ORIGINAL

91-109A-91

OFFICIAL TRANSCRIPT OF PROCEEDINGS

Agency: Nuclear Regulatory Commission
Incident Investigation Team

Title: Nine Mile Point Nuclear Power Plant
Interview of: MELVIN L. CRENSHAW

Docket No.

LOCATION: Scriba, New York

DATE: Thursday, August 22, 1991 PAGES: 1 - 14

ANN RILEY & ASSOCIATES, LTD.
1612 K St. N.W., Suite 300
Washington, D.C. 20006
(202) 293-3950.

Exhibit 3-1 (continued)

ADDENDUM TO INTERVIEW OF Melvin L. Crenshaw
(Name/Position)

Page	Line	Correction and Reason for Correction
4	10	Change "voltage-way" to "voltage-wave"
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6	9	Change "FAll" to "FAULT"
8	13	Change "IS" to "IN"

Page 1 of 1 Signature [signature] Date 8/25/91

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

INCIDENT INVESTIGATION TEAM

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Interview of :

MELVIN L. CRENSHAW :

(Closed) :

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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 8:22 a.m.

PRESENT FOR THE IIT:

Frank Ashe, NRC

Jose Ibarra, NRC

Jim Stoner, Duke Power Company, INPO

PROCEEDINGS

[8:22 a.m.]

MR. IBARRA: This is Jose Ibarra of the NRC. With me is Frank Ashe, also another team member. And we have Jim Stoner from Duke Power acting as a consultant to INPO on this investigation.

We are going to be interviewing Melvin Crenshaw, a consultant to Niagara Mohawk. Would you please state your name, company, experience and your connection with Niagara Mohawk for this investigation?

MR. CRENSHAW: My name is Melvin L. Crenshaw. I work for General Electric Industrial and Power Systems in the Power Systems Engineering Department in Schenectady.

I am -- I serve as a consulting engineer both to components within the General Electric Company; directly to utilities such as Niagara Mohawk for studies and investigation of incidents such as has occurred.

I was requested by Niagara Mohawk to review the electrical distribution system at the Niagara Mohawk plant and the event that had occurred with a view towards determining if analytical studies could shed any further light on the conditions existing on the plant distribution buses which could have affected the UPS unit operations.

MR. IBARRA: From the information that you are aware of today, can you determine if the disturbance

occurred on the low winding or the high winding of the transformer phase B?

MR. CRENSHAW: The initial disturbance appears to have begun with the high winding -- high voltage winding going to ground in some manner. There is a lack of any oscillographic records on the low voltage area or on other plant buses that eliminate or prevent you from making any conclusions, drawing any conclusions, about the involvement of the low voltage winding.

MR. IBARRA: Previous to coming on Monday, did the Niagara Mohawk believe that it was on the low winding side due to the physical evidence that was seen once you look into the transformer?

MR. CRENSHAW: Prior to my arrival at the site on Monday at around noon time, I had no information at all concerning the incident other than it had been a transformer failure. I had had no discussion at all with anyone from Niagara Mohawk.

MR. IBARRA: Have you reviewed the protection schemes and from that the flags and whatever cues are obtainable from that; what's your assessment, did the system act properly? Did it protect itself?

MR. CRENSHAW: A review of the basic one-line diagram showing the protective equipment and as it's connected to the transformer and the generator indicates

that for the fault within the transformer all of the protective relaying operated as it should have -- as designed.

MR. STONER: Mr. Crenshaw, in your review of the protection system, does the design of the protection system seem to be appropriate for the distribution system that they have at this plant?

MR. CRENSHAW: Yes. It appears to be within the guidelines established in IEEE standards.

MR. STONER: Did you assess the voltage-way forms that were reflected on the UPS 600 volt sources during and following the event and also on the 4160 volt safety buses?

MR. CRENSHAW: The only oscillographic records that exist are for the 345 KV switchyard, lines that enter and leave the plant and the 115 KV circuits. There are no low voltage oscillographic records available from any of the buses within the plant.

MR. STONER: From this information that is available, could you approximate what voltage-way forms on these lower voltages most likely would have looked like?

MR. CRENSHAW: I don't think it's possible. And the reason I say that is impossible to know the exact nature of the fault within the transformer. Little can be determined from the oscillographs except the fact that the fault involved the high voltage winding and ground in some

manner.

That fault could have been a flashover from the high voltage winding to the low voltage and then to ground; or it could have been a flashover only to ground. The relaying is -- the relaying does not distinguish low voltage faults as is presently implemented.

MR. CRENSHAW: Based on your experience with events of this type would you expect any particular perturbations to have been superimposed upon the voltage-way forms on these lower voltage buses?

MR. CRENSHAW: A review of the oscillographic records shows no unusual perturbations of the high voltage buses. If, in fact, the flashover had gone from the high voltage winding to the low voltage windings there could have been elevation of voltages that were not recorded.

MR. STONER: Do you consider the failure of such a transformer to be unusual or usual, expected or unexpected, or how would you characterize your assessment of the failure of such a transformer?

MR. CRENSHAW: In terms of the plant experience it would certainly be an unusual or an unexpected event. In terms of the broad spectrum of plants in service, transformer failures are not rare.

MR. IBARRA: Have you had a chance to look at the grounding -- the grounding scheme and what's your assessment

of it? Could that have caused additional problems for the UPS?

MR. CRENSHAW: I have looked only at the grounding scheme with regard to the one line diagram which yields no details of how the grid might be connected and how the grounds might be interconnected. My assessment, though, from looking at the one line in normal practices would suggest that there would be no ground current in the plant associated with that fall since there is not evidence that the generator neutral grounding equipment failed. That grounding equipment would limit the ground fault currents within the plant for a transformer failure to a magnitude less than 10 amperes.

MR. ASHE: Frank Ashe, NRC. With regard to the A and C phases, do you think there was significant distortion at the time of the fault in the B phase occurred and the A and C phases?

MR. CRENSHAW: From the 345 KV side and the 115 KV records there is very minimal distortion of the waves. There appears to be an abrupt reduction in the voltage levels, but relatively little distortion of the waves. It must be borne in mind that the recording equipment which is reasonably -- which is a high caliber recording equipment operates at a scan rate of just over 5 kilohertz. Therefore, accurate display of way forms above, perhaps, 500

hertz would not be expected -- would not be obtained from the recordings directly.

MR. ASHE: From your review would you say that the disturbance as seen by the 4160 would be greater than or less significant than that seen by the 13.8 KV side, this is in the in-plant side, the safety-related?

MR. CRENSHAW: Since the disturbance was within the transformer, the step-up transformer and did not depress the 345 KV voltage lower than about 40 percent, 37 to 40 percent, it is apparent that the fault was further in the transformer than at the high voltage terminal. This somewhat precludes you from making any assessment of how depressed a generator terminal voltage may have been. It could have been lower than the 345 bus because the system voltage and system contribution could possibly hold the 345 bus and the 115 KV bus at a higher voltage level than the generator voltage which was at that time through the normal unit auxillary transformer supplying the auxiliary buses. They could have been depressed to a lower level.

MR. STONER: Do you believe that if a dynamic analysis were performed on the electrical distribution system to simulate this event -- do you believe that the results would be meaningful? And why?

MR. CRENSHAW: I believe the results would be -- I believe that any analysis would be especially difficult

because of a lack of definitive knowledge of the failure within the transformer. In the condition that it exists now, after having sustained fault currents for a number of seconds as the generator coasted down, there will be little -- I believe, substantive evidence of the exact nature of the fault during the 6-cycle period that the buses were being supplied by the generator.

MR. ASHE: For a fault of this magnitude, do you feel that there was sort of a precursor in the B-phase?

MR. CRENSHAW: There was no evidence from the oscillographic record which shows about four to five cycles of pre-fault information.

MR. ASHE: Is a fault of this magnitude -- you mentioned earlier transformer failures were certainly not uncommon, would you characterize this type of failure, your observed physical damage on a transformer, is it worse than, less than, for transformers of this category?

MR. CRENSHAW: I have not viewed this transformer intimately. I have seen photographs of it and it has been described to me that the damage was, in fact, spectacular. It is not at all unusual to find very severe transformer damage in a case like this. The fault energy that occurs very early in a fault event of this type the pressure waves in the oil that occur very early, almost at the beginning of the fault, can be very destructive in the sense of rupturing

tanks and other things of that sort.

The subsequent electrical damage to the windings is, of course, somewhat the result of the relatively long decay time as a generator continues to feed a fault in the permanently connected, solidly connected transformer.

MR. ASHE: Do you have any type of preliminary assessment as to what you feel may have caused this?

MR. CRENSHAW: That is an area beyond my field of expertise, the assessment of how a fault could and would evolve within a transformer.

MR. ASHE: Would a transformer fault of this nature necessarily end in any type of damage to running equipment or the actual distribution system that it was powering at the time the fault occurred?

MR. CRENSHAW: I would say that it's not unusual for a transformer failure to result in failure of connected and associated equipment, in the sense that energy from high voltage windings due to an internal failure can be coupled to the low voltage circuitry by flashovers internally, so it is not unusual to have more equipment damaged than only the transformer.

MR. STONER: Have you drawn any conclusion on the cause of the UPS unit failure and if so, what are they?

MR. CRENSHAW: I haven't been asked to specifically look at the UPS and its electronics. I have

been involved in discussions with the plant engineers and looked over their tests that they have run and things they have found out about the UPS.

I have not looked at the UPS directly.

MR. ASHE: If there are two significant things, based on your observations and your scope, your work scope, what are the most two significant things that have occurred in this event?

MR. CRENSHAW: I was requested to review the event and the power circuitry with a view towards seeing if analytical studies could perhaps shed light on the 600 volt circuits, the lower voltage circuits in the power plant.

My assessment is that it is not possible to do a definitive study that would shed any light on that, given the lack of any records of the generator voltage or of the lower voltage circuits in the high tension yard.

MR. ASHE: Is there a second one, a second significant --

MR. CRENSHAW: No.

MR. STONER: I believe that you said earlier that a ground fault on the low voltage winding would not have been detected with the protection system that is installed.

Could you expand on that?

MR. CRENSHAW: The protective system follows the IEEE standard recommended for generator protective relaying,

which suggests that in order to protect generator-ground relaying from damage, since it is a very sensitive relay and during a severe fault can be subjected to a number of -- a multiple of its continuous duty rating, the generator ground protective relaying was removed from service by the generator lockup relay. That means that once -- and the generator ground relay is not an instantaneous acting device so that once the overall, the unit differential and overall differential relays had detected the fault virtually within a few cycles of its initiation, the ground relaying was disconnected as the system had been designed and it was no longer monitoring the generator ground.

MR. ASHE: In your assessment of the grounding system, could the ground potential have increased during this -- during or subsequent to this faulting condition?

MR. CRENSHAW: It appears very unlikely, since the ground current in the transformer, around 6800 to 6900 amperes, was being supplied essentially by the power system and the generator contribution to ground current as long as the grounding equipment is intact, which it has not to my knowledge been verified as of yet, but with that grounding equipment intact the generator contributes only 15 amperes of ground current into the grid or into the connection within the plant, so I would see no reason to expect the plant grounding system to be elevated.

MR. STONER: Do you anticipate that any RF signals which may have been generated during this event would have been propagated or attenuated within the plant?

MR. CRENSHAW: Our experience in RF propagation through transformers is somewhat limited to the testing that is done on transformers to verify the integrity of the windings.

For example, during an induced test where a relatively high frequency, high voltage is applied to a transformer and corona measurements are made, if corona is detected, testing is frequently done to determine if in fact the observed evidence of corona is a true one within the transformer or is coming from the testing device that energizes the transformer.

To verify this, tests are made in accordance with IEEE standards to measure the attenuation or the transfer if you will from the high side to the low side of the transformer.

Our experience in measuring power transformer attenuation shows that the one megahertz signal which is the standard used by IEEE, the one megahertz signals the attenuation is frequently in the ballpark of at least 1000 to 1, perhaps tens of thousands to 1, depending on the transformer design.

The attenuation of one megahertz signals occurring

on one side of a transformer and transferred through it depends a lot on the transformer design.

MR. ASHE: Based on your review of the transformer and the in-house electrical distribution system, do you feel that maintenance played, or the lack of maintenance played, any type of role in the occurrence of this event?

MR. CRENSHAW: I don't have a detailed knowledge of the maintenance that would have been performed on the transformer that failed. I have not seen any of the maintenance records, and I am not really qualified to comment on that.

MR. ASHE: Based on this event, in-plant monitoring of the distribution system, would that yield helpful information for other reasons, other than event analysis?

MR. CRENSHAW: Certainly recordings of disturbances and the voltages in various circuits can yield information concerning the status of equipment connected to those circuits. In addition to simply acting as an event record of what happened, it can also tell you, perhaps, the status of the connected equipment. It could prove useful, yes.

MR. STONER: Are there any other things which you looked at or considerations which you have made or

conclusions which you have drawn that we have not asked that you feel are pertinent as the result of this event?

MR. CRENSHAW: Not to the best of my knowledge.

MR. ASHE: Is there anything else that you'd like to say, for whatever reason?

MR. CRENSHAW: Nothing that I can really add, beyond what I have said.

MR. ASHE: Okay. That's it.

[Whereupon, at 8:46 a.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 MELVIN L. CRENSHAW

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.

91-109B-91

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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.