CRANDALL: Started with 1-Charlie. We recorded all the alarms that were indicated for use for troubleshooting later on, and reset all of those alarms. So that we did not lose the load on the startup, there is a plug on the maintenance supply breaker that we pulled so that that would be maintained, closed the AC input breaker, started the unit.

The unit came up and ran and everything was good. Typically that would be if there is no obvious damage to it, which is when we open the doors, there was no, you know, parts or whatever or no obvious type distortions and there was no reason to suspect any problem so we merely started the unit up.

It went up. It ran. It synced to the maintenance supply. Everything looked good. Closed in CB2. When we went to reinstall the plug for CB4 the operator opened for CB4. We removed the operator, closed that back in.

I'm sorry I have to clarify that because that's not in my notes. I am not positive that unit did that.

MR. ASHE: Okay. Could we just go back from the beginning? It appeared as though 1C was brought back up?

MR. CRANDALL: Yes.

MR. ASHE: But it seems as though there was another problem there. Could we just focus on that to the best you recall what the problem was?

MR. CRANDALL: One of the units, and I'm not saying in my notes, one of the units when the P6 block was put back on there was a closed signal still within the logic, or I'm sorry, an open signal which is not unusual on starting it up, that the logic will get a miscue and has to be reset sometimes, but one of the breakers, and again I am not sure it's 1-Charlie, one of the breakers opened on us, CB4, losing the load. That particular one we pulled the operator, put the breaker back up in, and then put the operator back down.

No, let me rephrase that -- pulled the operator up, closed the breaker. With it in that position, we then shut the unit back down, turned the logic power off, the DC control power, reclosed the DC control power, restarted the unit back up without a problem.

For some reason there was an off signal there, okay, which we -- basically from there we put the operator back down, transferred the unit, the load, over to UPS power successfully.

MR. ASHE: Okay. This process was repeated and obviously you may or may not recall the sequence; if you

do --

MR. CRANDALL: I do.

MR. ASHE: -- you know, I would appreciate it in terms of the --

MR. CRANDALL: It was One Charlie, One Alpha.

MR. ASHE: Okay. But obviously two units -- you were not able to restore two units?

MR. CRANDALL: That's correct.

MR. ASHE: I wonder, could you describe those activities that you might have participated in?

MR. CRANDALL: Okay.

MR. ASHE: Regarding those two that you were unable to re-establish?

MR. CRANDALL: We went to -- One Charlie was first. Then we went to One Delta, was next. That one was restored successfully. We went to One Alpha and upon closing the AC input breaker we heard the -- the way it's described is the bump of the T-3 transformer in there. Which is not unusual, the saturation current going into that transformer. We went to start the unit, it wouldn't start, and then I looked up and noticed that the AC power to the unit wasn't there. The breaker is on the same level. We went over into that panel and that breaker had tripped.

We knew it tripped at the point that we closed CB-1 on the unit, because had it been open during the event we

wouldn't have gotten any saturation current into the transformer.

So, we opened CB-1, I asked the operator to reset the breaker, we attempted one more start; on that start we got no bump, the breaker tripped again; I told him to leave it and we went on to the next unit. And I then radioed the control room and the TSC -- or the control room and asked them to relay to the TSC that that unit -- there is something wrong inside the AC part of that unit. It was staying on maintenance and we proceeded on.

MR. ASHE: Okay. That was the 1-A unit?

MR. CRANDALL: That's the 1-A unit.

MR. ASHE: Okay. And the next unit, did you proceed?

MR. CRANDALL: It was 1-B.

MR. ASHE: One-B.

MR. CRANDALL: That unit -- same -- same process we went through; started the unit up, successfully got it started, everything looked fine, we went to transfer it over to UPS power and the motor operator moved to the odd position but it didn't -- the breaker obviously didn't close. We lifted the motor operator off of the breaker and the breaker was tripped -- in a trip position. We reset the breaker and tried it again, same result.

Previous to this time, and there was already some

work documents in process and we were waiting for an outage on the particular downstream loads, that breaker had failed. We knew we had trouble with it in the past. Sometimes we could get a closure on it. Sometimes it would take a few times to do it, but after the second or third time of attempting it, we couldn't even reset the breaker.

So, we -- again we told the control room to relay to the TSC that that one is on solid on maintenance, unable to recover at this time and we went to 1-G.

Down on 1-G the exact same process, recorded all the alarms and everything, started the unit up, or attempted to start the unit up. I closed CB-1 -- no, let me rephrase that. Initially going down there because of the problem we had on One Alpha, the first thing we were doing was looking at the AC input meter. And we had voltage on that. I closed the breaker and I looked at it again and I didn't have voltage. And it tripped the upstream breaker. We reset the breaker in the UPS and I sent an operator to close that back in, which he did. He called back down and said it was done. We reclosed CB-1 and then proceeded to start the unit up successfully and transferred to loads over.

MR. ASHE: Okay. So as to 1-G, you were able to reestablish the loads back on main --

MR. CRANDALL: Yes.

MR. ASHE: Okay.

MR. CRANDALL: One C, D, and G were successfully started. A and B we were unable to.

MR. ASHE: I wonder, could you describe for us why you feel that none of the units were able to transfer over to the alternate source during the event? Your personal opinion, that's --

MR. CRANDALL: My personal opinion and it's not solidly -- you know, we're not solidly finished testing, we know that the DC logic control power within the units are on -- are off of maintenance supply. The maintenance supply in the units are fed right from utility power that feeds directly back to -- basically ties right into the grid.

We had verified electrically, in two units, that the B phase of the maintenance power feeds the DC power supplies within those units; through some of our testing we have approximated some things that appear to indicate that the circuitry given a low voltage or low voltage with a transient can drop the DC power within those logic supplies to trip the units.

MR. ASHE: Okay. Once the unit isolated though, why -- why wouldn't it have transferred over to a telephone supply? What do you feel is one possible explanation for that?

MR. CRANDALL: On a number of units, and I think it's two. Yeah, on two of the five units we found an alarm

standing in that's a voltage difference alarm. That alarm will only come in if there's a voltage difference across CB-4. If there's a voltage difference across CB-4, there is a permissive within the circuit that will not allow that breaker to close. And it is -- you have know way to know for sure. It is my opinion that because there was a low voltage condition on the B phase of the maintenance supply that the UPS sensed that, couldn't make that -- make up that permissive and therefore CB-4 was locked out from closing, per design.

MR. ASHE: Why do you feel that the low voltage alarm wasn't on the remaining three units? Do you have an opinion about that?

MR. CRANDALL: The voltage difference alarm?

MR. ASHE: That's correct.

MR. CRANDALL: I have an opinion, but coming from an outside representative as I understand it, that the voltage difference alarm is not an alarm that locks in. It's there while the voltage difference exists. While there's voltage across CD-4, but it will clear itself once the condition clears.

Under the circumstances we have the alarm actually shouldn't be there because it should have cleared once they closed CB-4 and had voltage across it. It's my opinion, that based on the transient that went into the DC power

supplies that there was a -- not the right technical term probably, but a logic lockup that didn't allow that -- that latched that alarm for us, in two units. It is conceivable, I mean -- and I would have expected that the alarm came in on all five units at some time, partially because CB failed to close and we have, through testing, verified, on all units -- no, I can't do it on the two that are down.

On three of the units we were able to transfer successfully, so that says the operator is working on those units. On two of the units we have tripped back and forth multiple times and proven that circuitry, so the only possible explanation is that we were -- we had a voltage difference to the maintenance supply, so they were locked out.

MR. ASHE: Is it in your opinion possible that the units could have lost this comparative circuitry such that the permissive was not made prior to the actual transformer failure?

MR. CRANDALL: Are you asking if they were able to transfer prior to this event?

MR. ASHE: I guess what I'm asking is, in your opinion is it possible that the synch signal could have been lost prior to the unit isolating?

MR. CRANDALL: I would expect that that is true. If the signal was received afterwards, there's every reason

to believe that they would have transferred, though that's conjecture, because we don't know what occurred.

MR. ASHE: Now, the class 1E inverters, as we understand them, were not lost. Do you have an opinion as to a reason why you feel that those would ride through this type of transient and in fact five units would not?

MR. CRANDALL: A transient on the AC input to any of the inverters -- to all 10 -- all 10 of them will react to it and ride through it and be unaffected by it. The difference between the five that failed and the five that didn't is that the five that didn't don't take their DC control power from maintenance supply; they take that from the DC supply that supplies the inverter sections of each unit, each of the five that didn't fail.

Because those five units rode through the transient on the AC side, the DC would not have even known that there was a -- it would not have seen it; it wouldn't have been reflected on the DC portion of the units, and therefore the DC logic supplies wouldn't have seen any transient.

MR. ASHE: Based on your analysis of the five that were lost in this event, could you explain to us as best you understand it now changes that are currently being considered with regard to design, with regard to preventative maintenance, and any other items you might

have, to preclude this event from reoccurring?

MR. CRANDALL: Let me give you my opinion on how it can be prevented, rather than saying we're committed to a certain design change that isn't approved yet. If the DC power supplies within these five units -- if that DC logic is fed from inverter output rather than maintenance supply then they would not fail in this scenario. They would be unaffected by any disturbances on the maintenance supply, and any disturbance on the AC input side, they'd ride through it and not know it.

MR. ASHE: What about any type of preventative maintenance being considered -- revision, modification, additions, any items in this area of being considered for revisions or additions? Is there anything that you know about in that area?

MR. CRANDALL: Previous to this, preventive maintenance was done on a less formal basis, as I mentioned. A lot of times we would go out and do preventive maintenance in order to preclude problems. In April I identified that there was not enough preventive maintenance on any of our 10 UPS's and wrote a document to outline what kinds of programs I thought should have been instituted. In July that was approved, and the process had started. It's a broad-based program, say, on all units. Our safety-related's much more frequent that the non-safety-related.

MR. ASHE: As a result of these event, is that going to change the documentation, or is it going to actually accelerate a program that was already in place?

MR. CRANDALL: I would expect that it will accelerate it. My personal opinion is that the preventive program we had going was adequate up to now and that the program we're putting in will definitely be an enhancement for the long term.

The one issue around control batteries that has come up: If the DC power supplies are fed from inverter output, any preventive maintenance on those control batteries becomes a moot point. The control batteries, in and of themselves, are not designed to help us ride through this type of transient; though they may have mitigated it some, it's speculation to say they would have prevented it.

If we're fed from the inverter power supply, in actuality I can take the batteries out of the unit and lose no reliability. The batteries will give our plant some troubleshooting assistance if we lost the total inverter and maintenance power; it would allow some lights to stay on in order to repair the unit down the road, and that's their main design function, not to ride out transients.

MR. ASHE: Prior to this event, were there any anomalies that you were aware of? If so, could you describe those anomalies? Prior to the occurrence of the event, any

anomalies, first of all, that you might have been aware; and, if so, could you briefly describe them for us?

MR. CRANDALL: I'm not sure I understand the question.

MR. ASHE: Okay. Prior to the event, the inverters, all five, were operating, as I understand it.

MR. CRANDALL: Correct.

MR. ASHE: To your knowledge or as best as you can recall, were there any things that you knew, that you were aware of, that were what I would consider abnormal? Did you have any maintenance orders on them? Did you have a work order to do something? Were you going to replace a light? Were there any types of abnormalities or off-normal conditions?

MR. CRANDALL: The only work request we had was on the one unit, 1-Bravo, for the breaker.

MR. ASHE: Could you describe that work request for us? What was wrong with that particular breaker?

MR. CRANDALL: The breaker would not always reset. If it didn't reset, we had difficulty getting the unit from maintenance supply over to normal supply. Sometimes we got lucky and it would reset and we'd be able to go over. Sometimes we had to try and reset it two or three times. Up until now, we had always been able to reset it. It might take two or three times trying to reset it, but we would

always be able to get it over to normal supply. Because of the equipment that it fed and the impact to the plant, we did not immediately want to take the unit down, because of that impact to the plant, but it was in the works to be done.

MR. ASHE: Okay. So the inability to reset a breaker on at least one of the units precluded you from closing that particular breaker; is that what you're saying?

MR. CRANDALL: That's correct.

MR. ASHE: Okay. And what was the --

MR. CRANDALL: But the fact that, prior to the event, we were on normal supply, so we have three sources of power to the unit, the inability to reset it, as long as you could go to normal supply, did not reduce the reliability of the unit, because reliability is based on AC in and DC backup power with the maintenance to fall back on if for some reason something went in the unit. So we felt the unit was reliable in that condition. That's why it wasn't any type of urgency to go out there and get that breaker. It was more important to keep the plant loads intact.

MR. ASHE: But in fact, had something gone wrong with the normal supply, the ability of that breaker to close would have been in question.

MR. CRANDALL: If we'd lost the normal supply, we would have gone on DC as designed.

MR. ASHE: So the backup DC was still there and still reliable?

MR. CRANDALL: Correct. The only way that breaker, that doesn't compromise it, but the only inability we had is once we -- if we lost AC and then lost DC and then went on maintenance and wanted to come back.

MR. ASHE: Let's see if I can do this now. So the real problem was not so much in opening the breaker but rather if the breaker is open the problem would be trying to reclose it?

MR. CRANDALL: Correct, which the only time you expect to be in that condition is under a maintenance situation.

MR. ASHE: But once the breaker is closed, then in fact there is really no problem?

MR. CRANDALL: Correct. There was no problem with any type of premature tripping or with the breaker closed it was reliable. It would latch. It would stay latched in. We weren't the least bit concerned about that.

MR. ASHE: Could you briefly describe now what's involved in repairing such a failure?

You said the breaker was unable to reset. Could you go with that and sort of describe it in the repair?

MR. CRANDALL: What we have to do? Take the unit totally out. We have to kill all loads off the unit, remove

the breaker, and put another one in.

MR. ASHE: Okay.

MR. CRANDALL: It's a replacement. It's not a repair.

MR. ASHE: Okay.

MR. CRANDALL: That's why there is a -- you have to make a judgment as to whether it is better to continue to go along, continue in your vital loads until there is a convenient -- I don't want to use the word "convenient" loosely -- an appropriate time to remove those loads, appropriate to the condition of the plant to make a breaker repair, versus giving up the ability to reclose it.

That wasn't in question really anyway until this particular time. There wasn't an urgency to do that because it was more important to keep the level loads intact.

MR. ASHE: As a result of the event and this occurrence, do you feel there will be changes in operating procedures, in the operating procedures, restart procedures, any type of operating -- have you learned anything that you might wish to consider to modify, revise or change the terms of procedures that describe how to operate the equipment?

MR. CRANDALL: There will be a revision to the one operating procedure to describe the way to close in CB4 with this type of failure. In fact, over the week, week and a half, we have been doing some informal training with every

operator that has been assisting us to show them exactly how that is done.

Ironically, a week before the event I sat down with the Operations Supervisor and requested and he agreed that we would take the operation procedures and have Training go through each, both the licensed and non-licensed operators and yearly go through those operation procedures at the unit, showing the operators where all of the control are and how to manipulate the UPS's as best they could doing mock transfers on that if necessary to get them better familiar with those units.

That, you know, was another thing that was in process. Part of that would have been that lifting of the motor operator to manually close the breaker?

MR. ASHE: How often have you seen any of these units produce a total trip like they did to totally isolate themselves let's say on a per year basis?

Is it once a year, twice a year? I realize that no exact number, but would you say that it's usual that that happens or is it very unusual for the unit to completely isolate itself?

MR. CRANDALL: I would -- I know of one definite. I would guess of two others since startup where there has been a total loss. One of those events was a personnel error. Another, a fourth event, was due to a maintenance

practice, so I would say of all five units in startup, four events probably total.

MR. ASHE: Is there anything, other information that you would like to provide that may be helpful in understanding or analyzing this event? Do you recall anything?

Are there any questions that you feel I should have asked that I didn't ask?

MR. CRANDALL: Not that I can think of.

MR. ASHE: Jim, do you have anything?

MR. STONER: No.

MR. ASHE: Okay. This completes the interview.

[Whereupon, at 2:55 p.m., the taking of the interview was concluded.]

REPORTER'S CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission

in the matter of:

NAME OF PROCEEDING: Int. of BOB CRANDALL

DOCKET NUMBER:

PLACE OF PROCEEDING: Scriba, N.Y.

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Ian Rothrock

IAN ROTHROCK

Official Reporter
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