NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF:

THREE MILE ISLAND SPECIAL
INQUIRY DEPOSITION

DEPOSITION OF:

SALVATORE CHARLES GOTTILLA

Place - Paramus, New Jersey

Date - Monday, September 17, 1979 Pages 1 - 117

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NUCLEAR REGULATORY COMMISSION

DEPOSITION OF: SALVATORE CHARLES GOTTILLA of BURNS & ROE, INC., by the NRC SPECIAL INQUIRY INTO THE ACCIDENT AT THREE MILE ISLAND.

BURNS & ROE, INC.
650 Winters Avenue
Paramus, New Jersey

Monday, September 17, 1979

BEFORE THE COMMISSION:

DENNIS ALLISON, Moderator
KENNETH MALLORY
BERNIE DOYLE
DOUGLASS METCALF
DONALD SULLIVAN

A P P E A R A N C E :

RICHARD B. DiFEDELE, ESQ.,
Attorney for Burns & Roe.

ALSO PRESENT: THOMAS HENDRICKSON

Reported by: EDITH STROUT, C.S.R.

ACE FEDERAL REPORTING
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I N D E X

MR. ALLISON: This is a deposition of Mr. Salvatore Charles Gottilla of Burns & Roe, Incorporated, conducted by the Nuclear Regulatory Commission Special Inquiry into the Accident at Three Mile Island.

Mr. Gottilla, would you raise your right hand, please.

(The witness having been duly sworn, testifies as follows:)

EXAMINATION BY MR. ALLISON:

Q For the record, Mr. Gottilla, would you state your name and business address?

A Salvatore Charles Gottilla, G-o-t-t-i-l-l-a. Off the record.

(A discussion is held off the record.)

A (Continuing.) All right. I work at 305 Route 17 South, Paramus, New Jersey 07652.

MR. DI FEDELE: Prior to continuing with any detailed questions I wish to state for the record that with respect to the transcript of this deposition, Mr. Frampton and Mr. Rogovin have agreed in order to facilitate the taking of this deposition today to hold the transcript of this deposition in confidence. And have agreed that this transcript rather than being

distributed in accordance with the normal procedures of your special inquiry group will be sent directly to their law firm to be accorded whatever protections are consistent with the promise that they have made to me today.

Further, before you go on I wish to request that only one person at any one time ask questions of Mr. Gottilla. And request that Mr. Gottilla be given a break every forty-five or fifty minutes in order to relax so as not to overly tire the witness.

MR. ALLISON: Certainly.

BY MR. ALLISON:

Q Mr. Gottilla, you've been previously deposed by the President's Commission. And we have read that deposition.

Have you been deposed or interviewed by anyone else in connection with the accident at Three Mile Island?

A No.

Q I'd like to show you our standard witness notification which is on a July 30th, 1979 memorandum from George Frampton to the Special Inquiry Group.

Have you had an opportunity to read that?

A Yes.

Q Do you understand it?

A Yes.

Q Do you have any questions --

A No.

Q -- about that?

MR. ALLISON: Off the record.

(A discussion is held off the record.)

BY MR. ALLISON:

Q Mr. Gottilla, prior to your President's Commission deposition, were you interviewed by engineers from the President's Commission?

A Yes. On two occasions engineers from -- two engineers from the President's Commission came in and asked questions of me.

Then the President's Commission lawyers came in and took a deposition. After that a team of engineers that had been apparently hired by the Presidential Commission came in and asked some specific questions about certain specific systems. Questions designed to find out in more depth how several systems worked.

Q Do you have records of the interviews other than the deposition?

A No.

Q All right.

I'll turn it over to Mr. Mallory, then, to begin asking questions.

EXAMINATION BY MR. MALLORY:

Q Okay.

Which of the TMI two control panels were not designed by Burns & Roe?

A I can't answer that, offhand. It is a matter of the memory. There were several panels in the control room that were designed by vendors of other equipment.

Several panels that were designed and built by B & W, but in those we had some hand in the design. I can tell you that B & W's involvement was with panels 3, 4, 13 and one other.

But in the cases of 3 and 4 we did the layout design, the placement of equipment on it.

Q Now, you say there were other vendors?

A Well, I believe, for instance, that associated with the Diesel generator there were Diesel generator panels that are designed by the Diesel generator manufaturers.

Although we influenced that to some extent with our Diesel generator specifications. There may have been others of that nature.

Q Okay.

Once the control panel design was frozen, Spec 46 was complete, and they decided on Mercury as a manufacturer, what was the policy for changes to the design?

A I don't understand the question. What do you mean by policy of changes?

Q Did you generally discourage any changes to the design? What kind of changes would you accept? What were the criteria for changes?

A Well, depended on who -- the impetus behind the changes. You say design was frozen, but when we chose Mercury was not the point at which the design was frozen.

The design for the panel boards continued on throughout the design life of the plant.

If a client wanted a change the change wasn't frozen. If somebody in the office here wanted a change there was less likelihood that we would make that change.

I don't think the word "frozen" applies in this case.

At any event, the change of site from Oyster Creek to Three Mile Island occasioned some rather massive changes to the design in the control room.

And there were changes after that.

I left the job not too long after. I can't tell what happened -- I can't tell you what happened after that.

Q Okay.

Do you know whether the background of Burns & Roe and control room design played any part at all in the

selection of Burns & Roe as an A and E for Oyster Creek, too?

A I don't think directly there was any relationship. I think Burns & Roe was selected because of its overall performance in plant design. And I don't think its capabilities in control room design were singled out as a factor.

Q Okay.

To the best of your knowledge, did oh, let's take right now all of the utilities together since it is hard to separate which ones when.

Did all of the utilities or any of the utilities place any requirement such as criteria standards on the control panel design?

A Frankly, I don't remember any. It is entirely possible that some might have.

In general, the generalization you can make is that every client is different and that there are no generalizations.

Some clients have strong engineering staffs and have strong requirements for control room design or for any design. Some are relatively weak and leave it up to you.

Some have strong requirements on the basis of existing plant design.

If, for instance, we are building a second or third or fourth unit for an existing plant, then the client has pretty good ideas of what he'd like in this unit based pretty much on what he has in previous units.

In the case of Oyster Creek the plant at Oyster Creek was a boiling water reactor and quite different. And, therefore, we didn't use that as the model or design.

But when the plant was moved to Three Mile Island, the Met Ed client thought he'd like the design made pretty much like the Unit 1 design.

As a matter of fact, some people on the client's staff thought they should be exactly the same. So, criteria comes to us in many different forms. But operator preference and utility preference on the basis of previous units very strongly enters into it.

Incidentally, when we first designed at Oyster Creek, we consulted with the Oyster Creek operators to find out what their preferences in design were.

Q Okay.

Here at Burns & Roe were regulars, say weekly or monthly or every six weeks, management reviews of the control panel concept held prior to its manufacture?

A Would you repeat that question?

Q Were regular management reviews of the control panel concept --

A No.

Q They were not?

A They were not.

Q Okay.

Did anyone here at Burns & Roe ever make a detailed review of the control panel layout with respect to panel operations?

A No, not that I know of.

Now, you know, this is a question of degree.

Every time we laid out a panel we thought in terms of panel operation. What controls we'd have to reach and which ones we'd have to look at and how could an operator sitting there encompass Action A plus Action B.

We did think of this. But it wasn't a detailed review which is the word you used.

Q It wasn't formal?

A Which would imply a more formal --

Q Right.

A -- review.

I think that would be more in the nature of an operations review that the clients would make.

Q Okay.

During the design process were alternative panels concepts taken into consideration?

A Yes.

Q What were they in general?

A Well, one that I'm aware of -- remember the panel design started before I came on the job.

When I came on the job, some decisions had already been made. Presumably some alternates had been considered and rechecked before while Mr. Gahan had been in charge.

But one decision that I recall was the decision to use a separate bench board and vertical panel behind it with a separate vertical panel behind it. We had submitted to the client some alternate arrangements. One showing a vertical panel with an integral bench board surface on it and another with separate arrangement. And asked his preferences.

He preferred the arrangement with the separate bench board and separate vertical panel.

Q I guess the next question, what are the principal factors used in selecting the final configurations or concept?

A Well, I don't recall. Except I know the client was asked to make a preference decision.

Now, whether it was totally his decision or whether he didn't have any preference or not all I can recall is that we did show it to him.

We, incidentally, bounced off most of the early

panel board designs, bounced them off the client.

We sent him the control room arrangement very early in the game. We sent it to the operating people at Oyster Creek at that time. And we sent it to the client Jersey Central client up here in Northern Jersey for their consideration.

And we got comments back from both of them which comments we incorporated.

We did also go down to Oyster Creek to confer with the operating people there on at least two occasions that I'm aware of to discuss preferences, arrangements, et cetera.

MR. HENDRICKSON: Charlie, I seem to remember that the client had a consultant that they sent some of the stuff to.

THE WITNESS: This is later. Mr. Thomas of GPU or Jersey Central of the client staff brought in a consultant from Southern Nuclear Engineering, Mr. Erga Gasser. E-r-g-a G-a-s-s-e-r.

Mr. Gasser was asked to review the Burns & Roe panel board layouts and comment on them. And he did. He was also later asked to review Spec 46 which he did at length.

MR. HENDRICKSON: I believe they hired Mr. Gasser because they believed him to be expert.

THE WITNESS: Well, the Commission asked me that question and I couldn't answer.

MR. HENDRICKSON: We really don't know Mr. Gasser's background.

MR. DI FEDELE: Could we go off the record for a second, please.

(A discussion is held off the record.)

BY MR. MALLORY:

Q Was the configuration you selected for TMI 2 similar to one or two panels designed by B & R in the past?

A I don't know. The original panel or design was by Ed Gahan. I would presume he had again started from square one.

But he had had experience with Burns & Roe before and experience in other companies before. He brought his experience to bear on a design on the panels.

Now, whether it was similar to any other Burns & Roe job or not I don't know.

Q Okay.

MR. HENDRICKSON: I might point out that Mr. Gahan's background included a period of time in Westinghouse where he was involved with the panel layout on the propulsion panels for the USS Nautilus before he came to our firm.

BY MR. MALLORY:

Q Okay.

What were the factors considered in selecting the controls and display for that control panel?

A Do you mean the configuration of the controls?

Q No, no. The actual -- the controls and displays.

A The actual pieces of equipment --

Q Right.

A -- that were bought?

Q Right.

A There were many factors.

Mostly experience factors. We had criteria we brought to bear on the selection of everything.

For one thing, miniaturization was in our mind because, as you know, panels were getting bigger and bigger at that time. And there was more and more information we had to accommodate.

Trend in the industry was for miniaturization.

Whereas, for instance, in previous jobs we had used large case recorders in this job for the most part we used miniature recorders. 6 by 6 inches. We used vertical scale indicators for that reason for miniaturization reasons.

The industry seems to -- the industry -- operators

seem to prefer pistol grip switches. Uses them largely. And we decided to use smaller ones. We went to SBM switches. GESBM rather than SBIs. Wherever possible we went to smaller switches too. We used Cutler-Hammer E 30 switches as being small functional switches with engagings on them.

We adopted many miniaturization techniques. In addition to which we applied standards for ruggedness. We have as you're aware in the power plant business, we design thirty or forty years service. In this case we were hemming for forty years service so we bought industrial grade heavy duty switches.

Generally, as a carryover in previous design all our switches have to be oiltight too, because there was a time when oil was actually brought to the panel board. So we used heavy duty oil-type switches rather than flimsier kind of switches that are used in computer technology, for example.

I can answer very specific questions if you have any, but I think in general that is all I can say.

Q I think it covers it.

If I may summarize you list three basic criteria. The miniaturization, operator preference and ruggedness as being the three fundamental criteria you think are important.

A Those are three I mentioned. If I moved my mind to it, there may be others that may be equally important.

Q If you come up with any later, let me know and I'll write them on my list.

MR. DI FEDELE: Excuse me. Let me interrupt for just a second.

Mr. Gottilla, I think you also mentioned previously questions of the operator's ability to operate the switches and the other items as far as their placement?

THE WITNESS: Well, he isn't asking about placement now. He's asking the choice of hardware to go in the panel board.

MR. DI FEDELE: Okay. As long as --

A There were other considerations too, now that we think of it.

There was distinct client preference for some things.

For example, a client had a distinct preference for one type of terminal block. It was a Met Ed standard on the site. So we went to that particular terminal block.

Q Okay.

How was it determined that, for usual operating situations, that there would be one operator responsible

for all control panels?

A One operator?

Q One operator.

A I have no idea. That is not my concern.

Q You were --

A That is an operational concern. That is a concern of the client.

Q You were given one operator as a base line. Is that right?

A No, I wasn't. I wasn't given a base line. The closest I can say to that concept is that the desk in the control room we showed two chairs at the desk and presumed that two people would sit there.

The client made several modifications in the desk, but it always stayed that way with two chairs shown at it.

Now, how many operators were going to be in the control room or not was never our consideration. We assumed that an operator or two operators would be the focus of the panel boards. But whether there were six others roaming around the control room or not I had no knowledge of that.

Q So basically what you're saying if I may clarify it for myself is that you didn't know whether one operator or two operators would be operating the control

panel?

A Or more.

Q Or more?

A Right.

MR. DI FEDELE: In that regard did you ever make any suggestions to the client as to how many operators would be involved in the plant?

THE WITNESS: No. This was an operating consideration. We do have a plant test and operations group that presumably can make studies of this nature if requested by the client.

MR. DI FEDELE:

Would it be correct for me to state that you assumed that the client would assign to the control room however many operators were necessary for its operation?

THE WITNESS: Of course.

BY MR. MALLORY:

Q What documentation was Burns & Roe required to deliver to support the control panel design?

A I believe there was a requirement. There was not a formal requirement.

What happened is as we designed the control room we sent copies of our designs to the client. Sometimes to the operating people as well. There was no formal

requirement. I think in general it was understood that there was a requirement to bounce anything of significance off the client.

In addition to which as the design progressed the client's staff increased. And there would be people spending more and more time at Burns & Roe looking over our shoulders or conferring with us as it were.

MR. HENDRICKSON: I could answer the question this way: We ultimately have to produce a specification of drawings so that somebody can build the plant.

And so you could consider the specifications with its drawings in the package and all the amendments and contract changes that went on as a means of documenting the control panel design.

THE WITNESS: But in point of fact there were many changes of information before the specifications went out.

MR. HENDRICKSON: Right. Over and above the specifications with its drawings. But ultimately what got built was what was defined in that specification package.

BY MR. MALLORY:

Q Okay.

During the process of designing the control panel did you examine potential personnel selection or training problems that might be involved in operating that control panel?

A No.

Q Do you have any idea who might have?

A I would have presumed that this was a client problem.

MR. HENDRICKSON: Could we go off the record a minute?

(A discussion is held off the record.)

BY MR. MALLORY:

Q Thinking back to the early days when you made design decisions, big design decisions like where things go on a control panel and the shape of it and everything could you give me some idea of what role precedent played in making these decisions? How you have done it before, experience?

A Well, it is two questions posed. One has to do with experience and one precedent.

Now, about precedent, I presume you mean previous Burns & Roe design?

Q Previous design and the experience of the designer.

A Well, generally a large role. We rarely pick

an inexperienced man to design a panel.

In this case Ed Gahan had many years of experience before he started on the designs of the panel. In my case I had twenty years of experience when I came to Burns & Roe. And the people that worked on the panel for me, Vince Burzi and Morris Fitter both had many years of experience.

So, if you talk of experience, every one of these brought to the panel board design some experience of what he had done before.

When you use the word "precedent", you're implying that there was some preceding design that played amajor role in the design of this plant. And I don't think it worked out quite like that.

I think it was a matter of the little bits and pieces of experience that each one had in his mind that entered into the design.

Q Such as a component selection?

A Such as a component selection, yes.

Q How about in warning system design?

A Well, for instance, you're talking about annunciators.

Q Yes.

A Well, in annunciated designs most of our experience has been in conventional, in the use of conventional

annunciators.we had in many plant designs before.

In Burns & Roe's experience and in our own experience had usually used the standard 2 by 3-inch window annunciator. We did have some information from Oyster Creek that the solid state annunciator that they had had been somewhat troublesome for them. So we avoided -- tried to avoid the same sort of trouble in our selection.

But in general we used the same kind of annunciator that had been used on many clients in our experiences.

Q How about on automation?

A There was no automation in this plant. Computer automation was still in the future. We had a plant data logger computer whose primary function was the gathering and printing out of data and which also had as its -- part of its capabilities the calculation of certain -- oh, various calculations for the plant. Performance calculations namely.

We had some thirty or forty performance calculations that we did with it.

In addition the computer complied with the nuclear steam supply system, calculated the number of parameters that were concerned with the flux, the flux tilting and leveling and nuclear consideration.

But there was no feedback automation in the plant.

Q You would consider this basically a manual plant then?

A Basically a manual plant. Of course, there were safety systems that were automatically operated. There was automatic control throughout the plant.

When you say automation I presumed you meant some computerized feedback automation. There was automation in almost all our control systems in the sense that they were closed loop controls.

All the safety systems were automatic. Designed to automatically trigger in the event some abnormality occurred.

Q This represents basically the state of the art at that time for the use of automation?

A Yes.

In point of fact the use of automation is still not common in nuclear plants or in --

MR. DI FEDELE: Excuse me for a second. In that regard I believe the question is ambiguous and I'd like to get a little bit more definition for purposes of the record.

When you say the "state of the art" what do you mean state of the art in?

MR. MALLORY: The state of the art in automation as applied to nuclear power plants

in 1968-69 time frame.

MR. DI FEDELE: Right.

MR. HENDRICKSON: And I think we should also define the terms very carefully. By automation you mean introducing a computer into the control function?

MR. MALLORY: Into controls function which would normally be manual.

MR. HENDRICKSON: I understand. You do not by automation mean a simple feedback control system which has been involved for years in plants.

MR. MALLORY: No.

MR. HENDRICKSON: You mean the computer. Excellent. Okay.

THE WITNESS: I answered it on that basis.

MR. HENDRICKSON: Yes. He answered it correctly on that basis.

BY MR. MALLORY:

Q One other point with respect to precedent. Nomenclature, marking and labeling.

A What is the question?

Q What was the -- what role did precedent play in the definition of nomenclature, marking and labeling?

A Well, initially precedent played the entire role. We label things in accordance with the way we had been taught or had learned to from experience.

However, as the job progressed the clients' operators and the clients' engineers had their own concepts as to how things should be labeled. And we have on record a number of communications where the client changed name plate designation, wholesale.

MR. HENDRICKSON: I believe we should add to that that the whole thing is conducted under the umbrella of a number of industry standards which governs labeling and colors used and so on.

Charlie, you might, if you can, recite some of that.

THE WITNESS: Well, yes. As far as -- well, I think we have answered the question sufficiently, Tom.

MR. HENDRICKSON: Okay.

A (Continuing.) The point is what you're concerned about is how equipment was labeled and how it was designated on the control boards. All right.

And how it was engraved on the annunciator windows. And all of that was influenced gradually during the course of the job by the client.

In most cases and, I guess, in every case eventually

every label was gone over with and approved or influenced or changed by the client.

MR. HENDRICKSON: And we used such things as red and green lights in accordance with the industry standards as to what they're supposed to mean in our industry.

BY MR. MALLORY:

Q Would you characterize the panel design approach that you took as directed towards minimizing the likelihood of human error?

A I would say yes, that was one of the considerations.

Q What steps did you take to do that?

A That is a big question.

For one thing, we standardized the colors we would use for lights. We standardized the functions we had to apply to switches.

We standardized the locations of the devices on the panel board. We gathered annunciator functions in locations which was specifically assigned to different parts of the plant. We kept the controls near the indicators which indicated the quality of control.

We put vertical panels which were controlled -- which were concerned with any one subject directly behind the console section concerned with the control of that

subject. We kept the controls and readouts of most concern within view of the operator while those he would seldom need or those that were peripherally associated with the plant in some other location more remote, et cetera.

This is a big question and there are many things we did to minimize human error.

Q Let me ask you some specific questions.

Did you ever perform a failure mode and effect analysis?

A No.

Q How about a hazard --

MR. HENDRICKSON: Wait a minute. Let me amplify that.

If you're talking about the control room as such, Charlie's answer is quite correct.

MR. MALLORY: That is what I'm speaking of.

MR. HENDRICKSON: Okay.

But it is just as meaningful to ask whether those types of things had been done with respect to the plant as a whole which must involve the control room. And the answer to that type of question would be yes. But we need different people and different circumstances to answer it.

MR. ALLISON: Just to try to clarify that,

Mr. Hendrickson.

When you say the plant as a whole, your typical failure modes and effects analysis would be the type of things you're talking about I think is on the system what would happen if NCSS does not work or if a pipe would break in a compartment how bad would the flooding be. These kind of things. Is that correct?

MR. HENDRICKSON: That's correct. There are other things such as --

MR. ALLISON: The control room as part of that.

MR. HENDRICKSON: There are other things such as loss of instrument air to be examined, plant blackout with and without emergency Diesels functioning. Such things as the requirement if a control room had to be evacuated how could the plant be brought to a safe shut down condition.

All of these things have been evaluated during the Three Mile Island design. Indeed, many of them are requirements of the Nuclear Regulatory Commission.

MR. MALLORY: The question here is asked with respect to human error, not with respect to

a failure at some point in some system, but with respect to a particular sequence of events that leads up to a man making a mistake in the control room and a consequence of that mistake.

MR. HENDRICKSON: Yes. Okay.

You also should understand, though, that from the point of view of the utility the Metropolitan Edison Three Mile Island Number 2 was the second unit as an existing station. The operating -- the program for training the operators and developing the operating staff was started on Unit Number 1 and gleened a new team from Unit 2 out of Unit Number 1.

The plant startup and testing was simply an extension of startup program for Unit Number 1. Unit Number 1 program was modified and adapted as required to start up the test on Number 2.

The operating procedures, the same thing applies. The operating procedures were prepared by Metropolitan Edison as an adaptation of the procedures that were developed for Number 1. In case of startup procedures and the emergency procedures and operating procedures we did draft a few of them and provide them to the Metropolitan Edison Company.

But the development and procedures from that point was entirely by them and did not involve us.

MR. DI FEDELE: One further question in that area.

Mr. Gottilla, do you know whether the performance of failure modes and effect analysis was part -- with respect to the control room was part of our scope of work that was requested by the client?

THE WITNESS: No. But let me just clarify my answer.

Board failure modes and effect analysis is a formal term and usually involves a sequence of things/with which I'm not completely familiar.

We did to some extent, nontheless, evaluate the consequences of error and the consequences of some failure. We did consider, for instance, if there were a fire in the control room what would happen.

If we had to evacuate the control room how would we shut down the plant?

There were some minor considerations of this nature, but nothing like the formal failure modes and effects analysis that I believe you're

referring to. Nor were we asked to do any such analysis.

Incidentally, there was a simulator which B & W modeled after, I believe, after the Rancho Seco plant. The simulator was used extensively in training operators in failure modes and effect analysis, or whatever.

MR. HENDRICKSON: Furthermore the simulator design was something that was given to us early in this design process.

Charlie, you might indicate some background on that.

A Well, B & W had indicated in the letter that they were including drawings of their simulator, I believe. And they suggested that it might be useful if we use that or keep that in a design of our plant. Mr. Gahan made some in depth analysis of these drawings and decided that we would be ill advised to keep that design since it was for a plant that was somewhat different from ours and for various other reasons.

And, that, however, we take it into account in our design, but not copy it.

MR. HENDRICKSON: The basic layout was what followed approximately, wasn't it, Charlie?

THE WITNESS: I don't recall.

MR. HENDRICKSON: We should find out from Ed Gahan. As I remember the simulator had influence on our design, but was not used in detail. For example, the simulator had light duty type switches. We used the heavy duty oil type switches. That had to be changed. But the simulator itself had an influence early in the process on so what we did in the control room for various reasons.

And they do relate to the question of operator and training and operator error and so on.

MR. DI FEDELE: Before we go any further forward, can we go off the record?

(A discussion is held off the record.)

BY MR. MALLORY:

Q It is quite likely that GPU can answer this easier, but I'll ask you anyway.

What acceptance test or checks were used to insure that the as built, delivered and assembled control panels were in agreement with your specifications or Burns & Roe specifications?

A I was off the job by that time. I don't know.

MR. HENDRICKSON: Well, I can answer the question in general.

There is a quality assurance program that's charged with that sort of thing.

The management of the Three Mile Island Number 2 quality assurance was by General Public Utilities. We did provide a number of people who worked as part of the quality assurance staff.

And the checks that were done are a matter of documented record. So although none of us here could answer the thing in detail it can be answered in excruciating detail.

BY MR. MALLORY:

Q Okay.

Can you give me your interpretation of the alarm philosophy used in TMI 2?

A Not unless you get more specific.

Q Okay.

Something breaks somewhere and you get a light that comes on and you get a --

A Let's stop right there.

As far as the field contacts are concerned they were normally closed. If a contact opened, not something breaks somewhere, if a contact opened the alarm would light.

Go ahead.

Q Would you give me the sequence of events

with the lights and the tones, you know?

A All right.

What happened was if this alarm contact which indicated an abnormal condition opened what happened is the alarm light would start flashing and then an alarm horn would sound.

Now, the operator would acknowledge by pressing an acknowledge button which would silence the horn and put the light on a steady bright rather than flashing load. After which the condition would be corrected and the light would flash again either at a different rate or at a dimmer condition until the operator acknowledged the return to normal condition and the light would go out.

Q Okay.

What basis did you use to select the frequency break for the flashing at the beginning?

A That's a standard with the companies, the frequency rate for the flashing. We don't select the frequency rate. We just asked for the sequence that would include a flashing ray.

MR. HENDRICKSON: Excuse me, Charlie.

So I understand, you're talking about the manufacturers of annunciators?

THE WITNESS: Manufacturers of annunciators have a standard frequency they use. Maybe it is

not a standard. Whatever frequency of flashing they use was satisfactory with us.

We did refer to an ISA standard for our sequence. I believe it was ISA 2A, but I may be mistaken in that number.

MR. HENDRICKSON: ISA stands for Instrument Society of America.

THE WITNESS: Instrument Society of America standard on annunciators. And I believe 2A is the ring back sequence that we used.

Now, that's when I was on the project. That may have changed somewhere as I left after I left.

BY MR. MALLORY:

Q Okay.

You said you chose these annunciators. Was there only one company or more than one company that made annunciators?

A There are a number of companies that make annunciators.

Q Why didn't you --

A There are a number of companies that make the same kind of annunciator.

Q Why did you choose the one that you chose?

A Well, generally we -- in this case I chose it for

uniformity because what happens is our annunciator -- there were a number of different annunciators in the power plant. Some were supplied by other vendors.

For instance, the Diesel generator vendor would supply an annunciator with his equipment. The water conditioning vendor would supply an annunciator with his equipment. So for reasons of uniformity in order to get the same spare parts inventory, repair, maintenance, for maintenance reasons, et cetera, we decided we'd like the same annunciator throughout the plant.

So on all of the switches wherever there was an annunciator required as an adjunct, as an accessory to the equipment we asked for the same annunciator or approved equal.

Or approved equal is a terminology we use whereby it gives the vendor the option of providing something else if he can show it is to our satisfaction that it is equally good.

MR. MALLORY: That is all the questions I have right now. Do you want to break?

MR. ALLISON: Off the record.

(A discussion is held off the record.)

(A recess is taken.)

BY MR. MALLORY:

Q In designing the console what anthropometric

percentiles range or percentiles did you assume for the operator?

A I don't understand the question.

Q Okay.

There are data published on people's armlengths, heights.

A Anthropometric measurement.

Q Right.

What percentiles were used in the design of this control panel?

A I don't understand what you mean by percentiles.

Q Okay.

That is a 95 percentile man, a 5 percentile man who is variably smaller. Usually when you design a control panel, you have a range from one to the other. I'm wondering what range was used here.

A Now, in the design of the console section you're talking about?

Q Console and vertical panels.

A All right.

What we assumed was without use of these anthropometric measurements and percentiles. We assumed someone in the range of five-six to five-nine with what we consider to be a normal reach. We didn't use any of the standard measurements in your anthropometric charts.

Q All right.

What was the basis for the choice of these?

A No basis.

What was the basis? We thought that would be the average operator height. Logic.

MR. HENDRICKSON: We should add that the basic design in control panels that the controls which need to be touched by the operator are grouped on the console which is in a semicircular arrangement around -- in the center of the control room. And the vertical panels do not contain equipment that needs to be touched by the operator, but rather contains gauges and dials and things associated with the controls on the console.

So the basic arrangement provided, encompassed within it the fact that any reasonable sized person would have no trouble getting to things.

BY MR. MALLORY:

Q Okay.

What conventions were used for color coding?

A For color coding what?

Q Color coding lights, indicator lights?

A Lights. What convention? Well, we used the red

for open valves, operating pumps, closed switches. And green for just the opposite. Green for shutoff flow, for open switches, for closed nonoperating pumps and motors.

Q How many manual and automatic?

A We didn't use red and green for that. But what colors were used I think were decided or redecided after I left the job. The colors other than red and green I understand underwent some changes during the course of the job.

Q Okay.

How about white and amber?

A White and amber were used, but I don't know what finally -- what final uses they found for those colors.

MR. HENDRICKSON: We can provide you with an answer to that by getting people who were on the project later.

MR. MALLORY: Okay. That is fine.

BY MR. MALLORY:

Q How about blue? Do you know anything about blue?

A I remember blue being mentioned, but I don't recall if it was used or not.

Q Okay.

You feel -- when you left the project do you feel that these colors were being used consistently. Is

that correct?

A Yes. There was consistency in our definition of where the colors would be used.

Q If a valve was open it would -- any valve that was open it would have a red indicator light?

A Yes.

Q Okay.

A There was no question as to that. There was -- it was still up in the air questions how the other colors white and amber and such would be used.

For example, we had made a study of the panel for the engineered safety features -- no, excuse me. For containment isolation valves.

The containment isolation valves were shown on the photograph panel all the isolations involves around the containment. There is a set of two isolation valves on each line. And it has to be shut off.

Those valves, some of them, are open during normal operation, some are closed during normal operation. We proposed a system whereby during normal operation we could have all white lights. And during a LOCA, during LOCA conditions we would have a red or a green light depending on whether the valve was open or closed.

Alternatively, we suggested to the client he could have it the other way around. He could have a red

or a green light during normal conditions. And then the event of a LOCA the board should all go white in order to make it easier for the operator to determine that the conditions of the board from the board color that everything was in place.

I left before determination was made. I think eventually they decided not to go with that system at all and use only red and green lights.

Q Are you talking about the emergency safety features panel?

A No. I'm talking about the containment isolation valves.

There was one use of extensive use of white that we had proposed and was still up in the air when we left. Then later on there was some talk about the use of white or amber for some operating conditions. Eventually the client came through and said, "Well, this is our standard and this is what we want."

That's the way it went.

But red and green were consistently from the beginning of the job always used in the same context.

Q What was the basis for your selection of your color coding conventions?

A Red and green?

Q Yes. Since you weren't there for amber and

blue and so forth.

A No. Red and green. As far as I'm concerned, all I can talk about is red and green. Red and green.

Those conventions for red and green seem to be standard throughout the power industry as far as I understand it. Also it appears in certain standards. For instance, NEMA standard, one of the NEMA standards has red for energized and for switch closed and power on. Green for just the opposite state.

There is an ISA standard, I think it is 5.2 which uses -- has some -- has no logic diagrams as examples in the back. And they use red for pump operating and green for the pumPshutoff.

So although there are a lot of standards that mention this whatever standards there are, are in agreement with general practices in the power plant industry as we were.

Q Do you know if these standards were available in 1967-68?

A I don't know.

The NEMA standard, by the way, is ISA, I believe.

Q Did either of these standards purport that their use of red and green are optimum from the operator's standpoint?

A Do either of them what?

Q Purport that their use of red and green is optimum from the operator's standpoint?

A Not that I know of.

Q Okay.

Was -- first of all, who selected the color of the panel, the tan that it is painted?

A I seem to recollect that I did. But there were a number of flip-flops on the color of the panel. Eventually--

Originally, being at Oyster Creek, the client entered into those discussions. And we moved up to Three Mile Island the client entered into them again. I believe they were changed back and forth several times. At least I had a hand in the selection.

Q Between you and the client, basically?

A Yes, yes.

Q Did anybody look at the --

A Incidentally, one of the considerations was that it not be the same as Unit 1, so that the operator knows -- now would know that he was in the Unit 2 and not in the Unit 1 by accident.

Q Anybody looking at the contrast between the panel face, the tan and the display before selecting that color?

A In a general way. We picked the color for several reasons. One was that it was different from the

other plant.

Q Were measurements ever taken?

A No.

Q Okay.

As the operator moves around the control room he oftentimes has to read displays that are at some distance.

Did anyone ever look at readability of displays at procedurally required distances before they were selected?

A We did on occasion. In point of fact, this was a consideration whenever we considered an instrument. We'd consider how far away it could be read.

I might mention that there was a -- there was a problem somewhere in the design with the -- in the procurement stage with the vertical scale indicators. For some reason we got a different size indicator than we thought. And we decided they weren't readable from the distance required. They were too small.

And I understand a lot of them were eventually changed. The more critical ones were changed. And the other ones had their scales changed to be made more readable. This was a consideration.

Q How did you make this determination?

A Frequently just by looking at the -- pictures in

the catalog or holding them up or getting an instrument in from the vendor and holding it up and looking at it to see how far away it would be readable, et cetera.

There were a number of examples where we had gotten samples from the suppliers in and we used the samples. Sometimes we'd make sketches of them and use the sketches.

MR. DI FEDELE: Excuse me. Charlie, how did you decide how far away you would have to be able to read a particular instrument?

THE WITNESS: Well,there was no set distance except we considered that the distance from the chairs that we had put at the desk, the distance from the desk to the vertical panel was probably the major consideration. But another consideration was the distance from the front of the bench board to the vertical panel. Certainly everything had to be readable from there.

If you want to find out what the -- what indicating lights were used for what I have a document that is dated after I left the job telling what colors were used for what purpose.

White was a supervisory, red was on or open, green was off or closed, amber is automatic

or abnormal or alarm condition. Blue indicated limited conditions.

MR. HENDRICKSON: I might add that a criteria of this type is typical of all power plant projects. The light colors are a mixture of standard industry practice which is largely with regard to red and green.

And practices of a utility which often involve the use of blue and amber and white.

And a scheme of this kind was always worked out eventually with the utilities and placed in our criteria which then plays out as the design progresses.

A Now, earlier we referred to the alarm sequence and the annunciators.

The ISA recommended practice Number 18.1 and the sequence ISA 2A is the sequence. It is called a ring back sequence.

Q Getting back quickly to the readability.

Did you -- you said you examined them. Did you ever conduct any kind of formal tests or experiments where you would try to duplicate the visual environment that you find in a control room?

A No, we did not.

MR. DI FEDELE: That answer and question

seems somewhat confusing. And, perhaps, it should be broken down into two separate questions so that we know what he's answering.

I think you asked, first, was any formal tests conducted. And then you asked in the same question was any formal test in which you tried to duplicate a visual environment. And I'm somewhat confused as to what you're answering.

MR. MALLORY: My basic question is, did he in any test try to duplicate the visual environment.

A No, I did not.

Q What was the basis of standards for control room lighting?

A For control what?

Q Control room lighting.

A Oh, I don't recall. The lighting level was set by, I think, by the electrical engineers. And I think it was on the basis of experience on other projects. But it seems to me that the clients entered into that discussion.

I do know that we selected indicator lights, red and green, amber, indicating lights on the basis of that lighting level.

One of the problems in the past had been too little or too much. Too bright or too dim. I don't recall

what. But we selected lights on the basis of the control room lighting.

MR. HENDRICKSON: In our business lighting level is handled by the electrical discipline. And it is a matter of criteria for which there is an explicit answer.

What you'll find is a cable in our criteria of spaces, buildings and levels in the building and the number of foot candles that are required.

The control room is the highest number on the list here. And it is 160-foot candles. That is the criteria. The office adjunct to the control room is 50-foot candles.

MR. MALLORY: Does that anywhere list the standards on which that's based?

MR. HENDRICKSON: No, it does not. But I can find that out for you.

MR. MALLORY: I'd appreciate that. And at the same time I have one other question and that is since it really does not -- you can't address it.

Was the lighting intended to be controlled by the operator because at Three Mile Island they removed units out of the ceiling. They

actually took out lights. I was wondering if there was any provision for the operator to control any way the light?

MR. HENDRICKSON: I don't know the answer to that, but we can certainly find out.

THE WITNESS: Off the record.

(A discussion is held off the record.)

BY MR. MALLORY:

Q We mentioned labels earlier, but I'd like to know what were the rules or conventions you used for labeling?

A That is a general question.

Q Like size and, you know, the contrast between the letters and the background.

A Oh. Well, it is still too broad a question, but let me answer it in part. Perhaps you're talking of name plates on the panel board?

Q Yes.

A All right.

Now, initially we had decided to use lamacode name plates. That is laminated plastic with a white layer sandwiched between two black layers or vice versa and an engraving which goes through to the second layer.

What happened is at the time our chief electrical engineer felt that these were dust catching labels which

created problems when they got dirty. And he found a label that he liked better. It was a back engraved label that several companies could make for us. And we picked that label.

Now, we asked for white lettering -- no. We asked for dark lettering -- well, we asked for a lettering color to contrast with the color of the label. There were many colors available.

At one time we had color coordinated control rooms with different color panel boards. Eventually we settled on the tan 23522 tan. But the blue vinyl name plates were the ones we used.

Now, the contrast of the lettering was not a matter of choice. It only came one way and that is what we used.

Now, eventually they may or may not have continued on the same course. I don't know what kind of name plates we used eventually.

Q So, then basically you didn't have any concept of the size of the --

A The size of the lettering, yes, we did. We specified the size. And I don't recall what it was.

We did also for the engraving of the annunciator specify the size. But we did it on the basis of samples of letters that we held up and looked at in order to see

how readable it was.

Q Okay. That gets into the next question, then.

Did you once again, did you conduct any kind of formal evaluation where you tried to duplicate the reading conditions?

A In the control room, no, we did not.

Q Okay.

What conventions or rules were applied to group controls in associated displays?

A We tried to group the controls near the associated displays or vice versa.

Q Did you basically try to put controls of the same system in one area?

A Yes. As a matter of fact we divided the panel board up into a number of systems. We tried to arrange the system in a -- in the flow pattern so that the feed water system fed into the condensate system, et cetera.

Q You say you tried to group them nearby. I take that to mean that if you had a control that controlled a display, you know,read that read out on a particular display you tried to physically put that display near the control. Is that correct?

A Yes.

Q Okay. Did you, at any time, try to show

the relationship with any kind of graphics?

A Some of our panels were graphic panels. I don't remember which ones now. In general, we used a judgment as to whether the system required a graphic display or not.

In some systems a graphic display was very useful. For instance, for delineating the feeder buses and transformers. There a graphic display showed which breaker, which transformers were on which feeder banks, et cetera.

On some infrequently used systems such as red waste systems we would consider the use of graphic displays. For the panel that showed the isolation valves we used a graphic display. Most systems didn't use graphic displays.

Q You said it was a matter of judgment as to --

A Sometimes conventions, too. Some electrical panels were conventionally shown graphically.

Q You judged on what basis? What were the major factors that you judged on?

A The lack of familiarity of the operator with the system, the frequency of use of the system, the conventions and client requirements would also enter into it.

Q On frequency of use is ambiguous. You mean you have them where you used something more or less frequently?

A No. If something was used less frequently and the operator, perhaps, needed refreshment as to what was happening in the process. And, therefore, he would need it. Something he operated very frequently he would be very familiar with the process. So that was not the only consideration, but it was a consideration.

MR. HENDRICKSON: I might interject the great amount of what you're asking is covered explicitly and in writing in the instrumentation and control criteria, Number 2, which was a document we had made available previously to the Kemeny Commission.

Do you have that document and have you reviewed it?

MR. MALLORY: No, I don't.

MR. HENDRICKSON: Well, you should have it and you should review it because it contains all of this stuff you're asking. Such things as what portion of the panels were set up in mimic fashion and what were not, what the color of the lights, the arrangement, the accessibility of the operator. All of that stuff is covered

in 33-page document here which I would suggest for efficiency we make available to you to review now because it is all there.

MR. MALLORY: Actually I don't have that many more questions left. I'd rather go through the questions anyway. Okay.

MR. ALLISON: Off the record.

(A discussion is held off the record.)

MR. DI FEDELE: On the record.

In this area I think we have to emphasize that Mr. Gottilla's involvement with this project occurred several years ago. And his memory of the kinds of specifics that you're asking for may or may not be good. And I think that you should rely more on the written criteria documents and the written documents which you will eventually obtain from us.

THE WITNESS: And in addition, anything that I did in that three-year period might have been changed or countermanded later on.

MR. HENDRICKSON: You remember I described to you that the engineering criteria documents are controlled documents. So this will tell you what the design criteria eventually was that was used. And you're really trying to give

Charlie a memory test in a situation where he was involved in three years out of a design process that took a dozen years. But all the things you are after /are in here.

MR. MALLORY: The basis -- the vast majority of what I'm looking for deals with process. I believe you're right about the details of the technical context. However, the process rarely covers in any documentation this decision was made on the basis of this and what did you take into consideration on. Did you run formal tests.

MR. HENDRICKSON: You're correct, the criteria is not historical. However, there is a design history which is in the files and available to you. It is hard to figure out, but it is all there.

BY MR. MALLORY:

Q Okay.

Did you consider any other kind of control display grouping other than mimic?

A No. Nonmimic does not describe it where there are three basic groups that I know of. One is the graphic or mimic. One is the semigraph c and the third is a ncngraphic.

Now, what we used eventually for most of the panel board is a nongraphic representation. In some cases we used a graphic. The so-called semigraphic which groups all the controls together near the bottom and up at the top shows a mimic. Without the instruments superimposed on the mimic is a semigraphic. We didn't use that.

Q All right.

In the annunciator window grouping what were the rules or conventions you used in grouping the annunciator windows?

A Well, I don't recall now. It was too long ago. I would -- my best memory can say is that we tried to put an annunciator on each panel board which contained the alarms associated with that system.

So, for instance, if we had a panel board devoted to electrical considerations that is breakers in distribution systems then the annunciator on that panel board would be for the alarms and in those systems.

Q So, basically if I were to look up at the annunciator panel and there is something flashing up there, I can come straight down into either the console or the vertical behind it and pick up the system that I'm worried about?

A That is basically true. Of course, nothing is

simplistic. And it didn't -- it may not have always been quite the case.

Q Okay.

A You know, you can appreciate that there are some alarms that might straddle several groupings. There are some groupings that might have alarms on several panel boards. But northeless, that is basically the case.

Q Let me make it more general. It was a basic philosophy or principle the group the annunciators so that they were in relation to the systems they reported on. Is that right?

A Yes. This is to the best of my memory.

MR. HENDRICKSON: It is a written criteria on Page 18 of the criteria.

"All systems are to be grouped functionally by system in their grouping on the control section should line up with the similar grouping on the vertical section insofar as possible."

And there are a great many criteria of human engineering nature, if you will.

BY MR. MALLORY:

Q Okay.

Is it -- when you bought the annunciator panels did the auditory alarms come along with it?

A We bought it with alarms, yes, with auditory

alarms, yes.

Q Okay.

A As far as I know the audible alarm is always bought with the annunciator.

Q What was the basis for or did you examine the auditory alarm and how well it could be heard and what it --

A No, we didn't.

Usually the -- my understanding is that usually these things are so loud that they cover any situation. And, frequently, they are so loud that the operators try to muffle them in some way.

Q Recognizing the constraints imposed by using the SBM switches were there any rules or conventions used for orienting the switches, the on-off position on the switches?

A Well, first of all, let's not say constraints because the SBM switches gave us a lot of capabilities that some of the simpler push-button switches did not.

So the SBM switches had many gang contacts in the back that gave us much larger capabilities than some simpler switches would.

But your question as to whether we had any conventions as to which position on the switch meant what I don't think that is strictly an electrical switch. The

electrical department would have made that consideration.

Q What I'm saying is if I look at a panel and I see a switch in a particular position and it is always in that position, and I know that that is an on, whether it occurs at one end of the panel or the other, okay? Did yo establish any conventions about the relationship between switch position and the function that switch was in?

A I did not. But again, I reiterate that would have been a function of electrical department.

Q Okay.

A They might very well have. And if there was a convention that the client preferred then I'm sure the client would have interposed his requirements in this respect. Okay?

Q Okay.

Did you give any consideration to the operation of the panel when the operator was wearing a breathing apparatus or special protective garments?

A No.

MR. DI FEDELE: In that respect, Mr. Gottilla, was there any study with respect to operation of the plant from outside of the control room?

THE WITNESS: Well, as long as the subject

has arisen criteria 19 of 10 CFR 50 appendix A requires that the -- in the event of loss of habitability of the control room that we able to shut down the plant from outside the control room. And we, indeed, provided such capability.

The loss of habitability of the control room could mean a lot of things. And I would presume that any event that required the use of breathing apparatus could conceivable require that the operators leave the control room and bring it to a shutdown from outside.

BY MR. MALLORY:

Q Were you aware that they used breathing apparatus during the accident at Three Mile Island?

A No.

Q Okay.

THE WITNESS: Off the record.

(A discussion is held off the record.)

BY MR. MALLORY:

Q In planning your control panel did you ever give consideration to how much information an operator must be able to correctly recall in order to operate the panel?

A Correctly recall?

Q Yes. From his training or some other

source?

A No.

MR. DI FEDELE: Mr. Gottilla, did you say before that you didn't know how many operators were going to be operating this plant?

THE WITNESS: Right.

BY MR. MALLORY:

Q Was consideration given to how much information the operator must process in order to correctly operate the panel? He's got meters over here and meters over here and they're going. And he's got annunciators. How much input his information processing must be to operate this panel?

A No. We don't consider his information processing rate.

Q In selecting panel components was any consideration given to their maintainability such as certain light-ups and processing labels?

A Yes.

Q Could you elaborate?

A No. In general from experience we picked items that were maintainable. Frequently we'd look at samples of the items to see if they were ruggedly made. If they were maintainable. If they were better suited to that situation than some other.

MR. HENDRICKSON: I would point out that the criteria which I have referred you to is replete with requirements in it that relate to maintenance.

BY MR. MALLORY:

Q Okay.

Assuming that failures occur, did you look at the time that the operator had to respond to certain failures?

A Failures of what?

Q Failures of any system on the panel.

A Failures of panel instruments or failures of plant equipment?

Q Failures of plant equipment. Did you do a systematic analysis of the times that the operator had to respond to the failures?

A No.

MR. HENDRICKSON: Well, let me hasten to add that that question really ought to be addressed to system designers for particular systems. And the intended mode of operation and the question of their reasonable time for the operator to act and react to something that is in the purview of the mechanical and electrical system designers and is contained

in system descriptions. See whereas Charlie did not do it does not mean that it was not done.

MR. MALLORY: I agree.

A In point of fact, the sort of things you're driving at were a consideration on occasion. For example, when we had the consideration of closing or opening a valve normally we had a red and green light associated with the valve to indicate whether it was open or closed. We considered that if a valve took more than a few seconds to open or close that the operator would not be able to stand in front of it and know whether everything was going smoothly.

If a valve took five seconds he could stand there after pushing the button, wait five seconds and then see that it indeed has closed or indeed has opened. But on the other hand if it took forty-five seconds, he would have trouble unless he stood by these lights and waited patiently. We felt no operator would have that kind of patience.

So I decreed that any valve that had an operating time of more than X seconds, I think it was thirty seconds, should have a position indicator on it. That is a gauge which went from zero to one hundred percent showing the position of the valve so that after he pushed the button he could watch that needle moving and know that it was

indeed going to the other extreme.

Q What was your basis for thirty seconds?

A I don't recall the time now. I just gave that as an example.

Q Mr. Gottilla --

A Because I seem to remember it was thirty seconds. And the basis was that it seemed reasonable to me that the man could wait for less time than that, but if it were more time than that he would get impatient. That was a judgment on my part, whatever number I used. I think it was thirty.

Q What AEC regulations and industry regulations were used to make the panel design?

A It is a broad question that I can't answer right now. There were many AEC regulations and industry standards that somehow influenced panel design.

There was regulatory guides. There was AEC regulatory guides. There are a number of them influencing panel design. There were NEMA standards which influenced panel design.

There were -- I can't -- I can't recall them now nor can I begin to list them because there were a great many.

Q One that comes to mind to me is high IEEE 279.

A 279 is indeed one of them. 279 was basically addressed to safety system, safety shutdown systems. However, it was interpreted by the AEC then or the NRC now to apply to all safety related systems, to apply to all safety related systems in the plant, not just safety shutdown systems.

There are only two shutdown systems. The reactor protection system and the safety features actuation systems. But in fact AEC applied them to every safety decision. And they effected panel design.

But there are many others. For instance, as -- that is an IEEE standard there is an NRC red guide for 1.97 that talks about most accident monitoring. Because of most accident monitoring requirement there are a great many instruments that have to be provided which then effect the paneling board. There are red guides and IEEE standards or seismic qualifications. And they affect the panel board design.

Q And they have gotten to be more and more?

A Yes. And I don't think the flood would stop.

Q How do you guarantee the accessibility of redundant class 1 E displays?

A Accessibility for what?

Q That the operator can see them? What is your philosophy on guarantying that the redundancy

requirements are met and that the displays are accessible?

A That is two different questions.

Q Okay. Take them in order then.

A By accessibility you mean accessibility for maintenance or readability?

Q For readability.

A How do I guarantee the readability of these instruments?

Q Right.

A By putting them within view and making them big enough.

Q Are they lined up together? Are they put in another room?

A Are what lined up? Are the redundant instruments?

Q The redundant displays; are they?

A No, they are not because the redundancy requires separation. The separation is sufficient so they can't be put near each other.

Q Are they put in other rooms? Are they on the sample --

A No, no. No. I don't know. We have a criteria for separation written into our criteria documents. I'm not aware of the latest requirements for that. But there are requirements of either physical separation or fire barriers in between them which would mitigate the requirements

for physical separation. But I don't know what they are.

MR. HENDRICKSON: I have it here.

MR. ALLISON: I'd like to mention for the record that the red guides that have to do with that separation have changed very ably since 19 1.

THE WITNESS: Oh, since the other job began.

MR. ALLISON: Since 1971, but there were some in those days.

THE WITNESS: Yes. But when our job began there were many, many changes within our organization as well from the red guides. And the client has promulgated his own standards and reviewed ours and changed ours. And there have been a lot of evolution in the area of separation and color coding.

BY MR. MALLORY:

Q Let's see. Let me see if I can rephrase it.

If I have a display that is 1E and I have to have another one now I'm looking at display that is 1E and that one is broken; where would I be likely to find the other display?

A I don't know.

MR. DI FEDELE: Can you explain by what you mean broken?

THE WITNESS: Inoperative.

MR. MALLORY: Inoperative. Nonfunctional. The meter is stuck or the point is stuck.

THE WITNESS: I know what he means. The answer, though, is I don't know how he would do that.

BY MR. MALLORY:

Q Okay. During the development of the control panel did you ever conduct walk-throughs using mock-ups or simulation to observe operating performance using the panel?

A We made no mock-ups or simulations of this panel. There was a client requirement at one time that we provide full scale photographs of the -- of everything that was going on to the panel so that they could make a mock-up for purposes of training. I don't know if this requirement was continued after I left the project.

But we did request of Mercury Company that in accordance with the Spec 46 they provide full scale photographs.

Q Okay.

Do you know if operator performance data were collected during plant and control room testing?

A I have no idea.

MR. DI FEDELE: Mr. Gottilla, were you involved in plant control room testing?

THE WITNESS: Not at all.

BY MR. MALLORY:

Q Does the -- does Burns & Roe have a program to monitor operator performance or design comments on a continuing basis at Three Mile Island?

MR. HENDRICKSON: Yes, we do. Charlie's not involved in it as such. But we have the option to practice for all of our clients. And all of our plants that we have designed to have the chief engineers personally visit the plant every couple of years to discuss with the utility their experience with the plant and any comments or difficulties they may be having.

And this type of information is fed back into our engineering standards which is an extensive million-dollar program. Providing company standards on how we do our work.

MR. MALLORY: I was getting more -- at a more control level than that in terms of trying, you know, trying to get a handle on how the -- trying to measure how well the operators are interfacing with the panel as designed.

MR. HENDRICKSON: Okay. That would be subcategory of the type of things you're talking about. That would be done by Jim Hayden who is the manager of instrumentation engineer. And Charlie's boss.

MR. MALLORY: You feel that kind of performance monitoring is ongoing?

MR. HENDRICKSON: I know it is ongoing, yes. By the way, the separation within the control panel for safety related circuitry is in the electrical criteria. It is all here in writing.

MR. MALLORY: Okay. One more quick question before we get away from this program of yours.

When was it started?

MR. HENDRICKSON: Oh, I don't think you could characterize it that way. That's been going on since the company was formed. Nor is it terribly formalized. But we can certainly demonstrate many cases where information that we have gleened from utilities about the performance of our plans have been factored back into design.

One thing that we monitor very carefully is

the availability record of our plants. And we are very proud of the fact that the availability of our plants in general exceeds the industry norm by substantial amounts.

MR. MALLORY: I just got a few more questions.

BY MR. MALLORY:

Q Was any attempt made to optimize the noise level in the control room?

A No.

MR. HENDRICKSON: Now, wait a minute. I'll have to look, but I believe there is a noise criteria. But you should continue. It will take me a while to find it if it is in here.

BY MR. MALLORY:

Q All right.

Did Burns & Roe participate in developing the operating procedure?

MR. HENDRICKSON: I can answer that. The operating procedures were developed by Metropolitan Edison's operating staff as an ingredient of Three Mile Island Number 1 procedures to reflect differences between the two plants. We were asked to draft a certain number of

procedures by no means all of them. There was a subcategory of the entire set.

We can provide you, if you wish, with a list of those operating procedures we did draft. But once we drafted them we were not involved in any other way with them. They were forwarded to the utility.

Subsequent to the accident we have asked the utility for a set of operating procedures and received them. So we do have a set here on file. But we were not involved in any more than drafting a few of the procedures.

The same thing would apply to testing procedures in the test program.

MR. DI FEDELE: Tom, could you explain what you mean by draft? I think that suggests it was a final procedure of some sort that you handed to them.

MR. HENDRICKSON: No, no. It amounts to being a rough draft which then goes through an extensive review process by the utility before they are through with it.

MR. DI FEDELE: At that point in time when we submitted them did we expect to be involved in the further development of these

operating procedures?

MR. HENDRICKSON: Well, our contract does provide that we prepare operating procedures. But that part of our scope of service was not exercised by the client. So I guess I would have to say that, yes, we did expect that we were to be further involved in it, but ultimately we were not.

MR. ALLISON: Okay. Let me interrupt here.

You're -- Mr. Gottilla's answer to the last question didn't get on the record.

THE WITNESS: I didn't answer the question because I didn't know. I had no involvement with the operating procedures. But rather than answer it I knew there was an answer forthcoming from Mr. Hendrickson so I waited.

MR. HENDRICKSON: Charlie was not on the project during that time frame from which operating procedures would logically have been developed. In addition we did very little of that type of work.

MR. ALLISON: The record will look a little nicer, I think, if you will let him answer first.

MR. HENDRICKSON: I apologize.

THE WITNESS: The answer is no, I was not involved in operating procedures. But I understand that subsequently Burns & Roe did have such involvement. And Mr. Hendrickson will tell you more or already has about that.

BY MR. MALLORY:

Q Okay.

I would imagine I'm going to get another answer from Mr. Hendrickson.

A You want answers, right?

Q Yes.

MR. ALLISON: That is what we are interested in is answers.

Q Did you use walk-through as simulation in preparing those draft procedures?

MR. HENDRICKSON: Is the question directed to me?

MR. MALLORY: No.

A Tom. I was not involved in drafting operating procedures. But perhaps Mr. Hendrickson can answer that question.

MR. HENDRICKSON: The answer is no. The process that was used here was to be developed system description later in the design phase as

I described it earlier. And then based on the system description operating procedures were drafted. We used the plant test and operations people.

We have a group that is involved in plant startup. All of our projects, where that service is requested of us. We use people from our plant test and operation group who have general operating experience in prior plants.

We assigned three or four of them to the Three Mile Island project to draft these operating procedures for our clients. But they were not based on walk-through. Obviously, we could not have done that since we developed them here in the design office.

MR. MALLORY: Were these men involved then as operators?

MR. HENDRICKSON:They're from our plant tests and operations group. They are engineers.

MR. MALLORY: CRO. Are they qualified CRO's?

MR. HENDRICKSON: I doubt if any of them are qualified chief reactor operators. They could be, but I doubt it.

MR. DI FEDELE: Do they have plant operation experience?

MR. HENDRICKSON: Yes, indeed they do.

BY MR. MALLORY:

Q All right.

Did B & R ever prepare detailed task analysis of operator tasks? As to that, I mean to whole specific operational problems.

A I'm not aware of any such.

MR. HENDRICKSON: I could amplify his answer a bit.

A standard part of the system description is to address operations, faulted conditions, casualty conditions, maintenance, initial startup, testing. Those are all addressed in a system description where the system designers must list his design intent for all of these things.

MR. ALLISON: Off the record.

(A discussion is held off the record.)

(A recess is taken.)

BY MR. MALLORY:

Q What was the basis for assigning readouts to panel indicators versus computer printout?

A I have to give you a little history there.

Initially, the plant was supposed to be totally desigr for use with a panel board. The computer was an adjunct to it which adjunct was completely redundant.

As time went on the concept was changed so that we invested more and more into the computer. And the concept changed to one in which the computer was to be the primary operating tool for plant operations and the panel board itself was to be adjunctee.

Now, the difference to these two admittedly are sometimes suttle. Nontheless, the client instructions changed in that respect over the years during the design.

Now, as far as the number of things and kinds of things we put on the computer we did -- I can address myself to the alarms. We at one time had a great many temperature monitor alarms. And the number was increasing to the point where we could no longer put them on the panel board.

There was one panel set aside for these temperature monitors. And a client came up with a new block of about seventy more and we decided we could no longer contain them on that panel. We decided to put them all on the computer.

Similarly, there were other blocks moved to the computer later on with the client involved in these moves. I'm not aware of what happened later.

Q Okay.

The reason for moving something from the panel to the computer was panel space?

A I'm giving you this one example for which the reason was panel space. Now, that is the movement of a lot of temperature alarms, temperature monitoring alarms. They were moved because of panel space.

Q Can you think of any other rationale that was used to separate those that would go up on the panel to those that would go on the computer?

A No because most of the computer development was after I left the project. So, initially, the client had contracted for a computer to be supplied with the nuclear steam supply system by B & W. That computer was equipped to handle all the NCSS functions.

In addition, it had an expandability which we were to take advantage of. We were to make a list of the requirements for the balance of the plant capabilities. The computer input-output capabilities could accommodate them.

The computer's main system could accommodate them. And thus, the computer would be expanded to take care of the entire plant. Well after I left the project the client decided not to utilize the NCSS computer for plant purposes. They went out and wrote a spec themselves

to purchase a separate computer with its peripherals for the balance of the plant.

Now, what went on on that and why and how was after my time.

Q Okay.

MR. DI FEDELE: When you say they went out and --

THE WITNESS: The client went out.

MR. DI FEDELE: Themselves?

THE WITNESS: They wrote the spec themselves and purchased themselves a separate computer for balance of plant functions.

MR. DI FEDELE: Do you know what Burns & Roe's involvement with that was?

THE WITNESS: None that I know of. Liaison.

BY MR. MALLORY:

Q Were controls displays or other features included on the control panel expressly to protect expensive equipment control items from damage?

A I suppose some were. Perhaps I don't understand the tenor of your question.

Q Switch guard or guarded switch was -- was a guarded switch expressly put on the panel to protect a particular piece of equipment from inadvertant actuation

or a particular kind of display, digital display to protect something from getting too hot?

A Well, either I don't understand the question or I can't think of any example of what you're talking about. There were -- there was equipment on the panel board whose function was protected. There was lots of protective relaying, for instance. Protection for the electrical systems.

Q It could protect expensive equipment now, not safety now?

A Yes, yes.

MR. DI FEDELE: I think the last question was ambiguous and the answer in my mind didn't make clear what it was addressing what his yes meant. Perhaps we can either have it read back and make sure that it is clear or you can rephrase the question.

Will you please read it back.

(The pending question is read by the Reporter.)

THE WITNESS: It would protect expensive equipment.

MR. DI FEDELE: Mr. Gottilla, were any protective systems placed in the panels for safety purposes?

THE WITNESS: I'm afraid I don't understand the tenor of that question. I didn't understand it when he posed it and I still don't understand what you're saying.

There were protective systems there. Most of these are electrical in nature so I don't know much about them.

BY MR. MALLORY:

Q What was the purpose of protective systems?

A There was a safety feature system whose purpose was to protect the whole plant.

MR. SULLIVAN: I interpret the intent of the question really is, is there any conflict in the system designed the panel board design, any conflict between protecting equipment on the one hand and protecting the health and safety of the public on the other?

MR. ALLISON: Excuse me.

Let's go -- we're going to go off the record and discuss this question.

(A discussion is held off the record.)

MR. ALLISON: We are going back on the record and in order to clarify the last series of questions and answers we are going to ask the

question again.

BY MR. MALLORY:

Q WAs the value of the equipment being controlled considered in the selection of the controls and displays?

A Yes.

Q Thinking back to '67 and '68 and '69-70 how did the personnel at B & R remain concerned with the state of the art control panel and design instrumentation?

A Well, once we were assigned to the project our primary way to remain current was to attend technical meetings, read journals, technical papers and contact with our peers.

In addition, we had input from other projects at Burns & Roe. We would get some input from other people in the company as to what else was going on.

Q Do you remember specifically what journals?

A No, I don't remember specifically which ones. But in retrospect one could list all the journals that are still around today. Some of them have changed, but basically the same ones. The journals of the Society of America, the Institute of Electrical and Electronic Engineers. The American Society of Mechanical Engineers. And the American Institute of Chemical Engineers. And the American Nuclear Society.

Incidentally, since I belong to four of those societies, I do get all the journals involved and most of my colleagues are members of at least one.

MR. DI FEDELE: Mr. Gottilla, in this regard do you know whether the company monitors the NRC requirements in these areas, the changes in NRC standards?

THE WITNESS: He wasn't talking about standards of requirements. He was talking about current state of the art.

In point of fact, we monitor NRC standards constantly. We have a group that does that. And each one of us gets involved in it that gets to see the last test issuance of those organizations.

In addition, I might say in addition to the journals of those societies there are several journals that are privately published that have that sort of information. Every one of these societies has their own journal or journals, but there are some private ones in addition.

BY MR. MALLORY:

Q Are you familiar with any of the military specifications that deal with control panel design?

A No. Although some of the people working for me at the time were.

Q In your deposition before the President's Commission you referred to a letter sent to the client by Mr. Gasser of SouthernNuclear Engineering which was forwarded to you and which contains Mr. Gasser's comments on panel board and for the design of TMI 2.

If you would like to refresh yourself here is the section.

A Well, I remember referring to it, yes.

Q Could we have a copy of Mr. Gasser's letter? Did you make a written response to his comments?

MR. ALLISON: Off the record a moment, please.

(A discussion is held off the record.)

MR. ALLISON: Does anybody else have any questions?

MR. DOYLE: Yes, I have.

MR. ALLISON: I have got a couple. Why don't you go ahead.

EXAMINATION BY MR. DOYLE:

Q Mr. Gottilla, during your responses earlier you indicated that when the control -- when the plant was changed from Oyster Creek to TMI that this resulted in, I put down "massive changes in the control

room design."

Can you tell us what those massive changes were and why they had to be changed?

A Well, let me answer the second question first.

Q Okay.

A The panel had originally been designed for a plant that was at Oyster Creek. When it was moved to Three Mile Island, Met Ed entered the picture.

Shortly thereafter we got a phone call from a Mr. Bartman who was apparently in Met Ed operations. He said, "I have seen your designs and they are quite different from Unit 1 Three Mile Island Unit 1. Change them and make them the same."

This was a tall order and I didn't know Mr. Bartman from a hole in the ground. So I went to my project management and said, "I got an order from a Mr. Bartman."

And they said, "Let's call the project manager and ask him."

I shortly got word that the project management at Jersey Central, GPU had said I wasn't to follow Mr. Bartman's directions. Instead I was to examine the Unit 1 drawings which they would send me and make some recommendations of my own as for changes or areas that I didn't think should change.

I did. And that is my letter of February 5th, 1969. You have a copy in front of you.

I made extensive comments. And some of my comments essentially said that we should not change them exactly. And that some of the changes might easily be accomplished.

The clients got a copy of my memo. We attached the letter to the front of it and sent it to the client. They took the thing under advisement. And then called a meeting at their offices in Parsippany.

At the meeting Met Ed was represented as were Jersey Central and GPU people and Burns & Roe people. I believe United Jersey and contractors who were at the plant construction company.

The matter of the similarities and dissimilarities between the control rooms and the advisability of making them similar was discussed at relatively great length. At the end of which meeting no decision had been made, but the client had decided to discuss it among themselves further and let us know their decision.

Shortly after we received a memo from a client saying, "Please make the following changes," with a whole page full of changes.

"Move this panel around to here, move this one here. Put this one in the back of the room, et cetera."

These changes, I presume, were designed to make Units 1 and 2 somewhat similar, but not necessarily the same. Because I think the consensus of the meeting had been, they should not be exactly the same. We should have some dissimilarities so that the operators never get confused to think they are in the wrong control room.

So we went ahead on that basis. And shortly thereafter another memo or letter or telecon arrived saying, "Hold everything. Change it further as per the following." And they gave us some more changes.

So this resulted in a considerable bunch of changes. I say considerable, but they may have been relatively superficial in that the basic U-configuration was maintained. And that concept of a separate bench board and vertical panels were still retained.

Q Were the position of the panels changed themselves?

A Yes. And there are exhibits mentioned in the-- in my deposition before the Presidential Commission.

Q Yes, we have them.

A Which --

Q Okay.

Now, you mentioned, I think I pronounced his name, Gahan.

A Gahan.

Q Gahan. That he was -- started the initial design from zero, square 1 I think you mentioned.

A Yes. He was the first lead instrumentation engineer on the project.

Q When you took over what percentage of the control room design was already established? How far had he gotten by the time you got into it?

A Well, I don't like the word "percentage" because basically he had the basic configuration and the location of the panels was all complete. So 100 percent in that respect.

On the other hand the evolution of the panels went on to a greater extent after that. There were changes, little changes, big changes restructuring, reorganization, replotting, relaying out. So that it is hard to give a percentage number to this. But the basic configuration was laid out when he was here and not changed for the rest of the time.

Q Is he still with Burns & Roe?

A He is.

Q You mentioned earlier that in the basic design at Oyster Creek the Oyster Creek operators had an input into the control panel design or the control room design.

Can you tell me how much input they had? Was this

just "What do you think fellows," or was there meetings or did they spend time with you? How much input did they have, in other words?

A Ed Gahan, when he made the original layouts of the control room and the panels sent it -- sent a copy of these to Oyster Creek as well as a copy to the Jersey Central offices in Parsippany.

After a while he called Oyster Creek and set up an appointment and went down there to discuss the layouts with operating people down there. The results of the first meeting documented in the conference note which apparently seemed to address itself only to items of control room arrangement and accessibility.

They didn't want a separate visitors room, but instead an observation window. They didn't want access to the turbin building through the control room. They get through too much traffic. They wanted a kitchen nearby or associated with the control room. That sort of thing.

Gahan came back and incorporated those things in it. And then went back to them a second time. And this time he went down, I believe, in February of '68. And there is another conference note on that.

He discussed with operating people, -- first, he toured the present plant. And while they were touring the present plant the operating people discussed with him

the present layout of the plant itself. What they liked about it, what they would like changed, what they would like done differently.

You have to remember that that plant is a boiling water plant. And as such is set up quite differently than TMI would be. In addition to which that is a General Electric Turn Key plant. And the whole General Electric concept would have its stamp on the whole panel.

So a lot of the things that they had there wouldn't apply to ourselves.

Nonetheless, they had certain specific likes and dislikes which they mentioned to Gahan and which then found its way into the conference notes. He came back and took care of those things in his design.

Q These were actual panels and layouts to panels rather than where the head was or where --

A Yes.

Q -- the walk-throughs?

A Yes. But I don't know the extent of the details of the panel layouts.

Q I see.

A He may have discussed, for instance, the kinds of switches they wanted or the kinds of indicator they wanted rather than details like "We'd rather have this over on the right a little or --"

Q Now, subsequent to the change from Oyster Creek to Three Mile Island, did the Met Ed operators have an opportunity to make a similar input into the control at that time?

A Yes. The first of which was John Bartman who telephoned me and asked me to change everything.

Q Is he an operator?

A I think he was involved with operations, but I don't -- I can't say that for sure.

Q Were there visits between the people from Burns & Roe to just discuss with the operators this or --

A There were visits. I don't know that we went down there, but I know that operating people from Met Ed were up in our office quite a bit.

Q I see.

A There was constantly liaison with Met Ed people. Initially Met Ed was not our client. See, our client -- as Tom tried to tell you, the flavor of the client changed.

It was Jersey Central and then increasingly GPU. And then Met Ed came into the picture. But they didn't quite take over at first.

What happens is more and more of them would appear on the scene and give me directions. Some of which I was instructed to disregard because these people were not authorized to give me directions. And some of which I

followed slavishly. And eventually they took over. And a Met Ed man became the project manager to whom we reported or assistant project manager, whatever.

Q I see.

MR. DI FEDELE: Excuse me.

Mr. Gottilla, when you said some of which you were instructed to disregard, who instructed you to disregard it?

THE WITNESS: The project manager at the time or assistant project manager with whom we communicated through whom all work was funneled.

BY MR. DOYLE:

Q Who was this project manager with?

A Well, either Jersey Central or GPU. It is hard to say from my point of view. See, I was a worker out in the fields.

What happened, is I received my instructions from a client. And then I'd go over to my project manager and say, "Okay. Who is this guy? Do we take orders from him?"

And he'd say, "Yes, he's the assistant project manager."

Whether he worked for Jersey Central or GPU was sometimes a little nebulous. And when I addressed a letter to one of them I left it to my project manager's

managership to put down his company affiliation on the letterhead.

MR. HENDRICKSON: I might try and amplify a little what Charlie is trying to say.

The decision to move Oyster Creek Number 2 to Three Mile Island Number 2 was made by basically by Lou Rodis (phonetic), who was the manager of the nuclear plant for General Public Utilities during this time. He gathered together people involved and included the President of Gilbert Associates and a few of his key people.

It included a senior official from United Jersey Construction who was building the project. It included the vice-president, head of the division here that was doing the Three Mile Island project. It included our project manager. It included Gilbert's project manager.

And basic decisions on moving the project were made including Metropolitan Edison personnel and Jersey Central Light personnel and GPU people. The basic criteria was that the project was to be relocated.

There were to be minimal changes required to adapt the design to the new site. And that there was not to be an attempt at reengineering

and optimization of the design of the Oyster Creek Number 2 design.

In that context both our client, GPU, and us have a design control problem that is severe. And the way that we handled it quite properly, both sides was to force design decisions through the project managers, both our organization and of the client.

So we had one party deciding in detail what is to be done and not having people all over the organizations on both sides interfering with the basic decisions.

Now, in that context Charlie Gottilla did exactly the right thing when some lower level client employee called up and ordered a fairly, as you characterized it, massive change.

And that was to go get his project manager. The project manager did exactly the right thing which is to get the project manager in the client organization.

Now, by the way, all of this I have seen in the files recently in looking up information for you and other groups. It is all committed to writing.

BY MR. DOYLE:

Q Mr. Gottilla, during your discussions earlier you talked about in the basic design that you didn't take into consideration or you -- it was up to the customer of how many people they were going to put in the control room to operate the power plant. Is there, or did Met Ed ever -- not Met Ed, excuse me. Burns & Roe.

Did they ever establish criteria for a minimum crew to operate that power plant safely?

A Let me elaborate on my answer.

As I said before, we had a desk with two chairs shown at it. I think it was the assumption of the instrument department that there would be two people sitting at those two chairs. And that the plant would be basically operated by those two people in that control room. But that there might be other people around. And these other people might have other functions in the control room, but be under the direction of some chief operator.

That was the basis on which we worked, but it didn't influence our decisions as to the designs on the panel board which is what I think the question was driving at before.

I think what happened is that we considered an operator-withacapital O-which may have been two or three or six different people unless we considered someone sitting at that desk who would have to do this work.

Now, I believe the nuclear group within our project organization, I believe the nuclear group may have made some consideration of number of people needed to man this plant. Not just the control room, needed to man the plant in general.

I know such considerations had been discussed, perhaps not in connection with this plant. That was a long time ago. And I'm relying on a shaky memory. But it seems to me that the nuclear people have considered the numbers of the people required to operate a plant.

Q In your best judgment could you tell us if you believe that one operator, single operator could be capable of operating that plant and keeping it in a safe condition? Under normal conditions, not safety conditions.

A I should say I couldn't make that kind of judgment. I would say under normal conditions if absolutely nothing is going wrong I can't say why you would need more than one person. On the other hand I can't see that normal conditions are the conditions one should design for. But one should consider all the abnormal and emergency conditions. I couldn't guess at how many people would be required.

Q More than one, though, would you say?

A I would suggest one. And we did make a considera-

tion once in implementing Criterion 11 which later became 19.

I mentioned before that is shutting down from outside the control room. We did consider it one time how many people would be required to perform the shutdown from outside the control room if we had distributed shutdown controls.

That is, if a man had to run and close a valve in one place and then had to go some place else, look at an indicator and turn another switch. And we thought that it would require a number of people on roller skates or bicycle to get back and forth in time to accomplish all this within a few minutes.

Later on after I left the project, I understand they coalesced these controls into a panel or two which were located near the control room so that they wouldn't have to run around on roller skates and need a large number of people.

Q During the -- while you were answering some questions Mr. Hendrickson mentioned and we were talking about the simulator that B & W had and how that influence, if it had any influence, on the design of the control room.

I think Mr. Hendrickson said the simulator did have an influence from a very obvious reason.

A For very obvious reasons.

Q Yes.

What are the obvious reasons that he based this change?

THE WITNESS: Would you care to address yourself to that, Tom? You said for very obvious reasons.

MR. DOYLE: I just want to know what the obvious reasons are.

MR. HENDRICKSON: Well, I think there are basically two. One is that the whole fundamental layout of B & W panels was obviously B & W inspired matter. And, second of all, there is the obvious reason. If a simulator is to be most useful for training it ought to be as similar as possible to the plant which the operator will eventually operate.

BY MR. DOYLE:

Q Did you know at the time that the Met Ed was going to use B & W simulators as a training vehicle for their operation?

A We did know that. They said in the letter that the reason they thought it would be useful to keep their simulator is that the operator would be better trained during emergencies to respond to emergency.

Q All right.

And one final question. At least one final area.

We went through the lighting criteria for red and green and so forth on your panels and et cetera.

Are the same criteria applicable to TMI1control room that are applicable at TMI2control room?

A I don't know much about TMI one's control room. But as I understand it the criteria for red and green are applicable throughout the industry, throughout the power industry.

Q Okay.

A I understand there are other industries that do things differently.

Q All right.

A But the power industry I think is universally agreed as to the use of red and green.

Q Thank you, Mr. Gottilla.

I have no other questions.

MR. ALLISON: Don, do you have any questions?

MR. SULLIVAN: I would like to -- can we go off the record?

(A discussion is held off the record.)

EXAMINATION BY MR. MALLORY:

Q There is one area that we have neglected

so far. And that is communication between the control room and outside the control room.

What were the criteria that you used in planning communication?

A I have to defer that question to the electricals. The electrical engineers did all the communication systems. There were several methods of communicating with the rest of the plant and I'm not sure at all what they are.

MR. MALLORY: Okay.

Doug, do you have any questions?

MR. METCALF: No.

MR. ALLISON: I have got a couple.

EXAMINATION BY MR. ALLISON:

Q Mr. Gottilla, I think one of the striking things about TMI 2 control room is that it is large. It has lots of indicators and alarm panels and so on. Would you agree with that?

A Yes. But large is a subjective word. Large compared to whom or what?

Q Okay.

I'd like to try --

A The point of fact the control room was large enough to contain all the panels and equipment that we had, but not t o large.

Q Sounds like Abraham Lincoln's legs.

A Yeah.

Q Was it like -- I'd like to find out why it is large. Was it the trend in the power industry in general in nuclear power plant control design at that time? At the time that TMI 2 control room was designed to put more and more indicators and controls in the control room in comparison to older plants; the old reactor plants and the older fossile plants as well?

A Yes.

In point of fact the regulatory requirements now demanded many more instruments. Client's requirements, the complexity of plants was such that there was more and more to monitor or measure. There were more systems in these plants than there had been in previous plants.

Operators demanded more. There was an expansion, a large expansion in instrumentation requirements from project to project. Every plant required more than the plant before.

And in point of fact that had become a problem that everybody was aware of because every magazine every month there would be some article about how the control rooms are growing in size and complexity and how we can miniaturize them and what we should do in order to take advantage in new miniaturization techniques, et cetera.

It was a real problem. And we understood it and

it affected every facet of the panel board. The number of recorders had grown so that now we used miniature recorders. The vertical indicators were replacing the larger round scale indicators because they took up less room.

There was consideration to going to smaller annunciators. Subsequently we felt an annunciator's function is to command attention and small annunciator lettering or small windows couldn't do it as well as the large one could.

The less the number of annunciator points kept going on. Up.

The temperature monitors I was referring to.

It is not uncommon for a power plant to use the Edison omni-guard system which had four alarms and about a six by six space. And spread a number of these on the panel boards. But our panel board they grew so much that they overflowed and we couldn't expand the panel board any more after a while.

Eventually we decided to take that off and put it either on a temperature monitor or on a separate digital monitor or on the computer. The number of annunciator points increased to the point where we had an awful lot of annunciators around now. And panel boards just got bigger and bigger. This was indeed a trend. We

tried to counteract this trend with miniaturization.

Q Among those reasons you just mentioned, you just discussed quite a few. One was client preference. Would it be true that part of the client preference reason was a desire to reduce the number of operations that were performed manually outside the control room and put in more remotely activated dials to the operator of the control room?

A You're asking me to guess at his motivation. I imagine that possibly motivated him in requesting more information in the control room. On the other hand that is a guess.

Q Do you think that would effect some of these changes? That is to make more things done from the control room rather than manually outside?

A Yes.

There was more centralization in the control room whereas before a number of things had been monitored and left outside the control room.

Now, it was thought better to bring them into a central control room which is another reason I hadn't mentioned before. But another reason for increase in the control room size requirements.

Q Okay.

Do you think that trend has any benefits from a

safety standpoint, had any benefits?

A It is a moot point that I don't think should -- would serve any useful function to debate right now. But having more information is always good if you can assimilate handling the information.

But on the other hand, if having more information tends to saturate the receiver and boggle his mind then there is no -- it serves no useful function.

I think we could talk about this at great length sometime, but this is not the place for it. I think nobody would argue that it is nice to have all the information.

Q Well, I don't want to debate it. But I just wanted to ask your opinion as to whether at some time when not -- sometimes not much is going on and a few alarms per shift is received, say, fifty on a shift, during conditions like that I was asking, do you think that a big control room has a positive effect on safety?

As you mentioned before, we know it has a negative effect when it gets a lot of alarms and you have trouble digesting and diagnosing.

A Let's not consider the size of the control room. Let's consider the amount of information required.

I would say it is always better to have more information. And when things are going right, having

more information around is always good.

Now, the question is when things go wrong and the information comes flying at you kind of fast, can you assimilate it and is it better than to have more information or less?

Now, given the option I would always opt for more information. But maybe I'm influenced by the fact that I'm information oriented. I'm an instrumentation man.

On the other hand, if at Three Mile Island the operator didn't have all the information we gave him, if he didn't have the heated drains information it wouldn't have made any difference. But if we didn't have information about some systems that turned out in this accident to be more critical then it would be hell to pay today.

So I would always opt for having all the information and in making sure we had operators to assimilate it with training enough to assimilate it.

Now, you understand the trend today is to present just as much or more information, but do it in different fashion with more modern control rooms. And that approach is froth with all kinds of problmematic areas that have yet to be solved. That is namely in the areas of programming this information so it is useful to the operator.

But nonetheless, the trend is not to take informa-

tion away, but to add even more. I think that trend will not abate, but will continue.

MR. DI FEDELE: In that regard do you mind if I ask a question?

MR. ALLISON: Go ahead.

MR. DI FEDELE: Mr. Gottilla, let's make an assumption that there is some potential kind of serious accident that could occur at a plant which we cannot protect at this point and which we cannot for some reason assume might happen. If there was to come about some sort of prioritization of alarms and we -- there was an accident that we couldn't protect would you assume that an alarm or I shouldn't say that --

Is it possible that an alarm that might have something to do with that unpredictable accident might be given a very low priority because the accident is unpredictable?

THE WITNESS: Boy! What a question. This hypothetically phrased question about a hypothetical incident. It is entirely possible that you could have, if you had a proliferation of alarms, you could have a very critical alarm about some system that we didn't think was going to be critical, hidden somewhere.

In point of fact in this accident there was information about the reactor coolant drain tank that was important. But that information was hidden on a panel board in the back because we never in our wildest dreams considered that the operator would have to have this information in front of him. And I would say, therefore, that something has achieved importance out of all proportion to its true importance only because of some accident which we could not have expected.

Now, what you're driving at is if you took alarms and you put an alarm and gave some priorities so one had a louder ring than another, is it possible that you can obscure some alarm, you can relegate to it a lower status and have it turn out to be important enough so that we have an emergency condition. Yes. That is entirely possible.

The only function of the alarm is to hit the operator over the head to alert him to the fact that there is an abnormal condition occurring. He had better look up to the board and see what is wrong. The only function of the alarm is to call it to his attention. It is not

there in order to show him that something is wrong. IT is there in order to demonstrate how far off normal it is. It is there to call something to his attention.

It rings a loud bell and annoys him so that he has to look up and see what is wrong. That is the function of the alarm.

You can theorize as to whether some alarm should be louder or different pitch so that he can tell the difference between one or another, but it is hard to detail in advance which are going to be the important parameters in any one accident.

We can theorize, for instance, that heated train alarms and there were fifty of them cluttering up the place, could have been shoved away in this accident. On the other hand, the next accident could involve them in some way. Now, I would rather you hadn't asked the question at all.

BY MR. ALLISON:

Q Okay. Back to the original control room design.

When you were designing the control room and, I believe, you testified that intuitively at least you took

some account of the task that the operator would have to perform. When you laid out the control board did you have any particular standard in mind for the operator along the lines that he can't -- he's not going to do anything for ten minutes or something of that sort?

A Well, it naturally occurred to us. In general, the plant control room is designed on the basis of normal operation. We thought in terms of normal things an operator would have to do and the flow of information across through the plant and across the panel boards that would assist them in performing their function.

We did take into account some emergency conditions. And then someone would theorize and say, "Well, hell. When an alarm horn goes off in some emergency situation the operator is going to sit there stunned and say, 'What the hell was that?'"

And we theorized that this could happen. But by the same token we had to assume that an operator would be trained in procedures such that he would know what to do in the event any one of those alarms went off. That for everyone he would have a procedure he'd have to initiate based on his training.

So in answer to your question, yes, it did pass our mind that the operator might not do anything for ten seconds or ten minutes. But on the other hand, we had

to assume that he was trained to handle any emergency.

Naturally, you have to understand we couldn't contemplate all the emergency situations. We thought, for instance, in terms of a LOCA as being the worst emergency situation. We thought in terms of an earthquake. We'd say, "Okay. Here comes an earthquake down the pipe. What would we do?"

Or, "Here comes a LOCA." And for LOCA we would very simply answer, oh yes, he does not have to do anything because this will happen and this will happen and this will happen and then he'll go over and calmly turn off these two valves and everything will be finished.

But what we didn't consider was what happens in a series of equipment malfunctions or shutoffs. And then some operator mistakes here and there. So that the whole thing added up to a low grade situation that slid under our protective security blanket and did damage.

All right. We did not, nor can I see how we could have contemplated this sort of thing. It seems to me that now that we see this kind of accident we can contemplate it, a simple shift in gears to accomplish, to accommodate this in the next design is the kind of reaction we need to Three Mile Island.

I get the impression that we are overreacting in many respects. But it seems to me an accommodation to

this kind of accident is called for in any future design.

Q That is very good.

Now, if I understood you for a standard big LOCA this system was designed so the operator didn't have to take any immediate action or for an earthquake and a number of other situations. You had that answer in mind. Is that correct?

A Yes.

Now, when I said, immediate actions, under immediate actions there is a procedure that he had to follow. I didn't write it. I don't know what it is, but I know there are procedures that he has to follow in the event of any preimagined accident.

This one had been imagined in advance or somebody had a scenario for it.

Q Okay.

Before -- I'd like to thank you very much for your time and your cooperation. Mr. Hendrickson, Mr. DiFedele too. You've been very helpful to us. I have one last question to ask.

That is, is there anything else that has not been covered in this deposition or the President's Commission deposition that you feel is important to our understanding the accident at Three Mile Island that we ought to know about?

A Let me --

MR. DI FEDELE: Let me object to that question.

First, if you mean with respect to the subject matter that was covered here today I think it is a fair question. But from what we've seen from the President's Commission they are making an attempt to digest many hundreds of cubic feet of documents. And I don't think it is a fair question to ask Mr. Gottilla if there is anything else that should be brought to your attention with respect to every aspect of the accident at Three Mile Island.

THE WITNESS: Are you sure if --

MR. DI FEDELE: I have no problem with him attempting to answer it. But I think you should not take his answer as an exhaustion of everything he could think of of that area.

MR. ALLISON: Why do you object? Let me see, let me restate it then, maybe.

MR. DI FEDELE: Okay.

MR. ALLISON: The question was anything that we should know to understand the accident that has not been covered, that the President's Commission didn't ask him about and that we have

not asked him about that we ought to know.

MR. DI FEDELE: Okay. That has not been previously asked.

THE WITNESS: Let me say, this is all I know about the accident is what I read. I haven't read any more than anybody else.

As a matter of fact, I seem to have latched on to erroneous sources of information because I read the newspapers and I started contemplating what could happen and why we did this and why we did that.

Then I found out the accounts were all wrong and see new accounts.

After speculating on that a while I saw still newer accounts. So right now I don't have a clear picture of the entire accident.

I worked very hard in the weeks following the accident. Burns & Roe set up a station to answer everybody's questions and give them all the information they can. So they could get themselves out of the emergency condition. During all that time I was bombarded with question about how the system worked and how that instrument worked. And nobody told me anything.

So, all I have been able to get is from the reports. Now, the latest report that I have seen is NRC report of May 8th which seems like a very comprehensive chronology. I'm sure if you've read it then you have all the information that I have about the accident.

I was unaware, for instance, of the air pockets that he talked about. So, obviously, I don't have any more information than you do.

I have contemplated what might have happened if we had done things differently only to find out that the instruments I was studying didn't malfunction at all. Initially they said the pressurizier level went haywire. And I spent some time saying, "Gee, what could we do differently?" Only to find that the pressurizer level worked fine.

So, to answer your question, I really don't know any more about the accident to help you. If you're asking the kind of questions like, "Can you think of any other searching questions, probing questions you could have asked the answer is no. I have been asked everything by now.

You got another one?

BY MR. ALLISON:

Q Well, do you have any recommendations that you haven't already given us that you would like to give us about control room design and how it might be improved?

A Well, from what I understand EPRI has made an exhaustive study of the accident and has come up with some recommendations or is coming up with some recommendations. I haven't seen them yet.

I attended a meeting recently of the Instrument Society of America, ISA new committee. And this new committee has taken as its task a study of Three Mile Island accident and how it affects ISA code standards and practices.

And from this committee they expect to make recommendations for further study. And although I didn't participate in the committee as a member because I have been enjoined from my Counsel from getting too involved with anything that has to do with Three Mile Island, I was an observer at this meeting. They did come to the conclusion that they ought to look at a few things and, perhaps, come up with a standard or a code.

Some of the things they want to look at is a more efficient interface between annunciator alarms and the operator. Because the coupling between the two, the

interface relationships between the two seem to be lacking.

I might suggest that at this point that this is an automated thing to look at since the state of the art in annunciator displays is rapidly changing. Soon we are going to the concept of CRT and abandoning the concept of separate two by three annunciators.

The whole question becomes academic. It becomes a different kind of question altogether.

There are a number of things that this committee wants to look at. That is the only one I could think of offhand that is of significance.

Q Okay.

MR. ALLISON: Well, we don't have any more questions. Thank you, again, for your cooperation, all of you.

THE WITNESS: My pleasure.

MR. ALLISON: Thank you, very much.

THE WITNESS: And if I can answer any further questions later, just call me.

MR. ALLISON: The session is adjourned.

(Whereupon, the hearing is adjourned at 3:45 p.m.)

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C E R T I F I C A T E

I, EDITH STROUT, a Notary Public and Certified Shorthand Reporter of the State of New Jersey, do hereby certify that the foregoing is a true and accurate transcript of the proceedings in the above-entitled matter as reported by me stenographically on the date and at the time and place hereinbefore set forth.

I DO FURTHER CERTIFY that I am neither of counsel nor attorney for any party in this action and that I am not interested in the event nor outcome of this litigation.

Edith Strout

A Notary Public of New Jersey

Dated: 9/20/79