SCHEDULE A

TERA (1)

UNITED STATES
NUCLEAR REGULATORY COMMISSION

In the matter of:

MEETING OF THE ADVISORY COMMITTEE ON

REACTOR SAFEGUARDS,

SUBCOMMITTEE ON THREE-MILE ISLAND, UNIT 1

NUCLEAR POWER PLANT

Place: Middletown, Pennsylvania

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UNITED STATES

NUCLEAR REGULATORY COMMISSION

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American Legion Hall
137 East High Street
Middletown, Pennsylvania

Friday, February 1, 1980

The Committee on Reactor Safeguards, Subcommittee on Three-Mile Island, Unit 1, Nuclear Power Plant, convened at 8:30 a.m., in Middletown, Pennsylvania, Harold Etherington (Chairman of the Subcommittee), presiding.

PRESENT:

Dr. Stephen Lawroski

Mr. Jesse Ebersole

Mr. William Mathis

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P R O C E E D I N G S

MR. ETHERINGTON: This is a continuation of an open meeting of the Advisory Committee on Reactor Safeguards Subcommittee on Three Mile Island Unit 1.

I would like to start with a short caucus which will be off the record.

(Whererupon, a discussion was held off the record.)

MR. WALLACE: We are prepared to discuss with the availability of -- we're prepared to discuss basica.ly four items that were on yesterday's discussions, so, not necessarily in this order, the instrument air service air cross-connect and its advisability in Unit 1; the augmentation of our materials technology chemistry sections in the new organization; the as-built drawing program for modifications; and we have some additional statements we'd like to make on the long term items from Table B of NUREG 0578 to supplement what we said yesterday.

Shall we proceed? I'd like to introduce Mr. David Slear who spoke yesterday who will address the as-built drawing program for modifications and also, has some additional comments on long term items.

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MR. SLEAR: I want to clarify some points on the long term requirements of NUREG 0578. Staff pointed out that my slide was deficient in that it only had seven line items when, in fact, there are something like thirteen

modification-type long term committments that are required. I guess that I'd like to point out and the Staff mentioned that, I think, it is water level indication and the technical support center were among the items that he specifically mentioned that he felt weren't covered.

There are seven line items on this slide and the last line item really covers two of the requirements, so, by my count there's eight long term committments on the slide that I used. And in addition, I previously discussed our committments in the area of the hydrogen recombiner safety grade emergency feed water flow indication and safety grade emergency feed water auto-start indication. So, I felt that I had covered eleven of the thirteen.

The two that were specifically mentioned, the reactor vessel water level, I think, was discussed in a fair amount of detail yesterday and I don't think I see a need to go into that any further right now. And as far as the technical support center, we are proceeding on a schedule which would allow us to complete the requirements, the long term requirements by January of '81 and we have not yet ordered all of the appropriate equipment that might be required as such, but pending any equipment availability problems, I would perceive that we would be able to meet that kind of schedule.

With regard to as-built records, we will have updated prior to restart the as-built records for all of these

modifications that we're proceeding with as part of the TMI 1 restart program.

Are there any other questions in those two areas before I leave today that the Committee has?

MR. ETHERINGTON: I think not, thank you.

MR. WALLACE: I would like to introduce Mr. Dave Kauffer who will speak to the augmented materials technology capability that we've added to the organization.

MR. KAUFFER: I manage the materials technology section that was formed last summer in the reorganization. The concentration of materials, materials evaluation and analysis, inservice inspection, and non-obstructive examination of all the engineering. The organization right now is a headquarters technical support group with a section head in Parsippany, designed support with Waulding Engineering materials engineering, materials lab in Reading with four materials engineers, three technicians.

Another group for inservice inspection planning and non-obstructive examination that will have a level three and a mechanical ISI planner and we support the sites in those districts, as well as Waulding Engineering, materials engineering, non-obstructive examination, inservice inspection, and materials analysis due to --

MR. ETHERINGTON: Are there any questions in this area?

DR. DILLON: You're talking about compositional analysis, I assume, not analytical in terms of --

MR. KAUFFER: As well as analytical, yes, sir -- to respond to the onsite operations for inservice inspection findings take the lead in evaluation according to the code, the right to report, to make the recommendations to plant management on corrective action where repairs are required.

DR. LAWROSKI: How familiar are these people as to the details of the plan.

MR. KAUFFER: They are people out of many experience levels. In that discipline, or so we hear, that all of them for the most part are senior types; I have one engineer that's about two years out of school and he does a lot of plant work, operates the labs, directs the technicians. The remainder of the people are senior-type engineers.

DR. LAWROSKI: How well does each know the plant?

MR. KAUFFER: The plant, interface with the plant would always be through onsite personnel; he doesn't know exactly where something is, he's working through an operations type maintenance type. We are always called into the job when the need arises for an evaluation, so we're working with people onsite that are totally familiar with it.

We provide the analysis work and we provide a level three, for instance, we go in and assist in non-obstructive examination of a finding that's already been detected

by an onsite group, okay. We support the investigation of a finding to satisfy our needs for the interface with the design for where stress analysis is required. My own personal experience is 16½ years in the nuclear industry. I just joined GPU from an NSSS supplier about 2 months ago. I am a member of Section XI Boiler Code.

We have, as I said, the engineers in my group are all degreed engineers and with the exception of one junior-type, they are all seniors.

DR. DILLON: You have your staff in place now.

MR. KAUFFER: Yes, with exception of the ISI/NDE group; that group is -- we have open ROP's to hire those people. I satisfy that need.

MR. ETHERINGTON: No further questions?

Thank you.

MR. KAUFFER: Mr. Chairman, two of our members are not yet with us this morning and I would like to defer discussion on some of the other supplemental items and proceed on to the pipe cracking discussion.

MR. ETHERINGTON: As I mentioned yesterday, Mr. Arnold was unfortunately called away because of a death in the family and Mr. Herbein had a prior longstanding arrangement that prevented him also from being present today; so that the topic on organizational changes will be presented to the Full Committee if the Full Committee meeting is held next

week, but we will not be heard by the Subcommittee.

MR. WALLACE: Mr. Chairman, on the subject of organization changes, we will have available for the Subcommittee copies of the releases which announce that organizational change which give a brief description of --

MR. ETHERINGTON: Just a handout, but no presentation is that it?

MR. WALLACE: Yes, sir; that is correct.

MR. ETHERINGTON: Good.

MR. SILVER: Mr. Chairman, if I might.

The Staff has some people on their way up to this meeting who should have been here already and have not yet arrived. One of them, specifically, is knowledgeable in the area of pipe cracks and most likely could contribute to this area. I have no idea what's happened to them or why they are not here.

MR. ETHERINGTON: So, if it's agreeable to Mr. Wallace, we'll pick up something else first?

MR. SILVER: That would be my suggestion, but I --- we seem to have conflicting problems in this area.

MR. WALLACE: Yes, sir. That would be agreeable if there's something else that you would like to cover. We do not have our other presenters available right at this moment other than Mr. Croneberger to talk about the pipe cracking.

DR. DILLON: May I ask another question then

regarding this materials center.

Do you have plans or any interest in a supplementary capability in the chemistry area? Are you thinking anything like that's needed?

MR. KAUFFER: With regard to materials --

DR. DILLON: Yes.

MR. KAUFFER: With regard to impacts on materials, yes. I think that there's no question that we could have at our disposal the chemistry lab. The materials lab and the chemistry lab are located -- both of them are located in Reading. And we have chemistry input as well as the design of stress analysis input that is being required by the code.

We have resources.

DR. DILLON: Who's in charge of the chemistry activity?

MR. KAUFFER: It's under Dr. Long. Bob Hopkins. is the manager of the chemistry lab.

MR. WALLACE: Mr. Dillon, we anticipate that there will be someone here this morning to speak about the chemistry technology section.

DR. LAWROSKI: How many chemists on site do you have?

MR. KAUFFER: I can't speak for the chemistry lab. I'm not that familiar with the lab.

DR. DILLON: Steve, I talked to a gentleman yester-

day, Reed, that gave me some information.

MR. WALLACE: Mr. Chairman, Mr. Michael Ross who is the supervisor of operations arrived and will be able to address the instrument air service air cross-connect and its advisibility; if you'll allow him a moment to take his coat off and come in. And, then we can proceed with that portion of the program.

MR. ETHERINGTON: I can't hear very well --

MR. WALLACE: I'm sorry: Mr. Ross has arrived and as soon as he comes into the room and takes his coat off, we'll be able to proceed with the discussion of the instrument air service air cross-connect.

MR. ETHERINGTON: Good.

DR. CATTON: Excuse me. One of the things left over, you were going to bring in the training manuals for us to take a look at? They're as illuminous as you say; I don't see them anywhere.

MR. WALLACE: Yes, sir; they are also on their way. We've checked on that this morning. They'll be here momentarily.

DR. CATTON: Is a semi comming?

MR. WALLACE: That may be the delay.

Tape 2
U.O.

MR. LAWYER: With respect to part of an answer that we got, that some of this talent -- I guess it was on capability of materials examined, it was located at Redding, is that correct?

MR. WALACE: Yes, sir.

MR. LAWYER: Is there a reason why it's that far away from here? That's not exactly --

MR. WALACE: Sir, the GPU System Laboratories are located in Redding, which include the material technology and chemistry sections.

They provide services for a large segment of the GPU Systems, including the phosphorous stations. They do a good bit of conventional metallurgical analyses in that laboratory and they have all of the equipment centrally located within the system for that reason.

MR. ROSS: Good morning, gentlemen. I'm Mike Ross of Metropolitan Edison. I would like to address the questions you all raised on service air gets in an air cross connector. In front of you are drawings showing our service air pertains to an air cross connector.

The points I would like to make on that cross connector is one, it's not a normal system cross connector. The cross connector is only functional if a low pressure exists in the instrument air system. 1939 264

The second point I'd like to make is in that cross

connector reexisting is an oil filter and both systems have moisture removal ability or aid to do the thing. Therefore, the air is virtually the same.

I'm open for your questions on that particular item.

DR. LIPINSKI: This automatically connects at low pressure?

MR. ROSS: Yes, sir, that's correct.

DR. LIPINSKI: What's the transferrence now we enter PSI and the instrument air?

MR. ROSS: The instrument air is roughly a hundred PSI. The set point I believed I've marked there for you is about 75 PSIG.

DR. LIPINSKI: Oh, yes. I see that in your note.

Do you have any restrictions as to what goes on in the plant with the service air? I know you're not putting water in it today. Is there anything they say you can't put water in your service air tomorrow?

MR. ROSS: We change them a lot no matter whether it's a major or a minor must be approved at the minimum in the on site engineering group.

DR. LIPINSKI: I'm not thinking of the change in mode as some temporary jury rig. It is required based on the work of the day. It may not be permanent.

MR. ROSS: Temporary jury rigs are also looked at

in the same light. Temporary jury rigs -- something, would have to have a work request or a special operating procedure. All of this must have some level of approval.

DR. LIPINSKI: With all the considerations of what it might mean in the way of a compromise. The service air gets connected to the instrument air, because instrument air pressure dropped.

MR. ROSS: In the worse case you would still have moisture removal traps. You would still have an oil filter, a pair within those suited through the existing instrument air dryer to be dried. All the air would still be the same within the receivers in there.

DR. LIPINSKI: Are you implying then that TMI 2 do not have the filters and the traps as to why the water gets down to the valves?

MR. ROSS: I'm implying the reason the water gets in the valves in the Unit 2 is they have a gross volume. They had a total cross connector to the water to the air system.

DR. LIPINSKI: Well, that's what I'm talking about in this case here. Today you don't have this water on your service air. Will there by anything that prevents you from having water in your service air at some point later in time.

MR. ROSS: Just our local controls will prevent it. No controls in that we do not hook anything to our air system

without either changing one or work request or something that allows a guy to do that.

DR. LIPINSKI: Okay. You're saying that you would never consider an interconnection of the systems that would admit water into the air system?

MR. ROSS: No, sir. I don't think we ever considered that since Unit 2.

DR. LIPINSKI: Okay.

MR. ETHERINGTON: Are there any further questions? Let's see, was there something else, Mr. Walace?

MR. WALACE: Mr. Chairman, we do not have the person to make the discussion on the chemistry area and that completes the other items that we -entioned we would address. We're ready to proceed with the pipe cracking discussion why Mr. Silver's --

MR. LAWYER: I have a question, and I'll start first with the staff. How satisfied is it with the extent of the separation of Units 1 and 2?

MR. SILVER: We have --

MR. LAWYER: -- considering that there will be large numbers of people involved in the attempts for restoration of Unit 2 or rather diverse --

MR. SILVER: People, I'm not sure understand that thrust of your question.

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MR. LAWYER: Well, how satisfied are you that the

plan separation is adequate to protect Unit 1 -- personnel access in particular?

MR. SILVER: The question of security is that the direction you're going?

MR. LAWYER: Yes.

MR. SILVER: Is under review separate from the order? However, it is in fact, being considered and I at this moment do not have information that I can give you on this . But, I certainly will have it if we do have a full committee meeting.

MR. LAWYER: Well, I'd like to ask Met Ed his remarks on that.

MR. SILVER: I'm sorry sir I didn't hear the original question.

MR. LAWYER: The extent of the separation of Units 1 and 2 with respect to personnel access from the standpoint of protecting Unit 1 against unauthorized entry or whatever.

MR. HERBEIN: Mr. Jack Thorpe?

MR. ETHERINGTON: Perhaps you might tell us what normal connections there are between the two facilities.

MR. THORPE: We've established two separate and distinct security systems on the island for the two units and we have attempted, with respect to security, to isolate them as much as possible.

There is a controlled access between the two units.

But, you know, In order to pass that access you have to have the proper identification badging. We have separate badging systems. In other words, a badge that will get you into Unit 1 appropriately, will not get you into Unit 2. You have to have a special badge for Unit 2. So, we are maintaining them as separate as possible.

There are people on the island who have only access to Unit 2, some who have only access to Unit 1, and then some people who just for their needs have access to those units.

MR. LAWYER: Could you tell me how many people will have access to both units?

MR. THORPE: Gee, I'm not sure that I know that.

MR. LAWYER: Is it going to be 10? Is it going to be a hundred or 200?

MR. THORPE: I would say it was more like the hundred number but it's mainly the management type people from the TMI Generation group.

MR. ETHERINGTON: Is the direct access from one unit to the other truly for the convenience of senior management personnel or is it a necessary access? Why couldn't you completely close the door?

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MR. THORPE: I'm not sure I can answer that question, but it would make travel in many people in there function who must go from one unit to the other. It would make that

travel very difficult, because the main entrances to the two units are almost diametrically opposite from one another.

MR. ETHERINGTON: Well, now I'm surprised that you say many people have to go from one to the other.

MR. THORPE: Well, it depends on your word of what you mean by the definition of the word many.

MR. WALACE: Mr. Chairman, the distinction I think is principally one of function as Mr. Thorpe said. There are a large number of contractor personnel on site, some dedicated to Unit 1, some dedicated to Unit 2 and those people by and large do not have authorization to both sides of the units.

There are people in the Met Ed GPU Organization because of their specific functions who do have responsibilities in both units and because of their location on the island, the physical location of their office space and facilities are required to go either into Unit 1 or into Unit 2 and therefore have the capability to go back and forth.

In general, I would say that the majority of people who have the authorization into each unit are company people. There are NRC people who have similar authorizations and each one of those people, regardless of whether they are company people or NRC, have gotten specific review of their job function and authorizations have been granted by senior management at TMI.

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MR. ETHERINGTON: Perhaps we should see at sometime

the number or categories of people who have responsibilities with respect to both units. Because we somewhat got the impression that Unit 1 was treated almost like a separate plant.

Are there any further questions in this area?

MR. WALACE: Mr. Chairman, if you would like at this point while we are waiting for the staff's personnel to arrive before we go into pipe cracking, we could provide you with some comments with regard to our interest in going to full committee meeting next week.

MR. SILVER: My people have arrived, Mr. Chairman.

MR. ETHERINGTON: They have? Well, which would you prefer Mr. Walace?

MR. WALACE: At your discretion we could do either.

MR. ETHERINGTON: Why don't you continue as long as you're prepared to.

MR. WALACE: With the pipe crack discussion?

MR. ETHERINGTON: Yes.

MR. WALACE: Yes, sir. I'd like to introduce Mr. Don Croneberger. He is the manager of Engineering Design for the TMI Generation.

MR. CRONEBERGER: My name is Don Croneberger. The handouts that you're being given now are copies of the slides I will be using for the presentation.

First, I'd like to review the history of the pipe cracking that was experienced at TMI 1. Back in April of 1979 plant personnel did detect one thru-wall leak in an 8-inch schedule 40S Type 304 Stainless pipe in the Spent Fuel Cooling System. The evidence was crystallization of boron on the outside of the pipe.

As a result of that discovery, further visual examination of the stainless piping containing borate of water was performed. The results of that were finding five more thru-wall leaks in the balance of the Spent Fuel Cooling System and there was one leak discovered in the Decay Heat System, this being the suction off the borated water storage tank.

There were metallographic studies of the first leak specimen extracted. This examination of that failure resulted in the conclusion that there was intergranular stress corrosion cracking in the sensitized area of the heat effective zone.

Attempts were made for confirming the intergranular stress corrosion cracking by radiography and those attempts were not successful. The radiography did not pick up the cracking.

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MR. ETHERINGTON: You didn't mention the size of the leak in the crack and the Decay Heat System, did you?

MR. CRONEBERGER: As far as size, most of the sizes

of the thru-wall crack were on the order of fractions to an inch and a half or something like that. What exact length of the crack is in the Decay Heat System, I forget. It was probably approximately an inch was the exposed portion on the outside of the pipe.

MR. LAWYER: What kind of leak rate did you --

MR. CRONEBERGER: There was no visible observance of moisture. The detection was in fact just the boron crystals on the outside of the pipe. It wasn't really water on the floor that was observed. It was simply the crystals on the pipe.

As a result of those visual examinations, it was concluded that we should be going in and nondestructively examining all of the joints in piping systems which I'll describe later. Attempts were made to develop an ultrasonic technique that would permit us to detect the cracking similar to that which produced the thru-wall cracks.

Various configurations were tried and fundamentally as shown on this slide the best procedure was one which used a 60 degree stainless steel block transducer frequency as shown on this slide. The configuration of both the methods that were used are shown on this slide.

This slide also depicts the typical joint detail, the BUTT joints that were being looked at. On each case on the three or four stainless pipe one had a counter bore in

this particular area and the actual specimens which were extracted indicated cracking initiated in the counter four region in a heat effected zone.

One of the difficulties in developing an appropriate UT technique was one which would avoid the geometric reflectors associated with that counter bore. The final conclusion as far as the most appropriate examination methods is this one over here.

Of the initial seven leaks which were determined, six were from one specific heat of steel, one was from another heat of steel. This is a chemical analysis of the heat which was the dominant one as far as the thru-wall cracks were concerned. This specification did satisfy -- this analysis which was performed did show that the materials satisfied the specification requirements for 304 stainless.

You will observe that the results are high on the carbon side.

Continuing in this evaluation, to explore the sensitivity of that particular steel to sensitization, we have simply plotted on the steel chart where that particular heat of steel fell relative to this equation. This simply shows that indeed the material that was used is susceptible to stress corrosion cracking.

DR. DILLON: Excuse me, what heat were you looking at on this particular spot you got here?

MR. CRONEBERGER: The heat which I showed, which was represented by this chemistry. Now as I said, this chemistry that I've elected to show here was the one in which of the seven leakers that were found six of the leakers came from this heat.

DR. DILLON: Okay, well you don't happen to have the heat number, do you?

MR. CRONEBERGER: I can give that to you in just a minute. I should check to make sure my quote is right. That heat number -- if the information I have here is correct -- was heat number 334165, which was an Alleghany Ludlow.

DR. DILLON: Yeah, that's the one I think it is, but we have seen other analyses for that same steel at a somewhat lower carbon concentration then that. I don't know whether it's significantly different, but somewhat lower, .069.

MR. CRONEBERGER: That could be. Now, I do know the other heat where the leak occurred was again Alleghany Ludlow and I want to say 334164, and that had a somewhat lower carbon than what I'm showing here. This was our analysis for that particular heat I quoted.

As a result of these determinations, we reviewed which systems in the plant contain borated water. Particularly we would expect it to have reasonably highly oxigenated water

and some other cases here and contain the 304 stainless steel.

The systems that were examined by the UT Technique which was developed or shown here -- again, Spent Fuel Cooling which was the one evidencing the major initial problem Decay Heat, Building Spray, Make-up, Core Flood, Pressurizer Spray and Surge System.

It should be noted that in the Core Flood System that was -- at this point in time we didn't discriminate between 304 and 316 Stainless. Our recollection is that all of the piping and Core Flood System was 316. There was occasional use of 316 in one or more of the other systems.

As far as the variables which were investigated in addition to the basic UT Examination was an investigation of Heat Number and Chemistry, Shop vs. Field Weld, individual welders, an investigation of the environmental flue conditions, and with the Heat Number the investigation of the Carbon Content for that specific heat.

MR. ETHERINGTON: With a composition referring to the susceptible area, why do you assume that boric acid is an important factor in the failure.

MR. CRONEBERGER: Again, the conclusion is that we need a susceptible material for the stress corrosion cracking. We need a stress propagation with that cracking-- we need a corrodent.

MR. ETHERINGTON: Then, you don't have oxygen

as for BWL, so you're looking for something else.

DR. DILLON: Oxygen is present in --

MR. ETHERINGTON: Well, then I'd repeat my question. Why is boric acid -- is that a known promoter of the intergranular stress corrosion?

MR. CRONEBERGER: To my understanding that the low temperatures we were talking about for these systems and all of these systems are basically low temperature systems with maximum design temperatures of a 140 degrees to my knowledge, there has been no evidence that I'm aware of where the low temperature borate of water has been a contributor to intergranular stress corrosion cracking.

We're talking in the past, particularly with the BWR experience for higher temperature rules.

MR. ETHERINGTON: I'm sorry I didn't understand. I thought you said there was no evidence of boric acid being the bad acid.

MR. CRONEBERGER: To my understanding that where the borated water has been a contributor to intergranular stress corrosion cracking, this is occurring where the borated water is at some elevated temperatures. In this particular case, essentially all of the lines that we're looking at contain water which would normally be at a temperature of 75 to 100, hundred plus degrees, with actual design temperature being 140 degrees.

To my knowledge, there have been no previous indications of stress corrosion cracking associated with low termperature borated water.

MR. ETHERINGTON: Could you comment --

DR. DILLON: Would you like me to --

MR. ETHERINGTON: Yes, would you try and identify for me.

DR. DILLON: All right, let me say this, that since the first discovery of this cracking situation there have been a number of laboratory attempts to produce stress corrosion cracking in simulations of the cool storage chemistry environment. We have looked at a number of fairly sensitive tests.

For example, the cost of extension test, which are such as to induce stress corrosion cracking under maximum conditions of stress. With very few exceptions, one of which occurred in our laboratory, we've been unable to produce stress corrosion cracking in pure low temperature boric acid environments typical of fuel storage situations.

MR. LAWYER: But, it appears to me that's its also oxygen free or air free.

DR. DILLON: No, it's not oxygen free. It's exposed to air as would be the conventional fuel environment. We have in a few instances run cost extension rate tests in combinations of boric acid and small amounts of chloride

up to 10 or 15 parts per million of chlorodine. We have still had trouble in inducing stress corrosion cracking under these circumstances.

Right now the preponderance of evidence on cracking studies in the laboratory have seemed to indicate that we are not in a stress cracking regime in pure boric acid solutions. Now, the only exception to that, is the experiment that was run in our laboratory with a specimen cup from one of these effected pipe wells. At very low strain rates, we were able to produce something that was akin to stress corrosion cracking. Maybe two or three grains deep. But, we have seen no other evidence of it. We've been unable to reproduce it in later experiments in our laboratory.

Our present studies are related to somewhat lower strain rates than those we've been able to use up to this point and they have been quite low. The evidence in my mind suggests that there is a synergism perhaps between boric acid and some as yet unidentified contaminant in the pool.

Now, the subject of oxygen is a very difficult one, because we're dealing with a service environment which to my knowledge has never been accurately described. It represents a stagnant environment in the pipe and I hope you'll discuss the matter of how often this system is exercised so that we have some basis of estimating how long the solution is in that pipe if such evidence exists.

But, oxygen represents an unknown quantity. You can make some back of the envelope calculations that suggests given enough time, that this could have been a more or less oxygen free environment because of the diffusion of oxygen to the reactive metal surface and the slow depletion of oxygen with this kind of a device.

So, the situation is largely unknown in terms of the chemistry in the pipe during the cracking process, because of the inability to get analyses in the local environment for the piping crack because of an unknown situation on the oxygen environment.

So, at this point, nobody is really sure about what the process is itself. It appears that based on other storage conditions of which I might point most reasonably to boiling water reaction fuel storage environments where no cracking has been observed and where no boric acid is present.

You begin to wonder about some significance in the presence of boric acid. But by itself, it doesn't seem to be an adequate promoter of stress corrosion cracking to induce the effect. Therefore, we think in terms of the synergism between boric acid and some unspecified contaminant.

MR. ETHERINGTON: Is this composition sufficiently abnormal to be an important factor --

DR. DILLON: Well, I hope we can get around to

that. If you go through the information here on the analyses of the fuel pool over a period of time, there are a few periods of reported increases in chlorodine which might have a relationship, but I think the evidence is mixed on whether those analyses are real or not.

MR. ETHERINGTON: Well then I probably should let --

MR. LAWYER: But, referring to your figure that's with title Susceptibility of Type 304 Stainless Steel to Sensitization, if I had all the points around that line what kind of a band would I have, instead of that nice straight line that separates susceptibility to resistance? Things can never be that nice, so how big is the margin of error here? You understand what I'm asking?

MR. CRONEBERGER: Yes, I think so.

You're not interested in the real scatter but what would be a tolerable scatter?

MR. LAWYER: A real scatter, yeah.

MR. CRONEBERGER: We haven't plotted that data. We do have, again, the major element in here being carbon. My recollection is that we have a scatter with some of the heats being on the left of that line, but the majority of the heats of the 304 Stainless that we were looking at would be on this side of that line. I don't have them plotted.

MR. CLARK: Mr. Chairman, I think --

MR. LAWYER: Under the subject of corrosion I would expect the scatter to be pretty bad. But isn't --

MR. CLARK: I think we'd like to and we do agree with Dr. Dillon that the cause of this corrosion is not well understood. The Company has a fairly extensive ongoing program to further investigate it.

Information being presented today is not in our view a definitive answer, but is indicative of the kinds of things which we are pursuing to find an answer. So, I don't want to give the context that, you know, this is what's causing it. We don't know. We're trying to find out and in the interim we're carrying out an inspection and repair program and an ongoing surveillance program to find any additional cracking.

MR. ETHERINGTON: Thank you. But, I think I'm guilty of having interrupted your full presentation.

MR. LAWYER: Bob, would you have a guess of --

DR. DILLON: You mean our mail data?

MR. LAWYER: -- this scatter.

DR. DILLON: Well, our mail is data. Of course, I don't have immediate access to it, but I'm sure there is a substantial scatter.

MR. CLARK: The straight line is somebody's equation.

MR. CRONEBERGER: That is correct.

MR. CLARK. That's not intended to be an imperical line.

MR. LAWYER: I understand. I --

DR. DILLON: But, the straight line is just a straight line.

MR. CRONEBERGER: We have all of the chemistry to the various seats.

DR. DILLON: But, in terms of the title of it, it has to have a band of some sort. I'd estimate that most of the 304 in this system would be well to the right of the curve.

MR. LAWYER: The scatter would be -- I see mostly to the right?

DR. DILLON: I'd say most would be on the three-fourths of the data.

MR. CRONEBERGER: Again, there may be different values for this particular point, but my recollection is that this heat involved the greatest departure from that line of any that we have.

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What I'll do now is to summarize the results of the UT Examination. You must appreciate that we went through slightly more, but basically two cycles in ultrasonicly examining each of these joints.

One was using that first method which did not permit us to adequately discriminate between geometric

reflectors and cracking and that is this column. The column which we're using now in accessing our repair and inservice inspection needs is included under these screen indications. So, that you find as I indicated before six of the tnru-wall cracks were in the Spent Fuel Cooling System.

In further examination VIA ultrasonic techniques we found a total of 22 which included those 6 leaks.

MR. ETHERINGTON: Just hold it a moment.

MR. CRONEBERGER: Further by the UT Examination are where the additional indications four leaks were found.

Furthering the next few slides give more details of the indications as to specific locations and some of the other variables which were looked at and consequently evaluated. A number of conclusions from this examination were that in accessing the indications of Shop vs. Field there were a high proportion of the indications found in the Field Welds and of the Field Welds a higher proportion that were associated with a repair of Field Welds which suggests from a standpoint of residual stresses that the welding procedures that were used heat input, et cetera obviously may have contributed to higher residual stresses on those repaired Field Welds.

You will find that as far as locations, we were looking to see if in these joints there was cracking on the pipes -- or not the cracking -- indications on the pipe side

of the joints or on the fitting sides in essentially all cases the cracking occurred at a pipe to fitting joint.

You will also see here that there are occasionally from the examination indications which appear to be on the fitting side. To date in the repair process when we've cut these out, we have not confirmed in any case that the cracking was indeed on the fitting side.

You see also here which was used in subsequent evaluation of breakdown of heat number for each of the pipes of these joints and the associated carbon content. If you scan down through here as far as carbon content is concerned, although there are I think some exceptions, I believe you will find from the heat that I described before which was this 334164 was on the high side and we have some which go down to about .054 on this slide.

MR. ETHERINGTON: What is the condition of the pipe? Is it quenched or annealed or -- Can you answer the --

DR. DILLON: Can you post weld?

MR. ETHERINGTON: Pardon?

DR. DILLON: You mean after welding?

MR. ETHERINGTON: No, as supplied. Is it quenched or annealed?

MR. CRONEBERGER: I can't answer that. I can get the answer to that question and give it to you.

MR. ETHERINGTON: All right.

MR. CRONEBERGER: Continuing down on the -- it's further summary of the findings of the UT Examination and what we were able to discriminate as to the variables I discussed before. This is simply a complete tabulation of the indications that were investigated or examined.

Now one of the investigations that was performed were exploring the number of indications vs. heat. I'm sorry, I think I may have given you the wrong information. I believe that heat that we have that chemistry for wasn't this 334164 but may have been this 165.

MR. LAWYER: That's what you said.

DR. DILLON: Yeah, that's what you said the first time.

MR. CRONEBERGER: Yeah, did I say 165. Okay, that meant the 165. This is a summary of the total number of joints in the system that were investigated, the percentage in the total population, basically, the number of indications that would have been expected and the actual number that were encountered. You do see that where, in fact, there is a reasonable population of the indications that are defined here, it's a relatively few number of heats which culminate.

Another summary of the information is a summary of the actual number of indications. Again, when I'm talking about indications it's indications by the UT Examination plus the set of leakers. You again find a dominance of the

indications occurring with the carbon on the high side.

Now, to try to respond to one of the questions, a substantial number of the leaks and indications occurred in the Spent Fuel Cooling System. If in fact, there was one location which dominated as far as the leaks and the indications on that Spent Fuel Cooling System it was associated with a portion of that piping system which was used for mid cooling of the -- what I call the refueling transfer canal area -- a portion of the system which would normally only be used, in fact, would only be used at each refueling. So, that the normal service for the lines where the dominant indications/leaks occurred is a line which during the approximately seven years that the unit has been in operation have been exercised I believe approximately six times.

Is that fundamental with the area you were interested in?

DR. DILLON: You have any idea what the interval was before you discovered the -- How long was it between the discovery of the cracking and the last time it was exercised?

MR. CRONEBERGER: It would have been exercised basically within a month or two of when it was found. We were refueling what was that January through March?

MR. ROSS: We shut down for last refueling February 16.

MR. CRONEBERGER: February 16th?

MR. ROSS: -- was the time off we were back off March 27th.

MR. CRONEBERGER: Okay.

DR. DILLON: That was a month?

MR. CRONEBERGER: So, it was March 27th --

MR. ROSS: Six weeks.

MR. CRONEBERGER: -- and we discovered the leak April 4, 1979. So it was something approximating a month before the discovery of the leak that the system would have been last used. It would have been used I believe six refuelings or five?

MR. ROSS: We're on a fifth core which means we loaded six times.

MR. CRONEBERGER: Six times.

MR. ROSS: Counting initial.

MR. EBERSOL: May I answer the question about the character of the leaks in one sort of summary aspect. I look upon leaks as a desire of supportive revelation of potential structural failure. As a matter of fact, I'd like to see leaks occur long before structural integrity in a more comprehensive sense as implied.

Have the leaks that you've seen occurred at a point where there was still extensive margins to general structure failure or have they occurred at a point in which structural

failure might have been imminent. I'm talking about gross failure, do you follow me?

MR. CRONEBERGER: Yes.

MR. EBERSOL: I want to include the big pipes and the castings that make up pumps and valves and so forth.

MR. CRONEBERGER: In each case where we have found leaks we have investigated the stress analyses that were performed for the basic service loads. In each case, our interest was to determine if in fact that stress contribution would have been contributing to the leaks. In each case, the calculated stresses are quite low. We're talking about low temperature lines and my recollection of the small thermostresses, dead weight stresses, result in numbers which are like 5000 PSI and low. Very low stresses as far as the normal service loads were concerned.

DR. DILLON: Could I interject here? I have a piece of paper here that is apparently something developed by a users group that had somewhat similar problems to this. In reference to this specific pipe section, which concerns us most at the momemt, there is a point made here that there is evidence that very poor fit up was common in these systems. So, that you had high stresses associated with the fabrication of this system.

MR. EBERSOL: I see.

MR. CRONEBERGER: Again, it was our conclusion

because of the low stresses for the normal service loads, that the stresses were those for residual stresses, stresses associated with the installation of welding the joint.

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MR. CRONEBERGER: Again, it is suggesting that if you amplify the results of the stress analysis.

In the spent fuel cooling systems, we did a stress analysis to ascertain for the worst location in the system and the normal service loads plus the extreme environmental loads, namely the earthquake, how much of the metal section would be lost, and we concluded that one could have a 360°, 50% loss of metal section and it would still satisfy the code stress criteria which was used.

We have been specifically looking at what the significance of the loss of something approaching let's say an inch and a half for a through wall crack on those service loads, but I would estimate that the resulting stresses even for the design loading conditions, not the loads that were actually experienced, but the design loading conditions which suggest there is a very substantial margin.

DR. LAWROSKI: Are you aware of anybody else experiencing this with their plants?

MR. CRONEBERGER: To my knowledge, no. I have not heard any results of the examinations which I believe others are pursuing right now.

MR. ETHERINGTON: Can the staff enter that answer?

MR. TABOADA: I am Al Taboada, from NRC.

We have a bulletin out requesting people to examine their piping of similar types where there is a stagnant or near stagnant fluorated water --

MR. ETHERINGTON: At present there is no evidence of a serious problem elsewhere?

MR. TABOADA There have been cracks found in other plants. Arkansas, for example, had cracks prior to the cracks that occurred at TMI.

They tend to be in the containment spray system. I believe there are a half a dozen or so plants that have had conditions similar to this, but not to the degree that TMI has had, except for Arkansas.

MR. CRONEBERGER: One other slide I have in here to try to summarize some of the data for the investigations performed to date where we have not indications, but confirmed cracking, either by leaks or by radiography or having pulled out the joint and performed a metalagraphic examination, we still of the number of heats which were identified on the previous slide have only confirmed the cracking to have occurred in the two heats which were identified here.

I discussed, as I showed the three tabulations on the -- which joints had indications or leaks the

question of the shock versus the field and this tabulation simply summarizes and demonstrates the dominance of the indications or leaks which occurred on the field welds and the relatively high portion of those which are in areas which have been confirmed as being repaired field welds.

Now, the various approaches that were looked at for addressing the repair, the actions being taken are where the repair method employs removing the joint with the indication, the replacement materials are type 304-L which will have a hardened content of .035% or lower.

We are performing buttering using the 308-L material on the idea of the pipe to protect the heat affected zone on the type 304 material which will still remain and we are satisfying reg guide 131 requirements as far as welding procedures are concerned.

DR. LAWROSKI: Excuse me, would you go back to the slide of shock versus field welds? Is there an explanation for the core predictability between the second and third lines? I take it that that means predictability?

MR. CRONEBERGER: Yes, if in fact --1939 293

DR. LAWROSKI: It is a rather poor correlation.

MR. CRONEBERGER: If in fact there would be

a normal distribution of the indications recognizing what the population of shock versus field welds were we expect to have a larger proportion of the expected number of indications leaks to have occurred under the shock welds and indeed the reverse was the case that it appears that the field welding and particularly the repairing of the field welds is a dominant factor.

In short, I feel confident that this is demonstrating that the welding procedures or controls for field welds was a dominant factor in the high residual stresses which contributed to this problem.

MR. CLARK: The prediction was a very simplistic one assuming it was all one population. The results seem to show they are two very distinct populations.

DR. LAWROSKI: Do you expect that to influence your practices in it.

MR. CRONEBERGER: Indeed, as far as the repair procedures are concerned it has a very dominant effect on the practices.

MR. CLARK: And surveillance.

MR. CRONEBERGER: Now, one last thing which was discussed these are the steps that we are taking now to address the identify conditions at TMI-1.

In addition, we still have some outstanding work being done by Batelle Northwest.

We also have some work which is -- which we are contributing to being sponsored by EPRI. We also are in the process of developing an in-service, a supplemental in-service inspection program for examination of those joints which we identified being from material or joint types which are not being repaired now but we think should be continued over a period of time to be examined.

DR. DILLON: Excuse me.

MR. CRONEBERGER: Yes?

DR. DILLON: May I make one, an expansion to your comment in reference to the work done at Batelle Northwest. We are indeed working on pipe section from Three Mile Island Piping.

The work in subject though, is funded by DOE on a program on fuel storage. It is not a program that is directly funded by Three Mile Island.

MR. CRONEBERGER: I believe there was some work done by Batelle Northwest which was directly funded early, but I think as far as anything remaining now, I believe that is correct.

DR. DILLON: That isn't my recollection, but it really isn't important one way or the other.

MR. CRONEBERGER: And that basically concludes the summary of where we stand.

We have a specific program for repair developed now which is being implemented.

We have a program for longer term monitoring of the systems, both monitoring environmental conditions and monitoring joints, and we are also pursuing changes in practices as far as use of the systems to assure that where the system does permit more frequent active use of the system to avoid the long stagnant periods that indeed those systems will be exercised.

DR. LAWROSKI: It would seem to me that you have to look for something that is more for giving as regards to the, call it, QA and fields welding.

MR. CRONEBERGER: Again, I think as far as the field welding practices we have a uniquely developed welding procedure and enhanced quality control coverage of use of that welding procedure for the repairs.

DR. DILLON: This is a difficult problem because we are attempting to apply criteria as far as elimination of stress codes and cracking are concerned that are developed and understood for BWR kinds of conditions.

We are looking for the improvements that might be anticipated in going to low carbon steels and this sort of thing.

As yet, we haven't really identified what the combination of environmental factors might be that are producing the effect.

So, I must confess that the fixes that are now described by Three Mile Island are perfectly rational in terms of what we know of our stress codes, and cracking under these general conditions, but they have not been satisfactorily demonstrated for the particular situation that we are dealing with.

I wanted to comment a little bit on the environmental work that I believe is being considered by EPRI and which no doubt would be related to Three Mile Island ultimately.

And that includes an attempt to monitor in stagnant areas and in cool areas generally; such factors as the relative passivity of the steel service that would be determined by the appropriate monitors.

That gets back to this general uncertainty about the precise nature of the environment in this stagnant pipe in the absence of any available sampling to determine what might have been present in that solution.

Of course, that is sort of after the fact kind of information, but it may be helpful in explaining what is going on and it might explain what caused

the cracking in your particular case.

I wanted to ask a few questions about the environment,which are going to be necessarily be conjectural, I am sure.

They have to do with first of all with the fact that we may have encountered at one time or another some incidents of high chloride, and we are talking about part per million quantites, I have noted in the handout that at least on one occasion you had something at close to 2 parts per million, which in the cool of the rough size that you are dealing with is pounds of chloride, and I wanted to inquire as to as whether or not there was anything in the history of the client that suggested that you might have gotten chlorides in those quantities in your cool, or should I conclude that the analysis itself was at fault?

MR. CRONEBERGER: In the investigations that were performed on the water chemistry aspects there were some cases where the analyses indicated some upset condition.

To my knowledge those investigations did not discover any reason why those upsets might have occurred. Mike, can you respond?

MR. ROSS: Mike Ross. We know of no reason why we should have any high fluoride contents.

There are no unusual events similar to unit two events where they got sodium hydroxide in their system or anything like that, but we are aware of unit one at this time.

DR. DILLON: Is there any coupling at all of either your caustic solutions that are used for core spray systems or perhaps thiosulfate leakage into the system which I think were shown to be farily high chloride contaminated and might have been the source of the kind of levels of chloride that you are discovering here.

MR. ROSS: I don't understand the question, sir.

DR. DILLON: Well, I am trying to come up with a rational explanation, if one exists, of how you might have gotten the upset chloride condition in the cool.

MR. CLARK: Is there any inter-connection from your caustic or your thiosulfate systems?

MR. ROSS: The thiosulfate tank and the caustic tank both have inter-connections in there existing systems through closed valves. The valves are operated on neo-signal and when we lock shut, we are down. The inter-connections do exist, the valves are controlled, the possibility would exist

through that path.

MR. CRONEBERGER: To your knowledge there haven't been no identified periods when there has been leakage through those valves. That was the indication of our people who investigated --

MR. ROSS: And I know of no time when we actually had an incident where a valve was opened through neo-signal, we actually took caustic and thiosulfate in our systems.

DR. DILLON: Well, I confess that I am not very much concerned about the caustic because the ph never showed a corresponding change, but the thiosulfate might be a possible entry point. Nobody analyzes for sulfur and with chloride contamination in the thiosulfate was somewhat higher. So, that would be the area of where you would think first to look, and may I ask another question which is not entirely related to this inquiry but is a matter of some concern.

Did any occasion during the unit two problem was there ever a possibility that core spray material could have gotten into the fuel storage tank?

MR. ROSS: If I understand your question right, the question was, was there ever a possibility where the inner tube spray --

DR. DILLON: Got into the unit two fuel storage.

MR. ROSS: Got into the unit two fuel storage.

DR. DILLON: I realize you have had no problems there it is just a matter that I am not clear in my own mind whether you ever used the core spray system in this incident, and if so, could have it found its way into the fuel storage cool?

MR. ROSS: Okay, the building spray system in the unit two was used during the course of the accident and it ran some three minutes and thirty-one seconds.

Now, whether or not it could have gotten into the fuel core of unit two, I don't see the path ready and available to me or apparent to me for that to occur.

MR. WALACE: There was a short period of mass transfer out of the reactor building after the accident which occurred long before the accuation of the core spray system. Since the actuation of the core spray system there has been, with the exception of a minor sample which were drawn recently, there has been no mass transfer out of the building.

So, that water would still be in the reactor building.

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DR. DILLON: And I assume that analyses are made on a regular basis on the unit two fuel storage pool, so there is no evidence of high chloride or anything in that environment?

MR. CRONEBERGER: Again, on unit two you have to appreciate there is no fuel in storage in the inner tube pool, the pools are dry.

DR. DILLON: All right. There is not. Excuse me, that was unnecessary.

MR. ETHERINGTON: Are there any further questions?

MR. WALACE: Mr. Etherington, in answer to your earlier question about whether or not the piping system were quenched, the answer to that question is yes.

MR. ETHERINGTON: Yes, what is the answer?

MR. WALACE Yes.

MR. ETHERINGTON: It is quenched?

MR. WALACE: Yes.

MR. ETHERINGTON: Thank you.

I would like to ask the staff, this is an item outside of the NRC orders isn't it?

MR. SILVER: That is correct.

MR. ETHERINGTON: Are there other items outside the orders? I think there are.

MR. SILVER: Yes, indeed there are. There are items that the staff is reviewing in let us say the normal course of events that are outside the order we can address those.

MR. ETHERINGTON: But, we haven't discussed any of those up to now, excepting this one; is that right?

MR. SILVER: That is correct, yes.

MR. ETHERINGTON: Thank you.

Do you have any comments on the latest presentation?

MR. SILVER: Yes, I would like Al Taboada of the staff to give us a brief statement of what the staff is doing in this regard.

MR. TABOADA: I'm Al Taboada again. I am from NRC staff.

We have been following this problem. To date, we haven't had the all the information that I feel we need to make a good judgment.

We have been involved in both the non-destructive testing procedures that have been developed by Met Ed to do this work. We have reviewed those and some of our consultants reviewed them and we find that in general they are consistent with the general approach that is used in administering for lengthy examination. However, we have asked Met Ed to do some disruptive evaluation

on those sections of pipe that are being removed and have been removed where the UT examination have determined that the communication system to establish that the UT techniques really do find cracks.

I think in their initial testing they identified a number of conditions which apparently are geometric dis-continuities rather than cracks.

It was in their second approach that they developed two different techniques.

The initial technique determined that quite a few indications which the second technique later culled down to approximately forty and these forty indications will apparently, as I understand it, will be removed and will be examined disruptively to verify that they are perhaps to establish what they are if they are not cracks.

At that time, we will have a better picture with respect to what should be done about the overall surveillance program for the piping.

In addition, we have requested Met Ed to send a section of one of the leaking pipes to one of our contractors at Brookhaven National Laboratory so that they might do an independent metallurgical evaluation of that condition.

The one unique aspect of that particular

piece of pipe that is going to work with them is that it has not been contaminated by cleaning solutions or a liquid penetrant solution. So, in a sense it is a virgin piece of material that still might have the contaminants in the crack.

So, we are anxious to see what they might discover.

We are hoping we can shed a little light on what the contaminant is that might be causing the crack.

Brookhaven has also been doing some studies in this area where they have not managed to correct the stainless steel that has been sensitized using the straight boric acid solution.

However, it is our understanding that they have at least in early testing cracked it with some thiosulfate additions.

So, it would appear to us in our preliminary evaluation that the corrodent in this case is probably a contaminant. That is what was suspected and reported in the work that was done in Arkansas plant.

I believe it was, well I am not sure who the laboratory was that did the metallurgical evaluation but I was going to say the Batelle Columbus, but I am not sure, however, it was reported it was possibly due

I guess we do have a request out so the people, the BWR people in general to review this problem in their plants and we expect within the year to have some results on the examination of their piping.

MR. ETHERINGTON: Why would you assume that the BWR people don't have a problem?

DR. DILLON: No boric acid.

MR. ETHERINGTON: Not in the pool?

MR. TABOADA: The BWR people don't have boric acid, however, we are not sure that --

MR. ETHERINGTON: And we are not sure that boric acid is --

MR. TABOADA: The reason we are going with PWR's is because that is where the occurrences have been and I think when we get through examining the problem we may have a better insight as to whether or not we should review it and leave that question with the BWR people.

There is a requirement that all plants do an in-service inspection on these pipes as part of the overall insert inspection program so it occurs in the the BWR plants that we would expect to find it in the course of time because of those inspections.

However, in the case of PWR at the plants the occurrences have occurred specifically in the areas

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of stagnant and non-stagnant effluents that have been in the primarily in certain systems and looking at those systems and specifically what we want to look for in them.

I believe that is all I have.

MR. ETHERINGTON: Any questions?

MR. WALACE: Mr. Etherington --

MR. TABOADA: One more point, excuse me. We do have -- the NRC has initiated the PWR or type crack study group who will certainly review this as part of their overall -- they expect to have completed their work in six months.

MR. ETHERINGTON: If there had been a complete break in one of these pipes, would the consequences have been serious, would there be plenty of time to rig up an emergency cooling arrangement?

MR. TABOADA: I haven't been --

MR. ETHERINGTON: No, it is not your field --

MR. TABOADA: Right. It is my understanding that certainly in -- do you want Met Ed to answer the question?

MR. ETHERINGTON: Either, yes perhaps or someone in the staff.

Has this been analyzed as an accident?

MR. SILVER: I am sorry, sir, would you repeat?

MR. ETHERINGTON: Supposing one of the pipes had broken completely suddenly was there a major problem or would there be plenty of time to rig up an emergency cooling?

MR. TABOADA: It is my understanding that this spent fuel coolant release that this would not be a problem. That there is a redundancy in the cooling systems and in addition to that the -- all we needed is when they are moving fuel and they have time to rig up portable systems such as fire hoses, et cetera.

MR. ETHERINGTON: Yes, sir, that sounds all right excepting when you hear it is an eight inch pipe, that doesn't sound like a very small --

MR. SILVER: It is a ten inch pipe.

MR. ETHERINGTON: Ten inch, is it? Of course, you could let the pool get hot obviously. No problem there.

MR. WALACE: Mr. Etherington, we have in general, these systems are low energy systems and we have analyzed in the past through all cracks and leaks rather than catastrophic failure. We are going back to look at the potentials and as Mr. Croneberger indicated earlier he has some analysis on the potential for failure, we are looking at the effect.

We think that there will be ample amounts of

time to isolate any particular break location and take remedial action.

MR. ETHERINGTON: Yes, in low energy I think it is only a seismic event that it would be likely to cause a sudden fracture.

MR. CRONEBERGER: If I might just amplify. The design basis for the spent fuel cooling system is again redundant systems with the heat low associated with a full core load. That would be the normal design basis for a spent fuel cooling system.

In the investigation of this problem, we did in anticipation of what would be the requirement if in the repair we have a totally disabled the spent fuel cooling system investigate how long it would take for the cooled temperature to get up to boiling and that time would demonstrate it that we had I think it was eight to ten days of key up before we would achieve that temperature, and that temperature in itself would only then start causing a loss of the water in the pool, it was not necessarily a point where there would be a catastrophic occurrence. But, anyway we did that investigation based upon the heat load for the fuel currently in the pool and it was approximately eight to ten days to get to 212°.

MR. ETHERINGTON: Yes, it would be my judgment

that there is no serious problem but I think it probably should be looked at.

Any further questions?

MR. EBERSOLE: That eight to ten days, that was -- you said would the fuel principally in the pool, what about the worst case of a press charge in the pool.

Let me give you the basis why I ask you.

I recall a case where we were looking for possible boiling in the pool as a final method of cooling and one of the problems was there was about eight feet of concrete around that sheet metal liner and the liner is attached to it and the concrete doesn't move very fast but the cladding does and the cladding was attached to concrete by pin fasteners and it seemed to be a possibility of buckling if the cladding rose much faster and the temperature to the concrete which led to stresses of the points where the testers were attached. What would be the shortest time before you would expect trouble with the differential movement from the cladding to the concrete?

MR. CRONEBERGER: First of all, the investigation that we did was on the basis of what would occur if we hadn't the safety system now. I don't believe we did the analysis that you are suggesting. I would like

however, to suggest that simply because there may be instability of the pool liner, it does not suggest that there is leakage of the pool.

That the instability of the liner does not suggest high stresses in the liner.

MR. EBERSOLE: You don't think it would pull out the anchor , it may buckle but that wouldn't lead to a leak.

MR. CRONEBERGER: It is very similar to the containment liner.

MR. EBERSOLE: All right, thank you.

MR. CLARK: But, basically, unless and until you disable one cooling system you have redundant systems either one will work all the evidence is that it will leak and not break and that there is a lot of margin you can take the design stresses even with a crack all the way around and half way through. So, you know, we are pretty far down the path before we get anywhere near this problem.

DR. DILLON: I am not clear about how much water can leak out of the pool in the event that you lose this line with a guilotine break.

MR. WALACE: The pool is designed so that there are no penetrations below a certain relatively high level. They go through a surge tank and an overflow

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at a very high level. So, it is a closed box below that elevation, well above that level of the fuel.

MR. ETHERINGTON: Well, it will siphon down to some level or is there another siphoning at all?

MR. WALACE: It will drain down into a level and there are anti-siphon features in the design then against siphoning additional water out.

DR. LAWROSKI: Is your pool below grade, or mostly above grade?

MR. ROSS: The pool in unit one is mostly above grade.

MR. ETHERINGTON: Are there any further questions? Thank you.

MR. WALACE: Mr. Etherington, before we proceed with the remainder of the program I would like to provide the press releases on our organizational --

MR. ETHERINGTON: Oh, thank you.

MR. WALACE: -- anticipated organizational changes. If you have any questions which you would like us to specifically address, we will be glad to do it at the full Committee meeting.

MR. ETHERINGTON: We will look at those.

Item 12 is other questions as indicated by the Committee. This is attached and if we have anything additional to those items as we have discussed --

Tape 3
24 end

(Whereupon at 10:15 a

recess was taken.)

MR. ETHERINGTON: The next item on the program on the agenda, item 5, is the Committee caucus and selection of items for presentation to the Full Committee on February 8 or later meeting if so determines.

MR. MULLER: You've missed this item here.

MR. ETHERINGTON: Oh, I've forgotten that one.

MR. SILVER: You seem determined not to do that one, Mr. Etherington.

MR. ETHERINGTON: Yes, I'm ahead of myself.

Okay, the Staff's status report.

MR. SILVER: If I may before we begin that, during the break, I communicated with our security people in Bethesda; and they have brought me up to date on where we stand with regard to the security proposals made by Met Ed with regard to the separation of the two units.

A formal second or third submittal actually was made on January 9, by Metropolitan Edison which has been reviewed and essentially accepted by our security people. I do not believe this has been formalized as yet. But, they are satisfied with the measures being taken by Met Ed.

There has been one additional item which has apparently not been discussed with Met Ed and there has been in the last couple of days some communication difficulty in getting the people together to pass this along. It has to do with hardening the final access control point, and I'm sure it

will be communicated to Met Ed within hours or certainly, next Monday.

With that one exception and there is no problem anticipated with that one, we do not have any problem with the security measures being taken by the company to separate the Units 1 and 2.

DR. LAWROSKI: Mr. Silver, have you read the sandia reports dealing with vulnerability of --

MR. SILVER: Yes, sir, I have. Not recently, I might point out.

DR. LAWROSKI: Has anybody from Met Ed read those?

MR. WALLACE: Sir, I am not personally familiar with that report and I don't believe that we have anyone here who is, but I'm sure we've had people --

MR. CLARK: We don't have our security people here.

DR. LAWROSKI: Well, it's more then just security; I'm interested in whether your management people had read -- there are about three reports including this so called Michaelson report which I think it would be well to read before coming before the Full Committee.

But, these reports are very germane with respect to the hardening of Unit 1 particularly during the rather extensive activities that are going to be occurring at Unit 2 for quite some time, including the presence of many contractor personnel, if I heard correctly yesterday and today.

MR. SILVER: As has been indicated a couple of times yesterday and today, there are issues outside the scope of the order which have arisen during the TMI 1 reload evaluation or in the course of events not connected with the TMI 2 accident.

These are not being considered with relation to the restart of TMI 1, except as they may relate specifically to various items in the order; and those that do will be, of course, coordinated closely with the people in organizations doing the bulk of the work.

Dominic Dianni who is the DOR project manager on TMI 1, separate from the restart order, is prepared to give you a status report on these items which we have called just to name the group just to name the group, the back log items.

MR. DIANNI: As Harley said, my name is Dominic Dianni and I'm the project manager for TMI 1 for the back log items. These items were ongoing and I may add that they're common for most of the operating reactors in varying degrees.

Some of these back log items are generic in nature and others are unique to TMI 1. Now, as far as the total number of items that are outstanding, there are 37 items that are outstanding; and I might add that this is pretty much common for other operating reactors. They generally vary from about 35 to in the areas around 40 or so. So, this is not unreasonable.

If one assumes that the startup will take place in the fourth quarter of this year, our present plans are that we could have 32 of these items complete: five items would be open, but these items are considered not affecting the safety of the plant.

For an example, there is one item which is the cast drop. That problem will be solved after startup since they won't be shipping any fuel before startup. Sc from a priority standpoint, we put those type of open items in that B catagory.

DR. LAWROSKI: Excuse me; how do I interpret that A, the 32, it says number of items scheduled for completion if is permitted. Is that by the fourth quarter or considerably before the restart?

MR. DIANNI: Well, we don't know the exact date of the restart today, so what we're doing is we're --

DR. LAWROSKI: Well, what is your anticipated schedule for completing those items? Of the 32, is it going to be 28 of them, is it going to be --

MR. DIANNI: No, it will be all 32.

Now, I should also mention, at this point, if you look at item C, there are some of the items --

DR. LAWROSKI: Could all 32 by the end of the third quarter in 1980, or well before then?

MR. DIANNI: Well, in the fourth quarter.

DR. LAWROSKI: Go ahead.

MR. DIANNI: Well, I guess for planning purposes, we could say that we certainly would have those items completed say, in November of 1980.

Now, some of these items that are in the 32 are items that we consider could be impacted by the hearing or the interrogatories. Of course, if they are impacted, well, then they would be delayed.

An example of this is the -- we have the revision of the filter technical specifications that are in progress now. That could be impacted by the hearing.

In the group of the 37 items that are left open, a lot of them were generic and they are a problem to most of the operating reactors that are similar in design to TMI. And that turns out to be 24.

As far as items that are unique to TMI, that turns out to be 13. Now, as far as some of these items that are unique to TMI, I should mention, are revisions to the technical specifications, certain parts and bringing them up to today's standards.

My next three slides is a detailed breakdown of these items. Incidentally, here in the comment section, these letters correspond to the catagory items in the first slide. I will go down -- I won't hit each one of these items because some of these are in review by the technical staff,

but I will just go down say, take for an example, the small break ECCS. This was part of the exemption that was issued during the number five reload. And, we expect that item there would be completed by startup.

The conversion to the standard technical specification: that would fall under a long-term item which would be not critical to startup, but it will be bringing up the technical specification up to today's standards.

As far as the filter technical specification, this, too, would be bringing up the technical specification, the license, up to meet Reg guide 1.52, revision 2.

Incidentally, if you have any questions on any one of these specific items, I will be glad to answer it if I can; if not, I can certainly get the answers for you.

We talked about the pipe crack problems. This is item number 13 on the list, this is one of the items that although it's not on the order, it will be completed. In other words, the resolution to this problem will be resolved by the time of startup.

As far as inservice inspection and testing is concerned, this is to bring the requirements in the technical specification up to meet the ASME Section 11 code. This is item number 20 and is concerned with the valve testing and pumps and item number 21, pertains to the surveillance program of wells.

A long term item, which is number 23, is the hydraulic snubbers. This is concerned with -- there are requirements now in existence for the surveillance program for hydraulic snubbers. This would be bringing it up to current standards.

There was also mentioned yesterday, I believe, the problem with containment purge. This item over here deals with the valves themselves, the purge valves, so that in the event of a DBA LOCA accident, the valves will be able to close.

Now, the licensee has committed to 90 hours of purging per year and there was also another letter that was issued on the 28th of this month where it would limit that when the valves are -- when they are purging, they would limit the opening of the valve to between 30 and 50 degrees open.

We have asked the licensee to commit to this within 45 days of the receipt of the letter.

Is there any of those items on this view-graph that any of the Committee Members would be interested in?

DR. FOSTER: Back on your previous page, item 8, elimination of non-radiological environmental from the test specs, is that because that's being transferred over to EPA to state?

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MR. DIANNI: That is correct, yes.

MR. ETHERINGTON: Any other questions?

MR. DIANNI: With regard to the degraded grid voltage problem, this is being worked on also and there is really another part to this one and this is the voltage distribution for the undervoltage problems associated with that. And this would be one of the items that, of course, would be completed prior to restart.

Moving on to say, take item number 33 the uneven drawdown of the reactor building: this change will also include the changeover from the use of sodium thiosulfate and in its place we'll be using sodium hydroxide. And this is to assure that during the spraying of a containment, that item 131 is taken up with the sodium hydroxide.

DR. LAWROSKI: You presently have been using thiosulfate, did you say?

MR. DIANNI: Well, thiosulfate and together with sodium hydroxide.

DR. LAWROSKI: With sodium hydroxide.

MR. DIANNI: Yes.

DR. LAWROSKI: But, you plan to eliminate the thiosulfate?

MR. DIANNI: Yes, and go strictly with the sodium hydroxide.

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Associated with this particular problem is also whether you have several tanks that contains the solution and it is to control also at the nozzels inside containment to

assure that you will have a pH of between 8.5 and 11 ; so, this is another phase of the problem to make sure that whenever you are drawing down, you will have the proper pH at the nozzels.

Items 34, 35, and 36 deal with security and some of these are ongoing programs.

Item 37 is -- will illustrate a typical item that is unique to TMI. This had to do with the instrumentation calibration for measuring power level, and these are -- you have to calibrate these periodically together when you do your feed balance and power balance to make sure that they meet. There were some problems in this area. I should say that this has been resolved and is just a matter of preparing the SER.

Another thing that I should also mention here, well, a good bit of these items in here will not result in the test spec change. They will be written off by a safety evaluation report.

MR. MATHIS: One question: what's the significance of item 30 when you look back at item 25 on the previous page: wouldn't that be covered? I guess what I'm really asking; are these things really individual items or are they apt to be duplicates?

Number 25 is containment leak testing --

MR. DIANNI: Oh, yes.

MR. MATHIS: And 30 is containment leakage due to seal deterioration: I guess my question is what's the difference?

MR. DIANNI: Okay. The difference: as far as this item, this is meeting the requirements of Appendix J which it may require an exemption. Whereas, in the case of the seal leakage, this has to do with long term wear of the seat and it may be -- and it's more or less like a probability analysis that sometimes you don't seat the valve properly and you get slow leaks and this may progress with time.

I don't know if I made myself clear on that.

MR. MATHIS: I think so. I'm still convinced of the duplication.

Because if you've got progessive leakage, it's going to show up in testing by and large. So, I don't look at this as being two separate distinct entities, as far as cleanup programs are concerned. Maybe I'm getting the wrong impression.

MR. DIANNI: I can look it up for you.

MR. MATHIS: It just looked a little peculiar; it's not worth spending that much time on. Thank you.

MR. EBERSOLE: Could you clarify a point for me? When I look at this list, it appears to be oriented to more or less specific topics that are of the design change character or a modification of some sort. And then I look back on

the agenda here and recall the discussion that we've had about procedures and administrative changes in a variety of sorts. And the one I have a particular interest in is the supplementary emergency procedures, which take up the matter of failure, of the same failure criteria, which I understand is in prepartion but by no means finished.

I don't see that you have that identified as a back log open item, but surely these administrative matters must be still open. You don't characterize them on this list as being still open.

Do you follow me?

MR. DIANNI: Yes. I think I do.

MR. EBERSOLE: I'm saying you have characterized a number of topics here and more or less indicated these were all of the open items, but I think there a many number -- many administrative type items that are still open, including reviews, well, even preparation of review of such procedures that I have mentioned.

MR. DIANNI: I guess I should have mentioned this earlier. This list, or the numbers, change from month to month according to -- if I would have given you this presentation in November, that number up there would have been 44. But, you see, they keep on coming in, and this is in our course of review.

Now, what you are saying is absolutely right: that

would probably be coming up and showing up in our list.

MR. EBERSOLE: You mean as added to that list?

MR. DIANNI: That's right.

MR. EBERSOLE: It's kind of discouraging to see added things to the list; I'd rather see them come down than increase.

MR. DIANNI: Well, it did come down from November.

MR. EBERSOLE: Well, there certainly must be a number of administrative procedures in other documents in preparation which are still open.

MR. DIANNI: That's right.

MR. EBERSOLE: But, they're not identified there at all.

MR. DIANNI: That's right. Well, as far as administrative procedures, some of these are included in here. It depends on which -- what you mean.

Like, for an example --

MR. EBERSOLE: Well, let me give you a case in point.

I hear that we have an alternate procedure for feed bleed. I don't think it's developed yet.

MR. WALLACE: Excuse me, Mr. Ebersole, if I can interject. The procedures which you're referring to in our procedure revision program is in progress; it is not yet complete, but it is covered under the order--

MR. CLARK: Under the order --

MR. WALLACE: And would not be listed under this particular list.

MR. EBERSOLE: Okay, then these are exclusive of the order item --

MR. WALLACE: Yes, sir.

MR. SILVER: I tried to make that clear in my introduction. These are exclusive items, except that some of them are related to items in the order.

MR. EBERSOLE: So, this list is exclusive, then, of those order items.

MR. SILVER: Yes, sir.

MR. EBERSOLE: Thank you.

DR. LAWROSKI: Are you nearly through with this?

MR. DIANNI: Yes, I am. If there's any other questions, I'm finished.

DR. LAWROSKI: Okay.

MR. THORPE: Could we comment for just a minute on that subject?

DR. LAWROSKI: Yes, sir.

MR. THORPE: The company is in the process in attempting to develop a firm schedule that we will work to for restart. Even recognizing the uncertainties of the hearings et cetera, we need to have a date towards which we focus all of our efforts.

To that end, we will be working with the Staff and really need them to identify which items are required for restart, even if it occurs earlier. There's some possibility that our date for restart would be a little earlier than the fourth quarter when we try to set the schedule. And it is going to be important to us to get that identification of which things are required for restart and which can be handled on the schedule consistent with other plans on which the same questions exist.

DR. LAWROSKI: Thank you.

Did you want to add something, Mr. Silver?

MR. SILVER: I would just like to say, of course, that we understand this need and Dominic and I and other people in the Staff will work towards that end to assure that those that we will require, we collectively, will require for a restart are, in fact, identified and transmitted to the licensee.

There will probably not be a large number of these, that is my guess, that we will require. The number here of 32 are simply those that are expected to be resolved. Some of them, in fact, will be required; others will not

MR. DIANNI: Thank you.

DR. LAWROSKI: Thank you.

I guess, Mr. Chairman, we've reached the point where I think we were going to ask both the Applicant and the

Staff to indicate what it is that they would hope to achieve from a meeting with the Full Committee at this time when, obviously, there is still much to be done.

MR. ETHERINGTON: I think that's good.

DR. LAWROSKI: So, I don't know which one of you --

MR. ETHERINGTON: I think we might ask Met Ed first.

MR. THORPE: All right. First we recognize that it would be unusual to go to the Full Committee with the number of questions which is presently open; that that would be an unusual situation.

We believe, however, that the TMI situation is in total unusual and in at least two respects: one, the review being made by the Staff and in some respects, I think, by the ACRS is more detailed than in the past, and of necessity, can't be completed until later in the process. We need that more detailed work done before it can be reviewed, et cetera.

So, that's pushing the final review off.

Second, the TMI accident has caused a great deal of basic re-thinking of safety systems, regulatory requirements, et cetera, by everybody involved: by us, by the Staff, by ACRS, by Commission, et cetera.

Therefore, the review, we think, by the Full Committee has a great potential for getting into undefined areas,

areas where criteria are just being developed.

Even if a second review with the Full Committee would be required, it would be our strong desire to have the review next week in order to, from our standpoint, attempt to identify those issues which the Committee would have; and perhaps, be helpful to the Committee to have the chance focus more directly on this problem early on while there's a chance to have a little more time to think it over before coming to a final conclusion.

So we also think that that meeting next week would be consistent with the sense that we have of the Commission's orders and the Board's order to proceed expeditiously; that it would be helpful in attempting to do that.

MR. ETHERINGTON: In the event there were a meeting next week and the Committee felt that it could not write a letter, would that still be helpful?

MR. THORPE: Absolutely. Even if we knew today that it would require two meetings, we would strongly prefer to have a meeting next week. It would nice if it could all be settled in one, but we recognize that it may well not be possible.

MR. ETHERINGTON: I don't think you can assume that there will have to be a later meeting. I don't think there's any chance that next week's meeting could suffice.

And it might very well be that the Committee might say, we're not prepared to write a letter and the only letter would be written after the second meeting.

You say that this would still be useful?

MR. THORPE: We would still prefer to have the meeting next week and address the items at that time; yes, sir.

MR. ETHERINGTON: Does the Committee have any questions?

DR. LAWROSKI: I think I very much agree with what you've said, Mr. Chairman.

Could we hear from the Staff?

MR. ETHERINGTON: Yes, do the other Committee Members have any questions?

MR. EBERSOLE: May I ask a question?

Suppose that you come to the Full Committee meeting and there's always a limited time period there. I have my own views as to what you might present when you went up there, but maybe you've got a different one.

And what we're viewing this whole situation, the TMI incident, is that a few salient things come out of it: one is the importance of the operators. There's some design changes, of course, but I think the operators, now, are -- have a new recognition.

Beyond that, is what can the operators do if, in a broad sense, the single failure criterion doesn't work?

And I heard earlier that you have supplementary procedures where you branch out from the normal operating procedures and you have some diversions which, I think, you represented as being in a supplementary document to the emergency procedures.

It would be my own opinion you would want to sort of talk about things that had never been talked about before like this diversion that the operator can undertake and succeed in doing if the single failure criterion fails and matters of that sort. Now, maybe you have different views.

MR. THORPE: Well, I think we certainly would want to talk about the operator. We would talk about the "what if" thing that you referred to.

I think that we would be very glad to have any guidance that the Subcommittee could provide on subjects which you feel would be particularly important to the Full Committee; and we would attempt to address those.

MR. ETHERINGTON: Do you think that that will come out during the Subcommittee's caucus and we may speak to that later.

May we hear from the Regulatory Staff on their position with regard to a meeting now.

MR. SILVER: Well, we considered the quality, the completeness, the scope of our safety evaluation at the time it was prepared and considered whether it should even

be published as it stood; and whether we should proceed in through ACRS and so forth. And we decided that primarily because of the Commission's directive to proceed expeditiously that it should, in fact, be issued.

We realize, of course, there are a large number of open issues. I would suggest that discussion by the Full Committee with a follow-up meeting, if it's necessary, would also work in the direction of expediting the full process.

MR. ETHERINGTON: Even though, again, no letter might be written next week?

MR. SILVER: I might suggest that some kind of letter, obviously this is really a suggestion, identfying additional issues that should be discussed, should be examined as part of the restart program might be in order.

MR. ETHERINGTON: Well, I have no feeling whether the Committee would write a letter or not, I'm just exploring this possibility --

MR. SILVER: I quite understand. My point is that following the idea of the Committee assisting, so to speak, in the process, this might, in itself, be a useful function.

MR. ETHERINGTON: Well, yes.

MR. SILVER: Just to go a little further, as Mr. Arnold noted yesterday, most of the conceptual ideas have been submitted and, in fact, accepted by the Staff. Most of the open items, as Mr. Etherington himself noted earlier,

are minor; they relate to details in design of procedures and so forth which the Committee normally does not get into.

For those items where conceptual resolution has not yet been agreed upon, there are very few items in dispute between the Staff and the Applicant: There are some. I said Applicant, I meant Licensee, of course. Met Ed has given us a schedule for submittal of all items which would permit our review in time for a supplement in mid-March.

I would point out that if, in fact, we do issue a supplement in mid-March, the normal time spans would result in a full ACRS meeting in May which constitutes a three-month delay from even a first meeting in February.

The Staff does believe that it would be helpful in proceeding with the issues presently covered and in identifying new issues, for the Full Committee to review the TMI 1 restart in February.

MR. ETHERINGTON: Let me ask one more question then.

When must you have a final write-off from ACRS in order to make a fourth quarter startup?

MR. SILVER: That's not clear to me, sir.

MR. ETHERINGTON: Well, let's exclude interventions and things like that from consideration.

MR. SILVER: Because of peculiarities of this case or the unusual nature, it certainly is not -- this may or may

not feed directly into the Staff's evaluation; we would certainly address the ACRS letter in a supplement, as we normally do; but how the Commission might weigh the ACRS letter or at what time, I certainly have no information on.

What affect it might have on the hearing is likewise not clear to me; hearing boards seem to put different weights on the ACRS review and whether that's a matter of law or practice, I don't know.

So, I'm afraid I can't address that.

MR. ETHERINGTON: Is there anything else either party would like to say?

Well, we'll go into executive session and this will not be recorded. Let's record it, shall we? We'll record it.

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MR. ETHERINGTON: Do any of the members or consultants need to leave within the next half hour?

Then we'll -- let's see. I'd like to pass your --

MR. SILVER: May I make a suggestion, Mr. Etherington?

For the record it may be well for the Committee to solicit public comments even though there don't seem to be any members of the public here.

MR. ETHERINGTON: Oh, is that something we should do?

MR. SILVER: I guess it wouldn't hurt if there's anyone that wants -- we've had no --

MR. ETHERINGTON: Is there any member of the public here present who wishes to make a statement?

Apparently, not.

Dr. Silver, we'd like to have your input as to things that we feel should be presented at the Full Committee.

DR. DILLON: All right. I've got a --

MR. ETHERINGTON: Dillon, Dr. Dillon. Excuse me.

DR. DILLON: I have a couple of items here I want to -- I won't necessarily read them but just let me say that my general impression is that the low-pressure boric acid piping systems don't represent a present danger. I do think that any of the high pressure systems involving

low temperature boric acid are a subject of further consideration. The generic problem of boric acid assisted pipe cracking is being studies elsewhere and probably doesn't need any further consideration here.

MR. ETHERINGTON: In other words that couldn't compare to some of the other things that are something of a nonproblem as far as anybody --

DR. DILLON: Well, certainly it doesn't represent any safety problem that I detect.

The second thing that I wanted to mention was the fact that we do need a better information on the chemistry of the fuel storage water. I'd like to see both the analysis and the schedule review for relevance to this cracking process.

I think that the problems of sampling an analysis of water and gas samples in the event of an accident suggest that improved shielding of the sample lines and, perhaps, techniques for taking water samples under conditions where less operator irradiation would occur are highly desirable.

I've heard nothing that suggests any systematic improvement plan for the clearance of the systems.

Those are the principal items that I considered in trying to arrive at what I think are significant items.

MR. ETHERINGTON: Does the Subcommittee wish to comment on these items?

Thank you very much, Dr. Dillon.

Do you have something written there that we can pass along?

DR. DILLON: Yes. It's not terribly legible.

MR. ETHERINGTON: I think I have a lot of written reports from our consultants and members and I think I would like to ask them to read them and comment from them as they wish as they go along.

Dr. Foster?

DR. FOSTER: Shall I go ahead?

MR. ETHERINGTON: Yes, please.

DR. FOSTER: I've focused, principally on the emergency planning particularly from a radiological aspect. One of the things which has come up to my knowledge as new for the first time are these emergency planning zones since this is an implementation of the new Appendix E which is really still in the mill.

So, consequently, it is kind of plowing new ground and I'm not quite sure how this really fits into the overall schedule of the NCRP Requirement. But, relative to the emergency planning zones it's quite clear that Met Ed has followed part of the guidance of drawing ten-mile circles and 50-mile radius circles while the State and County people have quite different ideas about implementing a plan.

I think that since it is somewhat precedent setting that the NRC's Staff ought to take a real hard look at the

intent of the Appendix E language and determine whether or not what is being done here is what they really intended.

My own view is that it makes no sense to have the ten and 50-mile circles on an emergency plan if that is not, in fact, what the State and County people plan on implementing and it could, in fact, be quite confusing if someone is looking at a ten-mile circle and believing that there will be no need for any evacuation beyond that distance when, in fact, the State people are planning evacuations, perhaps, out to 20 miles.

The second item relates to the ability of TMI to estimate source terms at the time of an accident.

These are -- they are always difficult but there are some special soft spots here which we talked about during the review. One of these is simply whether or not the probe which is in the stack is drawing a representative stack sample of what's going up. Another one is whether what the probe is pulling in is ever really getting proportionately to the analyzers and instruments which are looking at it.

It is my understanding that the source terms as estimated at the plant are supposed to be verified to some extent, at least, in the field.

There is some degree of confusion, perhaps, only in my mind as to whether or not those field measurements are in any way supposed to be quantitative. My feeling is

if it is intent that the off site monitoring teams are going to make any real kind of a quantative estimate that the capability of that is very rudimentary both in terms of the numbers of people and, perhaps, their training for doing the job that could be set out but also the interpretation of the information and then, of course, a knowledge of where to go within a limited period of time to get any kind of an off site pattern.

So, I have some substantial doubts about the accuracy of any near-term estimates of source terms and potential doses to groups of people based on that information alone.

Obviously, there is going to be early backup material which is going to be coming in from the State people, from their home teams and from others that are brought in. This will, however, take time.

One of the things which, again, is especially important in this area is the dose estimates which will be made on the basis of source terms and the field measurements.

We didn't probe very much into the capabilities of the Met Ed Staff for doing this, my perception is that much of that under emergency conditions would, in fact, result from the emergency implementation plan in a somewhat of a cookbook fashion but that plan is still in process and I think at the appropriate point why the staff should

really take a hard look at that implementation plan and the radiological aspect of it and how that is really related to rather significant action which might be based on this as far as surrounding populations are concerned.

Again, perhaps, a small item is that in looking at the new emergency plan I didn't see the liquid pathway aspect described. I understand from the State people that such a plan is, in fact, in place where notifying down-stream users. This is a small item, but I think that you should take a second look at that plan to make sure that those liquid pathway items are, in fact, included in the plan.

On the positive side I was very glad to hear of the reorganization was an upgrading of the radiological control function so that it now reports directly to Mr. Arnold, I believe.

I think the Met Ed should be complimented for, that is be complimented --

MR. THORPE: Excuse me, Mr. Foster. Could we correct that the Radiological Plan Department reports to Mr. Herbein, who in fact is a Vice President and in charge of Unit One. But it is completely independent of operations or anything else.

DR. FOSTER: In fact, I did understand that it was to a Vice President, thank you.

MR. ETHERINGTON: Thank you, very much.

Charlie?

MR. MATHIS: Well, in considering a meeting with the Full Committee in response to Harold's suggestion as to what would they like to hear, it seems to me that they would be interested in a general status report, if you will, on progress that is being made to satisfy the entire list of lessons learned items.

I think the other items remaining are -- you had a name for it and it slipped my mind, anyway --

MR. ETHERINGTON: Backlog?

MR. MATHIS: Backlog, yeah. And I think some general status on those would be important. But I think far more important would be a discussion of the specific items, what I would term in dispute and unresolved, and the most important part of that I think would be as to why there is a difference. Because I think if we are going to make some progress the attempt here should be to get it out on the table and hopefully we can get some assistance and resolutions.

A third thing that I am sure they would be interested in is the item that Mr. Clark mentioned a minute ago, and that's the licensee's schedule for completion of a prestart program.

Now, I recognize that there are many variables in that that skip the interrogatories and that sort of thing, but considering design procurement of the conceptual ideas as well as the general administrative thing I think they'd like to hear what your schedule, as you see it, would be for a restart.

Harold, I think that is about all I've got.

MR. ETHERINGTON: Thank you, Charlie.

Steve?

DR. LAWROSKI: All right, I'll continue some items that I would suggest for consideration by you for presentation at the Full Committee meeting next week.

One would be a discussion of Met Ed's position, including rational as appropriate with regard to the implementation of Reg. Guide 1.97, this has to do with instrumentation that follows, of course, the facts.

Secondly, and this is understood because Mr. Arnold had planned to give us that today, but it was agreed yesterday that it would be done at the Full Committee and that at the Full Committee meeting and that's a discussion of the organizational changes in Met Ed that G.P.U. with emphasis on where and how much augmentation has been -- will have been achieved in regard of technical support in particular areas of technology.

As suggested earlier this morning I think that

the Committee would like to have a closed session with the licensee and NRC Representatives to discuss the protection measures to be undertaken to assure the security of the plant against acts of sabotage and so forth.

If none of the management people at Met Ed or G.P.U. has not yet read these three or four Sandia classified reports and I emphasized the classified.

I think it would be very well for one or more of them to have been so done.

MR. SILVER: If I might point out the arrangements can be made for this.

DR. LAWROSKI: I think it is important that it be someone in addition to the man who's in charge of physical security because I think that we've seen a deliberate effort already in other areas on the part of management to get more responsibly involved.

MR. THORPE: I'm going to read them. Some of the others may have -- I will read them.

DR. LAWROSKI: Okay.

MR. THORPE: Assuming I can get them through the system by next week.

MR. SILVER: You will have to come down to Bethesda, I'm quite sure. Or downtown.

DR. LAWROSKI: And then, I guess, we'll -- the Committee would certainly like to hear, at least, a summary

presentation on the improvements in the training of personnel both on the operating side as well as those who are involved in the maintenance. I think that the difference is that we'll now obtain as compared to what was the situation prior to TMI-2. I'll think that out a bit here because some of the points have already been covered by others.

MR. EBERSOLE: I picked two kinds of topics here one of which I will call a general one I think it's pertinent to the unusual situation we have here. I'll just attempt to, briefly, read those off.

I think it might be that the Committee would like to hear a presentation and discussion of what you call the appendencies to the emergency procedures which describe those actions to be taken at each point in the procedures which have the notation verify that, confirm that, and so forth and I expect those actions to be taken if the verification of confirmation shows that a given service is not available. In short, that's the part of the operating procedures which, heretofore, has been absent. They tell you how you are going to recover from conditions that will be on the single failure criteria.

The applicant has stated that a set of such instructions will be available to operators to aid in restoring critical service which may not be available, and if he can give us a sample or for that matter the supplementary document

itself, I think it might be helpful.

I think the basis for that is clear. These are -- this is information which we normally have not had. It takes up emergency repairs, recovery operations of a variety of sorts that I think it is a point that if you lose the critical service water system for some reason how do you recover that. I am trying to avoid the consternation of the operator which may be present if he has no ordered procedure with which to recover these alternate sources in case they fail to appear when he needs them. That's the general topic. It's the extrapolation of emergency in abnormal procedures to recover available services should this condition be present when you need such services.

As a special topic, I'd like to say I appreciated a very thorough tour by Mr. Hartman on the matter of the D.C. Service System that you have here,

I gathered from that that there is possibly a loopy in it, it might be available to you to recover from what might be a bad situation there although it is not clear that you can do it in the allowable time that's necessary.

That situation, as you know, it is generic to all power plants and my choice of it as a particular type here is merely to think it out of the generic topics and see how well TMI-1 can possibly recover from this situation and I think it might be worked out very well because I found

that the emergency feed water system may, in fact, be available without any support D.C. which would extend the time to restore this power a great deal beyond the some 20 odd minutes that one would have otherwise.

I have the impression you are well along on investigating what could be done in these circumstances which, I think we must, at least, come to some conclusion concerning the consequence which may be a cold metal if not worse.

The basic issue is do you have time to do the things that you can do before irreversible and severely damaging consequences result.

Considering that you have to do these manual operations at various switchboards some distance apart in total darkness with a somewhat questionable possibility of having diesels available because they can field flash and with an unknown consequence, an aspect of whether the AC power system fails consequentially when a DC system fails, it may or may not, as I understand it.

I think a first credit that would be worth presenting to the general Committee since it's a topic of some interest to several of the members.

MR. THORPE: Mr. Ebersole?

MR. EBERSOLE: Yes?

MR. THORPE: I hope we did want the source of your belief we're far along in looking at that. Last night

after the meeting we, in fact, geared up and initiated a thorough systematic look at it.

I think it is unlikely there is going to be much result by the end of next week. We've thought about it, as have a lot of other people, and had, you know, the kind of general ideas that were discussed but I'd be misleading you if we indicated we'd have very much in the way of an engineering systematic study next week.

MR. EBERSOLE: Well, even that statement itself is worth bringing to the attention of the Committee since they have been led to believe by the numbered study NUREG 305 that somehow there is a time available in which to do things. I think maybe that's not so accurate a picture as we might have otherwise.

MR. CLARK: We'll present what we have but it is not going to be very detailed or very far along.

MR. EBERSOLE: I think just that presentation confirms a suspicion.

DR. CATTON: I think most of the items that I have written down have been covered, but I'll go through them quickly.

I think the three most important aspects are control rooms, operator training and procedures.

As far as the control room, I think changes in available information contrasting what the situation was

before it was now.

Secondly, the TMI philosophy regarding use of the process computer.

As far as operator training is concerned, I think the goals and philosophy would be important. And I went through your plans and my feeling is that the topics to be covered on heat transfer fuel mechanics which have been a sore point with me for quite a while appear to be well thought-out. It looks sort of professorial.

My guess is that the -- just then a quick estimate -- the six week program, this aspect amounts to about 15 percent, and looking through the remainder of the program, however, I find that that part just seems to be left out and I don't know if it is my interpretation of your lesson plans or what but I think that your program would be significant enhanced if application of the basics coming from modular one were incorporated into modules two through six.

In any event, I think some of this should be discussed with the Full Committee. As far as the procedures are concerned at least as I understand your approach which is iterate of this approach with the simulator operators and they're input back into your procedures. To me it seems to be a very good method of developing your procedures and I would think that the Full Committee would like to hear about that, particularly the role of the B&W Simulator

Operators would play.

Dr. Lawroski mentioned Reg Guide 1.97, I think in particular the rationale for not needing in-vessel liquid level would be of interest. The rest of these are kind of secondary.

Containment hydrogen, I personally would like to hear where the sensors are going to put and why, and this involves some consideration of in-containment circulation.

I don't know how you plan to hook the combiner up to the air conditioning ducts but how efficient are they going to be. Is it just attached to the side?

DR. LIPINSKI: That's it, in the side.

DR. CATTON: Well, is it just attached to the side?

DR. LIPINSKI: Yeah, sucking on the side of the circular --

DR. CATTON: How efficient is this process going to be in getting the hydrogen out of the flow that's circulating through your air conditioing system?

DR. LIPINSKI: In diluted form.

DR. CATTON: Will the hydrogen collect in high spots, and lastly, what kind of a sensor is going to be used and how will it be qualified. Can it be affected by moisture, and so forth?

I think some discussion of the pressurizer system, things like susceptibility to water problems, namely, the wire -- where the wire is connected to the heaters. Also, I am not sure what that box was that was on the second level but it looked like it was not water proofed, I don't know what's inside it but how qualified is your pressurizer system to the environment that it will seek?

Also, the rationale for placement of the Delta P Cells at six-foot level, youknow, why not ten feet. It seems to me that where you put them or the elevation that they are placed shouldn't be difficult to move or to change if it is not right.

Feed and bleed seems to enable TMI-1 to survive everything. I think that deserves a little bit of attention.

That's all I have.

DR. LIPINSKI: Item 1, we discussed containment isolation occurring at four PSI and a here at 30 PSI and the valves two each at 58 inches are allowed to be opened 90 hours per year which is one percent of the time. So, the question is what break sign is required to develop four PSI when these valves are open.

I had given a note to Muller earlier and the plans

for the existing plant computer, what you're proposing to do to it before you go into operation and then your longer-term plans with the new computer system would be of interest.

There is one item that we discussed about the operators being able to move through the plant under emergency conditions and it was said that would have to be covered under closed session to discuss how they can move about if your security system presents them a problem.

We discussed the remotely operated purge valve on the reactor vessel covered and you offered arguments as to why you didn't need that. I think that would be an important item for discussion.

The next item has been covered by Dr. Catton, and where you plan to run the outputs from the high point vents and your general philosophy of hydrogen collection and how you plan to route the collection points to the combiner.

Now, we did see that you did have one of your collection lines already installed in the side of the ventillation duct to add the input to that recombiner.

We talked about your immediate emergency peak order system the fact that the storage tank piping valving assessment requalified, but that your air system is not but you argue that you will fall back on feed

and bleed on the primary system and then you counter that argument by saying you still think you do not need reactor vessel level instrumentation redressing. Whole change requires a discussion on parts of emergency peak order system, the fact that the air is not seismically qualified that you would utilize the feed and bleed and if you do utilize feed and bleed you do not think you need level instrumentation.

The general subject of containment isolation is of interest with your various levels of isolation that you will not have one single signal isolating all lines simultaneously and then the radiation monitors that you plan to install on the affluent lines in terms of being able to tell what is leaving containers.

The next item was discussed by Mr. Ebersole and the operating procedures. I think it is good that you have already taken the approach to give the operator alternate courses of action if these first immediate actions aren't an effect of -- I won't say anymore.

Now, we did look at your training manuals and your first module is a 32R module and reactor theory in heat transfer include dynamics. Having fingered those, they look good but I think a discussion as to how you are going to take this theoretical material and apply it to the balance of the training material to show the operator

how this theory applies to the unit that he's operating would be of direct interest.

That's all I have.

MR. ETHERINGTON: Thank you, Walt.

I think the next question is whether we should recommend that the Full Committee hear her presentation next month -- next week and start on --

All right, Charlie, would you like to express your views?

MR. MATHIS: Well, after hearing Mr. Clark's discussion of his wishes and also Mr. Silvers, I would say we go ahead and take this to the Full Committee with the recognition that there will not be a letter written of any substance, if you will. We're not going to resolve very many things.

I think we may get some things out on the table and possibly introduce some additional subjects, but I think we would be misleading everybody involved if you thought there was going to be any letter that would give you much guidance come out of it.

That's just my personal opinion.

MR. ETHERINGTON: Steve?

DR. LAWROSKI: Taking everything into consideration I believe that we should proceed and invite them to the Full Committee meeting, bearing in mind that they should

try to stay within the, approximately, four hours allotted at this time, because we do have some very important items that must get finished at the next week's meeting.

I would suggest as soon as the time permits that you look at the transcript and see where some of the presentations might be sharpened up and you might be able to get more material across at the Full Committee meeting in a minimum of time.

MR. ETHERINGTON: Dezi?

MR. EBERSOLE: Yeah, I would concur this single thing in that you should meet with the Full Committee in the spirit of the fact that I think the Full Committee must look at your attempt to obtain a goal which you get listed and comment on it before you've finished and perhaps furnish some guidance along the way so that when we have the final meeting there will be no obvious need to be writing letters.

MR. ETHERINGTON: The Subcommittee will make that recommendation.

What day is held available for --

MR. MULLER: Friday morning.

MR. ETHERINGTON: Friday morning.

MR. MULLER: Starting at 8:30.

MR. ETHERINGTON: Now, the time allowed was four hours.

MR. MULLER: This is the chairman's report.

MR. ETHERINGTON: Just the Chairman's report.

MR. MULLER: No, that's including the Chairman.

MR. ETHERINGTON: Including.

Well, then we haven't heard Mr. Arnold's presentation on the organizational changes. We have the closed session, we have -- I'll cut my remarks down to about five minutes, boldly, ten to the most.

So, we're left with something like two and a half hours for what has taken today and yesterday something like 8, 10 -- 12 hours. That involves a considerable cut down of the content and it's understood, of course, that a large part of this time will be taken in questions by Committee members.

Looking over the agenda, as we had it today, I don't see anything that really we need to -- we can dispense with I think we have to more or less acknowledge every item on the agenda.

Does anyone see anything we can, say, cut out we don't want that.

MR. MATHIS: With just detail I think we can cut down.

MR. ETHERINGTON: We can cut down on detail, that's what I'm coming to but there's no total, there's no individual item that we can cut out, so I would suggest that we follow through the sequence here pretty much as it is here, it

can be broken down differently but eliminating detail and letting detail come out largely as a result of Committee questions.

You will, of course, be well advised to place emphasis on those things which have been read to you or read out during this executive session as the recommendations of consultants and Subcommittee members.

Does the Subcommitte wish to add anything?

MR. EBERSOLE: Mr. Chairman, I think I'd like to ask for somewhat sharpened presentation on item 4E which is the policy on prevention of filling pressurizer solid and the counterpart policy which we have, I believe, of utilizing the feed-bleed method. These are in contradiction to each other and in my own mind it's not altogether clear to me how well these procedures are organized.

When you depart from one to the other and then how you perceive from one set of emergency procedures to another. You can do that with or without the presence of the vessel level gauge, the absence of it makes life somewhat more complicated, I think.

MR. ETHERINGTON: As Dr. Lawroski points out, when the Committee has a pre-meeting with the expectation of a follow-up meeting, it is usually on the basis that there are certain items that you can write off and remove from later consideration.

We don't really see any such items in this sequence there may be a few, but there are too few to really justify complete write off in view of the large number of unresolved items.

This was one of the reasons, of course, for our hestitancy concerning the -- having the meeting next week.

Do the rest of the Subcommittee or consultants wish to add anything? Then I would like to ask whether Met Ed is clear on the time available and the scope --

MR. CLARK: We understand what you said. We are pleased that your recommendation is to go to the Full Committee.

We are pleased that you are recommending that it go to the Full Committee. We recognize that there will be a follow up meeting, and that there is no conclusion to be reached at this meeting next week.

MR. ETHERINGTON: This is the Subcommittee's opinion, there may indeed be a conclusion reached.

MR. CLARK: But, certainly, you are telling us don't expect a conclusion, and we understand that.

It would be helpful to whatever extent the Full Committee is willing to put questions or guidance or areas of particular concern, to whatever extent they are willing to put those into a letter or other format, so that we will have the advantage of knowing what those areas are and be able to concentrate on them after next week, that would be very helpful.

MR. ETHERINGTON: You mean, do this after the meeting?

MR. CLARK: Yes.

MR. ETHERINGTON: The Subommittee doesn't usually do -- it would only do this through a letter to the Commission, I believe.

MR. CLARK: I understand that. I understand you may not want to do that, but to the extent or if you decide to do it, that would be helpful to us.

MR. ETHERINGTON: The Committee might do that.

MR. MULLER: The Committee's concerns will be in the transcript,if you get questions from the Committee, it will appear in the transcript of the Full Committee meeting, in any case.

MR. ETHERINGTON: Does the Staff wish to make a statement?

MR. SILVER: No, sir. Except to the extent, to say that we, as I have indicated earlier, I believe we should

go to the Committee and I am pleased that we are doing this.

I appreciate your patience with the Staff and others in this room during this meeting.

MR. ETHERINGTON: I would like to ask the Members of the Subcommittee and the consultants to be sure to turn over the write-ups from which they spoke recently to Mr. Muller.

MR. MULLER: Ivan still had one comment.

DR. CATTON: Actually, not a comment, a question. Something that I forgot to ask earlier.

Could somebody describe to me how the in core instrumentation penetrations are made in the lower head -- at the bottom of the vessel?

MR. WALACE: Yes, sir. If your question is about arrangement, I think we can probably --

DR. CATTON: Not necessarily arrangement. What does it look like, is it a welded fitting, is it a -- just what is it?

MR. ROSS: The penetration is a pipe welded fitting in the incore itself is a cable-looking structure that slides through a tubing arrangement, it is like a tubing arrangement slides through the welded penetration pump into the block of the --

DR. CATTON: Does that pipe inside stick all the

up into the core?

MR. ROSS: No, sir. The piping arrangement ends at the bottom of the core, and sticks up into the core as a thermal structure itself or incore structure itself.

Thus, making it removable prior to adding fuel.

DR. CATTON: So, you -- if you were to pull one of those out, there would be a hole in the bottom vessel that one could stick a breaker or a pressure cap of some kind.

You could replace it then?

MR. WALACE: Yes, sir. The incore instruments. The housing ware penetrates the bottom of the vessel, the pressure boundary extends out through a relatively lengthy pipe and is terminated up above the elevation of the vessel.

MR. CLARK: If you replace it, would it sense primary cooling pressure?

MR. WALACE: Yes, the primary cooling battery does extend through this tube to its final entity.

MR. ROSS: So the pressure boundary is at the top or we should be getting on the core.

DR. CATTON: Is it conceivable to remove one of those and replace it with a pressure cap?

MR. WALACE: Yes, sir. I would think it would be conceivable to do that, since it does receive primary pressure.

DR. CATTON: Actually, what I am trying to

determine is how much difficulty you would have if you wanted to put a level gauge across the vessel.

It seems to me that if you replace one of those --

DR. LIPINSKI: You don't have to replace it, you just tap it.

DR. CATTON: Well, you have to pull the wires that are in it, now.

DR. LIPINSKI: No, you don't. You just tap it.

DR. CATTON: So you don't even have to replace it?

DR. LIPINSKI: No, just tap it.

DR. CATTON: I see. Thank you.

MR. ETHERINGTON: Does anyone else wish to comment?

MR. EBERSOLE: Since we picked up a little topic like this -- I was going to leave this but I may as well get it here.

I look with interest at your diagram I got a while ago on the instrument air system, and in view of its being upgraded to increase the liability, I notice that it is -- of course, it is true about water, I guess the Jacket of the compressor is water cooled and also you have after coolers.

Is that water pressure system -- is that treated water or well water? If it is either of those, then what pressure is it relative to the air pressure heat? I will tell

you in the end what I am getting at.

Is there some potential for gasket failure or tube failure that will charge your instrument air system with water from that source?

MR. ROSS: To answer your question, the water systems is nuclear service closed, it is a treated water system. There is an emergency backup in the case of an emergency of the instrument air in taking water directly, so we do provide a cooling.

Pressure when closed is slightly higher than instrument air pressure.

MR. EBERSOLE: Doesn't that lead to an undesirable potential that you can easily correct?

MR. ROSS: It may lead to an undesirable flaw. We have not experienced any difficulties or major difficulties in that area.

MR. EBERSOLE: I see. But then since it is treated water, you should have no trouble with it.

DR. LAWROSKI: Mr. Chairman, may I make a statement?

MR. ETHERINGTON: Please do.

DR. LAWROSKI: I would like to add one more suggestion to you, with respect to next week's meeting.

That is that you consider very seriously, having an appreciable representation from your operating personnel present at the meeting.

I think, many of those people, I heard from my colleagues who did visit the plant the day before yesterday, felt that those people did very credibly a job in answering questions.

I think it would be good to have some of those people, not only as backup for yourselves to answer questions and details, but to get an appreciation of what is involved in these reviews.

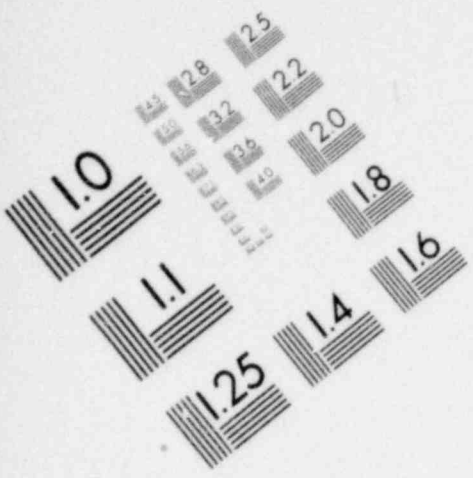
Thank you, Mr. Chairman.

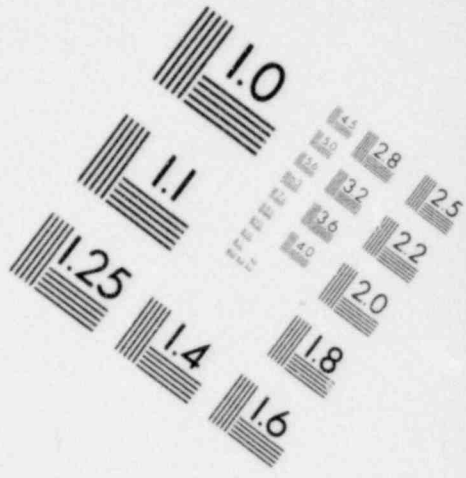
MR. ETHERINGTON: Are there any further comments?

Well, thank you, gentlemen.

The meeting is adjourned.

(Whereupon the meeting was adjourned at 12:05 p.m.)





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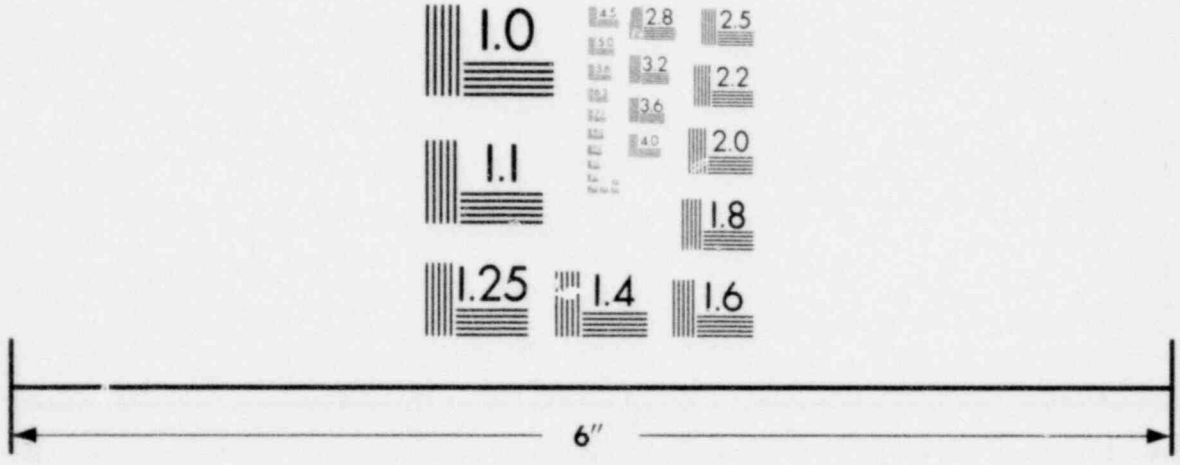

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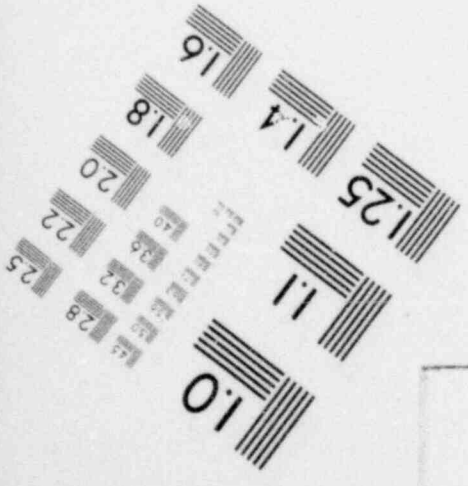

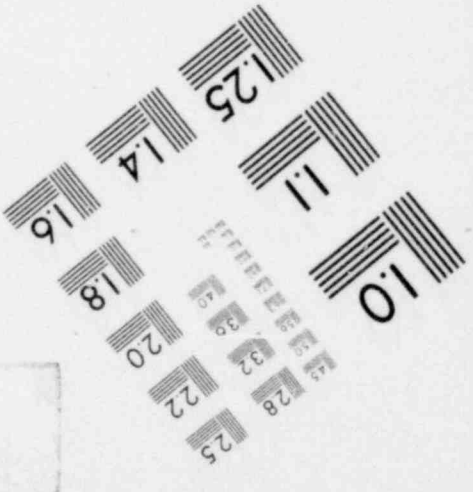

CERTIFICATE OF AUTHENTICATION

This is to certify that the attached transcript of the meeting of the Advisory Committee on Reactor Safeguards, Subcommittee on Three-Mile Island, Unit 1, Nuclear Power Plant, held in Middletown, Pennsylvania, was held as herein appears, and that this is the original transcript thereof for the file of the Commission.

Sue Glocker

Sue Glocker

Janice Smith

Janice Smith

Sharon Corsanico

Sharon Corsanico

1940 004

to the chloride contamination the crack and corroding, supposedly due to chloride contamination.

We also intend to review the proposed corrective actions to date, what has been told to us is that they plan to go to replace the piping when they cut out a piece of pipe will be a three or four cut of stainless steel.

In addition to that they will butter the inside surface of the pipe that remains in place to prevent any sensitization of that section of the pipe when they make the weld.

That is consistent with what we have been proposing for the BWR --

MR. ETHERINGTON: When you butter the end of the pipe you don't set up another defective zone adjacent to it?

MR. TABOADA: Well, we do it but the buttering technique is done with much more and there is also a much more tortuous staff for the cracking to progress along and as a consequence it is less likely to crack through the piping.

It is a technique that has been developed by GE for BWR's, and it seems to be an improvement.

It is certainly an improvement over a straight weld.