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UNITED STATES DISTRICT COURT

SOUTHERN DISTRICT OF NEW YORK

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GENERAL PUBLIC UTILITIES CORPORATION, :
JERSEY CENTRAL POWER & LIGHT COMPANY,
METROPOLITAN EDISON COMPANY and :
PENNSYLVANIA ELECTRIC COMPANY,
:
Plaintiffs,
:
-against-
:
THE BABCOCK & WILCOX COMPANY, and
J. RAY MCDERMOTT & CO., INC., :
:
Defendants. :

- -x

Continued deposition of THE BABCOCK & WILCOX COMPANY, by EDGAR ALLEN WOMACK, JR., taken by Plaintiffs pursuant to notice and adjournment, at the offices of Kaye, Scholer, Fierman, Hays & Handler, Esqs. 425 Park Avenue, New York, New York, on Tuesday, January 27, 1981 at 9:40 a.m.,

DOYLE REPORTING, INC.
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before Charles Shapiro, a Certified Shorthand Reporter and Notary Public within and for the State of New York.

* * *

Appearances:

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BY: RICHARD C. SELTZER, ESQ.
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BY: ROBERT F. WISE, ESQ.
-and-
RODMAN W. BENEDICT, ESQ.,
of Counsel

Also Present:

DAVID TAYLOR

* * *

EDGAR ALLEN WOMACK, JR.,
having been previously duly sworn, resumed, was examined and testified further as follows:

EXAMINATION (Continued)

BY MR. SELTZER:

Q Dr. Womack, you realize you continue to be under oath?

A Yes.

Q Dr. Womack, I think that either there was an error in transcription or I misspoke in the second day of your deposition.

I would like to show you page 261 and 262 where we were discussing the ability of reactor coolant pumps to continue to operate with a very high void fraction. You were telling me that there were experts on the engineer staff at B&W who knew that, and I said, "And there were such experts on --" I believe I said or I meant to say March 28, 1979, the day of the accident.

Is it a fact that there were engineers at B&W on March 28, 1979 who knew that under emergency conditions the reactor coolant pumps can continue to operate with a very high void

fraction?

A Let me just review that.

Your question is were there such experts on March 28, 1979, and my answer would be yes.

Q There was one other point that I wanted to clarify.

At Three Mile Island during the March 28th accident the high pressure injection pumps actuated early in the transient, right?

A That's my understanding.

Q And they were substantially throttled back but not completely shut off by the control room operators; is that right?

A That's not entirely clear. There has been, to my understanding, a degree of speculation on whether they were completely shut off or -- excuse me -- whether the flow was completely shut off or whether it was allowed to continue at a very low rate. So I really can't define that for you.

Q In GPU Exhibit 7, which is the final report of the Technical Review Committee that you served on, at page 4-9 there is a heading just above the middle of the page which is "Plant

Status at 150 Minutes."

Would you take a look at the second paragraph that appears under that. (Handing document to the witness.)

Q That paragraph says "Reactor coolant makeup Pump A was running with high pressure injection valves throttled. This high pressure injection condition has existed essentially since two minutes into the transient."

At the time that the Technical Review Committee wrote that, does that indicate that their understanding was that the high pressure injection was throttled but not completely shut off?

A As before, it's difficult for me to, or impossible for me to testify as to the understanding of the Committee or all of its members. I will be glad to give my understanding of the word "throttled."

Q Okay.

A My understanding of the word "throttled" is that it can mean a reduction in flow by the use of the valve which could be anywhere from zero to something less than full flow. Throttled could mean entirely -- the flow entirely cut off, to me.

Q So that paragraph doesn't clarify the situation or refresh your recollection that the valve remained somewhat opened?

A No, and it's not my testimony that the valve did not remain somewhat opened. I simply don't think we know exactly where the valve was. We have the testimony of the response of the system and we have, as I understand it, the operator had debriefed, he mentioned himself that he had cut back on the valve (indicating), I guess while he had been debriefed.

Q Even if the operators had closed the valves completely so that there was no high pressure injection into the system, if the primary coolant pumps had remained on up through the point at which the block valve was closed, is it your understanding that there would have continued to be a sufficient void fraction in the reactor to continue to cool the core effectively?

A I simply don't know.

Q Have you ever seen any analysis of that?

A No.

Q It wouldn't be difficult to perform

the analysis, would it?

A It would not be difficult to perform an analysis; however, the assumptions and methods in that analysis might be subject to question.

Q A key parameter would be the rate of flow of coolant through the open PORV, right?

A That would be among the key parameters.

Q What would you have to know to determine that flow?

A The flow of coolant through the PORV? You would have to know the quality of the coolant at the entrance to the PORV, the thermodynamic conditions, pressure and temperature and the discharge coefficient applicable to the PORV.

Q From the studies that have been done since the accident there is empirical data to show what the flow was through the valve during the accident, isn't there?

A I am not sure there are empirical data.

Q You haven't seen it or you don't recall seeing it?

A I don't recall empirical data.

Q What kind of data have you seen?

A These data are -- these estimates, as I

understand it, have been made based on empirical work done prior to the accident and generalized to the particular case of the pilot operated relief valve at Three Mile Island.

Q Who would be the person most knowledgeable at B&W about rate at which coolant would be lost through a small break?

A I would confer with Mr. Dunn or one of his senior staff.

MR. SELTZER: I would like to mark for identification as GPU Exhibit 32 a report entitled "Safety Aspects of the Mulheim-Karlich Plant in View of the Three Mile Island-2 Accident," May 1979.

(Report entitled "Safety Aspects of the Mulheim-Karlich Plant in View of the Three Mile Island-2 Accident," dated May 1979, was marked GPU Exhibit 32 for identification, as of this date.)

Q Is GPU Exhibit 32 a copy of a document which you received in the regular course of business and have previously reviewed?

A It appears to be a copy of a document which I received in the regular course of business and

have reviewed in part.

Q Did you review any parts of it prior to its final dissemination?

A I don't recall whether I did or not.

Q Who prepared GPU Exhibit 32?

A A team of people, most of whom were or are members of our internal project -- management internal project engineering group, and I believe working directly with engineers at the company BBR.

Q What engineers at B&W worked on it?

A I am not sure I can identify all the names. Mr. Bohart was part of the team, I believe. Also I believe Mr. Jenkins was a part of the team.

Q Do you know who headed it for B&W?

A I think that Mr. Bohart was the principal team leader for B&W.

Q What is Bohart's area of expertise?

A Bohart is a reactor systems engineer and engineering manager.

Q What is a reactor systems engineer?

A Well, he would be concerned with design and operation of systems such as makeup systems and reactor coolant systems and the like.

Q For what purpose were you reviewing

GPU Exhibit 32?

A At what time?

Q How many times have you reviewed it?

A I can't -- I can't really say how many times I reviewed it, but the thrust of my question was are you -- you asked me a moment ago did I review it before issue, and let me answer that if I did review it before issue, it was because it was prepared by people who were working within the plant design section. Mr. Bohart was a member of my staff.

Q Yes.

A And so he may have asked me to look at parts of it either before or after its issue.

Was that what you were looking for?

Q Why were you looking at it?

A Well, because I had a general interest in the kinds of things my section produced, and of course we were heavily involved at this time in all aspects of the TMI-2 accident.

Q You also had some personal involvement in the MK Plant, didn't you?

A Yes, I had -- additionally I had the background of some involvement with the Mulheim-Kaerlich Plant.

Q If you had seen things in the report, GPU Exhibit 32,which you believed were inaccurate, would you have let the authors know that you thought they had made a mistake?

A I certainly hope so.

Q What particular portions of the report did you read?

A Well, let me look at it. I think I have at one time or another looked at generally at the description of the accident area, at the comparison of TMI-2 and MK and some of the appendancies, perhaps at other parts as well.

Q Did the people who were preparing the report consult you for information that they then incorporated in the report?

A I don't believe that there was any significant consultation on my part with -- relative to this report, certainly relative to the contents of this report prior to its release. I was particularly busy at the time with domestic concerns related to the accident. This report was -- I don't recall what the date was, but it was published very, very quickly after the accident and I don't think I had much consultation, if any, prior to its

publication.

Q Was the report accurate, to the best of your recollection?

MR. WISE: As of the time that it was written or as of what he knows today?

Q When you read it.

A I think that there are some inaccuracies in the report. One that I remember having spotted in particular I think is somewhere in this report says that -- mentions a certain number of PORV failures which I believe probably reflected the best knowledge that these people had at the time, but it -- I think we subsequently learned that there were a different number of failures.

Q There were more, right?

A There were more than are noted in here, and I believe there are probably other points in which the report may have incomplete information or may have opinions based on incomplete information or opinions based on specific ideas of the people who wrote it which have not been thoroughly reviewed within B&W for a range of consultation.

Q Are there any opinions in here that you believed when you read it were wrong?

MR. WISE: First of all, he said he only read part of it.

MR. SELTZER: Yes.

MR. WISE: He would only be able to testify to that portion that he read.

MR. SELTZER: Fine.

A My recollection is that there are some thoughts expressed in here which I would question. I think, again, it's been a while since I have looked at this, but I think that some of the judgments made by the authors with regard to the kinds of failures and those failures in the context of the German licensing code KTA-3501 probably deserve a further review and there may be other examples. As I said, it's been a while since I have read it.

If you like, I will be happy to try to read it and pick the specifics out, but it's going to take me some time.

Q Have you ever advised anybody in B&W in writing that you believe there were portions of this that deserved further consideration?

A I don't remember whether I have or not. I probably have not but I don't remember whether I have or not.

Q Do you recall specifically whether you advised anyone at B&W orally that you believe there were portions of this report that deserved further review?

A Again my recollection is not good enough to give you a positive yes or no on that.

Q Okay.

Section 4, which you said you believed you did read, is called "Comparison of TMI-2 and MK."

Would you turn to page 4.2-4.

MR. BENEDICT: What is the microfilm number?

THE WITNESS: Yes, I am having trouble finding it.

MR. SELTZER: E-5671.

MR. WISE: Off the record.

(Discussion off the record.)

MR. SELTZER: I would like to mark for identification as GPU Exhibit 33, a memo from G. E. Rambo to Messrs. Womack and Taylor, subject: Proposed B&W Positions Regarding High Point Vents, Water Level Measurements, and Void Fraction Monitoring, December 20, 1979.

(Memorandum from G. E. Rambo to Messrs. Womack and Taylor, subject: Proposed B&W Positions Regarding High Point Vents, Water Level Measurements, and Void Fraction Monitoring, December 20, 1979, marked GPU Exhibit 33 for identification, as of this date.)

Q Is GPU Exhibit 33 a copy of a memorandum which you received in the regular course of business in or about late December 1979?

A Yes, it does appear to be.

Q Just for the titillation of people who might want to understand this, what are hot legs?

A The expression "hot leg" is used in reactor system jargon to refer to those poritions of the primary piping system which carry the heated water, coolant water exiting the core to the heat exchanger or the steam generator.

Q For those who view this thing more orally, what would your definition be of candy cane?

A In the B&W NSS configuration, the hot leg piping is connected to the reactor vessel which holds the core, and after coming out horizontally for a short run, makes a 90 degree turn and has a

vertical run to the top of the steam generator and slightly above. At that elevation the piping makes a 180 degree turn in order to carry the reactor coolant into the upper plenum of the once-through system generator. This configuration with a long vertical rising leg and 180 degree bend at the top resembles a candy cane and it's sometimes called that.

Q Are hot legs and candy canes synonymous?

A In the B&W system pretty much so.

Q I think it has to follow pretty logically that if the hot leg is taking water into the steam generator, the cold leg must be taking water out of the steam generator?

A Yes. The cold leg is that portion of the piping system which leads the water from the primary -- water from the cold part of the steam generator back to the inlet of the core -- the inlet of the reactor vessel.

Q How long does it take for water to move through one complete cycle?

A I don't know that number exactly. It takes a number of seconds. If you are speaking about the condition in which the plant is running with the

reactor, main reactor coolant pumps operating, I don't know the number exactly.

Q Is it less than a minute?

A My recollection is that it's a little bit less than a minute, but I would like to not have you use that number for purposes of designer safety calculations before I check it.

Q Will you look at the page numbered '09 in the right-hand margin, please.

Primary system water is the same as reactor coolant system water, right?

A Yes.

Q The heading on this page is "Proposed B&W Positions Regarding Primary System Water Level Measurements."

Is what is set forth here a proposal for adding instrumentation to the B&W design in order to measure the level of primary system or reactor coolant system water?

A Yes.

Q This is equipment which was not in B&W plants at the time of the Three Mile Island accident, right?

A Yes. This equipment is not -- was not in

B&W plants at that time.

Q Near the top of the page it says that "The purpose of the reactor coolant system water level measurements is to provide: 1. The reactor operator information to follow the course of an accident, so that he will know whether he is losing primary system inventory."

"Inventory" is a fancy way of saying water; is that right?

A Yes, the total volume -- generally liquid water is referred to.

Q "2. An indication to the operators on when to operate and secure the primary system vents."

What are the primary system vents?

A I believe in the case of this staff recommendation, he is referring to the vents that he discusses in the just preceding pages of his recommendation.

Q Those are proposed vents to be added to the hot leg?

A Yes.

Q Are the pilot operated relief valves on the pressurizer sometimes also referred to as vents?

A They may be referred to in that way.

Q If an operator knew that he was losing primary system inventory, would that also be an indication to the operator that he should secure the block valve behind a pilot operated relief valve?

A Yes.

MR. WISE: Do you mean if he knew that it was the PORV that was the leak, or do you mean if the candy cane broke open?

Q Looking down at the last paragraph under the heading "Proposed B&W Level Measurement Position," it states there, "Safety grade water level indication on each of the hot legs with control room read out is necessary to satisfy the purposes stated above."

What did you understand was being identified by the phrase "Safety grade water level indication," what kind of indication was being proposed for each of the hot legs?

A I believe Mr. -- Dr. Rambo referred in this proposal to instrumentation which would basically show the level of liquid water in the hot legs assuming the water was not in forced flow.

Q Not in forced flow?

A Yes, not in forced flow, three words.

Q In other words, if the primary coolant pumps are shut off, then the only source of water flow through the hot legs would be natural convection; is that right?

A Yes, that would be the source of flow through the hot legs and cold legs.

Q If there were no water flowing through the candy cane hot legs, that would indicate that there had been a loss of water or, as people sometimes say, inventory from the reactor coolant system, right?

A Not necessarily. It would indicate only that the circulation had been interrupted.

Q If the system has its normal inventory, am I wrong in having assumed that the whole reactor coolant system is solid except for the top of the pressurizer?

A No, you are not wrong.

Q Well, then, wouldn't the hot legs be filled with water?

A Yes, they would.

Q If the hot legs were not filled with water, wouldn't that mean that there had been some

loss of reactor coolant water system inventory?

A It would indicate some loss of liquid inventory, yes.

Q Isn't that what I asked you before?

A I thought your question was if there was a lack of flow would that indicate a loss of liquid inventory.

Q So if there is not water in the hot legs, it would mean that there had been a loss of liquid inventory from the reactor coolant system, right?

A Yes. I am answering all these questions with respect to volumetric inventory. The reactor coolant can and does change its specific density with temperature, and some people use the word "inventory" to refer to mass inventory. One can change the volumetric inventory without changing the mass inventory.

All these questions have been answered with respect to volumetric inventory.

Q Has B&W designed equipment to measure reactor coolant system water level?

A Yes, we have such equipment. The specific equipment referred to here, however, I am not sure

where it stands with respect to design. I have some reasons to question the feasibility of the proposal as well as its necessity.

Q Why do you question the feasibility?

A The -- for part of the objectives that Dr. Rambo states here, the conditions in which one might conceivably want to utilize this instrumentation to measure the level or the volumetric inventory in the hot legs might make it difficult or impossible to interpret a conventional level measurement in a way that would be sufficiently unambiguous to give the kind of guidance to the operator that -- the additional guidance to the operator that Dr. Rambo proposes.

In point of fact, I think we believe that there are better ways already available to the operator for making the key decisions which need to be made to operate his plant, and so we have some questions about this NRC imposed requirement.

Q Could you just put a manometer on the side of the vesel?

A You could put a manometer on the side of the vessel, but you would have to ask yourself what

such a device would be measuring in the condition that you are interested and presumably in that condition you would have substantial amount of heat being passed from the core into the quiescent water, and that heat would be creating vapor in the water and a lot of the water in the hot leg might be mixed single phase, two phase. You would have something of a frothy mixture.

Q So the quality of the coolant in the manometer would not be representative of the quality of the water in the reactor coolant system?

A You would have to, I think, understand quite thoroughly what you were measuring before directing operational decisions based on it.

Q You said before that you thought that there were better ways to measure primary system water level of reactor coolant system inventory than what Rambo was proposing in GPU Exhibit 33.

A I hope I didn't say exactly that because if I did I misspoke. I thought there were better ways based on already available indications to the operator of making the operational decisions, that he needs to make, I thought I said.

Q Could you be more specific?

A Well, with respect to knowing whether or not he is losing primary system inventory for the purpose of the actions that he should be taking when he is losing primary system inventory, I feel that the thermal hydraulic measurements of temperature and pressure compared to the saturation line of water give him information sufficient to take the actions needed to assure that the loss of inventory does not jeopardize the cooling of the core. That information already is readily available to him.

Q Is it possible to have saturation without a leak?

A Certainly. But it's a condition you would have to basically create by bringing the pressure down through the normal pressure control system to the saturation pressure at the temperature of the coolant you have in the reactor at that particular time. Saturation in fact will exist normally in any -- unless the pressurizer of the reactor coolant system is functioning as it's designed to function.

MR. WISE: Could you read back that last answer, please.

(The record was read.)

A Let me add something to that because it is

possible to be confused by that answer.

The pressurizer is intended to provide a pressure higher than saturation pressure for the particular operating temperature and, therefore, maintains subcooling in the reactor.

Q The heaters in the pressurizer make sure that the water is kept at a subcooled level; is that right?

A The heaters in the pressurizer are designed to raise the temperature of the water in the pressurizer above the temperature of the water in the balance of the system. The water in the pressurizer is thus saturated, if you will, at a higher temperature and therefore creates a pressure which is transmitted throughout the system which makes the rest of the system subcooled.

Q So the heaters in the pressurizer are not intended to transmit heat to the rest of the reactor coolant system, but are a device for controlling pressure and it's the pressure from the pressurizer that is transmitted to the rest of the reactor coolant system?

A Yes, sir, that's why it's called a pressurizer.

MR. SELTZER: Off the record.

(Discussion off the record.)

(A recess was taken.)

BY MR. SELTZER:

Q What has happened to the proposal for a direct measurement of primary system water level?

A I frankly don't know where it stands right at this moment. The NRC, as this exhibit indicates, had asked for the addition of this kind of instrumentation to all pressurized water reactors, and their recommendations were fairly prescriptive. However, they have changed their requests and recommendations a number of times.

For our part we have, since this staff recommendation was made and during the period of time that I was still on a basically continual involvement with design engineering, we reviewed the needs here and reviewed the potential for providing reliable additional information and the need for reliable information and basically concluded that with the operational decisions that needed to be made, that the best instrumentation was probably already on the reactor.

That does not mean that in response to a customer request or an NRC directive we might

not have gone forward to attempt to provide additional information that they demanded.

Q If operators at a B&W plant realized that a loss of coolant accident had commenced sometime earlier, is there any instrumentation that would tell them how much inventory had been lost?

A Yes, to a certain level of accuracy it's possible to tell from quantitative measurements of what has come out of the reactor coolant system; for example, pump level instrumentation can give the operator a guide. Also, if he has been supplying injection water from one of the sources of injection water, the makeup tank or the borated water storage tank, the volume in those tanks can give him a guide.

Q The sump does not have an infinite capacity, does it?

A No.

Q In fact, it has a rupture disk that opens when its level is exceeded.

MR. WISE: You mean the sump or --

A Perhaps there is some confusion here between the reactor coolant drain tank or, as it is sometimes

called, a quench tank into which the pressurizer relief valves discharge and the sump which is the area in the basement of the reactor building into which overflowed water from the primary coolant system actually finally ends up.

The reactor coolant drain tank does receive discharge water from the vent valves if any is produced until it's filled, and then it will overflow through a rupture disk or some other arrangement and finally the water makes its way into the basement of the reactor building, and that's what I meant when I said the sump level.

Q I see.

A You are quite right, though, in the implication of your question that in considering, in counting the inventory one would also look at the reactor coolant drain tank volume level.

Q Are there read-outs in the control room for water level in the sump?

A Yes, I believe there are. I think this is BOP instrumentation and it probably varies from plant to plant, but I feel fairly safe in saying that there is some indication of sump water level in all plants.

Q I asked you this before and I apologize for asking you again. How many B&W plants have you been in?

A Of those plants which now have an operating license?

Q I will start with that, fine.

A Let me think aloud. I have been in the Davis-Besse plant before it was started up. I have been at TMI-1 after its operation and at TMI-2 before its operation. I have visited the Crystal River Unit 3 plant. I have visited the Bellefonte plants under construction. I have visited the Washington Public Power Supply System plants under construction, and I have visited the Mulheim-Kaerlich plant under construction. I have visited the Midland plant of the Consumers Power Company under construction.

Let's see --

Q Which of those --

A I think that's the list.

Q Which of those plants did you visit before the Three Mile Island accident?

A Davis-Besse, TMI-1 and TMI-2, Bellefonte, Mulheim-Kaerlich.

Q Were you in any of those plants before the Three Mile Island accident while the plant was generating electricity?

A I don't recall what the status of the plant -- the operating plant that I visited before TMI on the B&W system was.

Q Do you recall any of the plants that you visited before the Three Mile Island accident were critical at the time you visited?

A No, I don't.

Q Did you visit the control rooms of those plants that you saw before the Three Mile Island accident?

A Generally, yes, to whatever extent the control rooms were completed or constructed.

Q Had fuel been loaded at any of the plants that you visited before the Three Mile Island accident?

A Yes.

Q But at those which fuel had been loaded you don't recall whether the reactor was critical; is that right?

A No, I don't recall whether the reactor was running at that time or critical.

Q Did you spend any time talking to control room operators at any of the plants that you visited; and if so, at which plants?

A I don't recall to what extent the people to whom I spoke were control room operators. I may have had some casual conversation with control room operators, but it's hard for me to say.

Q You don't have any recollection of having any technical conversations with control room operators before the Three Mile Island accident?

A In visits to B&W plants?

Q Right.

A I don't recall having had technical conversations specifically with control room operators while they were operating.

Some of the people with whom I spoke at various plant tours were people who were involved in operations and may have been either then or later control room operators.

Q When you say, "may have been," you don't know whether they were or not?

A That's correct.

Q Prior to the Three Mile Island accident did you ever have any technical discussions with

control room operators who were attending training courses at B&W in Lynchburg?

A I think the answer to that question is generally no, to the best of my recollection. I may have had some discussions but they don't stand out in my memory.

Q Prior to the Three Mile Island accident did you ever review the content of the courses offered by B&W to train control room operators?

A No, I don't recall ever having done that except as I participated myself in a brief one-week session which is really an executive session, as I understood, a summary session, not necessarily for training operators, along with some of my colleagues from the BBR Company. There may have been common material presented in that session.

Q Are you saying it's not your belief that the course that you were given in that brief training session was the same as the content of the course given to control room operators who come to B&W?

A I can say it more strongly than that. I can say while there may be some common material,that that is not the course, that the course that is given to

control room operators would be more extensive is my understanding.

Q After you took the brief executive training course, did you give Mr. Elliott any advice on how he could improve the B&W training program?

A I don't know whether I gave it to Mr. Elliott or not, but I am sure that I gave,during the course of the course, comments and feedback which I recall as generally positive to the instructors.

Q Did you have any suggestion for improvement in the training program which you passed along to Elliott or any of his staff?

A I don't recall. I may have had some, but they don't stand out in my mind as being earthshaking.

Q Before the accident at Three Mile Island, did Elliott ever ask you for your assistance in developing or improving the training of operators?

A I can't recall such a request in the generic way you ask it. We, in the Engineering Department, did provide, on request, technical specialists to lecture as a part of training contracts at the request of Mr. Elliott, and I would work with

Elliott or a member of his staff in selecting these kind of people to give these lectures and try to get people who would give the best possible information and lectures.

Q Before the Three Mile Island accident, did anybody from the training department ever ask you to review whether the B&W training program was adequate?

A I don't recall such a request.

Q Did anyone from the training department ever ask you before the Three Mile Island accident to assign anyone from your department to review whether the training program was adequate?

A Except as I have already noted, I don't recall such a request.

Q You say except as you already noted.

A In the sense of the direct contribution that I discussed in an answer to your previous question.

Q None of the people that you supplied were being supplied by you for the purpose of doing a review of the training program to see if it was adequate, were they?

A I don't recall that that was the case, no, sir.

Q Prior to your development of the

abnormal transient operating guidelines program, are you aware of any other program at B&W that was intended to involve design engineers integrally in the development of a training program?

Did I say development of a training program?

A Yes.

Q I want to focus on the development of the program.

MR. SELTZER: Please repeat the question.

(The question was read.)

A Well, let me comment first. I would not characterize the abnormal transient operating guidelines program as the development of a training program. I think that goes beyond the characterization that I would make.

Let me see if I can answer the question then as -- the following question, did I -- am I aware of any program in which design engineers were involved in the development of the training program.

I am not personally aware of this, that I can recall at this time.

Q Since the Three Mile Island accident have you had any technical discussions with control

room operators?

A Yes.

Q Which ones?

A Well, I visited the control room in Crystal River-3 and spoke with the operators there after the February 26, 1980 transient at Crystal River-3, sometime after. I have talked with control room operators on a casual basis on several occasions in visits to the simulator area; and, of course, on the day of the accident I talked with some of the GPU operators who were at the simulator.

Q With whom did you talk?

A I think Mr. Floyd is the only name I remember, Jim Floyd. I think I testified to that in an earlier deposition.

MR. SELTZER: I would like to mark as GPU Exhibit 34 for identification a memorandum from R. E. Braumiller to Messrs. Bateman, Hamilton and Dowling, subject: New Idea - Subcooling Margin Indicator; Ball and Womack, October 11, 1979.

(Memorandum dated October 11, 1979 from R. E. Braumiller to Messrs. Bateman, Hamilton and Dowling, marked GPU Exhibit 34 for

identification, as of this date.)

Q Is Exhibit 34 a copy of a memorandum which you received in the regular course of business on or about October 11, 1979?

A Yes, it appears to be.

Q And does it refer to a bright new idea that you were a co-author of?

A I will accept your characterization.

Q What was the idea?

A The idea was for a means of electronic implementation of a device which would detect and measure the loss of subcooling and the margin of subcooling in a hydraulic loop.

Q And is one of the hydraulic loops for which you developed this new idea the primary coolant loop of a B&W NSS?

A It would be applicable there, yes.

Q Have you applied for a United States patent on this?

A I believe a patent application is in process.

Q It has not been issued?

A No, I don't think it's been issued.

Q Do you have a copy of the patent application?

A I don't think I do.

Q You signed the patent application, didn't you?

A I don't remember. I probably did.

Q You applied for patents before, haven't you?

A No, this will be the first patent I will ever have applied for. It is novel for me.

Q Did Ball apply for the patent with you?

A Yes, I believe he did.

Q Have you assigned any rights in the patent to B&W?

A Yes.

Q Who is processing the patent on your behalf?

A B&W has a central patent organization, and I can't remember the names of the individuals right now, but they are handling the patent application.

Q Is that handled out of Lynchburg?

A No, I think that office is either in New Orleans or in Barberton.

Q Has a prototype of your invention been constructed?

A Yes.

Q How does it work?

A Superbly.

Q Has it been offered for sale?

A Yes, I believe it has.

Q Has the world been beating a path to B&W's doorstep?

A Would you define world beating a path to B&W's doorstep?

Q Have any customers lined up to get one of these new inventions?

A I think examples of this device or its evolution have in fact been sold by B&W. There are other companies which offer similar devices also.

Q Is what you have devised a computer-assisted saturation meter?

A It could be called that, although the device is not based on a general purpose computer. It's based on dedicated digital logic in which the same way that a digital watch is based on dedicated digital logic to perform a single function or group of functions.

Q Is this device of yours a Tsat meter?

A Some people call this kind of device a Tsat meter.

Q Would you understand it to be a Tsat meter?

A Yes, perfectly well.

Q Are you familiar with the competing Tsat devices?

A Not very, no.

Q Has the Three Mile Island accident increased the salability of Tsat meters?

A I believe it has, yes.

Q Do you know whether any of your competitors had Tsat meters on the market prior to the Three Mile Island accident?

A I don't know.

Q Why do you believe that the occurrence of the Three Mile Island accident has increased the salability of Tsat meters?

A Because among the indications which were available to the operators during the Three Mile Island accident, of a disturbance and possible leak in the primary system, was the saturated conditions of the reactor coolant system fluid.

Q I take it it's the function of a Tsat meter to bring immediately and forcibly to the operator's attention the existence of saturated

conditions?

A It would serve that purpose, yes.

Q In fact, you recognize that that's one of the, if not the primary purpose of the Tsat meter; isn't it?

A Yes, that would be the purpose, part of the purpose it would serve. It also measures the margin of saturation if that's of interest at a particular time.

Q Is the Tsat meter which you have invented capable of being used in a safety grade installation?

A Well, I know of no reason in theory why it should not be used; however, I am not sure that the version that B&W has prototyped necessarily meets all the requirements of safety grade instrumentation.

Q In the fifth page of Exhibit 34 your co-inventor, Ball, says, "The only prior art which would apply to this system that I know of would be the use of a book of tables (Keenan and Keyes) or the use of a computer which has a look up table or computes the right answer with some special algorithm."

Kennan and Keyes is the standard

reference work on saturation?

A Yes, Keenan and Keyes is the standard reference work in the United States on the properties of water in thermodynamic systems.

Q Are there charts in Keenan and Keyes that show steam lines?

A Yes, I believe there are.

Q Have you worked with Keenan and Keyes?

A To some extent, although this kind of information is available from many, many other references. It's very common information.

Q Do you know of any B&W plants that have installed your invention?

A I am not sure where that stands. I know a number of B&W plants -- excuse me, I know at least one B&W plant, I believe there is more, which I implemented this kind of saturation meter. I believe the NRC imposed a requirement for a device something like this after -- at some point after the Three Mile Island accident, and it may be that compliance with that requirement has caused all plants to have some equivalent to this.

Q What are they putting in in Unit 1, do you know, TMI-1?

A No, I don't know offhand.

MR. SELTZER: I would like to mark as GPU Exhibit 35 a memo entitled "System Dynamic Response/Response to TMI-2 Concerns Task Description."

(Memorandum entitled "System Dynamic Response/Response to TMI-2 Concerns Task Description," marked GPU Exhibit 35 for identification, as of this date.)

Q Is GPU Exhibit 35 a document which you prepared?

A I was just trying to figure that out. I don't think I prepared it.

Q Was it prepared under your supervision?

A I really can't -- I really can't place it. I am not sure.

Q Is it a document that you think you have seen before?

A Well, I think this is my handwriting on the document, at least some of this is my handwriting, the marginal notes on the document.

The answer, I think, to that question is yes.

Q I see.

A But when, I am a little -- I am at a loss on.

Q Under the heading "Background" just above the middle of the first page of GPU Exhibit 35 it states, "There are several main issues that have been discussed and reported in ACRS recommendations, NRC staff positions, and NUREG - 0560. The key words describing the issues are:" and then it lists six phrases.

The first phrase is "Bucking Bronco."

What does that phrase connote?

A Well, I am not sure who invented that phrase, but, as we discussed earlier in this deposition, the coupling between the primary and the secondary system via the once-through system generator in a B&W plant is tight, meaning that the primary system responds to secondary system dynamics fairly quickly, and I think someone of the NRC staff who was given to colorful language, it may have been Dr. Ross who is himself a Texan, I believe, probably thought that would be a colorful way to express the fact that this coupling is tight and that the system is responsive to changes in the secondary system dynamics.

Q In other words, the primary system in a

B&W plant responds very quickly to upsets in the secondary system; is that right?

A Yes, that's true.

MR. SELTZER: Why would that be picturesquely described as a bucking bronco effect?

MR. WISE: Are you asking him now?

Q What did you understand was the basis for that?

MR. WISE: What did this witness understand whoever the unidentified person was that may have made up that phrase?

MR. SELTZER: Yes.

A Beyond the connection that I have constructed to you, I don't think I can add anything.

Q The next phrase that's listed there is "Pressurizer Size."

Am I correct that if there were a larger pressurizer or larger pressurizer inventory, that the pressurizer could act as a buffer?

A The pressurizer does act as a surge tank for changes in primary system temperature. One could increase the size of the pressurizer and increase the range of primary system temperatures for which

the pressurizer would act as a surge tank.

Q When the pressurizer acts as a surge tank, is it dampening the bucking bronco effect?

A Well, I think we ought to get off the bucking bronco effect. If you would be more specific in what you are asking me technically, I will be happy to try to answer.

Q As you have explained the bucking bronco syndrome, it's that the primary system is responding very quickly and directly to upsets in the secondary system, right?

A Right.

Q The fast response of the primary system means that it may show sudden rises in temperature or rises in pressure in response to upsets in the secondary system, right?

A Yes, that can happen.

Q If you had a larger pressurizer in a B&W plant, the larger pressurizer could dampen or reduce the sympathetic response of the primary system, couldn't it?

A Yes. That's -- but that's simply a matter of scale. It already does -- serves that purpose; and if you have a larger pressurizer, presumably

you could possibly dampen the larger dynamic variations on the secondary side or in the primary side.

Q So if you had a larger pressurizer, it would reduce the rise in temperature or rise in pressure resulting from upsets in the secondary system, right?

A No, I don't think that would be the effect of first order. A larger pressurizer would simply be able to supply more water to a decreasing temperature transient and there might be some dampening effect on pressure responsiveness of the larger pressurizer on pressurizing transients.

Q So it would reduce a pressure rise; is that right? A larger --

A In theory, a larger pressurizer with a larger gas space might reduce the rate of pressure rise to the same presenting transient. I think it would do so, yes.

Q The third item is "Loop Seal in Surge Line."

What is the issue described by those words, as you understand it?

A It's been pointed out that the surge line which is a length of piping which connects the

pressurizer tank to one of the reactor coolant system hot legs comes down from the pressurizer and then rises back up to go to the hot leg somewhat similar to the trap underneath a sink drain. This is sometimes called a loop seal, although I do not understand that it was installed for that purpose.

It was asserted shortly after the TMI accident in some of the studies that the dynamics of the pressurizer water level behavior might have been affected by that particular line construction as opposed to a line which would come horizontally or even with a downward slope from the pressurizer to the hot leg. (Indicating.)

I believe now that those who asserted that now all believe that it would have made no material difference to the pressurizer's essential response during the course of the accident had the line been simply sloped downward or horizontal. (Indicating.)

Q In other words, the water level rise which occurred in the pressurizer during the Three Mile Island accident would have occurred in the same manner regardless of the configuration of the

loop seal surge line?

A I believe that conclusion has been reached by those who felt at first this might have something to do with it.

Q Do you have any opinion on that?

A I believe it would have behaved in the same way.

Q The next item is "Auxiliary Feedwater Initiation & Control."

I take it that since the Three Mile Island accident, B&W's engineering staff has taken the position that B&W ought to become more involved in directing the control that is appropriate for auxiliary feedwater initiation and control?

A Certainly among the many things that came after -- came from the broadened thinking about all plants in this primary to secondary interrelationship area, which came after the Three Mile Island accident, although not necessarily clearly related to the accident sequence, the performance of auxiliary feedwater systems was an important matter, and that I believe all licensing utilities and all pressurizer water reactor and I think also the boiling water reactor vendors have looked at auxiliary feedwater

systems since the accident.

Q When you say they have looked at them --

A Well, for example, I think all plants have been surveyed for auxiliary feedwater system performance reliability.

Q They have been looked at by the NSS vendors for that purpose?

A Well, the NRC did some studies itself, it directed its licensees to do some studies. We assisted our customers at their request in NRC-directed studies.

Q What is the significance of the words "Inadequate Thermal Capacity"? What issue does that relate to?

A I am not sure at this point what issue that relates to. It may relate to a comparison of the inventory of water in the once-through steam generator to recirculating steam generators which is a thermal capacity of the system. I would not characterize that as inadequate, so I don't really know.

Q B&W's once-through system generator has less thermal capacity than the competitors' recirculating steam generators; is that right?

A That depends on your definition of thermal capacity.

Q They have less water within the steam generator, right?

A There is generally -- they're generally operated with less stored water within the steam generator; that's correct.

Q What does the phrase "Post Trip Inventory Control" mean?

A My best recollection of that is it relates to the pressurizer size issue we discussed before.

After reactor trip, the reactor coolant system bulk average temperature decreases, and this causes the coolant to shrink literally, and the shrinkage lowers the level in the pressurizer and in some reactor systems which have a less than full range of pressurizer level instrumentation, this low level on a slightly below normal trip will approach the bottom end of the instrumentation range. I believe that's what this refers to.

MR. SELTZER: I would like to mark as GPU Exhibit 36 for identification a memorandum entitled "Response to TMI-2 Concerns, Task Description, System Dynamic Response, Post

Trip Control," indicating as lead section manager, E. A. Womack.

(Memorandum entitled "Response to TMI-2 Concerns, Task Description, System Dynamic Response, Post Trip Control," marked GPU Exhibit 36 for identification, as of this date.)

Q Is GPU Exhibit 36 a copy of a memorandum which you prepared?

A Again, I can't -- I don't know for sure whether I prepared this or not.

Q If you didn't prepare it, is it something that would have been prepared under your supervision?

A That's likely. Although not necessarily under my direct supervision.

Q Item 3 is headed "Problem Definition." It states there in GPU Exhibit 36, "The NSS performance for various initial conditions is not in accord with the design assumptions."

What various initial conditions do you understand this is referring to?

A Well, I think the focus of this particular task was that issue that I mentioned to you briefly just a minute ago, and perhaps if I described it in

a little more detail, that would help.

Certain of the B&W plants were provided with pressurizer level indication which did not span the full height of the pressurizer tank. The pressurizer level indication did span the range which the design engineer thought was adequate for the pressurizer level variations that would be experienced under nominal conditions in reactor trip to meet the design criteria.

Q Excuse me, what are nominal conditions?

A Well, the nominal conditions would be the expected nominal operating conditions of steam pressure, steam temperature, the settings of the steam relief valves, the nominal flows of auxiliary feedwater, the normal auxiliary feedwater initiation times and so forth. Those are the kinds of things I mean.

TMI-2, as I understand it, by the way, was not one of these plants, but nonetheless because these plants had an indication range for pressurizer level of only 320 inches as opposed to the approximately 400 inch range of indication which was available at other plants, if certain aspects of the plant equipment did not function exactly

in -- as expected in nominal conditions after a plant trip, the pressurizer level indicated to the operator,which normally falls in response to a plant trip and then is restored,could appear momentarily to go to the zero level of the indication range.

The fact is that this in the first instance does not indicate that water is entirely absent from the pressurizer since there are some 40 inches of water level below the lower instrument tap in the pressurizer in any case, and also because of the dynamics of the pressurizer level measurement, it will tend in these circumstances to read about 25 inches low.

Nonetheless, as far as the operator's view of this transient, his indication was dipping down to or near zero, and the main thrust of this particular task was to address means whereby we could correct those control variables such as steam safety valve relief pressures to be more nearly as assumed in the original design analysis and eliminate this optical problem.

I think it is primarily an optical problem and not a problem of great substance.

Q Are you saying that the whole problem that's defined here is an optical problem not an NSS performance problem?

A It's an NSS performance problem in the sense that the NSS performance what is being discussed here. However, in terms of addressing questions of adequacy of water inventory after trip, questions which might, you know, lead to other concerns, we did not find that that was -- that those kinds of questions were really at issue here.

What we wanted to do was to be able to help these operators to be able to see more clearly that they did in fact have the water which was actually there and to -- and to conserve as much of it as possible by achieving as much as possible nominal performance or even perhaps some additional margins.

Q What, if anything else, was included in the task of post-trip control other than getting a better reading of water level in the pressurizer?

A Well, another way to shrink this water, of course, is to overcool the plant with auxiliary feedwater,and I believe attention was to be given here to any further steps that might be taken to

make this overcooling less likely. Overcooling with auxiliary feedwater or main feedwater, I should have said.

Q In the action plan,Item B is "Improve PT-IV model for trip and post trip low power analysis."

What is a PT-IV model?

A That's a Roman numeral. It's an abbreviation for analogue computer model which goes by the name Power Train IV, being the fourth addition of that particular analogue computer model, and it is a simulation which we use in the design of control equipment and it's used primarily for the design and tuning of control equipment in the power operating range, the integrated control system, for example.

And what was suggested here was making some additions to that model which would make its accuracy at very low powers which would be appropriate for after shutdown analysis better.

Q When you say "after shutdown," would that include during an unanticipated trip from load?

A Yes. When the heat production in the reactor core was essentially at the decay heat levels.

Q C under the action plan is "Define

target post-trip control criteria."

What were the target post-trip control criteria?

A These would have been criteria which would have said the variations in such parameters as pressurizer level and pressure in the primary system should not be greater than some value given another range of abnormal or off normal behavior of the secondary system equipment. That's the kind of criteria that were envisioned there, I believe.

MR. SELTZER: Will you please repeat that.

(The record was read.)

Q Have those criteria been developed or defined since this document, GPU Exhibit 36, was written?

A Let me think. I believe in follow-up tasks related to this general area we have tried to suggest some possible criteria,so the answer is yes.

Q What follow-up tasks?

A I believe we have done an owners' group task related to auxiliary feedwater control which addresses part of this general subject. (Indicating.)

Q Is there a name to that program or task?

A Probably Auxiliary Feedwater Control Task or Auxiliary Feedwater Control Upgrade.

Q Do I understand what you are saying to be that for this auxiliary feedwater upgrade you've postulated that there can be a secondary side upset caused by loss of auxiliary feedwater; is that the first step?

A That is a good first step to consider, yes, in most cases.

Q Then after the loss of auxiliary feedwater B&W has defined post-trip control criteria that should be observed in the primary side of the NSS; is that right?

A Well, the criteria would be set as objectives for a task which was attempting to make some performance changes in the -- in the system itself. These would be new criteria as objectives for change.

Let me see if I can make this a little bit more clear for you, if you like.

The auxiliary feedwater system is a system which has redundant equipment in it and -- but like most redundant systems, individual elements of the system may be sized to provide all the cooling that is really needed in the event that one of the

other elements of the system is for any reason inoperable.

In most cases, when a redundant system is called upon to work, all its elements operate, so you may be then supplied with two times or three times as much cooling as you really need. In such a case unless you take some other action to reduce the auxiliary feedwater flow, you will tend to cool the primary system more than you really need to, and there is nothing really bad about that; but if you wish to dampen it or reduce the variations in primary system parameters that the operator sees in response to, say, an initiation of auxiliary feedwater system, you can add additional control equipment which will in effect recognize that you have got more flow than you need and reduce it.

Q You are postulating the successful initiation of all the trains of auxiliary feedwater, right?

A Yes.

Q I think you were telling me a moment ago that another part of this task performed for B&W, users group examined loss of auxiliary feedwater; isn't that right?

A That was a different task and I would not connect that task with this one.

Q Has B&W defined target post-trip control criteria for loss of auxiliary feedwater?

A I think the answer to that question is yes. Loss of main feedwater, excuse me, the loss of auxiliary feedwater is not intended to be a design condition of the reactor. The auxiliary feedwater system is the backup system to the main feedwater system and it is redundant.

So, while we have done some investigation at the customers' request of a total loss of feedwater, that's not a design condition we define for the plant.

Q Since the Three Mile Island accident, B&W has designed substantially upgraded controls for the AFW, haven't you? Auxiliary feedwater?

A We have designed some upgraded controls for some customers and we have conceived some potential upgrades that have the effect that we discussed a minute ago with regard to reducing variability in feedwater.

Q What do you mean the variability?

A That's back to the discussion I gave you about the number of redundant trains that come on

and the amount of water supplied.

Q Item F was "Prepare interim report."

Has an interim report on this task been prepared?

A I believe that an interim report regarding the auxiliary feedwater control has been prepared and discussed with the customers. I am not sure where we stand on secondary side pressure control today.

MR. SELTZER: I would like to have marked for identification as GPU Exhibit 37 a memorandum entitled "Response to TMI-2 Concerns, Task Description, Main Feedwater System Reliability," led by the eminent section manager, E. A. Womack.

(Memorandum entitled "Response to TMI-2 Concerns, Task Description, Main Feedwater System Reliability," marked GPU Exhibit 37 for identification, as of this date.)

Q Is GPU Exhibit 37 a document either prepared by you or under your supervision?

A Yes, it appears to be.

Q Is this a project that went forward beyond its formulation in GPU Exhibit 37?

A It went forward to the point of being offered

to the customers. I am not sure that any of the customers have undertaken this project with B&W. The main feedwater system is balance of plant scope.

Q Under the section entitled "Background" it states that "NRC/ACRS post TMI-2 incident review of feedwater systems and their reliability indicate that upsets in the main feedwater systems of B&W plants result in more frequent and more serious challenges to the RPS and safety systems than in PWR competitor plants. Results to date from the operating plant data indicate that there are a large number of feedwater system upsets (64 of 246 reactor trips analyzed) that lead to reactor trips and challenges to the safety system."

Have you seen any data that is inconsistent with the NRC/ACRS indications that upsets in the main feedwater system of B&W plants result in more frequent and more serious challenges to the reactor protection system and safety systems than in PBR competitor plants?

MR. WISE: I will object to the form of the question. I don't see how he could possibly answer that without knowing what was in the mind of the NRC and the ACRS and

whatever they said, and I also don't know what you mean by data that is inconsistent with whatever they may have meant.

MR. SELTZER: They are making a simple comparative statement that there is more frequent and more serious challenge in the B&W plants than in competing PWR plants.

BY MR. SELTZER:

Q You understand that's what is written in this memo that you either wrote or had written under your supervision, is it?

A That's what is written here.

Q I am asking you if you have seen any data that is inconsistent with that conclusion.

MR. WISE: I will object to the form but I will permit the witness to answer. I will want my objection noted for the record.

MR. SELTZER: Obviously, it is noted. He writes down everything you say.

A The more frequent observation, of course, is an objective observation and it would depend on what plants you looked at at what period of time. I am sure there are data, I believe I have seen data, I can't put my finger on it, that would

indicate that some non-B&W plants might have more loss of feedwater events or feedwater events in a given period than some B&W plants, so I think that would have to be looked at in terms of statistics.

The question of what is more serious is considerably more subjective and I don't -- I am really not sure how to answer your question.

The B&W plant responds differently to feedwater system upsets than competitor plants and it responds to a number of feedwater upsets in a way which I consider to be less serious because it avoids, it was designed to avoid,challenges to the reactor protection system.

Q We have previously talked about the bucking bronco syndrome, and because of the reduced thermal capacity or size of the steam generator in a B&W plant, isn't it a fact that a feedwater transient will tend to disrupt the primary system more than in a competing PWR plant?

A Again, that depends on what you mean by disrupt more. I have previously told you that the system is tightly coupled through the steam generator; however, all feedwater transients cause disruption in the systems of which they are part.

The B&W plant is designed to take advantage of the responsive coupling between the primary and the secondary system and avoid reactor protection system challenges to certain kinds of upsets. For that reason it has a different or had a different safety system to deal with this occurrence than some of the competitors' plants and, therefore, it responded differently to situations in which the safety system was challenged.

Q Let me ask you this specifically: Do you consider the pilot-operated relief valve part of B&W's safety system?

A No, I do not.

Q So that a frequent challenge to the pilot operated relief valve would not be a challenge to the RPS or the safety systems?

A No, the -- challenging the PORV is not necessarily a challenge to the defined safety system of the plant.

Q How is it that a pilot operated relief valve, which is part of the primary pressure boundary, is not part of the safety system?

A Well, in the sense that the pilot operated relief valve's integrity as a part of the pressure

boundary is concerned, it is a part of the pressure boundary, but the safety systems, the active systems which are provided on the plant to assure that the defined safety criteria are met, do not call upon the pilot operated relief valve for venting or relief. They do not require its function for that purpose. And those systems which are provided to deal with leaks, such as a failure of that pilot operated relief valve might produce, are well designed to handle that result also.

Q Are you saying that the systems which are designed to handle a failure of the pilot operated relief valve are safety systems in the B&W design?

A The systems which are designed to handle leaks, leaks or losses of coolant accidents, are indeed safety systems, yes.

Q A block valve isn't a part of the safety system, is it?

A The block valve is not considered part of the safety system and the operation of the block valve is not necessary to assure safety core cooling.

Q The controls for the pilot operated relief valve are not part of a B&W safety system, are they?

A They are not considered part of a B&W safety system, correct.

Q And the controls for the block valve are not considered part of the B&W safety system?

A That is correct, as of the design as it was originally prepared, yes. I think that there may have been some NRC-directed changes to these control systems, and I don't know where they stand today.

Q Those are NRC-directed changes as a result of the Three Mile Island Accident?

A They follow the Three Mile Island accident; presumably they have some connection.

Q At the time that you or people working under your direction wrote GPU Exhibit 37, were you aware that there were certain upsets in the main feedwater system in plants, in B&W plants that result in more frequent and more serious challenges to the reactor protection system and safety systems than in PWR competitor plants?

A We were aware that that conclusion or conclusions to that effect had been reached by the NRC, and we, for our part, felt that the frequency of these occurrences was an area which would be to the benefit

of the industry to reduce.

Q Has B&W ever assembled data which would demonstrate that the NRC/ACRS conclusion about relative frequency and relative seriousness was incorrect?

A Let me take this separately.

Again, relative frequency, we have tried to assemble data on that to some extent, and I think that has for the most part been presented in ACRS testimony.

Q Since you are breaking it up into parts, does that data refute the NRC or AEC understanding that B&W plants have more frequent challenges to the reactor protection system and safety systems as a result of main feedwater upsets than occur in PWR competitor plants?

A I would have to go back to my earlier answer, Mr. Seltzer. I have the feeling that for certain periods of time in certain plants that statement would not be true,simply not be true; but for other times or other selections of plants it might well be true.

Feedwater system reliability or feedwater system performance is what's being addressed here.

Feedwater systems are designed by and at the direction of the utilities by a wide variety of architect engineers and they are different from B&W plants so their performance can be expected to be different.

Q Well, your staff had found from operating plant data, "there are a large number of feedwater system upsets (64 of 246 reactor trips analyzed)."

A Yes, that's correct.

Q Now, that is data from B&W plants, right?

A Yes, that is the data we had at this time, yes, sir. And I think that the conclusion that there are a large number of feedwater system upsets is a conclusion which has not changed.

Q And those feedwater upsets are not upsets that just occurred on one or two B&W plants; isn't that right?

A That's correct.

Q When it says that those upsets have led to reactor trips and challenges to the safety system, what kind of challenges to the safety system are being referred to here?

A A reactor trip is a challenge to the safety system. The reactor protection system which trips

the reactor is a safety system.

Q I see. So --

A So it's kind of a redundant statement.

Q Where in B&W is data on causes of reactor trips assembled?

A Well, various organizations within B&W have assembled it for different purposes. These particular data I believe were assembled within the Power Systems and Controls Unit.

Q Do you ever receive reports that show annual summaries of causes of outages to B&W plants?

A Yes, from time to time I receive such reports.

Q What are those reports called?

A Well, they might be called availability summaries or outage summaries. I don't know that I know of a particular name that they would all characteristically have.

Q How frequently do you get those reports?

A Well, I haven't received one for some time, but I think that they have been produced with varying frequency, perhaps once a quarter, once every six months, maybe once a year.

Q You took over as manager of the plant design section in August of 1978. At the time you

took over, unit managers were preparing monthly reports which they sent to the head of the design section, right?

A Yes.

Q They had been preparing them before you became head?

A Right. As I understand it, that's right.

MR. SELTZER: Let me state now so that I don't forget later, Bob Wise was kind enough to send me a letter on January 22nd responding to nine items of information or documents that we had requested after the last session of Dr. Womack's deposition, and for some of the categories you indicated, Bob, that the shelf files contained substantial material which you said, "We have not been able yet to review. We are willing, in any event, to make them available to you for review in Lynchburg on reasonable notice."

You also gave us "copies of certain periodic reports found among the shelf files."

We found the periodic reports that you gave us were only for the years '79 and '80, even though this witness took over the section

in '78 and indicates that there were reports prepared even before he took over, the periodic reports. And there are also central files that you identified which you say you believe they are duplicative of hard copy produced. I am sure you wouldn't represent that they are absolutely duplicates or that they're not responsive documents in the central files that were not duplicates of files you have produced.

MR. WISE: There is no way I can make such a representation. I haven't read all of that material. I understand it's massive and it's on microfilm.

MR. SELTZER: Right.

MR. WISE: Or fiche.

MR. SELTZER: We certainly appreciate the difficulty of reading fiche and microfilm and getting legible copies from fiche and microfilm.

We will endeavor promptly to travel to Lynchburg to review the substantial volume of shelf file material, and we will work out a date with you that is mutually agreeable.

We also want to get the periodic reports going back in time before 1979, and we will want to have access to the central files.

We will finish this afternoon our examination of Dr. Womack; and if you want to cross-examine him on anything that we have examined on, feel free to. We, of course, can't foreclose ourselves from some later time that I don't anticipate now, asking for another opportunity to depose Dr. Womack to ask him questions about documents that we just haven't had access to previously.

MR. WISE: I think we will just have to proceed and see what happens. I can't tell you the Court would not permit you to continue the deposition of Dr. Womack. We will just have to take that up if the time comes.

MR. SELTZER: I am not asking you right now. And if we did need to recall him, it would only be because we felt we couldn't get the information from somebody else who has not yet been deposed. This is not going to be our last deposition in the case.

MR. WISE: Are you at a convenient spot?

MR. SELTZER: Yes. Why don't we break for lunch and --

MR. WISE: We will meet back here --

MR. SELTZER: Off the record.

(Discussion off the record.)

(Luncheon recess taken at 12:20 p.m.)

* * *

AFTERNOON SESSION

(2:15 p.m.)

EDGAR ALLEN WOMACK, JR.,

resumed, was examined and testified further as follows:

EXAMINATION (Continued)

BY MR. SELTZER:

Q I think you have in front of you now a complete copy of GPU Exhibit 32, the report on safety aspects of the Mulheim-Kaerlich plant in view of the Three Mile Island-2 accident, right?

A I presume it now to be complete.

Q I have directed your attention to the page that is numbered at the bottom 4.2-4. Do you have that?

A Yes.

Q There is a reference at the beginning of that page to "The relief (or blowdown) valve at MK."

Is blowdown a word that is synonymous with relief for certain purposes?

A I think that's correct, yes.

Q Blowdown means it's relieving or letting down pressure?

A Yes.

Q When it states on this page, "The relief (or blowdown) valve at MK is also a PORV (Figure D-8). While it is a different design from the one used at TMI-2, the possibility of failure of the valve to close properly cannot be eliminated nor can failure of its control circuits. However, the MK design has pressure tap connections which make possible a more direct indication of proper closing of the valve." What do you understand is meant here by "pressure tap connections"?

A I don't really know what's meant by pressure tap connections here. I presume that this would mean some auxiliary connections to the valve other than the main flow connections.

Q Would the pressure tap as you understand it be downstream of the valve?

A I don't know.

Q If it were going to indicate flow through the valve, wouldn't it have to be downstream of the valve?

A Well, if the intention here is to indicate that there is a -- that there is a pressure drop type flow indicator in the line of this valve, it

could be really placed anywhere because the flow into the valve and the flow out of the valve has to be the same when the valve is actually passing flow, so it could be either place.

Q So you are saying that the pressure tap which would make possible a direct indication of proper closing could either be in the valve or downstream of the valve?

A It's possible, yes.

Q Is there any other place it could be?

A If the pressure -- if one were to undertake to provide a pressure drop type flow measurement, one could put it across the valve or one could put it in any of the lines which lead into or out of the valve along with the necessary additional equipment to make it function, I suppose.

Q Were you aware prior to reading this report, GPU Exhibit 32, that there was a pressure tap connection on the MK plant that made possible a more direct indication of closing of the PORV?

A I don't know whether I was or not. I don't recall being conscious of that specifically.

Q The text on page 4.2-4 continues, "Furthermore, the PORV block valve is controlled by

the RPS rather than depending on operator recognition and action."

What does it mean that the block valve is controlled by the RPS?

A I understand that to mean that the electrical control equipment which is considered a part of the reactor safety or protection system includes the control of this valve at Mulheim-Kaerlich.

Q Under what circumstances would the safety or reactor protection system actuate a closing of the block valve?

A Well, I am not sufficiently up to date on the details of this to know, but my recollection is that those control variables were described elsewhere in the report.

Q Would you take a look at page 5.4-1 also numbered in the margin E-5690.

Is this the description that you recalled?

A Yes, I think this is the description that I recalled.

Q And on this page it described the conditions in the reactor coolant system which would signal automatic closure of the block valve?

A Yes, that appears to be correct.

Q On page 5.4-1 the authors have described the function of the PORV in the MK plant.

Do you see that?

A Yes.

Q Is that function substantially the same as the function of a PORV in the Three Mile Island Unit 2 and in other B&W plants constructed in the United States?

A As I understand it, those valves serve these same functions in the United States.

Q And the functions that are described here are, one, reducing the frequency of challenge to the code safety valves, and, two, reducing the frequency of reactor trips; is that right?

A Yes.

Q On the same page where it describes the circumstances under which the block valve would be signaled by the reactor protection system to close, are there system conditions listed which would have signaled the TMI-2 block valve to close if this kind of protection system had been installed in TMI-2 the day of the accident?

MR. WISE: Could you read that back, please.

(The record was read.)

MR. WISE: I am afraid I am not sure I understand your question. Are you asking the witness to assume certain conditions at TMI-2 based on what he has read? What are you asking the witness to assume in order to answer that question?

MR. SELTZER: There are five conditions under which the reactor protection system would signal closure of a block valve.

MR. WISE: In the MK plant.

MR. SELTZER: Right. And those are listed on page 5.4-1.

Q Right, Dr. Womack?

A Yes.

Q I am asking you, to your knowledge, which if any of those five conditions existed in the Three Mile Island Unit 2 following the failure to close of the pilot operated relief valve on March 28, 1979?

A Well, the conditions which are designed into the automation of this particular valve in this particular plant are listed here qualitatively except for one temperature set point. I am not -- I

have not reviewed this or studied it sufficiently to know which of these conditions would have existed when. However, I believe it's asserted elsewhere in the report that one or more of these conditions might have been encountered in a similar accident in this plant.

Q When you say, "this plant," which plant do you mean?

A Mulheim-Kaerlich.

Q And did the system actuate automatic closure of the block valve?

A No, I think that I meant that in hypothesizing a similar accident from Mulheim-Kaerlich I believe the authors assert that these conditions would have been reached.

Q In other words, in hypothesizing the occurrence of the TMI-2 accident in a plant having Mulheim-Kaerlich's reactor protection system, one or more of these points calling for automatic closure of the block valve would have been reached?

A I believe that's asserted in this report, yes.

Q Let me ask you to turn to page 5685.

Does that page contain the statement that you were just referring to?

A Yes, I think that's the statement that I remember.

Q In other words, according to this report in GPU Exhibit 32,the reactor protection system that is in the Mulheim-Kaerlich plant would have generated a signal to close the block valve at two minutes into the accident?

A Yes, that's what is asserted here.

Q In other words, at least one of the five conditions listed on page 5.4-1 would have been reached by two minutes into the Three Mile Island accident?

A That's an extrapolation of what's said, but I believe that's a fair extrapolation.

Q The statement on page 5685 also numbered 4.2-9 is as follows:

"The TMI-2 PORV block valve has no automatic function. It is equipped with a remote actuator and can be repositioned by the operator from the control room.

"The corresponding MK valve is automatically closed by the RPS in response to appropriate signals to ensure that a failed relief valve is isolated in a timely fashion. At TMI-2,

this valve was closed at approximately 140 minutes after the start of the accident. The MK protection system would have closed the valve at 2 minutes into the accident."

Looking at the list of five conditions which would call for automatic closure of the block valve, there is a certain amount of redundancy built into that list, isn't there?

A There appears to be some redundancy, but presumably they were designed to cover different functions.

Q At TMI-2 during the accident on March 28th, reactor coolant pressure fell, didn't it?

A So I understand.

Q Reactor coolant hot leg temperature fell, didn't it?

A Yes, as I understand it.

Q Containment pressure went up?

A I understand that also happened, yes.

Q It's also true that containment temperature rose; isn't that right?

A That I think that happened to some degree, yes.

Q So depending on what the trip points were for automatic closure of the block valve, any of those four conditions might have called for automatic closure under the MK reactor protection system, right?

A Depending on what the initiation set points were.

Q Is there anything in this report that indicates what the initiation set points are?

A I don't remember.

Q According to this report, if the Three Mile Island plant had been equipped with the Mulheim-Kaerlich reactor projection system, the core uncovery that ensued at Three Mile Island would not have occurred; isn't that correct?

A I don't think that's a conclusion that this report makes. This report makes the conclusion that a TMI-2 type accident in this Mulheim-Kaerlich plant would have had certain automatic actions because of the particular design and design philosophy of this plant which would have, in the hypothetical case treated here in the comparison, led to different plant performance.

Q One of the differences in plant

performance would be that the block valve would have been closed, right?

A That is asserted here, yes.

Q The Three Mile Island --

MR. WISE: Excuse me.

What is asserted here?

THE WITNESS: That the block valve would have been closed in a similar hypothetical -- in a hypothethical accident similar to the TMI-2 accident should it have occurred in the Mulheim-Kaerlich plant.

A That's what I understood you to mean, right?

Q Correct.

A Good.

Q There is no doubt in your mind, is there, that if the block valve had been closed at TMI-2 at two minutes into the accident, other things being unchanged, there would not have been an uncovery of the core; isn't that right?

MR. WISE: I will object to that as hypothetical and does not give the witness enough facts in order to enable him to answer. I will permit him to go ahead and answer as best as he can, but my objection is noted.

A I believe that all else being unchanged, an early closure of the block valve at TMI-2 should have prevented the loss of cooling to the core.

Q Certainly closing the block valve at two minutes into the accident would have preserved effective core cooling; isn't that right?

MR. WISE: I will make the same objection.

A I think that with the same qualification, my answer would be the same as I made before.

Q Namely, yes?

A Early closing of the block valve would have preserved core cooling.

Q All I am trying to establish is that two minutes is early.

A Oh. I would agree that two minutes is early.

Q On page 4.2-4, which is also numbered 5680, the last sentence states, "The existence of such a valve control on TMI-2 would have significantly changed the course of the TMI-2 accident."

In light of what we have just been discussing about how the MK plant's reactor protection system works and that it would have closed the block valve at two minutes into the accident, if hypothetically such controls had been in place, do

you agree with the sentence that I just read?

THE WITNESS: Could you read that back, please.

(The record was read.)

A I think I would simply say again what I said earlier, that an early closure of that block valve with all else being equal would have led to or should have led to the preservation of cooling, in cooling, and I would say that would have been a significant change in the course of the accident.

Q If the block valve had been closed at TMI-2 at two minutes into the accident, from your knowledge of the sequence of events, would the valve have even begun to pass water as opposed to steam?

A Which valve?

Q The PORV or the block valve.

A I don't really know.

Q So it's conceivable that if the block valve had been closed at two minutes, there might not have even been water in the drain tank?

A It's conceivable, although the drain tank would condense into the steam that is passed. Since steam is water and it condenses, there probably

would have been water in the drain tank.

Q From your knowledge of the MK system, if the block valve is closed two minutes into the accident and everything else functions as it's intended to, would the reactor even be tripped off line?

MR. WISE: Under what circumstances?

A In what set of circumstances?

Q A loss of feedwater transient.

A In which you -- are you making the further assumption that the pilot operated relief valve remains open?

Q Remains open, right.

MR. WISE: And this is a loss of all feedwater or the loss of only the regular feedwater?

MR. SELTZER: I guess we better hypothesize loss of all feedwater.

A The reactor would have been tripped off line at Mulheim-Kaerlich.

Q Why wouldn't the PORV keep relieving pressure so that the system did not reach the pressure trip point for reactor scram?

A The PORV is not sized to relieve sufficient

quantity of gass to significantly delay the reactor trip.

Pardon the split infinitive.

Q Will you take a look at page 2.3-5, please, which is numbered 5523.

A 5523.

Q This is in the section of GPU Exhibit 32 called "Description of the TMI-2 Accident."

In the middle paragraph, do you see the sentence that begins, six lines down, "Also starting at 1 minute"?

A Yes, I see such a sentence.

Q It states there, "Also starting at 1 minute, indicated pressurizer level starts to increase and goes off scale (400 inches) at about 6 minutes, presumably going solid shortly thereafter."

Am I correct that the pilot operated relief valve is at the highest point in the pressurizer?

A I believe that's correct.

Q Up until six minutes, according to this, the TMI-2 pressurizer had not gone solid, right?

A That's what this says, yes.

Q Therefore, up until six minutes the pilot operated relief valve was only experiencing

steam flow, right?

A Well, that is a conclusion you can draw from this.

Q Would you draw it? I am more interested in what you would draw from it than what I would draw.

A I think I would want to look more carefully than this, but as I think we discussed earlier, it is certainly possible that and probably likely that the PORV passed steam only in the early portion, early minutes of this transient.

Q In other words, up until the time when the pressurizer went solid, it was passing steam and after that it was passing water?

A Well, one of the problems I have with this is the definition of the term "going solid." I think we must imagine the pressurizer as containing, particularly in its upper portions with a -- with an open valve in the top, containing a mixture of liquid and vapor, and the definition of "going solid" therefore is, if you will permit a pun, a little bit frothy.

Q If this description is accurate, would this refresh your recollection that at two minutes

into the accident the pilot operated relief valve would have been passing just steam and not water?

A It is likely that, as I said earlier, it's likely that at two minutes the pilot operated relief valve is still passing steam. That's very possible.

Q From your work at B&W and on the MK plant, when, to the best of your knowledge, was the reactor protection system for automatic closure of the block valve designed?

A I don't know when the design that included these features was actually put into place.

Q Just to give somebody a sense of scale, by what date would you say it was certainly done before this date?

A I am really not sure. The reactor protection system design requirements from the German customer are of course substantially different from those in the United States, and I suspected that -- I suspect that the design,which was to a large extent done in Germany, departed early from the design of U. S. customers, but I really don't have a time scale in mind. I don't recall myself becoming aware of this specific difficulty we have discussed much

earlier than the time period around TMI-2.

Q When was your last day-to-day involvement in the --

A Mulheim-Kaerlich plant?

Q -- Mulheim-Kaerlich plant?

A I had a day-to-day involvement in the Mulheim-Kaerlich plant as a project manager up until I took the plant engineering section in August of 1978.

Q How long prior to August 1978 had the principal design work on the NSS been completed?

A Which NSS?

Q Mulheim-Kaerlich.

A Oh, I think design work to meet evolving German requirements and customer needs was going on continually in the period with which I was affiliated with the project.

Q Who was principally responsible for development of the reactor protection system?

A BBR.

Q Is there any gentleman in BBR who you'd say would be the most knowledgeable person on features of the reactor protection system?

A Yes, there are several such people. As an

overall management level engineer I think Dr. Peter Wirtz would have been knowledgeable.

Q If you wanted to find out more about the design of the reactor protection system to close the block valve automatically on the MK plant, who is the person that you would get in touch with?

A Probably Dr. Wirtz.

Q Is he still with BBR?

A Yes, he is.

Q Where is his office?

A In Mannheim.

Q Does he speak English?

A He speaks English.

Q Have you ever spoken with anybody about the fact that the MK plant has provision for automatic closure of the block valve?

A Yes.

Q Who?

A I have spoken with counsel.

Q Anyone else?

A I have probably mentioned it in casual conversation with others. I don't have specific recollection of those conversations.

Q Have you ever discussed it with Dr. Roy?

A I can't recall.

Q Have you ever discussed it with John MacMillan?

A I can't recall.

Q You mean not to the best of your recollection?

A Not to the best of my recollection; not to exclude that it might have happened.

Q Do you have any idea when in time the decision was made to include automatic closure of the block valve in the reactor protection system for the MK plant?

A I really don't. I believe the differences in design requirements existed early in my familiarity with the project. So, it could have been at any time.

Q Are there other features in the Mulheim-Kaerlich plant which if they had been installed in Three Mile Island-2, other things being equal, would have prevented the accident from proceeding to the point of core uncovery?

MR. WISE: I will note for the record an objection to the form of the question. It has not been established that the block valve actually would have prevented a core uncovery.

A There are certainly --

THE WITNESS: May I answer?

MR. WISE: You may.

A There are certainly other different features of the Mulheim-Kaerlich plant springing from the different requirements of the German customer with respect to the role of the operator in transients. Some of these might have affected the course of a similar accident or an accident initiated by a similar set of circumstances had it occurred in the Mulheim-Kaerlich plant.

Q That's exactly what I want you to focus on.

What is it in the MK plant that would have prevented the gory consequences?

A I don't know that I can focus on specifics. I think that's the thrust of this report and perhaps you can call out other areas of this report which discuss that. But the general difference in philosophy that exists in Germany has to do with the philosophy of the operating utility in Germany with respect to the role of the operator, which we have discussed earlier in this deposition, and that philosophy requires,at his request,a higher degree

of automation than is preferred and desired by utility customers in the United States, specifically a requirement that accidents proceed to a conclusion without taking credit for operator action during the first 30 minutes of the accident.

A That is a criterion for design of German plants?

A Yes. Which leads to design differences between German plants and plants designed for United States utilities who seem to have a different view about their desires with respect to the operator's involvement.

Q How do you know they seem to have different views? Whose views are you reflecting when you say that?

A Based on the -- based on my interaction with representatives of our utility customers where the questions of installing automatic equipment versus the questions of -- versus allowing the operator to make judgments are concerned, the utilities with whom I have interacted generally prefer to allow the operator the freedom of taking the actions and which may be needed in a reasonable time to terminate transients.

Q It sounds like you get into a very Miltonic discussion with people about free will and controlling human destiny.

A I don't think it's necessary to get into a Miltonic discussion. It's only necessary to look at the degree of automation which is achieved in the industry for pressurized water reactors.

Q Let me ask you specifically, can you identify the utility official with whom you were speaking who told you that he preferred to have operators be able to intervene to arrest a transient rather than have equipment automatically arrest a transient?

A Well, I am not so sure I can identify a name and a subject. That is an opinion formed by a number of interactions plus interactions with others of my colleagues.

Q Are you saying that you cannot name a single utility official who has espoused that point of view?

A I am not saying that I cannot name such a person --

Q I would like you to, then.

MR. WISE: I would prefer that you

would let the witness finish his answer before you interrupt him with another question, Mr. Seltzer.

MR. SELTZER: It's the same question.

MR. WISE: It's not, and I would prefer that you not interrupt my witness when he is speaking.

A I haven't tried to test my memory in this general area, and I will spend some time thinking about it.

Q Please do. But I want to know, just focus your thinking, I want to know the name of a utility official who has told you that he would prefer to have the operators free to intervene to arrest a transient rather than having equipment there automatically to arrest a transient.

MR. WISE: The witness never testified that anybody said that to him in those words. He testified to an opinion that he has formed over a period of time in the course of his employment interacting with various officials.

If you want something more than that, you may pose a question and see if the witness can answer it. He is not required to

necessarily come up with a name of an individual who said specifically the words that you put into somebody's mouth.

A I think in the course of replying here the best thing that I could do to illustrate what I have been talking about is simply point to the difference between a standing written rule in Germany which requires automation out to this 30 minute period and the absence of such a rule from the regulatory authorities in the United States, and a certain degree of discussion over the years in industry groups and with the regulatory authority about what is a period of time at which operators should -- operator action should be credited in safety actions.

Now, I would have to go back and research to some extent the industry written record on this subject, but I am quite confident that that research could be done.

Q Are you saying that as you sit here now, you cannot identify a single manager from a United States utility who has said in words or substance what I asked you to recall?

MR. WISE: Identify by name, rank and

serial number; is that your question?

MR. SELTZER: I don't know whether he has a serial number and I wasn't even asking for rank. I don't think your snide comment helps.

MR. WISE: I object to that sort of comment.

MR. SELTZER: I withdraw it.

A As I said, an illustration of the sort that you are requesting with the precision that I would want to have in order to mention a person's name doesn't come to my mind, but I have no question that, as I said, that the written record of industry discussions on this subject will bear out what I have said.

Q Where would you look for this written record of industry discussions?

A Well, I think I would look at standards groups, which have discussed operator role, which have discussed periods of time for taking credit for operator action in response to accidents. I would look, if I wished to look farther, I would look with -- at the whole series of contract discussions with all -- between all vendors and

their utilities. I would look at the control rooms' designs which have resulted in the industry and their degree of automation.

Q Would there be names written in the control room,who proposed this?

A The names of the people who had those responsibilities and who made decisions associated with that certainly are traceable for those plants.

Q Well, do you know for a fact that B&W has ever offered to an American utility the type of automation of control of transients for the first half hour that is installed in the Mulheim-Kaerlich plant?

A No, I don't know that for a fact.

Q Have you ever had a discussion with any American utility prior to the Three Mile Island accident regarding the possibility of installing controls that would handle all transients for the first half hour without human intervention?

MR. WISE: I don't know that it's been established that Dr. Womack was in a position prior to the Three Mile Island accident to have had that sort of discussion. With that qualification I will permit the witness

to answer, if you just want whether or not he personally has had such a conversation.

A No, I don't believe I had such a conversation.

Q Have you had a conversation with anybody at the NRC regarding the desirability of installing automated control of transients that would obviate the need for human intervention during the first half hour of any transient?

MR. WISE: This is at any time up until today?

A As a general criterion? I think I have mentioned in the course of conversation with NRC colleagues perhaps this difference in design philosophy which exists in Germany to the extent that I believe that this is well known to the -- to at least some of the Nuclear Regulatory Commission, because they do have a continuing dialogue at the highest levels with the German regulatory authorities. With respect to specific conversations which I might have made such a declaration, I don't recall having made such a declaration.

Q With whom at the NRC have you had such conversations?

A Well, I can't be sure that I could, you know,

focus individual conversations; however, the German Reactor Safety Committee, representatives of the German Reactor Safety Committee, which is the German counterpart of the NRC's Advisory Committee on Reactor Safeguards visited the United States not long ago and they had conversations covering the broad range of subjects with members of the NRC staff and members of the ACRS and in my presence at least with -- one member of the -- or one member of the ACRS.

Q Michaelson?

A No, Michaelson is not a member of the ACRS. Mr. Ebersole.

Q During that discussion in your presence was the desirability of having the plant automatically control a transient for the first half hour discussed?

A Not explicitly in that way, but I think that there were -- I believe there were discussions -- there was discussion of differences in approach, which would go to this fairly fundamental approach to automation.

Q Have you had any such conversation or been present at any such conversation regarding completely automated control of a transient for the

first half hour? Have you had any conversation like that with anybody from the NRC or its predecessors prior to the Three Mile Island accident?

A I don't recall having had such conversations or such a conversation.

Q Have you discussed with anybody from the NRC the fact that Mulheim-Kaerlich has provisions in its reactor protection system for automatic closure of a PORV block valve?

A I don't recall whether that's been explicitly discussed with the NRC or not.

Q Do you know whether prior to the Three Mile Island accident B&W ever offered such automatic control of the block valve to any of its United States customers?

A No, I don't know.

Q Do you know whether since the Three Mile Island accident B&W has offered such control to any of its United States customers?

A Yes, as a follow-up to NRC requests in this regard or suggestion in this regard in order to restore, or as a part of the program to restore the pilot operated relief valves to the operational objectives which allow it to help to avoid

challenges to the reactor protection system we have suggested automatic block valve closure.

Q Where does that recommendation stand now?

A I can't tell you today. I believe it's been given to our utilities and certainly has been discussed with the NRC.

Q Did BBR take a more assertive role in the design of the emergency feedwater system for the MK plant than B&W took in the design of emergency feedwater for the Three Mile Island Unit 2?

MR. WISE: I don't know it's been established that this witness has any qualification to speak about what role B&W took with respect to the design of the emergency feedwater system at TMI-2. I don't even think he was employed by B&W at that time.

MR. SELTZER: I think he has come to know.

MR. WISE: I don't know whether he has or not.

A No, I don't really feel qualified to answer the question exactly as you asked it for the reason that counsel has stated. BBR has a different

contracting arrangement, however, than B&W with respect to the Mulheim-Kaerlich plant.

Q Are you aware that the emergency or auxiliary feedwater system for MK is classified and designed as a safety system?

A Yes, I am.

Q The emergency feedwater system for TMI-2 is not designed as a safety system, is it?

A I am not exactly sure what requirements and how classified the system was at that time. I believe, however, that the classification and design of these systems did become a practice and requirement in U. S. industry after the TMI-2 design was complete.

Q In the design of the MK plant there are provisions, are there not, that would prevent an operator from easily overriding emergency safeguard systems?

A Yes, I believe I have been told that. It may not be so much provisions as an outgrowth of again the strategy which relates to the operator's response to transients.

(Continued on following page.)

Q Do they have anything like a key lock pass to limit the circumstances in which an operator can override the system?

A I don't recall that detail. It may be in this report.

MR. SELTZER: I would like to mark for identification as GPU Exhibit 38 --

MR. WISE: Off the record.

(Discussion off the record.)

(A recess was taken.)

BY MR. SELTZER:

Q The last time we were together you were enlightening us that SMUD was not a dirty word but the acronym for one of B&W's estemed customers, right?

A SMUD is an acronym for the Sacramento Municipal Utility District which is the utility that owned a B&W reactor.

MR. SELTZER: I would like to mark for identification a memorandum from E. A. Womack, the new Manager of Plant Design, to B. A. Karrasch, Manager of Plant Integration, subject: SMUD Rapid Cooldown Transient, August 21, 1978.

(Memorandum dated August 21, 1978 from E. A. Womack, Manager, Plant Design, to B. A. Karrasch, Manager, Plant Integration, marked GPU Exhibit 38 for identification, as of this date.)

Q Is GPU Exhibit 38 a copy of a memorandum which you sent to Mr. Karrasch in the regular course of business on or about August 21, 1978?

A Yes, it appears to be.

Q What was the initiating event in the SMUD rapid cooldown transient?

A I think this was a power supply failure and brought about by a, if I am placing the right transient here, I think this was brought about by a short caused by an operator who was performing maintenance, I think changing a light bulb in the instrumentation system.

Q He dropped a light bulb and it shorted out the panel?

A That's my recollection of this.

Q You state in the first sentence to your manager of plant integration, "Based on our discussion last week, I understand that you will put together a small group of key designers to review the SMUD

rapid cooldown transient and brainstorm what could have been done or what could be done in the B&W NSS/Plant Design to reduce the likelihood or limit the consequences of such an event in the future."

You went on to say, "As we discussed, I believe that events such as this and the Davis-Besse 1 blowdown contain important feedback for us regarding our designs."

Is it correct that the Davis-Besse 1 blowdown that you referred to is the September 1977 transient?

A It probably was, yes. I am not sure which one -- what it was, but it probably was that one.

Q And the September 1977 transient was when the pilot operated relief valve cycled several times and then failed open?

A Yes, I now know a great deal more about it than I did then.

Q What did you mean when you told Karrasch that you believe that events such as this SMUD and the Davis-Besse blowdown contained important feedback for us regarding our designs?

A Well, I meant simply that by looking at the kind of abnormal things that might be happening in

our plant and by really trying to understand them and seeing what could be sifted out of them, there was something that we might learn,that there were things that we could conceivably learn which could help us to make our future plants operate better. It's a view I have always held.

Q And you prefaced that second sentence with the words, "As we discussed, I believe," et cetera.

A Right.

Q Is this something that you had previously discussed with Mr. Karrasch?

A Apparently. The idea of trying to have key designers look at particular events in the future I think was what was discussed.

Q You asked Karrasch to put together a small group of key designers --

A Yes.

Q -- to review and brainstorm.

Did Karrasch put together such a group?

A No, I don't believe that prior to the work we did in the midsummer of 1979 that this really followed up, that this idea was really followed up. Unfortunately, this was a number -- one of a number

of ideas and which -- for which we did not have direct support from our customers to do, and so it came into the category of initiatives to try to get underway and we undoubtedly would have gotten it underway in any case, but we did in fact put in place something like this, a transient assessment program in 1979.

Q Under what circumstances do you believe you first learned of the Davis-Besse blowdown or loss of coolant accident through its PORV?

A I learned of the transient when I was working on the Mulheim-Kaerlich responsibility as a project manager it had caused some, and I believe I recall it had caused some damage in the insulation because of the actual expulsion of the steam, and I think at the time it was of interest to some of the -- our German counterparts, and I may have been the conduit to pass information from some of our people to the German -- to my German colleagues at that time.

At any event, about that time was when I learned of the transient.

Q How soon after the September 1977 occurrence of the transient did you learn of it?

A I don't recall.

Q How did you learn of it?

A I don't recall that either. Probably through conversation.

Q Did you ever follow up on your memo to Karrasch, GPU Exhibit 38, to see whether Karrasch was pursuing your requests?

A I am not sure whether I did or not. If I did,in any event, we didn't get it high enough on priority until the dates I mentioned to have achieved the objective here.

Q In the last paragraph of GPU Exhibit 38 you wrote, "I believe we may find by regular review of serious operating incidents and operational problems which have become serious because of their frequency in our plants that feedback resulting in a more excellent product will result."

I take it that was a view that you held at the time you wrote this and that you continued to hold throughout the time you were manager of plant design?

A And that I hold today.

Q Yes, you held it then, you continue to hold it, and you still hold it?

A Yes.

Q And you intend to continue holding that view?

A I found nothing in recent experience to divert me from that view.

Q You concluded by saying that, "I look forward to a session on the SMUD rapid cooldown transient."

You looked forward to it so that you could review the operational problem?

A No, that was simply the final line in a memorandum which kind of summarized the action that I expected that Mr. Karrasch would take when he could get to it in his other duties.

Q Did you ever castigate Karrasch for not putting together the group of key designers and having the brainstorm sessions that you had asked for?

A I don't know whether "castigate" is the right word. I -- my -- my inkling is that I did discuss it with Karrasch and again at some later time got going on this idea, but I can't recall whether that was before or after TMI or whenever.

Q What did he say to you?

A He said he was very busy and it was on his list, I think, is the best of my recollection.

Q Is there now institutionalized within B&W a program for regular review of serious operating incidents and operational problems?

A Yes, there is.

Q Who is responsible for that?

A Well, I am not sure right at the moment who has the lead in this transient assessment program, but it's a program which we do in cooperation with our customers.

MR. SELTZER: I would like to mark as GPU Exhibit 39 yet another memorandum from E. A. Womack, this time to Kosiba, Manager of Customer Service Department, subject: Recommendation for "Quick Look" Evaluation of All Reactor Trips, August 30, 1979.

(Memorandum dated August 30, 1979 from E. A. Womack to Mr. Kosiba, Manager of Customer Service Department, marked GPU Exhibit 39 for identification, as of this date.)

Q Is GPU Exhibit 39 a copy of a memorandum

which you wrote in the regular course of business sent to Kosiba in or about August 30, 1979?

A Yes. I may have had assistance in authoring the memorandum, from the staff.

Q Is that your signature on the last page, page 4?

A Yes, it is.

Q At the time that you wrote GPU Exhibit 39, B&W was getting ready to institute its quick look evaluation of all reactor trips; is that right?

A Oh, this was a recommendation to institute such an evaluation.

Q Was it subsequently instituted?

A After some time, yes, it was subsequently instituted.

Q In your summary at the top of page 1 you say, "This memo describes a program to evaluate the performance of the B&W NSS during reactor trips at all operating plants. This analysis will produce a "quick look" report which describes the cause of the upset, the overall plant response, and recommended corrective action or further analysis to prevent recurrence. Plant Design --" I presume that means your group --

A Section.

Q "-- recommends that this program be initiated immediately and be funded by B&W until such program is sold to the 177 Owners Group."

In evaluating the performance of the B&W-NSS during reactor trips, were you looking at it, were you proposing that the company should be locking at it to determine whether improvements should be made in the product being supplied by B&W?

A Yes, or in the manner in which the plant was operated or in portions of the plant which were not supplied by B&W. I think that a more mature understanding of this would have caused me to write the performance of plants which have B&W NSS during reactor trips because in many instances a narrowing of focus to the NSS doesn't produce what one would like ultimately to learn from.

Q You said in the introduction on page 1, "One of the most important lessons learned from the TMI-II incident and its aftermath is that B&W must be more aware of the operating characteristics and problems of the NSS. The evaluation of the B&W NSS performance during transient and steady state

conditions can lead to several advantages for both B&W and the customer."

Is the primary focus on the B&W hardware in this analysis?

MR. WISE: It assumes there is a primary focus.

MR. SELTZER: Right.

Q If there is a primary focus, is it on the B&W hardware?

A No, I don't think so. I think -- the words as written here would perhaps tend to focus the B&W hardware, and indeed that's the hardware we can influence at least to some degree on future plants; but as far as improving plant availability for existing operating plants and the like, I think one has to broaden the focus to other parts of the plant and other areas of responsibility.

Q Why did you believe that B&W should fund such a program immediately?

A Well, I thought that it was novel to the extent that our customers had not typically asked for or expected this kind of response or assistance from B&W, particularly the operating customers, and that we would need to fund the program in its early

stages in order to provide examples of what we might be able to do,hopefully so that the customers could see some value in our doing it. I think that proved to be the case.

One of the things that was perhaps naive about this earlier memorandum and perhaps to some extent this memorandum also is that funding alone is not sufficient to make such a program work. It requires a willingness and a willing cooperation and interest on the part of the utilities who are operating and are responsible for the plants, and there was no, by no means, immediate agreement on the part of the utilities that they wanted B&W to participate in this kind of an evaluation in this way.

Q How do you know that?

A Because of discussions with their representatives and owners group meetings subsequent to this.

Q At the owners group meetings did B&W ask the utilities to pay for this?

A Yes, B&W did ask the utilities to pay for this since it was certainly an area for which we had no existing contract commitment with them, but --

Q Are you a lawyer?

A I beg your pardon?

Q Are you a lawyer?

A No, I am not.

MR. WISE: Mr. Seltzer, I wish you would stop interrupting this witness. Let's go back to where he was in his answer, and why don't you let him finish one question before you ask another.

MR. SELTZER: Fine. I thought he was finished, but if he is not, he can continue.

MR. WISE: Will the reporter read back to the point where Dr. Womack was interrupted.

(The record was read.)

A (Continuing) I think what I was going to add was that there were issues other than funding which were involved in the early discussion of this program with utilities.

Q When you say that B&W had no existing contract commitment --

A That was my best understanding.

Q You say in the point 2 of the introduction that "Potential safety problems can be pinpointed and corrected before serious incidents occur."

Do you see that?

A Yes.

Q That was going to be one of the purposes of this program, right?

A That was a hoped-for goal, yes, sir.

Q Are you rendering the opinion that B&W has no existing contractual commitment to address potential safety problems and correct them before serious incidents occur?

MR. WISE: I don't think that was the witness' testimony at all.

MR. SELTZER: I am asking him now.

MR. WISE: Well, I don't think it was the witness' testimony and I don't think that your question is a fair one. I think you ought to rephrase it.

MR. SELTZER: I won't because he said that for this particular program which had as one of its purposes pinpointing potential safety problems and correcting them before serious incidents occurred, he said B&W had no existing contractual commitment. I want to find out if that's really what he meant to say.

MR. WISE: That's a mischaracterization of his testimony and I object to it. The witness' testimony stands the way he stated it and that is not what he said.

MR. SELTZER: He can answer my question.

MR. WISE: I am afraid I have lost track of what your question was at this point.

BY MR. SELTZER:

Q Is it your view, Dr. Womack that B&W has no existing contractual commitment to spot any potential safety problems and correcting them before serious incidents occur at B&W plants?

MR. WISE: I will object to that on the grounds that he has not been qualified as an expert in the various contracts that B&W has. It is quite different from the question you asked him earlier, and the answer that he gave concerning whether or not B&W had under contract an obligation to provide a program such as is outlined in this particular memorandum which has been marked as GPU Exhibit 39. That particular program, the witness has said, he did not understand B&W had a contractual arrangement with its customers

to provide.

Now you are asking something very different. You are asking what B&W's obligations were with respect to safety concerns. I think that's an extremely different question and one which he has not been qualified here as an expert on, so that he could give an answer.

MR. SELTZER: Mr. Wise, I think you are not recalling my question correctly because my question previously was did B&W ask the utilities to pay for this program, and it was in response to that question that the witness volunteered the answer that B&W had no existing contractual commitment.

MR. WISE: For this program?

THE WITNESS: For this program.

MR. SELTZER: Yes.

MR. WISE: That answer stands. That's in the record.

MR. SELTZER: Well, one of the purposes of this program was point 2 in the introduction, and I want to find out a little bit more about what this witness meant by no existing

contractual commitment, and I want to find out --

MR. WISE: I don't think you are asking questions that this witness is qualified to answer.

MR. SELTZER: Fine, if he wants to volunteer that, he may.

MR. WISE: He has answered with respect to this program.

MR. SELTZER: Good. Now I want my question answered.

MR. WISE: He had no contractual commitment to do this program.

THE WITNESS: Please restate your question.

BY MR. SELTZER:

Q Is it your view based on the same knowledge on which you have answered prior questions this afternoon that B&W has no existing contractual commitment to pinpoint potential safety problems in its nuclear plants and correct those safety problems before serious incidents occur?

MR. WISE: I object to that question until you lay a proper foundation for it.

I direct him not to answer.

Do you want to establish what this witness' knowledge was of contracts that are relevant to this case? You may do so and then ask him a question based upon that knowledge.

BY MR. SELTZER:

Q Are you aware of any existing contractual commitment that B&W has to pinpoint potential safety problems in B&W nuclear plants and correct them before serious incidents occur?

A I understand commitments under a 10-CFR-50 on active NSS contract for which we -- for which are now active and certain other commitments more generally under 10-CFR-50, part 50, 55-E and 10-CFR-21 with respect to potential safety problems.

Q But what is the commitment with respect to potential safety problems under those regulations?

A To report those which meet certain criteria defined in those regulations.

Q When you were the head of the design section and in your present position of responsibility, was it your understanding that B&W had a continuing responsibility to purchasers of its plants to

identify potential safety problems and correct them before serious incidents occurred?

MR. WISE: His understanding as to what, contractual commitments or -- I don't understand the import of your question. Are you asking him for a legal opinion as to whether or not --

MR. SELTZER: No, not a legal opinion. Whether he felt it was B&W --

MR. WISE: Whether he felt it was a good thing to do or what?

MR. SELTZER: What is my question?

(The record was read.)

MR. WISE: My problem with the question is when you say "identify potential safety problems." Are you including or are you asking this witness whether he thinks B&W had an obligation to go out and demand information from utilities or are you talking about information that might come to B&W from time to time through reading the newspaper?

MR. SELTZER: We will get to all those possibilities. I am asking this witness --

MR. WISE: I think I am entitled to

have the record clear so we have a clear question posed to the witness and we don't introduce the ambiguity into the record here.

BY MR. SELTZER:

Q Did you feel that B&W had any responsibility to identify safety problems and correct them before serious incidents occurred on plants that you had already sold?

A Responsibility, as I have stated, was what I understand and understood under those regulations to report safety problems or evaluate and report safety problems that came to our attention under those criteria.

Q After a plant has been issued an operating license, do you understand that those regulations impose any continuing obligations on B&W with respect to those plants?

A Only as information which might meet the test of those criteria that might come to our attention in the course of business.

Q What is the threshold criterion?

A Those criteria are complex, and I am not thoroughly enough versed to quote them for you.

Q But you are refreshing my recollection

that there is something about a serious nuclear incident has to be reported to the NRC; isn't that right?

A Again I am not going to -- I don't think my memory would serve us well for me to try to quote.

Q I didn't ask you to quote. Are you familiar with --

MR. WISE: He just said he is not familiar enough to answer the question you have asked.

MR. SELTZER: He said he is not familiar enough to quote.

MR. WISE: I think in the context of the two or three previous questions you have asked he has told you the sections of the CFR. We can all go look at them and argue as to what they say.

Q Is it your understanding that B&W's continuing responsibilities are limited to what is spelled out in 10-CFR?

A That and its responsibilities that it undertakes jointly with its customers by some agreement, contract or whatever.

Q Do you have any sense that a nuclear plant is such a complex and potentially dangerous instrumentality that a manufacturer of such a plant has a continuing obligation to make sure that the plant has been safely designed?

MR. WISE: I am going to object to that question and direct him not to answer. You are out of bounds now.

MR. SELTZER: What is the ground for your instruction?

MR. WISE: The grounds are you are asking legal questions that are more appropriately addressed to the District Court and perhaps other courts.

MR. SELTZER: I am entitled to know what the man who was head of the design section believes are B&W's responsibilities.

MR. WISE: You and I have a disagreement, Mr. Seltzer. It won't be the first time, and I am sure it won't be the last.

I don't think what this witness believes the responsibilities were is relevant. I think that a court of law will eventually determine what the responsibilities were.

And if you want to ask him questions about what the practice was in the industry, what he understood other competitors were doing and what he understood utilities believed, I am perfectly willing to have those questions asked; but if you want those conclusions and opinions on what B&W's responsibilities were legally, I think you are out of bounds.

BY MR. SELTZER:

Q As a matter of practice, has B&W felt that it was its role to continue to examine its designs to determine whether there are potential safety problems and correct those problems before serious incidents occurred?

MR. WISE: I will object to the form of the question, but given the objections that I have stated earlier, I will permit the witness to answer if he can. But I do object to the form of the question.

If you want to take your chances with it, you can.

A To the best of my knowledge, as a matter of practice, B&W has always attempted to make its designs respond to the needs of nuclear safety

as we saw them, as our customers saw them and as the Nuclear Regulatory Commission saw them.

Q Has it been B&W's practice, to your knowledge, to attempt to locate safety problems in plants that have already been designed constructed, licensed and placed in operation?

A To attempt to locate safety problems --

Q Safety problems affecting the design of the plant.

A In the course of continuing design work and given similarity of design, I think the answer to the question would have been -- would be that we have, to the best of my knowledge, always given that kind of attention. To the extent that we have been asked by customers to assist them in doing that kind of thing, I think we have also done it.

I don't recall specific examples of that. I am not sufficiently knowledgeable.

MR. SELTZER: I would like to mark for identification as GPU Exhibit 40 a memorandum from D. H. Roy to EAW, the subject, Analysis of Loss of Main Feedwater Flow for 177 & 205 FA Plants, dated April 5, 1979.

(Memorandum dated April 5, 1979 from

D. H. Roy to E. A. Womack, marked GPU Exhibit 40 for identification, as of this date.)

Q Is GPU Exhibit 40 marked for identification a copy of a memorandum which you received in the regular course of business in or about early April 1979?

A Yes, it appears to be.

Q Is that your handwriting on the last page?

A On the last page?

Q I mean on page 15.

MR. MAC DONALD: 1350.

A No, I don't believe so.

MR. SELTZER: Let me correct the record. Off the record.

(Discussion off the record.)

A Your question was, was that my handwriting on page 1350?

Q Yes, that is the question.

A No, I do not believe it is.

Q Do you know whose it is?

A No, I don't.

Q Roy wrote to you saying that the recent

accident at Three Mile raised a number of questions.

The first question he asked you was, "If auxiliary feedwater flow had been initiated as normally analyzed in our FSAR's, would the operator have been confronted with a filling or filled pressurizer and possibly been prompted to terminate high pressure injection flow if it has been initiated as a consequence of a stuck open electromagnetic relief valve."

There is some handwriting immediately after that. Is that your handwriting?

A Yes, I believe that is my handwriting.

Q What did you answer?

A Yes, I thought that in the circumstances -- circumstance of the question I believe he was asking, I had indicated apparently that we had some computer analysis which would have indicated that pressurizer level would probably have risen in either case.

Q In other words, the loss of auxiliary or emergency feedwater did not affect the filling of the pressurizer during the Three Mile Island accident; is that right?

MR. WISE: Had no affect at all? Is

that your question?

MR. SELTZER: I will let --

Q No, the question is the loss of auxiliary feedwater or emergency feedwater is not what caused the filling of the pressurizer, right?

A I don't believe that the filling of the pressurizer would have been averted with the supply of normal feedwater. I think that's the sense of the question he asked, and I believe apparently we had some analysis which indicated that the pressurizer level would have increased with feedwater flow from the auxiliary feedwater system.

Q The next question that your boss asked was, "Assuming auxiliary feedwater flow was delayed in accordance with the TMI-2 event sequence log, would the sequence of events have led to a covered core at all times if the electromagnetic relief valve had seated properly."

And you answered that; is that right?

A Yes, there is the note that is on here which again I think is in my handwriting, and that's with the understanding that the electromagnetic relief valve would have reseated and re -- contained the

reactor coolant system pressure at the end of whatever series of actuations it might have undergone due to the extensive delay in auxiliary feedwater.

Q There was an eight-minute delay before auxiliary or emergency feedwater flow was restored; is that right?

A That's what I understand, yes.

Q And you are saying that notwithstanding that eight-minute delay in achieving auxiliary feedwater flow, if the electromagnetic or pilot operated relief valve had closed properly, the core would not have been uncovered, other things being equal?

A At the end of that eight-minute delay if the electromagnetic relief valve had closed properly, I believe the answer to the question that he asked is yes.

Q Yes, the core would not have been uncovered?

A That's my best guess, yes, other things being equal.

Q His fourth question to you is, "Would raising the bottom of the pressurizer above the

elevation of the surgeline nozzle on the candy cane make a material difference in the sequence of events as they occurred at TMI-2. Would making this change in elevation of the pressurizer provide significant additional margin in avoiding going solid during a loss of main feedwater event."

Is it correct that the location of the pressurizer is such that in a loss of coolant accident the inventory of water in the pressurizer does not drain by gravity into the reactor vessel?

A No, I don't think that's entirely correct.

Q Is there something incorrect?

A Yes, I think that the -- if the pressure within the loop side of the system, the main side of the system is allowed to equalize with pressure in the pressurizer, the water will seek its level. It will drain down to a certain point and there may be some water left in the U or loop portion of the surgeline. You would have to define a particular set of conditions.

Q Is the bottom of the pressurizer above the top of the core?

A Yes, I believe it is.

Q Is the bottom of the steam generator

above the top of the core?

A No, it is not. I don't believe it is.

Q In some of the B&W plants is the bottom of the steam generator above the top of the core?

A It has been raised in some of the B&W plants, and the exact relative elevation on the top of the core and the steam generator I don't recall. We can check.

Q In the plants in which the steam generator has been raised, do those who were in the know call those raised loop plants?

A Yes.

Q And for cognoscente the plants in which the steam generator bottom is lower than the top of the core, those are called lowered loop plants?

A Yes.

Q TMI-2 is a lowered loop plant?

A Yes.

Q Davis-Besse-1 is a raised loop plant?

A Yes.

MR. SELTZER: Can we take a short recess, please?

MR. WISE: Sure.

(A recess was taken.)

BY MR. SELTZER:

Q Dr. Womack, during the earlier session of your deposition you referred to B&W operating specifications for its customers' plants.

I wrote a letter to your esteemed counsel asking him could he please provide a copy of the operating specifications that you had referred to, and I got a letter back from him saying, "A further check with Dr. W. reveals some uncertainty in his own mind as to what documents he meant during his testimony. You may wish to explore this further with Dr. W. during the remainder of his deposition.

MR. WISE: I would like to note that my letter was not phrased "Dr. W." With that exception your question can stand.

MR. SELTZER: But for your having said that the reporter would have typed Dr. Womack anyway.

MR. BENEDICT: I hope not.

Q Is there some uncertainty in your own mind regarding what documents you meant?

A Yes, there is. I hope that I properly qualified all those answers that I made about

operating specifications and related matters or operating documents prior to the ATOG program when we discussed that.

I have a general understanding born of listening to discussion, a series of discussions that were kind of compressed together in my own mind about B&W's relationships in its NSS utility contracts to support the utilities in preparing operating procedures,and I thought at one point in time that I had understood that a concept of operating specifications was used.

I gather than an attempt was made as a result of my comment to you to find such things that drew -- that really was not the way that it had begun, so I can only apologize to you for my lack of information in that regard and for misleading both you and Mr. Wise with respect to finding those things, and suggest that perhaps a better qualified person than myself might be able to enlighten you more specifically.

Q Is there some other document that you believe does exist that B&W used for the same purpose?

A Having said all I have said, I feel very reluctant to speculate. With regard to consistency,

contract to contract, I believe I have understood that in the past B&W has assisted utilities in various ways in preparing operating procedures, and the degree of that assistance and the documents produced I don't really have knowledge really good enough to be talking about.

Draft procedures may be a part of what is exchanged. I think I have heard that term. But, again, I think you have readily available to you better sources of information than I.

Q Okay. I am glad I explored that further with you.

A I hope you will accept my apology. If that's the only question of that uncertainty in this record, I shall be very surprised.

Q You don't have to apologize.

MR. SELTZER: I have no further questions at this time. If further documents demonstrate a need to recall Dr. Womack rather than being able to ask other witnesses to explain them, we may have to recall him.

We will also consider whether there is a need to recall Dr. Womack to answer some of the questions on which he was instructed not

to answer, but other than those contingencies we have no plans to recall Dr. Womack.

Do you want to cross-examine him?

MR. WISE: I would like to take just ten seconds and go off the record.

Off the record.

(Discussion off the record.)

MR. WISE: We have no questions at this time and we will consider the deposition closed subject to obviously your right in the event that you wish to make any motions concerning objections that were made during the course of the deposition. As to documents that may be produced during the remainder of this case, we will simply have to take that under advisement when the time comes.

(Continued on page 947A.)

MR. SELTZER: Fine.

Dr. Womack, thank you very much. Nice meeting you.

THE WITNESS: Thank you.

(Time noted: 4:10 o'clock p.m.)

EDGAR ALLEN WOMACK, JR.

Subscribed and sworn to before me this day of , 1981.

* * *

CERTIFICATE

STATE OF NEW YORK)
: ss.:
COUNTY OF NEW YORK)

I, CHARLES SHAPIRO, a Notary Public of the State of New York, do hereby certify that the continued deposition of EDGAR ALLEN WOMACK, JR. was taken before me on Tuesday, January 27, 1981 consisting of pages 808 through 947A;

I further certify that the witness had been previously sworn and that the within transcript is a true record of said testimony;

That I am not connected by blood or marriage with any of the said parties nor interested directly or indirectly in the matter in controversy, nor am I in the employ of any of the counsel.

IN WITNESS WHEREOF, I have hereunto set my hand this 18TH day of FEBRUARY, 1981.

Charles Shapiro

CHARLES SHAPIRO, CSR

Tuesday, January 27, 1981

I N D E X

E X H I B I T S

Tuesday, January 27, 1981

E X H I B I T S

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