T-1164

ORIGINAL

OFFICIAL TRANSCRIPT PROCEEDINGS BEFORE

NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

DKT/CASE NO.

TITLE 272ND GENERAL MEETING

PLACE WASHINGTON, D. C.

DATE DECEMBER 9, 1982

PAGES 1 - 285

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

272ND GENERAL MEETING

Room 1046
1717 H Street, N.W.
Washington, D.C.

Thursday, December 9, 1982

The Committee met, pursuant to notice, at 8:35 a.m., Paul G. Shewmon, Chairman of the Committee, presiding.

ACRS MEMBERS PRESENT:

PAUL G. SHEWMON
CHESTER P. SIESS
ROBERT C. AXTMANN
J. CARSON MARK
FORREST J. REMICK
JESSE C. EBERSOLE
DAVID A. WARD
DAVID OKRENT
MYER BENDER
DADE W. MOELLER
JEREMIAH J. RAY
HAROLD ETHERINGTON

DESIGNATED FEDERAL EMPLOYEE:

RAYMOND FRALEY

PROFESSIONAL SECRETARY:

M. NORMAN SCHWARTZ

ALSO PRESENT:

BILL RUSSELL
CHRIS GRIMES
S. POWERS
T. RAUSCH
B. RYBAK
N. SMITH
M. ERNST
MR. SPULAK
MR. BERRY
MR. KACICH
MR. AMICO
M. BAIN
MR. MILLS
T. NOVAK
C. STAHLE
R. WARNICK
D. HUNTER
C. TINKLER
MR. BUTLER

P R O C E E D I N G S

MR. SHEWMON: Good morning.

This is the first day of the 272nd meeting of the ACRS. During today's meeting the Committee will hear reports and discussions on the SEP evaluation of Dresden and Millstone Station Unit 2 and Millstone 1. We will have a brief report on the Zimmer plant QA problems and the Sequoyah Nuclear Power Plants 1 and 2 regarding control of combustible gases following a serious accident.

The meeting is being conducted -- needless to say, there's an agenda in the back of the room. My prompter seems to have forgotten that today.

The meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act and the Government in the Sunshine Act, and Mr. Raymond Fraley is the Designated Federal Employee for this portion of the meeting.

A transcript of portions of the meeting is being kept. It's requested that each speaker use one of the microphones, identify himself or herself, and speak with sufficient clarity and volume that he or she can be readily heard.

We have received no written statements or requests to make oral statements from members of the public regarding today's meeting.

(Whereupon, the Committee went into executive session.)

OPEN SESSION

MR. SHEWMON: Without further ado, I will turn it over to Chet, who will handle Dresden and Millstone.

MR. SIESS: I'm just trying to see what's in the folder under tab 2 that you can look at. I haven't seen it yet myself.

MR. SHEWMON: But you're sure it's there?

MR. SIESS: Yes. It has a schedule.

What we will be doing today is looking at the SEP review for the fourth and fifth plants in the program. This will conclude the five plants that are what I call relatively of recent vintage. We start off with Palisades, then Ginna. The past month we did Oyster Creek, which was the first boiler. And today we will be doing Millstone Unit 1 and Dresden Unit 2, both of which are boiling water reactors.

They are somewhat similar to Oyster Creek, in that they are Mark I type containments, but they are a different type of reactor systems. These are both jet pump plants. They are very similar in the NSSS, although they're not all that similar in balance of plant, and of course they are at different sites. One of them is on Long Island Sound and the other is on a small river in Illinois, that probably is a lot larger today than it was last week.

We are proposing to look at the two almost simultaneously because of their similarity in the issues or the topics, and even to some extent in the resolution of the topics. Not only are Dresden and Millstone quite similar in the whole presentation, in the whole process; they were reviewed together and they are also similar in many respects to Oyster Creek, which I hope you have some recollection of from last month.

The Subcommittee in a meeting last week did go through its review in this essentially simultaneous manner and it seemed to work and it seemed to expedite our review and expedite our understanding of the issues and how they were related to Oyster Creek. So the Staff will be making its presentation in essentially that fashion today.

As you will recall, we start off with 137 issues in phase two, which were reduced from several hundred in phase one. Phase one was to boil it down. A number of those issues get put to one side, either because they are obviously not applicable to the plant because of its type -- it might be a PWR issue and it's a BWR plant -- or they're not relevant because of the site. Another set gets put aside because they're being treated generically on all plants, the USI and TMI items, the resolution of which will be handled in a different fashion and presumably will be reviewed by us when we review these plants for the provisional operating license or full-term operating license.

All these five plants will be coming up later for full-term operating licenses. I might mention in that respect that Dresden 2 will have to convert its license. Dresden 3 started out with a full-term license.

MR. SHEWMON: Chet, would you tell me the difference between the SEP and the full-term? I kind of thought that's why we were doing this.

MR. SIESS: No. The SEP is the systematic evaluation of the older reactors to see how they compare with current criteria. The idea originally was to start back at the beginning with Yankee Rowe and Dresden 1, Big Rock --

MR. SHEWMON: It's not just a comparison. The utilities are committing to change?

MR. SIESS: Yes. Let me finish.

We started with the old plants that we knew didn't meet current criteria, see where they didn't and decide what to do about it; obviously, not to backfit them to current criteria, but to make judgments. Added to that first list of the very old plants were a number of plants that were not all that old but were still operating under provisional operating licenses, under the theory that by reviewing them as part of the SEP that review would make it easier to do the review for the full-term license conversions.

These were put into the program because they did have provisional licenses, because it would contribute to the full-term license review. This does not replace it, simply because the SEP does not cover all of the outstanding issues.

The Committee decided with the Palisades plant that we would not try to sign off on a full-term license. The Staff was not ready to sign off on a full-term license and the Staff will issue an SER for a full-term license when they have completed evaluating the status of the USI and TMI fixes.

The Staff does not intend that all those fixes must be made to these plants to get a full-term license -- that would not make sense, since there are 40 or 50 plants out there with full-term licenses that are still in the process of making them -- but that they would determine the status and acceptability of operating without that.

The full-term license reviews are still to come and just how the Committee will handle those we will have to decide. I have some research going on how we have handled them in the past, but these six plants are obviously older.

Many of the plants that got provisional licenses will be converted to full-term in a couple of years. That was the general idea originally. We gave them a provisional license and if they haven't blown up in two years we give them a full license. Obviously, that's not the way it was done.

Then the Commission sort of backed off on full-term licenses and all of these plants that applied for their full-term within a year or two -- I guess the law says that as long as you have applied for it and the Commission hasn't denied it, you can keep operating under your provisional license until the Commission decides what to do about it.

So here we have plants 12 years old that are still provisional. Now, these plants, then, are very similar to Oyster Creek in the nature and type of review. As I said, the Staff starts with 137. You eliminate the USI and TMI items and you end up with some number which they will explain to us, and then those are compared against current criteria.

They either meet the criteria or meet them on some defined basis where the criteria allow for an alternate, or they do not meet it. Those that do not meet current criteria were then subjected to what is called the integrated assessment, integrated plant safety assessment.

The results of that were reported in the two yellow volumes which I assume you have received, but I will not assume you have read. The main thrust of the reviews on the other three, and I think it probably should be here, should be on those items that did not meet current criteria, where the Staff had to make a decision as to what to do about it, and those decisions were of various kinds.

In some cases they decided nothing was needed, they were satisfactory even though they didn't meet current criteria. In other cases they decided that some procedural change or some tech spec change would bring them up to the appropriate level of safety.

In other cases hardware backfits are required. I say required; most of the Staff has said, this would resolve our concern, and the applicant has agreed to it. When it gets to the point of requiring, then the Staff would have to invoke the backfit rule or something else. So far I don't think they've had to invoke the backfit rule in that the changes they have proposed have been agreed to by the licensee.

In both plants, as in the case of the earlier plants, other plants we looked at, there are number of items that have not been resolved because they require further rather extensive studies by the licensee, evaluations, analyses, et cetera. Much of this relates to seismic resistance item by item.

Because of some codes that have been changed, in the case of Millstone all of the structural problems are being looked at in an integrated fashion. Whether it's the change in code or the change in earthquake or the change in tornado or something else, they try to do an integrated review and correction of structural problems. But the pattern is the same.

I have asked the Staff to go through it rather quickly on the items that were deleted, because those are relatively straightforward. The Subcommittee has looked at them. These are USI-TMI items and not applicable items.

The next list the Staff will present are those that in the Staff reviewer's opinion the plant either meets current criteria or meets it on some acceptable or defined basis. There again, I have asked the Staff to give us a list and if you have questions or want further details on any item in the list as to how it meets current criteria or what any other defined basis is, they will provide the details.

But I've asked them to give you a list and let you pick from them. Then they will go into the items that -- I forget what comes next, whether it's those requiring further evaluation or those requiring backfits. But we will go through those in a little more detail.

Again, the Staff is prepared to present detailed discussions, the Staff or the Licensee or both, detailed discussions on any item you wish. Those they did not meet and those that are resolved are discussed in considerable detail in chapter 4 that you have or we can provide you with copies of. I think that should give you the picture.

We have asked the Licensees to take a few minutes to give a brief description of the plant, just to bring you up to speed on that. Oh, one other item. In its integrated assessment, the Staff has used in a somewhat limited way a PRA. On the other plants we looked at, they got a PRA for the nearest plant to that if they didn't have a plant-specific one and, by a procedure which was described to us at a couple of other meetings, they got some measure of the affect of possible changes on reliability and used that as a guide to deciding whether something needed to be done.

For Millstone Unit 1 there is a plant-specific PRA as a result of the IREP program. That was used, shall I say, directly for Millstone Unit 1. It was used indirectly for Dresden in much the same fashion that the Millstone 1 IREP was used for Oyster Creek.

It was our impression that the plant-specific PRA wasn't a real tremendous improvement over using one for a similar plant. The Staff couldn't use the PRA exactly for anything. It didn't cover earthquakes, for example, so it wasn't much help on seismic flooding or any extreme external event problems, and they were using it as a sole basis for decisionmaking, but the Staff didn't use it that way. If some things were rated low by the PRA, they thought it should be fixed anyway, and I'm not sure whether it was vice versa, but they'll tell us that.

So we did have a Millstone plant-specific PRA. I don't know where Dave went. We have been provided with volume one of that, which is really the summary, isn't it, Bill?

MR. RUSSELL: (Nods affirmatively.)

MR. SIESS: It had more in it than I was interested in and probably less in it than somebody else might be interested in. It will all be available some day.

Are there any questions at this stage?

MR. MOELLER: Yes. We have of course the

comments on the SEP's by the four consultants.

MR. SIESS: Yes. Each plant -- let me just mention this. The Staff has had, I guess, consultants or a peer review panel or what have you. They started off with five. Spence Bush, Herb Isben, Joe Hendrie, Bob Budnitz, and Zenon Zudans are the names that are quite familiar to us, and those consultants have reviewed, usually a draft of the integrated plant safety assessment.

So some of their comments even in this case are on a draft, and this thing is a continuing process. For Dresden 2 and Millstone 1, there are only four consultants. Bob Budnitz I believe had some kind of a conflict on it. And those reports have been passed out to you. I only got them yesterday and I haven't read them all.

MR. MOELLER: What I wanted to know, for example, each consultant in essentially every case and particularly in Zenon's case, they have raised a list of questions. Like on page 3, Zenon Zudans' review of Dresden, he has a whole list of questions. And it would be helpful to me to have the Staff tell us --

MR. SIESS: We will arrange that. The Subcommittee did not have a chance to explore those, because as I said we got them yesterday. I will ask Mr.

Russell, the rest of them here -- Chris is here. Chris Grimes I think can address Zudans' questions, can't you?

MR. RUSSELL: Yes. I would only like to make one comment. The report that the consultants review is identical to the report which the ACRS is reviewing. The consultants' reviews were completed prior to the Committee's review today, so that you would have the benefit of their views on the Staff's document as well.

In each case, the Staff has provided a specific response to each of the questions raised by the consultants. That is sent back to the consultants and the licensee and that is incorporated in the final integrated assessment report.

And we are prepared to address all of the questions. I can't say that we will be able to address every one satisfactorily, but we will address each one in writing.

MR. SIESS: Now, the two NUREG's you have, 0824 and 0823, are what the Subcommittee had to review. We were updated on a number of items. As I say, this is a continuing process. What you get today will not agree exactly with what is in the NUREG's, but it will be more recent in many, many cases.

The agenda says that we will take a brief description from the Licensee, Dresden 2 first and then Millstone, and then the Staff will take it over and we will go through on this parallel process of the two plants, with questions from the full Committee. And then at the end we have asked the Licensees if they wish, depending on the length of it, they could comment on the beginning, on their perceptions of the SEP and how it is operated and how successful it is.

I have asked them to do that for a couple of reasons. I think we're interested in knowing what they think about it, but there is also an issue that will be coming to us some time in the future as to whether the SEP should be continued into a phase three with another group of plants and maybe a phase four, et cetera, et cetera.

These five plants provide probably the best basis for getting some feeling about that, since they are of more recent vintage than the five you are going to start seeing next year.

Are there any questions?

(No response.)

MR. SIESS: Okay, I'll call on the representative of Commonwealth Edison, then, first. Are you going to use the lectern with some slides?

MR. RAUSCH: Yes. I have the same handouts again, Dr. Siess.

MR. SIESS: That's fine.

MR. RAUSCH: The full Committee hasn't seen them.

(Slide.)

MR. RAUSCH: Good morning. My name is Tom Rausch. I represent Commonwealth Edison, Dresden Unit 2. We have a small group of people with us who will attempt to answer any type of questions you may have about the design of our plant or some operating history.

I'm handing out a small packet of material. I'm not going through all of these. I have slides on all of what I'm handing out. But basically what you have there is some simple one-line diagrams of some of the unique features of our plant versus other BWR's.

We are a rather typical BWR-3. Our rated thermal power is 2527 and 834 megawatts electric gross. We're located on the confluence of the Kankakee-Illinois Rivers about 30 miles southwest of Chicago, Illinois. We use the river -- we have used the rivers as a once-through cooling until 1971, at which time we completed installation of a large cooling lake, 1275-acre cooling lake.

Very recently, we now are allowed to run on once-through cooling with the river, using the lake to cool the discharge before it goes back to the river in the summer months, after which our efficiency went up quite markedly.

We are a three-unit site. In 1959 Dresden 1 received its operating license. Dresden 2, the construction permit didn't come until 1966. The fuel load began in December of 1969, in a short time period, less than four years. We were critical, in 1970, January. We began retrospectively what we called commercial service in 1970, in August. Dresden 3 began operation in January of 1971, so there was not much lag between the two units.

We made our timely application for the full-term operating license conversion in 1972, and here we are ten years almost to the date and maybe we'll be getting it.

Some of the more major modifications are pointed out on here. In 1973 we completed installation of the modified offgas system, which has a rather dramatic reduction in gaseous effluents, essentially recombiners, charcoal bed system.

In 1979 we had a large augmentation in our security. That was ongoing for several years, but we're up around 100 guards now, 130 if you count all the supervisory.

We're still in the process of completing TMI mods. The major ones are completed: the technical support center, high radiation sampling systems, emergency operating facility. And another one of the big ones we're doing right now: We will be changing out process computers and putting in much larger and redundant computers to support some of the fancy monitoring.

Yes, sir?

MR. MARK: From a purely practical point of view, what difference does it make to you whether you have a full-term operating license or an interim license?

MR. RAUSCH: Very little, assuming the Staff doesn't allow it to expire. It's a minor nuisance when you are attempting to receive nuclear material or things you are required to have a license for. We don't like to refer to that license. We refer to our Dresden 3 license. A lot of vendors are more comfortable with the real full license. Practically speaking, there is no difference.

The last major modification that is still in the process of being installed is our high-density spent fuel racks. It was a contested case. We're very near completion now with this. We would already be at the point wh- we could not have a full core discharge and we could not even undergo refueling if we did not have these modifications. With the mod, it'll let us go to roughly the year 2,000.

(Slide.)

This is just a simple plant layout that'll give you a little idea of what we look like. You'll note the river, the Kankakee, is in this direction. Unit 1 is the 1950-vintage here. Unit 2 and 3 reactor buildings are side by side. The control room is in between Unit 1 and Unit 2. It's a three-unit control room.

We have had to add an administrative building. The staff is much larger than we anticipated in the early seventies. It's uniquely located outside the security areas. It makes a nice to have people be able to come into the sites.

These diesel generators are separated in this end of the turbine building for Unit 3. Unit 2 is up over here, and the common 2-3 diesel generators are located in the middle of the reactor building. I'm pointing that out because that is one of the open issues we are still attempting to resolve, that is tornado missiles on diesel generator exhaust systems.

MR. EBERSOLE: Since you have transverse units, are you in good shape as regards 180 percent speed missile problems out of the turbine?

MR. RAUSCH: Are you talking about the turbine missile issue?

MR. EBERSOLE: Yes.

MR. RAUSCH: How did we answer that, Neil? Do you recall?

MR. EBERSOLE: What I don't want to hear is that you disallow the 180 percent missile.

MR. SIESS: I don't think the Staff agrees with you, Jesse.

MR. EBERSOLE: Are they going to allow them to postulate all failures at a single speed?

MR. SIESS: Let the Staff answer that. This is being handled the same as the others.

MR. RUSSELL: The approach that the Staff has taken is to look at two aspects, to look at the material properties of the discs, the inspection program for the discs, and allow an inspection schedule to be developed based upon the results of the current inspections which have recently been done on the various units.

That addresses the failure from overspeed up to the normal overspeed. It's not the destructive 180 percent overspeed.

With respect to the higher overspeed, the Staff has chosen to look at the reliability and redundancy in testing of the overtrip speed mechanisms rather than addressing the much higher RPM. So it is the current approach that we are using both on new plants and on the SEP plants.

MR. EBERSOLE: Is this to say that as a generic basis the Staff is now permissive of the concept of 180 percent failure? In other words, it's depending on the reliability of the steam interception system?

MR. RUSSELL: That's correct. We feel that the emphasis should be on the redundancy, reliability, and testability of the overspeed trip mechanisms to assure that you do not get to the destructive overspeed.

MR. EBERSOLE: Well, that focuses on the main steam stop valve precisely, and I don't think the Staff has any --

MR. RUSSELL: No, it could be the control valves, governing valves, and overspeed trips on the turbine itself.

MR. EBERSOLE: On the turbine motor ejection, you need to stop that; am I incorrect?

MR. RAUSCH: You're correct.

MR. EBERSOLE: You're solely dependent on the stop valve. Any delay in its function and you've had it. And that valve is not a regulated engineering design feature. For instance, my last --

MR. RUSSELL: We'll have to get somebody from the Staff to come down. We'll call back and get a more specific response. I generally characterized what we're looking at. We have not, to the best of my knowledge, looked at timing of main steam stop valve closure, for example.

MR. EBERSOLE: You haven't even looked at the structural design.

MR. RUSSELL: That's correct.

MR. SIESS: But now let me get something straight. Did I hear you say, Bill, that these are current criteria?

MR. RUSSELL: That's correct.

MR. SIESS: And your conclusion is that with the inspection the plant then meets current criteria, and that Mr. Ebersole's argument then is not with the SEP for Dresden but with the current criteria?

MR. RUSSELL: That's correct. We have been using this to provide assurance that the historical probability of generation of turbine missiles is appropriate, and we are not doing the detailed probability analysis of P-1 through P-4.

MR. EBERSOLE: Have the other plants which have accommodated the 180 percent missile been relieved of this?

MR. RUSSELL: I can't answer that question. I don't know.

MR. EBERSOLE: Well, I think it is generic, as Chet said.

MR. SIESS: I think there will be a number of opportunities to see what current criteria are, because we are looking at more things here.

MR. OKRENT: I don't know what you mean when you say these are current criteria.

MR. SIESS: The object of the SEP is to determine the extent to which these plants meet current criteria.

MR. OKRENT: I don't recall seeing a paper from the Staff which says these are the current criteria.

MR. SIESS: We'll ask Mr. Russell to tell us what constitutes current criteria.

MR. OKRENT: For turbine missile questions. I'm trying to find out in fact --

MR. SIESS: Let's ask Mr. Russell where we would find the current criteria at, the standard review plan or a reg guide or where?

MR. RUSSELL: Generally, it is contained in the standard review plan, NUREG-0800. In the case of the turbine missile issue, this approach is being used on recent OL's, and I am not aware of the status of the revision to the standard review plan to reflect this change.

MR. OKRENT: I'm sorry, but --

MR. RUSSELL: We can have somebody come down and, by reference to the SER's that are being used in new dockets which address this issue --

MR. OKRENT: I'm sorry, there is an unresolved safety issue we were just talking about yesterday morning on turbine missiles. If it's an unresolved safety issue, I have to assume that this term "current criteria" is a vague thing. There may be something that the Staff is accepting, but that does not state criteria to me.

MR. SIESS: If there's an unresolved safety issue, it's not supposed to be part of the SEP if it's a generic issue.

MR. RUSSELL: It is a generic issue, but to the best of my knowledge it is not a USI. The issue on turbine cracking is generic to Westinghouse. We have required a number of inspections. We have had additional work done on General Electric. The position on Westinghouse has been in place for nearly a year, to the best of my knowledge. The GE position is following the approach that was taken by Westinghouse, and GE is now proposing and has proposed to the Staff generic methods to be used to develop turbine inspection frequencies based upon results of previous inspection material properties.

MR. SHEWMON: But 180 percent is likely to go --

MR. OKRENT: It doesn't matter.

MR. SHEWMON: I think there are probably two different issues here.

MR. BENDER: Well, the impression that at least I developed, and I think they would agree with me, is that the Staff is trying to shift its position. But in fact, we have not heard the case for deciding to back away from this requirement.

MR. OKRENT: Right. It may be that this is going to be all right or whatever, but I was just having a problem understanding what the term "current criteria" means. And it is true, at least at the meeting yesterday morning, it was called the meeting on generic issues. And this may not be a USI, but it is in this list of things.

MR. SIESS: I think that's a good point,

Dave. And I believe one way of saying what current criteria means as far as the SEP is concerned is that these reviews were made initially by the same technical reviewers that are reviewing other plants. They reviewed it according to what they considered current criteria, whether it was the standard review plan or Staff policy. If they say it meets current ceriteria, then the SEP staff accepted it.

MR. OKRENT: In fact, in a letter we wrote recently -- I don't remember on which case -- we asked that the Staff tell us how in the end they are going to resolve the turbine missile issue so that we can at least see what it is they're going to do. Because usually they say we're going to handle this and tell you in some future SER, which is usually a one-liner.

MR. SIESS: Our follow-up system isn't working, I guess.

MR. OKRENT: I don't think they've written the detailed description of the basis for resolution.

MR. MOELLER: On this same item, this is one that Zenon Zudans addressed. I wonder if --

MR. SIESS: I think we're getting ahead of ourselves, gentlemen. The items will be flashed up later for you to take up. Right now we are asking the Licensee just to give us a plant description, so keep that in mind.

MR. SHEWMON: We're trying to.

MR. RAUSCH: I haven't much to go here. Briefly, some of the unique features of our plant, maybe not necessarily unique, but we have a two-loop recirculation system, flow control, three electric feedwater pumps. The containment is a Mark I type torus, suppression pool and water source. Water source is available for emergency core cooling as well as suppressing the pressure during a loss of coolant accident.

We have a typical ECCS system. The high pressure coolant injection system is steam-driven. We have four 33-1/3 capacity LPCI pumps, two 100 percent core spray pumps. Our automatic depressurization system uses four electromagnetic relief valves, plus a combined safety relief valve.

Dr. Siess has asked me twice. Our type is not the type that had the actuation problems that were experienced about five years ago. I believe it is a three-stage.

We have an isolation condenser, which we are probably one of the few BWR's. Millstone has one also. We use that for the passive decay heat removal for our condenser. It's a very reliable system, very simple.

One valve turns it on. It comes in quite handy.

Looking at safe shutdown analyses, it's essentially full heat removal capability five minutes after scram. We also have a separate shutdown cooling system. We do not use -- we do not have the typical RCIS and LPCI RHR modes, although we can use in extreme circumstances some ECCS for decay heat removal also. So we have a rather unusual flexibility in the ways we shut down the plant.

I have a slide of each of these type of systems later on, if you want to look through them. I don't plan on flashing them up.

MR. EBERSOLE: May I ask the Staff a question? This is one of the few plants which has electric main feedwater pumps, or boilers, that is, boiling water plants. Do these plants have a potential for thermal shock in the primary vessel as a result of overrun of the electric-driven pumps to a state of solid fill?

They can develop full feedwater pressure without any steam, which is not exactly a desirable feature. Is my question clear?

MR. RUSSELL: Yes, it is. We're just getting the answer.

Dresden has a feedwater pump trip that was installed after the event, and I believe the other aspect of your question relates to the applicability of the pressurized thermal shock issue?

MR. EBERSOLE: Yes.

MR. RUSSELL: I can't address that one. That's related to the USI. I just don't know the answer.

MR. SHEWMON: You'll never get the fluence up in a boiler.

MR. EBERSOLE: You don't get the fluence?

MR. RUSSELL: We discussed that earlier, and the fluence is significantly less because of the jet pump and because of the amount of water and the effective thermal shields. But the specific answer to your question is being looked at. There are detailed answers. I believe it's not a problem, but I can't give you the answer as to why it's not.

MR. BENDER: Unless the fracture toughness was low to begin with, there is no reason to think it's going to get any lower, because the fluence in these BWR's really doesn't get up to the threshold of damage.

MR. EBERSOLE: Is that to say you can develop a full feedwater pressure with the system and it'll be all right?

MR. RAUSCH: It would take a couple of

failures to get that to happen.

MR. EBERSOLE: Oh, I'm sure.

MR. RUSSELL: We can't answer that question. What we have done is to reduce the probability of that occurring by having the feedwater trips.

MR. EBERSOLE: Is that a safety-grade trip?

MR. RUSSELL: The Licensee is indicating it is. I can't answer that question.

MR. RAUSCH: Likely it would use the same water level instrumentation that was used for the safety-grade trips.

Just quickly, my last slide is just a rundown of our availability and capacity factors for the life of the plant. A couple of things you can notice on this. In the mid-seventies we went to 18-month cycles. As a result, we had some years with rather high avaiabilities.

Our capacity factor tends to be a little bit low compared to the domestic BWR's. I believe we're about tenth out of 22, life of the plant, domestic BWR's capacity factor. That is because we have made a practice for a number of years of using extended coastdowns. We've found it more economical to run the plant a longer time, even though we had reduced power.

Availability. Cumulative, I believe we're about sixth out of 22, so that's a pretty good record. In 1980 we were the highest in the entire world for a nuclear plant, 93.3 percent.

MR. BENDER: Would you clarify why 1981 has that difference?

MR. RAUSCH: That was a very long refueling outage. We installed our triple-clad feedwater feed spargers. We had the seismic modifications, IE Bulletin 79-14. We also had extensive Mark I containment work. I think it was close to a five-month outage.

MR. SIESS: I don't know why you call those refueling outages, when the refueling is the least thing you do. They are maintenance outages.

MR. RAUSCH: That's right.

MR. MARK: How do you decide to go to an 18-month cycle when you have previously been at some other cycle?

MR. RAUSCH: We had several economic studies that were performed.

MR. CARBON: Do you up the enrichment of the fuel?

MR. RAUSCH: Yes. Basically what's happened since the early seventies is, the vendors become more comfortable with putting in higher amounts of galinea in the fuel initially and raising the enrichments. When you start, you really don't have much limit to what you can do as soon as you understand your neutronics with the galinea in there. So we have a lot of galinea and the enrichments are getting very high. We're on the order of 2.8 percent, 3 percent average enrichments.

MR. MARK: That allows you to run longer, and then your fuel goes to 30,000 megawatts instead of 25?

MR. RAUSCH: That can happen also. It depends. You have a lot of variables on how you discharge the fuel, but in the end you're going to get some higher exposure also.

MR. SHEWMON: The old limits were also partially determined on the assumption you were going to reprocess the fuel, and that it has become more likely that it's economic to go to longer cycles.

MR. RAUSCH: Especially if you have a long outage, if you have them every 18 to 20 months as opposed to 24 months.

MR. SHEWMON: He's learns very quickly. That is a maintenance outage now.

Would you tell us roughly how Dresden 3 compares to that?

MR. RAUSCH: I have a few figures on Dresden 3. The capacity factor for Dresden 3 cumulative is less than a percent difference.

MR. SHEWMON: Above or below?

MR. RAUSCH: A little bit lower. Dresden 3 had some bad fuel failure problems in the early seventies.

MR. SHEWMON: I don't want to get into that as much. If that is your last slide, would you tell me the main differences between Dresden 3 and Dresden 2? And what I have in mind to ask the Staff later is, whatever they are going to require on this, why is Dresden 3 fit to keep operating without them, or vice versa?

MR. RAUSCH: We have taken the position that we are applying directly anything we do on Dresden 2 to Dresden 3, and to the extent applicable to Quad Cities Unit 1 and 2. A lot of the more immediate issues were of a procedural nature, and obviously we have common procedures between the units and they have been backfitted immediately.

There are varying stages of modification implementation, but we take the position that if we agree something is needed on Unit 2 then we agree it's needed on Unit 3. There are very little differences between the two units outside of the fuel, and we use Exxon fuel now and Dresden 2 is getting its first reload of Exxon fuel coming up in January.

MR. SHEWMON: And Dresden 3 has been on

Exxon?

MR. RAUSCH: It's just had its first refuel of Exxon about a year ago.

MR. SIESS: Any other questions?

MR. SHEWMON: You have liners in the fuel. Is that Dresden 1?

MR. RAUSCH: Quad Cities is undergoing an extensive change.

MR. SHEWMON: That's Quad Cities?

MR. RAUSCH: Yes.

MR. SIESS: In between, let me mention a couple of things I forgot. In the notebook there were letters, there are letters, from two consultants we had at the meeting, Ivan Catton and Walt Lipinski. You may want to look at those.

And then I think it might be appropriate to point out in between a difference between Dresden and Millstone. Both are three-unit sites. You just heard what is at the Dresden site. And there are some shared components between Dresden 2 and Dresden 3. Millstone is also a three-unit site, but Millstone 1 is a boiler, Millstone 2 is an operating PWR, and Millstone 3 is a BWR under construction.

You just heard Commonwealth say they are making the fixes on four almost identical BWR's. At

Millstone, they believe in diversity.

Okay, let's hear from Northeast Nuclear. Richard Casig from Northeast Utilities.

MR. KACICH: Richard Casig from Northeast Utilities. I just thought I'd take a second to identify the people we have from Northeast Utilities this morning. In addition to myself, in the licensing group there is Mike Vain, who works in licensing, who's been following the SEP topics on a day to day basis. We have Jan Rader from our reactor engineering branch, Bob Christie from our radiological assessment branch, and Ed Berry from our plant station. He holds an SRO license and is a shift supervisor, and he's going to be giving our plant presentation history.

MR. BERRY: Thank you.

As Rick said, I'm Ed Berry. I'm a shift supervisor at Millstone Unit 1. I've held the positio for four years. I've been at Millstone for 12.

You've seen most of the modifications that have gone into effect and also seen how well they work. In the first vugraph --

(Slide.)

-- we have a one-line diagram showing Unit 1. As was mentioned earlier, we are a three-unit site. Millstone 2 is a Combustion Engineering pressurized water reactor, Millstone 3 is a Westinghouse. We do share one system throughout the site and that's the water system. We have three pumps that pump into that. It's a closed loop.

We also share some of the air systems, some of the makeup water systems. There are no safety-related systems shared as such. We have the ability to cross-tie some electrical power. If Unit 2 needs it, you could transfer it from Unit 3.

(Slide.)

We are a GE BWR-3. We are very similar to Dresden. One of the few things we don't have at Dresden, they have a HPCI system, we have a feedwater coolant injection system which utilizes our feedwater system and a gas turbine. We're rated 2,011 megawatt thermal, 680 megawatts electric. We're a Mark I pressure suppression containment. We were constructed by Ebasco.

We have two recirc loops with 20 jet pumps, and it's a once-through cooling system with the Long Island Sound. We have the on-site emergency power system, which consists of a diesel generator and a gas turbine generator, which I guess most of you people are aware of or have heard of.

We have the typical BWR-3 emergency core cooling systems, with the exception of the KWCI system. We also have an isolation condenser, and we're unique in the fact that we have a 100 percent turbine bypass capability. So the plant will ride out a full load reject without a scram. This has been tested, and also we have had several full load rejects and we have a success rate of around 60 percent on that.

(Slide.)

For the history on Millstone, the construction start date was May 1966. Initial on-line was November 29th, 1970, and we declared commercial operations December 1970. 100 percent power was obtained January 3rd, 1971. The procedure in the major outages -- we've had several long outages. The first one was attributed to a chloride intrusion incident. It was approximately a six-month outage. Then we had the first feedwater sparger replacement in the industry in 1973.

The next long outage was the seventh refuel. That was October 1980. That was our ten-year ISI program. We just came out of the eighth refueling about a month ago. It was a fairly typical refueling outage.

(Slide.)

Okay. Unit performance: Megawatt electric generated to date is 45 million; capacity factor of about 63.3 percent, which is kind of low and attributed to those two long outages. And the last one we were only running about 90 percent due to a forced last stage turbine wheel that was damaged on starup after the last refueling.

(Slide.)

Here we have the Millstone Unit 1 systematic assessment of the Licensee performance. Overall, we find the management attention at our facilities is aggressively oriented toward nuclear safety and effective use of ample resources has resulted in a high level of performance in operational safety and construction activities.

(Slide.)

Here is some more of that. The only area we got category two in was security and safeguards, and offhand I really don't know the reason for that.

That's about all I have. Are there any questions?

MR. SHEWMON: Would you tell me what your experience has been on stress corrosion cracking of the main piping?

MR. BERRY: I'd like to address that to Rick. I get involved after it's found out and we go replace the piping.

MR. SHEWMON: Have you gotten involved? Have you replaced anything?

MR. BERRY: Yes, we have replaced piping. We replaced the core spray piping. We thought we had attributed it to the isolation condenser tube rupture. I believe that happened in 1976. We attributed that partly to chloride stress corrosion cracking.

MR. SHEWMON: Chloride? You're on seawater? Your coolant is seawater?

MR. BERRY: Our coolant is seawater to the main condenser. The isolation condenser uses fire water for makeup. During that chloride intrusion incident, we did have high conductivity in the reactor vessel and we had the isolation condenser for service.

MR. ETHERINGTON: Well, you retubed your condenser, didn't you?

MR. BERRY: Yes, we did.

MR. CARBON: This is a little bit aside from some of the technical experience. What experience has Northeast or Millstone had with Intervenors or people who have objecting from the local neighborhood?

MR. BERRY: Very few that I'm aware of. We've been lucky so far. We're fairly close to Seabrook. Compared to Seabrook, we've had none.

MR. KACICH: In fact the answer is none, fortunately.

MR. CARBON: Do you know why? Do you have a particularly complacent set of people living around there.

MR. BERRY: No. The Navy has its submarine base right there. We have General Dynamics. So it's very used to nuclear.

MR. KACICH: Part of the reason I think is timing. Both Millstone 1 and 2 had received their operating licensaes before it became particularly popular to get into that sort of thing, and Millstone 3 has yet to reach the operating license stage. So there's a potential for that to occur at that time.

MR. CARBON: Do you expect that to be realized or not?

MR. KACICH: It would not surprise me if it happened. Let me put it that way.

MR. BERRY: Also, demonstrations have really fizzled out. They'll start and they don't get too many people showing up.

MR. REMICK: A related question along that line. Am I correct that some of the taxes go back directly to the local communities?

MR. BERRY: To Waterford. Yes, Waterford is very happy about that.

MR. EBERSOLE: You've got this great

old-fashioned thing called an ice condenser. Would you be unhappy if somebody took it away from you?

MR. BERRY: I definitely would. That is one of the best pieces of equipment we have.

MR. EBERSOLE: But you could get along without it?

MR. BERRY: We have, yes.

MR. EBERSOLE: What pressure rating is that? Do you have to blow down to use it?

MR. BERRY: It's full pressure 10, 15 seconds, then it goes into service. The operators really fall back on that. It's a really nice piece of equipment to have.

MR. EBERSOLE: That's great.

Do you have to have accessory electric equipment to DC/AC, et cetera, to run a long-term shutdown? To what degree of independence? Does this run into an electrical failure problem?

MR. BERRY: No electrical power is required whatsoever. The initiating valve is a DC-operated valve.

MR. EBERSOLE: Wouldn't you lose the seals on the pumps first?

MR. BERRY: The isolation condenser has no pumps.

MR. EBERSOLE: There might be other things if you held pressure up.

MR. BERRY: If we held pressure up, we could isolate the recirc pump seals and stay right there.

MR. EBERSOLE: Do you think it's been a progressive move on the part of GE to abandon isolation condensers?

MR. BERRY: My personal opinion, I'm very strongly in favor of an isolation condenser from an operator's standpoint.

MR. EBERSOLE: I always thought it would be regressive to go away from it and I still do. Thank you.

MR. REMICK: To get makeup to the isolation condenser, that's what, fire water?

MR. BERRY: Yes.

MR. REMICK: Is it diesel-operated?

MR. BERRY: Yes, it is. Initially, if we use fire water, since fire water is city water, after we take it out of service it will drain down the south side and put demineralized water into it.

MR. SIESS: Other questions?

MR. MOELLER: Yes. We had presented for Millstone the results of the SALP. I wondered if the Dresden people could just quickly tell us the results there.

MR. RAUSCH: Yes. We haven't had an SALP. We haven't received our final report. The results go back to, I believe, '80 and '81. We did not get quite the number of category ones that Millstone did. I believe we had four or five category ones, and the remainder were category twos, as an average. I believe we had one or two category threes. One I recall for sure was in the health physics area, because we had an overexposure event.

MR. MOELLER: Thank you.

MR. EBERSOLE: A question. Does your 100 percent bypass give you a substantial advantage in the bypass case?

MR. BERRY: It definitely does.

MR. EBERSOLE: Do you have any problems with bypass pressure? Is it challenged?

MR. BERRY: I believe Dresden has like 45 percent bypass capability, and they would rely on their relief valves putting energy into the torus or the suppression chamber, whereas our bypass system will go right down into the condenser, not into the containment.

MR. EBERSOLE: Well, with your relief valves, what capacity relief valve systems do they have? It's not reduced, is it? It belongs to the old generation where you have 100 percent relief?

MR. BERRY: We have 100 pounds per hour and we have 60, so it's not quite.

MR. EBERSOLE: Not quite.

MR. SIESS: Other questions?

(No response.)

MR. SIESS: Thank you.

I will now turn it over to the Staff. Who's going to start? Chris Grimes, and you are going to handle both, right, Chris?

MR. GRIMES: Yes, sir.

MR. SIESS: I've asked the Staff to start off at a fairly rapid pace on the items that have been deleted and gradually to get into more and more details, but we are stoppable at any point for expansion. I would suggest, however, that since our time is limited and somewhat more limited than I have asked for, that you would probably have more questions and more interesting questions the farther down the list you get. So pace yourself.

(Slide.)

MR. SIESS: Raise your slides as high as you can on that thing, Chris. If you can, get your back to the wall. If Dr. Okrent doesn't complain, that's all right, and he can move you back if he wants to.

MR. GRIMES: Good morning. My name is Chris Grimes. I am a system leader in the Program Assessment Branch. I have with me today Greg Cwalina, the Integrated Assessment Project manager for Dresden 2, and Drew Persinko, the project manager for Millstone Unit 1.

As section leader, I was nominated to provide a presentation for both plants simultaneously which is a statistical feat in itself, trying to keep the 72 issues for Dresden and the 87 issues identified on Millstone 1, and put them together without getting them confused, but I will attempt to do so.

The first slide identifies the topic statistics for the two plants. I will go through each of the categories of topics and identify where there were differences. Then I will make a presentation on the issues addressed by the integrated assessment, and when I go into the integrated assessment, I will convert from topics to individual issues.

The statistics are separated because the individual topics can have a number of issues associated with them.

(Slide.)

MR. GRIMES: Where I can, I will also identify those issues which were common to Oyster Creek, but I will not dwell on the resolution of the issues for

Oyster Creek because they were presented at the last full committee meeting.

(Slide.)

MR. GRIMES: Here is an outline of the agenda for the way the topics and issues in the integrated assessments will be addressed. The further evaluation issues will be discussed prior to the technical specification change procedural or hardware issues, because they might lead to procedure or hardware backfits.

(Slide.)

MR. GRIMES: With regard to the topics that were generically deleted, the list for Dresden and Millstone were identical, with the exception of Topic 5-4. During the course of the topic reviews, the issue on furnace sensitized safe ends was raised. Dresden had not yet made -- taken a corrective action in accordance with the generic program, so the issue was reviewed in part for Dresden.

(Slide.)

MR. GRIMES: With regard to the topics that weren't applicable, the bulk were not site related or applicable to BWR's. The list is identical with the exception of 24E dam integrity. The dam didn't relate to either Millstone 1 or Oyster Creek, because they are ocean sites. Also, I would like to point out that if you are trying to do a comparison of the tables, they match well for Dresden and Millstone but not so well for Oyster Creek because the integrated assessment project manager elected to take some things which were excluded on a generic basis for PWR's and put them on a generic list. In either case, they were either excluded on the basis of generic activity or because they didn't apply. Whichever reason you want to use gets it on the list of topics to be deleted, so we didn't pay much attention to that.

MR. EBERSOLE: Is 1517 strictly true for PWR's that have isolation condensers?

MR. GRIMES: That is true, because the issue to be reviewed was one of the transient events that occur for tube failure in the isolation condenser, as I recall, because there are upstream isolation valves, it is an isolatable and terminatable event. Therefore it doesn't fall into the same category as the issue that was was raised with regard to the PWR case.

MR. EBERSOLE: Are you saying it is not a required heat detection source?

MR. GRIMES: It is not a transient event of concern, because it is isolatable.

MR. SIESS: You can do that without affecting heat removal?

MR. GRIMES: Yes, because you can go to ADS. You can go to steam dump to the torus and use a feed and bleed approach with high pressure injection.

(Slide.)

MR. GRIMES: Now I will go into the topics which meet current criteria or are acceptable on another defined basis. The definition there is one of, if we were reviewing this issue on a new plant and it did not meet explicitly the criteria today but they had an alternative that was equally acceptable to the staff, we would document it and put it in the SEP and everything was fine.

That is another defined basis that was used in the topic evaluations to conclude that they were acceptable.

(Slide.)

MR. GRIMES: First, I will present those that were common to both Dresden and Millstone. The topics that are asterisked are those that were found acceptable on another defined basis. The list is generally the same for Oyster Creek, except for a number of issues that were reviewed at the integrated assessment. The number is small.

If you want me to go through that comparison, I will, but I don't really think it is that significant.

(Slide.)

MR. GRIMES: Here is a continuation of the same list.

(Slide.)

MR. GRIMES: If you see any topic on there that you are interested in, we will discuss it.

MR. SIESS: Was this list a whole lot different for the boilers than it was for the pressurized water reactors?

MR. GRIMES: I knew you would ask me a question that I wasn't prepared for. I didn't do a comparison. I would say that in general they are fairly comparable, but I haven't done it in detail.

MR. SIESS: Are there any outstanding things boilers didn't meet criteria on that PWR's did, or vice versa? That is all right.

MR. RUSSELL: There is only one area where the boilers came substantially closer to meeting current criteria than the PWR's, and they had to do a steam isolation. The General Electric design generally came closer to the GDC's for containment isolation than was the case on either Pallisades or Ginna.

MR. GRIMES: That is a good point. In boilers we often find isolation valves outside containment because of the cramped environment and use of check valves are more predominant.

(Slide.)

MR. GRIMES: With regard to the topics that were found acceptable or equivalent that were unique, the reason for the difference in this list is principally because there were issues raised on Dresden that were considered in the integrated assessment or on Millstone that were considered in the integrated assessment and closed out in the topic evaluation.

There were two issues on Dresden that were not applicable to Millstone, and those were both of the issues that I just alluded to in the deletion list, the dam integrity and the piping.

MR. EBERSOLE: You mentioned check valves inside containment. I believe it has been the practice of GE to always put exercisers on their check valves, yet in the PWR regime, which uses borated coolant, there are no such exercisers. What is the reason for this difference, and how does the Staff look at this difference? These are devices that move the check valve periodically --

MR. GRIMES: Positive acting check valves.

MR. EBERSOLE: -- to see that it is working.

None of the PWR's have it, yet they presumably have a greater chance of having trouble because of the use of borated coolant. What is the Staff's view on this? Or does it make any difference? It is a lot of trouble to put them on.

MR. GRIMES: I am not sure that the Staff has a particular view on it other than it enhances the capability to do in service inspection for operability of valves.

MR. EBERSOLE: You always made GE do it. That was the story I got from you a long time ago.

MR. GRIMES: That may be true. If we made GE do it, I don't know why we made the PWR's do it.

MR. EBERSOLE: I don't, either. Does anybody know?

MR. SIESS: Chris, why is reactor vessel integrity an item on Dresden and not on Millstone?

MR. GRIMES: Because the furnace sensitized safe end issue was resolved on Millstone in a generic sense. It was picked up by SEP because they had not yet made the safe end change.

MR. SIESS: Thank you.

(Slide.)

MR. GRIMES: Now I will go through the topics and issues which were addressed by PRA.

MR. SIESS: Will you take two seconds and explain the difference between topics and issues for the benefit of the committee?

MR. GRIMES: Yes, sir. A topic is a general category that was reviewed. The issues are the specific differences from current criteria that were identified from the topic evaluation. So, as we go through the integrated assessment results, there will be a number of cases where I identify a topic that falls into one or more categories of no action, procedural change, hardware change, or further evaluation.

MR. SIESS: Think of issues as subtopics.

MR. GRIMES: The results of the risk perspective inputs that were provided to the integrated assessment are summarized here in the fashion that they were summarized in the reports that are presented in Appendix E for Dresden and Millstone. For Dresden, the PRA evaluation used a modified Millstone IREP approach, and therefore, like Pallisades and Ginna, we have a limited risk perspective based on extrapolation of another PRA.

They categorized the risk of the issue in accordance with the difference from current criteria as either being low, medium, or high in the context of contribution to core melt. For Millstone, there was a plant specific IREP. The results are summarized in Appendix D in a ratio of a new risk to an old risk, the risk change being represented by making the plant modification from different current criteria.

At this time, Mr. Spulak from Sandia will give you a brief presentation on the difference between having a limited and a plant specific PRA, unless you have any specific questions about the lists of the issues, topics and issues.

MR. EBERSOLE: The first item, please. Do these plants have a fully pressurized main steam supply to the high pressure core injection pumps maintained at full pressure at all times outward of the isolation condenser? In other words, they maintain full steam pressure up against the stop valves?

MR. GRIMES: I don't know the answer to that question.

MR. EBERSOLE: Let's assume they do. If they do, one then has the problem of HPCI feed line failure and the requirement in almost an absolute context that you intercept steam flow. What is the reliability of those valves intercepting failed pipe steam flow? Do you follow me?

MR. GRIMES: Yes, sir. I will have to go back and check. As I recall, it is not up to the stop valve. It is in the inside containment.

MR. EBERSOLE: Is it?

MR. GRIMES: I believe so, but let me check.

MR. EBERSOLE: That changes the whole picture, if that is the case.

MR. MOELLER: Excuse me. For example, on that list, the first item, III-5.B, 55, and 511A, Dr. Zudans raised questions on each of those. Now, will we hear that later?

MR. GRIMES: They are addressed in the context of either requiring no action, requiring further evaluation. I will go into each of the issues in terms of the integrated assessment results after you understand how we were given a risk perspective on each of the issues.

MR. SIESS: We will now hear from Mr. Spulak on how they used the PRA. You are next. Are we going to hear from you on the PRA or not?

MR. ERNST: I would like to say a couple of words before we start on the PRA. It will come out during the PRA presentation that there were a number of rather low risk sequences identified that seemed to have some potential hardware fixes associated with them. In that regard, I think a few introductory remarks are worthwhile.

First, as was pointed out for Millstone, this was the first time that there has been a quantitative assessment of the SEP potential fixes versus the qualitative matrix kind of approach that was used before. For a number of -- a half-dozen or so of these issues, DST did take a look at the risk reduction, and did, based on some judgments that were provided to us, made some judgments on cost effectiveness. We found a couple of things.

As I mentioned, a number of them did appear to have rather small or insignificant risk reduction potential. Some of these did appear to have some potential hardware fixes associated with them, based on a reading of the NUREG. I think there are some points to be made.

First, the PRA's are uncertain, as all of us are well aware. Secondly, in a number of cases, as we understand it, the licensee desires to make some changes, for whatever reason, whether it be risk or some other reason. And we understand also that the end result is that some of the potential hardware fixes may not eventually take place anyway.

The final point, I guess, is that making judgments on the usefulness of hardware fixes, I think PRA is one consideration, but certainly not the determinative consideration. There are some useful PRA insights, namely, that in most if not all of these, the risks are at least on the order of or less than a couple orders of magnitude less than the safety goal, the core melt proposed safety goal.

If one takes a look at the individual risk reduction potential and some numbers on cost, whether or not thoroughly documented, may argue that such changes are worthwhile. It seems to me that there is a point, and I don't know exactly what that point is, but there is a point where the residual risk reduction potential probably is not worth the ball game of looking at it too hard, even if the alleged costs were very small.

And I do question whether very small so-called changes in hardware don't have somewhat large costs associated with them anyway. You just can't do too much for a little bit of money. But I just want a little bit of perspective that the PRA is not determinative. There are other considerations. And DST just looked at it basically from a risk reduction potential, and made some judgments that there were some marginally defensible hardware fixes, and those hardware fixes did take place.

There are two issues that remain, I think, looking towards the future, not just Millstone. That is the policy question of how much initiative should there be to consider hardware fixes for potentially very small risk reduction sequences, and if so, there should be some cutoff point at which you just do not pursue hardware changes any more based on your risk assessment of what would that cutoff point be.

I think this is something we have to look at in the future.

Secondly, with respect to Millstone, there are a couple of residual issues that were outside the scope of the SEP program that were identified in the PRA analysis. One of these involves a more reliable depressurization because this particular part of the safety of the plant was paramount in about five dominant accident sequences.

Secondly, apparently, if one loses instrument power, one also has the potential of losing containment shutdown cooling systems. I think these issues need to be addressed. The mechanism of address, since it is outside the scope of the SEP, and perhaps even outside the licensing requirements, is a question that needs to be addressed, and in a broader sense, I guess, addressed to the safety goal implementation plan, and how do you use PRA in any future safety goals and making decisions on that.

I just wanted a few moments for a little bit of perspective for the PRA part. Thank you.

MR. EBERSOLE: May I ask a question? Under reliability of the depressurization process which you suggest was very important, and I certainly agree with that, was any of that associated with environmental qualification problems with the solenoid valves that operate the depressurization system?

MR. SPULAK: We have problems with the work time.

MR. EBERSOLE: I want to know if one of the major contributors to the unreliability of blowdown is due to a weakness in the solenoid valve design which is inside a hostile environment.

MR. AMICO: Paul Amico from SAI. No, it would not be dominated by the operator failing to initiate the manual blow down process.

MR. EBERSOLE: Did you find qualification of the solenoid valves adequate?

MR. AMICO: We didn't go into that much detail.

MR. EBERSOLE: If you didn't go into it, you don't know.

MR. AMICO: We used the data available. Exactly what is included in that date is supposedly the actual failures. I am unaware of any other.

MR. EBERSOLE: Those are type tested. They are never in situ tested. Thank you.

MR. OKRENT: What do you mean when you say you use the data that are available?

MR. AMI The data that was available in the IREP study.

MR. OKRENT: Yes, but it seems to me when you answer a question, you should answer the question that is being asked, to say we didn't do that.

MR. AMICO: We personally did not do that.

MR. OKRENT: Fair enough. That is an answer.

MR. SIESS: Now, I wasn't quite sure what you were telling us. Were you apologizing for requiring hardware backfits where there was no reduction in risk? Or were you disagreeing with the SEP staff for either requiring them or not requiring them when they were cheap and there was no reduction in risk?

MR. ERNST: I think there are a number of questions where if hardware fixes are finally the resolution for the issue and there is some question in most of these cases and there are also some cases where apparently the licensee wants to make the change --

MR. SIESS: That is his business.

MR. ERNST: That is his business, yes, but if it becomes a resolution in any area where there is a requirement rather than the licensee saying he wants to do it, and this appears to have a very small risk reduction, I think in that case from a PRA and cost benefit standpoint we would say that it does not appear to be justified.

MR. SIESS: I can think of cases where there is a very small risk reduction, but also a very small cost. So the cost benefit may look high. And I think there are some instances like that. Maybe you can just point them out when we get to them. That would be better.

MR. ERNST: I think this is a policy question. Maybe it should be applied at Millstone. Maybe not. But looking ahead, I think one needs to say how small a level of risk reduction do we worry about.

MR. SIESS: I think there are some specific examples that will help bring this out.

Okay, Mr. Spulak. Let's see. Are you going to be able to give us the relationship between the numbers and the words? Is that a part of your presentation? Or will that have to come from Mr. Russell or Mr. Grimes?

MR. SPULAK: I am not sure I understand what you mean.

MR. SIESS: We were told at the subcommittee meeting that low was .9921.

MR. GRIMES: Dr. Siess, if I might clarify that, that is a part of Mr. Spulak's presentation, our definition of low, medium, and high, and what the ratios represent. So far as the relationship --

MR. SIESS: That is fine. I couldn't remember which end that came from. So proceed.

MR. SPULAK: I am going to briefly discuss the methodologies and some of the results for our risk analysis of the SEP issues, and concentrating on Dresden 2 and Millstone 1, and I will emphasize the differences in the methodologies which were used, the differences being that for Dresden we used a qualitative approach, since we didn't have a plant specific PRA, and for Millstone we had a plant specific PRA as a result of the IREP study.

Therefore, we actually calculated how resolution of the issue would affect the calculation of risk as calculated by the IREP study.

(Slide.)

MR. SPULAK: In both cases, the basis of the evaluation from a risk perpsective was -- this slide reiterates what I just said, that for Oyster Creek and Dresden 2 in this case we did a qualitative analysis of the impact resolution of each issue, and for Millstone 1 we did a quantitative analysis. For Millstone 1, we tried to give as broad a base as possible for interpretation of the results by calculating the change in core melt frequency, the changes in exposure, that is, man rems per reactor year to the public, and the change in risk which was total fatalities per reactor year.

For the qualitative analysis, we were not able to provide such a broad perspective. We were essentially looking at core melt sequences and the impact of resolution of the issues on core melt sequences.

(Slide.)

MR. SPULAK: The IREP Millstone PRA was used for the base case in both the qualitative analysis and the quantitative analysis. It was felt that the Dresden and Oyster Creek plants were fairly similar to Millstone 1, approximately the same vintage BWR's, and so forth.

For the qualitative analysis, we took the FSAR plant drawings and so forth for the plant we were looking at, either Dresden or Oyster Creek, and actually went in and changed the Millstone IREP fault trees to represent failures of the other plant systems. We weren't able to solve those fault trees and come up with cut sets or numbers and things like that, because that would have involved a great deal of effort. That would have essentially been doing a PRA on that plant.

But what we did do was use these modified fault trees, system fault trees, to make qualitative judgments about how resolution of the issues would impact the core melt sequences through the system fault trees. Of course, the IREP -- Millstone 1 IREP applies directly to Millstone 1.

To go into a little more detail about the qualitative analysis and what we mean by high, medium, and low when we classified the issues, this table gives the criteria which we used for these classifications. An issue was classified as low, starting at the bottom and going up, if by calculating a change in a component unavailability or calculating a change at whatever level the issue affected the system fault trees that we did -- that we developed for the plant.

We could detect no change in the component availability or, if we calculated a change in component unavailability and did the system fault trees and determined that there was just no way that that change in component unavailability could change the top of any of the system fault trees that appeared in any dominant sequences, we classified that issue as low.

What we meant by dominant sequences were sequences which based on the IREP Millstone PRA and the Brown's Ferry PRA, which is being published, I think, or soon to be published, and other PRA's of BWR's, we could reasonably expect to be dominant accident sequences. Mostly we looked at the Millstone PRA.

An issue was called of medium importance to risk if the issue would impact but not dominate the top event of a system level fault tree that would appear in a dominant accident sequence. An issue was called high if the resolution of the issue dominated the value of a system level fault tree based on our judgment which would appear in a dominant accident sequence.

These are the criteria we used to classify the issues as low, medium, and high importance to risk.

(Slide.)

MR. SPULAK: Now, the two methodologies that we used -- of course, the other methodology was a quantitative methodology. We recalculated the IREP Millstone PRA incorporating the changes in the plant and the fault trees to represent resolution of the issues.

The differences in the methodologies give rise to some differences in results. In this slide here, I have chosen four examples to discuss these differences in results. Two of these examples are the same across all three plants. The results are the same, and two of the examples, the results appear to have changed across the three plants.

The first issue is loose parts monitoring. For all three plants, we evaluated this issue in more or less the same way. From a PRA perspective, loose parts, the concern with loose parts is, they can cause damage within the reactor coolant system and cause transient events. Based on historical data of loose parts events, we find that the contribution of loose parts to transient events is very, very low, and in fact negligible.

So, both from a qualitative point of view and a quantitative point of view, loose parts contribute negligibly to risk to the plant.

The next issue is bypassing the thermal overload trips on motor operated valves during emergency conditions. For Dresden 2, we looked at the valve failure data and we looked at the failure data for the thermal overload trips which -- there are similar types of instrumentation and so forth.

And we determined that bypassing the thermal overload trips could decrease the unavailability of the motor-operated valve by some small amount, I think about 14 percent or something.

So, based on the fact that the system level fault trees that we had had motor-operated valves in them, and the component data that went into the fault trees wasn't changed, we decided that the top event could be affected by this change in data, but it wasn't going to be dominated by that.

So, we classified this as medium for Millstone 3 and Dresden 2. When we actually requantified the accident sequences at Millstone 1, using the data, changing the data generated by bypassing the thermal overload trips, we found that the total core melt frequency was reduced by about 1 percent.

The SEP branch, I think, has come up with some sort of way or judgment on their part as to what low, medium, and high would mean for Millstone. I think they say low is anything less than 1 percent; medium is 1 to 10 percent, and high is anything above 10 percent change. So, in this case this would be a low issue on the low end of things, whereas because of the cruder methodology at Dresden 2, we judged it medium.

Now, the qualitative methodology has a couple of built-in conservatisms because it is qualitative. This is an example of one of those conservatisms. That is that we assume that if we look at the system level fault trees, and we can detect a change in the top based on a qualitative judgement, we could detect a change in the top of the fault tree due to resolution of the issue. We have to assume that that change is non-negligible. We can't quantify the change.

In this case, the change is almost negligible. The 14 percent change in the component data translates to a 1 percent change in the total core melt frequency.

MR. OKRENT: I am sorry. Did you say that the SEP branch treats 1 to 10 percent change in core melt frequency as of medium importance?

MR. RUSSELL: We received some recommendations from DST as to when an issue should be considered, the thought being that if it was less than a 1 percent change in core melt, that that was two orders of magnitude lower than the core melt, and the change probably should not be considered. If it is in the category of one order of magnitude less, that is, a change of 1 to 10 percent of the core melt, it should be considered, but very carefully, and if it was 10 percent or greater based upon reduction in risk, that that was an issue that should be pursued.

MR. OKRENT: Is that the policy that --

MR. RUSSELL: No, this was just guidance. It was input. Basically, it was one order of magnitude or two orders of magnitude less than core melt.

MR. OKRENT: I guess I will ask Mr. Ernst. Is this what you were recommending as policy?

MR. SIESS: For what, new plants or SEP?

MR. OKRENT: For any plants at the moment. I am just trying to understand.

MR. ERNST: This for Millstone was the kind of judgmental approach that we were considering in trying to come up with some kind of an idea of how much does one really want to look at sequences that are very small in risk reduction potential. Clearly, the 1 percent is right on the borderline between should one really dismiss it or should one give it some further consideration.

So, to say if it is above 1 percent we clearly consider it and below 1 percent we don't is clearly far beyond the state of the art. We are struggling with the point of at what point do we stop worrying too much about the benefit cost aspect and just say on the basis of residual risk reduction it doesn't seem to be worth a trip to the store.

MR. OKRENT: I would like to talk about the point for a moment, Mr. Chairman. In the first place, I have a problem using core melt and not the release category. For example, if that 1 percent were reactor vessel failure, gross reactor vessel failure, I suspect it would be looked at as something of some considerable importance, but there are other kinds of accidents that have related not far different release categories. So I am just using that as something you can visualize.

Secondly, our knowledge of this 1 percent and 10 percent, it seems to me, have to be part of the consideration, and if you think you do not know things very well, that has to enter into the thing. I myself would say that contribution -- let me pick a number between 1 and 10 percent -- 5 percent of the core melt frequency to me is a big number, and you are just putting it into the thing that might be considered not something to be pursued.

What I am bothered by is the development of some kind of an ad hoc policy within the staff based upon crude estimates of core melt frequency which will grow into a pattern that this is what we no longer follow, and so forth. I would suggest in fact that you write something down, Mr. Ernst, and put it out for extensive comment so that in fact it can be a well-discussed issue instead of something that grows insidiously.

MR. ERNST: If I might take a minute, I am sympathetic to all your points, Dr. Okrent, particularly the last one. I do think we need to not have things grow insidiously. With regard to the 5 percent question, I perceive no difference between considering and pursuing. What we are really judgmentally saying is, if it is in the 10 percent or larger range, it is something that needs to be done, and in the other range of considering is taking a closer look at the problem, et cetera.

On the risk question, I agree wholeheartedly. I think the question is coming a little more simplistically than it was. We considered not only core melt, but reduction in risk in making judgments on the releases from the accident sequences. So the 1 percent sort of applied to both.

MR. AXTMANN: What sort of limits do you have in mind qualitatively for the reality of the overall core melt frequencies that you started with?

MR. ERNST: In my view, the 1 and 10 percent numbers are certainly not hard and fast. They are sort of developed taking a look at the estimated --

MR. AXTMANN: I am talking about 10 percent of what, and how good is that.

MR. ERNST: I am trying to get there. We took a look at from Millstone not only the core melt frequency advertised in the PRA but also the man rem, and these numbers were sort of all hard numbers based on

Millstone itself. If you had a situation with an entirelyi 1ifferent risk of core melt profile, the judgments may be somewhat different, but it is sort of considering what may be coming forth in a safety goal as you look at the advertised numbers in Millstone and make some kind of a judgment of sort of where might your decision breaks be, that kind of a thing.

So, we did consider the Millstone risk and core melt as advertised in the PRA and came up with these numbers. It could well be different if you had a different situation.

MR. EBERSOLE: May I ask a question, please? As a means of testing the application of this methodology, if you were to apply it to TMI 2, say, a year before the problem, do you think the findings would have intercepted what eventually happened there, that you would have detected what were the causative factors that led to the TMI 2 meltdown, and something would have been done about it?

MR. SIESS: Are you talking about the PRA or the SEP?

MR. EBERSOLE: The kind of methodology.

MR. ERNST: I don't quite know how to answer that, because I think in the PRA methodology if one considered the circumstances that actually occurred at

TMI, and you would carry that more than likely before the fact, you would carry that to a core melt with substantially different off-site consequences, I think, in the PRA world, but I am not sure what you were --

MR. EBERSOLE: I am saying application of your methodology, if it were stylish at that time, do you think it would have prevented TMI 2?

MR. ERNST: First, you would have to describe and fully understand --

MR. EBERSOLE: I know.

MR. ERNST: -- the sequence, and then I don't know where the number at TMI would fall. Clearly, the consequences might have been the 2,000 person rem or whatever the consequences were --

MR. OKRENT: To answer the question directly, I think if you take the approach currently used in the PRA's with regard to estimating the likelihood of operator error, given seven people in the control room, the answer is, it would have been a very unlikely event.

MR. EBERSOLE: Yes.

MR. OKRENT: If we did it now, knowing everything that happened, but using the kind of things one sees in the current PRA with regard to the chance of operator -- not just one person, but several people.

MR. SIESS: Given eight people and two hours.

MR. ERNST: That is true, but if you took the axisting situation as an historical event and then tried to calculate --

MR. SIESS: That was not the question.

MR. SHEWMON: But the obvious conclusion from that is, we need more PRA, not less? Is that correct?

(General laughter.)

MR. EBERSOLE: I won't draw that conclusion.

MR. SIESS: Gentlemen, I may be anticipating a little bit, but I think you have got some idea from the previous reviews of how the Staff was using these sort of indirect PRA's in their SEP judgments. I don't believe they used the Millstone IREP PRA any more extensively or any more strictly than they used the indirect PRA's. They applied an awful lot of judgment on top of it, or in spite of them, I am not sure which.

MR. OKRENT: I might comment, I looked at the PRA discussions, and most of the issues that are dealt with here are small issues. I guess I would classify them as not difficult issues involving both a large chance or a relatively large percentage of the overall risk of core melt and also a very expensive fix, and so forth.

So, I think in the end, I think the PRA tended to agree with their intuitive judgment for the most part. It was useful to do that. The issue I was raising was maybe that the philosophy will be applied elsewhere in things that are more substantive, and before that is done, I think the philosophy has to be examined in depth.

MR. SIESS: I agree. Okay, Mr. Spulak.

MR. SPULAK: The next issue on the slide, which is containment isolation, points up or at least illustrates one of the concerns Dr. Okrent raised. That is, that there is a difference between core melt and risk. For the purposes of this discussion, I prepared this slide with the numbers from core melt. The containment isolation would have a minimal effect on the core melt frequency in any case, no matter how bad it was or how good it was, but it could have a large effect on off-site doses and therefore risk.

MR. SIESS: But it didn't.

MR. SPULAK: No, that is true.

MR. SIESS: I happen to have another table that gives other numbers in them.

MR. EBERSOLE: In that connection, aren't these old plants susceptible to reduction of NPSH availability if you lose containment isolation?

MR. SPULAK: From the recirculation, you mean?

MR. EBERSOLE: Yes. The case I recall required retention of the atmosphere fraction inside containment to maintain NPSH on the pumps, to maintain suction. You need atmospheric components. You couldn't just let it leak off and have steam in the containment. Is that true of these plants?

MR. SPULAK: I don't know.

MR. EBERSOLE: How do you know that containment isolation is not important?

MR. SPULAK: It wasn't identified as important in the Millstone IREP study.

MR. RUSSELL: Can I answer the question? That does not affect these plants. The issue of whether you use containment pressure to provide adequate net positive suction protection for the pumps was looked at. I believe the event you are concerned about is one we discussed in detail, the situation that came up on Beaver Valley with the subatmospheric containment.

MR. EBERSOLE: Yes.

MR. RUSSELL: We do not have that problem for any of the plants we have looked at thus far in the SEP. That minimum positive suction head was looked at on those plants as part of the abnormal occurrence follow-up when that event was recorded.

MR. EBERSOLE: Well, that problem doesn't go away with non-below atmospheric plants.

MR. RUSSELL: That's correct. It does not, but we have not considered credit for the positive pressure in containment in calculating the minimum suction head requirement for these plants.

MR. EBERSOLE: Thank you.

MR. OKRENT: I am sorry. My memory tells me it was Millstone 1 we were talking about when the issue of net positive suction head became, let's say --

MR. SIESS: Maybe that is why it is no problem.

MR. OKRENT: No, again, at Millstone 1 it was not clear that at least for some events that they didn't need some pressure, so I would like to know, is my memory wrong or not? Are there any accident situations where they in fact are counting on some containment pressure for the pumps to work?

MR. RUSSELL: The event in the resolutions I was discussing were about 1976, '77, involved Beaver Valley, North Anna, Surrey. I don't know about Millstone 1.

MR. OKRENT: This arose before Beaver Valley. This was in '66.

MR. SIESS: The question is, does it exist now. Isn't that it, Dave, on Millstone 1?

MR. OKRENT: Did it exist, and does it exist? You have to live with it.

MR. SIESS: Let's ask the licensee, who certainly has done the analyses for his plant. Do you have the question?

MR. KACICH: I have the question. I don't know if I know the answer. I don't recall any specific incident unique to Millstone where this would have received any more attention than it would at any other facility. To the best of my knowledge, I agree with Bill's statement. Our analyses did not take any credit for assumed containment pressure. That is part of the calculation. We assumed atmospheric pressure.

MR. OKRENT: All right. Would you --

MR. SHEWMON: He will return.

MR. OKRENT: Would you confirm that that is the case? You may well be right.

MR. KACICH: Yes, sir.

MR. OKRENT: I will reserve judgment.

MR. KACICH: Yes, sir.

MR. SIESS: Onward.

MR. SPULAK: The reason that we assessed the containment isolation wasn't important to risk or core melt was because the pressure generated by the steam non-condensible gases during core melt would always be great enough to fail the containment even if no other type of failure occurred first, or if no other type of failure occurred first, such as a steam explosion.

So, the effect of failing containment isolation is minimal compared to the overpressure of failure and rupture by steam explosion.

MR. OKRENT: I read that, and I must say it seems to me that that is a case where you may have used PRA results directly without asking yourselves could there be other kinds of sequences which you ignore in the PRA because they do not seem to contribute very much in the same way as someone saying, well, at Three Mile Island you wouldn't have gotten to full core melt, and it didn't.

MR. SPULAK: I agree entirely. However, we were using the IREP PRA as our base case, so we didn't want to extrapolate for this specific case.

MR. OKRENT: I don't think you are on very solid ground on that particular argument myself.

MR. EBERSOLE: It seems to me you have ignored the set of accidents wherein failure of containment isolation results in degradation of equipment, which then produces core melt, which is the inverse sequence.

MR. SPULAK: There were not any of those kinds of sequences that have dominated Millstone.

MR. EBERSOLE: I asked about the failure of the HPCI steam line, which could have been the case, except I was told the pressure was not maintained outboard of the isolation valve. Do you look at this?

MR. SPULAK: I am going to ask Paul Amico, who is principal investigator for the IREP PRA, because he is much more familiar with the details, to answer that question.

MR. EBERSOLE: You did tell me that you found the plants did not maintain full pressure outboard of the interior isolation valves, didn't you?

MR. AMICO: I didn't tell you that. I am not sure exactly what you are talking about.

MR. EBERSOLE: I am talking about the failures on isolation system failures and ultimately that lead to core melt because of equipment degradation.

MR. AMICO: Secondary effects of pipe breaks outside containment.

MR. EBERSOLE: Right, which runs your equipment down to a failsafe state so you can't pump water any longer.

MR. AMICO: No, we did not do environmental effects. The only thing we did do is, we did look into the probability of an unisolated pipe break outside containment, and found that to be a negligible frequency event.

MR. EBERSOLE: I imagine it is a negligible frequency event, irrespective of its consequence.

MR. AMICO: Correct. There is a certain point at which we cut off the analysis. We couldn't analyze all the way down to 10^{-12} or anything like that, so there is a point below which an event was said to not be important even if just the occurrence of that event caused core melt because there were other combinations of events or something that were two or three orders of magnitude higher than the cutoff failure.

MR. SHEWMON: Gentlemen, let me remind you that as soon as we can leave this interesting topic, we can have a break.

(General laughter.)

MR. RUSSELL: If I might make one comment, there were a number of areas which we identified that were related to SEP issues which were not addressed explicitly or even considered in the PRA. The spatial dependency of pipe breaks, for example. Whether a component can function as designed. Does the relief valve have sufficient capacity that you do not have to worry about the event?

The issue you just brought up is the question, can the valve shut to isolate the break? The assumption in the PRA only looks at random failures of a valve, and does not look at quality of that valve or its ability to function under those design events. We tried to consider those issues and describe what the concerns were in our use of the PRA for the SEP issue, for the issue of concern.

This is why in some areas, for instance, the leakage detection of pipe breaks inside containment, we tended to not use the PRA results for arguing that nothing more needed to be done on leakage detection.

So, I think we will see some cases like that as we go through the specific issues that were looked at, where the approach from PRA looks at random failures but not at the ability to function, and whether there is an underlying basic problem with the design.

MR. SIESS: Onward.

MR. SPULAK: The last issue that I have chosen to discuss illustrates another type of conservatism in the qualitative analysis that we did. This is DC instrumentation. The concern here is that some battery failures or DC bus breaker failures, and so forth, may be detectable immediately with adequate instrumentation in the control room, rather than weekly or monthly or however often that particular component is tested, and this should reduce the unavailability of the DC power system.

For Dresden 2 and Oyster Creek, our qualitative methodology said, well, yes, if you can detect a significant fraction of the failures immediately instead of at test intervals, you could have a significant, perhaps dominant effect on the unavailability of the DC power system, and since DC power is a system which appears in dominant event sequences at other kinds of plants similar to Dresden and Oyster Creek, we rated that issue as high and important to risk.

On Millstone 1, when we changed the DC power fault trees to reflect the fact that you could detect some failures immediately, rather than waiting for testing, we found that it made a very small effect on the overall core melt frequency. The reason is that even though the DC power system does plug in or contribute to dominant core melt sequences, it senses the support system. The failures of DC don't appear in many dominant cut sets of those sequences.

There are other kinds of failures other than failures of DC which contribute to the core melt sequences. So that is another kind of conservatism.

In our ignorance about the exact way that DC power would contribute to core melt sequences at the other plants, we have to conclude that it could contribute significantly.

MR. EBERSOLE: Didn't that neglect the fact that one of these plants at Millstone has a bypass condenser for shutdown heat removal and the other doesn't? One plant doesn't need DC as much as the other. Did you account for the relative needs of these things in the plant design?

MR. SPULAK: I guess I would have to say no, although like I said, we are conservative in that we assume that at the other plants DC would be required.

MR. RUSSELL: Dr. Ebersole, all three of these units have isolation condensers. We did not have that particular aspect.

MR. SIESS: Dave?

MR. OKRENT: I would like to read a few lines from a letter written on January 15, 1970, from the ACRS to Dr. Seeborg concerning Millstone Nuclear Power Station Unit 1. It says, and I quote, "One design change, however, involved the reduction in the capacity of each of the redundant containment cooling systems. This alteration requires placing greater reliance on the heat capacity of the torus water for temporary storage of heat energy in the unlikely event of a hypothetical loss of coolant accident. The increase of the torus water temperature to 203 degrees F. under certain degraded conditions is an additional concern because of its potential effects on the performance of the emergency pumps. These include the direct effect of high temperatures on the pumps and the dependence on containment pressure to assure adequate net positive suction head." End of quote.

Now, I don't know. The situtíon may be different now. But that is what was in the committee letter in 1970.

MR. SIESS: You still want to know what the situation is now, right?

MR. OKRENT: I don't think it's vital to the SEP review, but I am curious.

MR. SIESS: You want to get historical accuracy. Mike?

MR. BAIN: Mike Bain, Northeast Utilities. I think I can answer that question. That concern came up before the plant was originally licensed. It subsequently had an amendment to the SAR, which was a result of some tests which were conducted prior to initial operation of the plant.

What was done initially was a test to determine the capability of the ECCS pumps to operate with the torus water temperature of 230° and also a loss of ventilation in the rooms. That did relate to an SEP topic on ventilation systems. We have just recently provided some documentation with those test results.

MR. OKRENT: Let's see, that would be 203° F water at atmospheric pressures?

MR. BAIN: Yes, that's right.

MR. OKRENT: Okay, that's fine. Thank you.

MR. SIESS: Here is another demonstration of Dr. Okrent's memory.

MR. SPULAK: This about concludes my

discussion unless there are questions.

In summary, I tried to show the differences between the qualitative methodology that we used for Dresden and the quantitative methodology we used in incorporating the IREP PRA for Millstone and to show how, you know, the different methodologies require different types of interpretation in order to provide the results of the analyses.

MR. SIESS: The remainder of your handout is an answer to our questions.

MR. SPULAK: That's right.

MR. SIESS: Are there any further questions on how this was done by the Sandia people? We will hear a little more from the SEP staff on the number of grains of salt with which they took these results.

MR. AXTMANN: Perhaps I'm the only one who is mystified by the last column in the table X-1 of the Millstone report. The new risk divided by the old risk. Where do those numbers come from?

MR. SPULAK: The IREP PRA did not do consequence analysis. They did not say okay, if we have a release, how many people are going to die. What they did do is they placed the various accident probabilities into various release categories. The release category gives the measure of the accident.

What was done was to take accident calculations for the various release categories, which were done for Northeast, River Valley composite site and weight the releases in the various release categories by their relative consequences. This we used as the measure of risk.

The consequences were total fatalities.

MR. AXTMANN: So the 550 man rem per reactor year is in case of a release; is that right?

MR. SPULAK: That is a different number, okay? That was calculated using the expected man rem exposure per release in a given release category. The risk and the exposure reported in that table are two different things, although they turn out -- the percent changes turn out to be just about the same.

MR. AXTMANN: Thank you.

MR. SIESS: Any other questions for Mr. Spulak?

(No response.)

Thank you, and we will take a break for ten minutes, if that's all right with the super-Chairman.

(A short recess was taken.)

MR. SHEWMON: Onward.

MR. SIESS: Okay, Chris, you're on again.

MR. GRIMES: I would like to start my presentation by firt making a clarification about the consultants' comments. You have been provided with copies of the consultants' comments on Dresden and Millstone. For all three boiling water reactors, we only had four. It was not an issue of Dr. Budnitz having any conflicts; he had a different contractual arrangement. It was more difficult to try to restart in the beginning of the fiscal year and we haven't gotten it restarted yet. Hopefully, he will be on the next review, which is Yankee. For the time being, we settled for four.

MR. SIESS: The trouble is Office of Contracts got -- not the legal office.

MR. GRIMES: That's correct.

MR. SIESS: I don't know which is worse.

(Laughter.)

MR. GRIMES: This is just a list of issues that were identified during the reviews that are common to both plants. A clarification there -- the commonality from plant to plant was my judgment. If they came reasonably close to being an issue, if they involved slightly different systems or if it was the same kind of issue, I called them common. For example, on unisolatable breaks outside containment, the reactor water cleanup system in both cases, by the related systems are not identical. The systems are the same.

The rationale for concluding no action is required is the same.

Dr. Zudans, in relation to the question that Dr. Moeller raised before, Dr. Zudans indicated in his comments that he felt that stresses in accordance with the Mechanical Engineering Branch technical position would be desirable. The staff concluded that the effort required to develop those stresses was not necessary because of the low probability of the unisolatable break in relation to the probability of simultaneous failure of both isolation valves.

Another comment was made by Dr. Bush regarding the ESF piping supports on both plants. We concluded that that issue was being adequately dealt with, but by I&E bulletin 79-14, Dr. Bush made the comment that he felt they were going in the wrong direction. But nevertheless, we feel the resolution of Bulletin 79-1' will resolve this issue and we don't need to pursu, it.

MR. SIESS: His disagreement was really with 79-14, not the review.

MR. GRIMES: That's correct.

MR. SIESS: He thought you were more likely to make a better judgment than 79-14, I think.

Just for the committee's benefit, 79-14 has to do with pipe supports. Bush feels like it is leading to more and more pipe supports and he thinks that direction is wrong; that we should have fewer pipe supports and more flexible systems. A view that the staff has not yet agreed with.

He expressed a particular concern that the staff is considering this as an industry program, and he was concerned that we make these people put in more pipe supports and two years later come along and tell them to take them out. And worse, he has to tell them they should take them out, a not unheard of occurrence.

The SEP staff has simply said this is somebody else's business, we've got to let somebody else do it. It's an industry-wide generic issue, and under your rules, you have to pass that on.

MR. GRIMES: That's right. We have no ability to change other programs. But where other programs will resolve issues identified in the SEP topic evaluations, we defer to those other programs.

Another example of that would be safe shutdown procedures where the TMI symptom-oriented procedures will resolve the issues related to safe shutdown, and we have deferred certain matters related to procedures to that generic program.

MR. SIESS: I'm not sure whether the committee understands completely the notation on here, but the alphabet soup on the left is a topic designation, and the numbers beginning with 4 are the numbers beginning in Chapter 4 of the NUREG, which is where these things are correct.

MR. GRIMES: That's correct. For your convenience, I have identified the common issues and the sections from the three integrated assessment reports from Oyster Creek, Dresden-2 and Millstone-1. OT is Oyster Creek, D2 is Dresden-2 and M1, Millstone-1. The asterisks on individual sections indicate that that is a issue that is being addressed in a different section.

For example, on the three sets, on Dresden-2, part of the issue was deferred to 79-14. Another part of the issue that was identified specifically during our seismic evaluation regarding the recirculation coolant pump and their supports with regard to the seismic capability is being addressed under further evaluation.

MR. SIESS: Okay, now, these lists we're going to put up and let people decide whether they want to know why -- whether there's anything they want explained as to why no backfit was required.

MR. GRIMES: That's correct. And before you decide what you would like a clarification of, there's a green separator sheet behind the handouts. In that, all of the issues are organized by topic number with a detail of the issue, the specific sections involved and a brief discussion of the resolution of the issue.

We will use those sheets to answer any questions to explain the staff's position. Any items on this. Jesse?

MR. EBERSOLE: Yes. The first item up there, I take it that was looked at in the context of dosage from small lines primarily that were not isolatable?

MR. GRIMES: No, sir, that was an issue where there was no stress data available to demonstrate compliance with the Chemical Engineering Branch technical position for super-pipe between containment and isolation valves outside containment. The resolution, as we see it, is that the probability of a pipe break combined with a random failure of the ani-board valve assuming that the outboard valve fails or the outboard valve breaks between the containment and the containment isolation valve -- the probability of both valves simultaneously or randomly failing together, given that a pipe break occurs.

MR. EBERSOLE: But do you have any background data about how well that operates in the presence of full flow?

MR. GRIMES: No.

MR. EBERSOLE: So you don't really know how well the valve operates in the first place. The only valves we've really tested in this context are the main steam isolation valves, and that was years ago.

MR. GRIMES: An issue was recently raised on purge valves, and it's being looked at in the context I think of the dynamic loading on piping systems in general.

MR. EBERSOLE: Are these small lines?

MR. GRIMES: The reactor water cleanup system I believe is on the order of 12 to 14 inches. The line that you mentioned previously, the HPSI line, was not a line specifically identified in our evaluation as susceptible to this problem. The steam line to the isolation condenser was. And in the staff's judgment, because they could not generate stress data to show that they've got a piece of super-pipe in there, the fact that the pipes are being restrained, the restraints are being reviewed. The fact that dynamic testing of valves has become an issue and is being pursued, we felt that it was not worth demonstrating compliance with the stress data, given all of the other investigatory pursuits along with the fact that there are design aspects that we did look at.

And therefore, we concluded no further action was required.

MR. EBERSOLE: Is full steam pressure maintained somewhere along the pipe outside containment?

MR. GRIMES: Probably. You want to keep it warm so you don't get a thermal shock.

MR. EBERSOLE: Under full flow potential, do you have a length of pipe outside containment?

MR. SIESS: That is addressed to both licensees, I assume, since this is a common problem.

MR. GRIMES: A common problem would be the isolation condenser steam line, I would expect.

MR. SIESS: Did you understand? The first one that understands the question can answer.

MR. EBERSOLE: We're looking towards equipment degradation.

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

MR. EBERSOLE: Do you carry full steam pressure, full steam flow, outboard of the primary containment ?

MR. RAUSCH: Yes, we carry full pressure up to the isolation condenser.

MR. EBERSOLE: How many feet or so? Is that 10, 15, 20 feet?

MR. RAUSCH: At least 100.

MR. EBERSOLE: If I blow that line, --

MR. RAUSCH: The line isolates if either valve works.

MR. EBERSOLE: So this is some distance outside the main steam line. It requires the function of one of the other valves.

MR. RAUSCH: That's right.

MR. EBERSOLE: And that's in the presence of not too good knowledge about the valve.

MR. SIESS: Pipe break and two valve failures.

MR. RAUSCH: In our case, the lines run through the reactor building but not in the immediate vicinity.

MR. SIESS: Any other questions on steam flow?

MR. GRIMES: Isolation steam valves is an example; it's not the only one involved.

(Slide.)

On the next page, with regard to topic VII.2 -- this is on the no-action list because the modifications that resolved the issue were actually implemented before the integrated assessment and may have been implemented without SEP, so we're crediting them in both cases in the no-action section and in the hardware section just to make sure we have every base covered.

MR. EBERSOLE: Let me return to the

non-isolatable failure. A recent PWR that I looked at had applied hydraulic delays or controls to the main steam flow check valves, which was obviously done in view of the concern that the sudden closure of these valves would disintegrate the valve and you would have an unisolatable break.

At this point in time, what proof do you have that your main feedwater flow checks will, in fact, intercept a reverse loss if you get a feedline failure upstream of the feedwater check valves? Do you have tests, do you have analyses? What is the quality of these? Do you know that the design basis is adequate to postulate that they will function considering the abrupt reversal and the violence of the reverse flow?

(Pause.)

MR. GRIMES: The licensees are trying to decide how they approach it. I would like to point out, as I did before, the concept of dynamic loading on valves, which really came to light with the purge valve issue, is being pursued in the context of equipment qualification. As you noted before, General Electric has, either voluntarily or through some design practice, come up with positive acting checks. I believe that the feedwater lines are also positive acting checks.

MR. EBERSOLE: They are not positive acting;

they are just exercises to see that the pivot line doesn't lock. They still depend on the mode of power. They didn't do that to the feedwater, anyway.

MR. SIESS: Let's go on, and when the licensees think they have an answer, they'll raise their hand and somebody will see them. The next list, Chris.

MR. GRIMES: That's the last of the common issues. Now for the specific issues for what action is warranted. I'll take this a half at a time, the top half first.

Here you will note that on topic III.1 for the fracture toughness data and topic III.4.A with regard to the tornado issues for service water condition and batteries, there's selection of the issues for which the staff concluded no further action was warranted. You will note that under the fracture toughness data, it is for reactor water cleanup, reactor building closed cooling water, and I can't recall what RSCS is. I was a little too liberal with my acronyms.

With regard to the tornado initial issues, the staff reviewed those selected systems. You will find, however, in the further evaluation section, the common issue with regard to providing protection of at least one train for tornado missiles.

MR. MOELLER: Would you comment on IX.5, which is not quite shown?

MR. SIESS: He was doing it a half a page at a time.

MR. GRIMES: With regard to IX.5, Millstone is asterisked because it, I believe, is under the further evaluation section. Yes, it's under the further evaluation section. It was a question of the consequences of a single failure causing a loss of ventilation for low pressure coolant injection of core spray systems. The pumps, specifically.

For Dresden, there was sufficient information available for us to conclude that the consequences were acceptable for a lack of ventilation for those systems. For Millstone, that information was not available and it's being pursued under further evaluation.

MR. SIESS: The next page.

MR. GRIMES: Now for the Millstone-specific issues for which no action is required. The one issue that might occur on this list but in my bookkeeping system did not show up was topic IX.3, station service water. That is an issue that will be ultimately resolved by the topic II.4.F foundation issue. The common line for the service water system is supported on peat material. Whether or not that material is sufficient to maintain the integrity of the pipe is an issue that once resolved, resolves IX.3 So IX.3 is actually a no-action issue because it refers back.

Are there any other issues on here? I also would like to point out on topic VII.3, we identified an issue related to the results from the PRA. In doing their evaluation they concluded that removal of automatic bus transfers would automatically lead to a design change for a redundant instrument bus. That reduced substantially the core melt frequency.

We indicated in our integrated assessment that the resolution of the automatic bus transfers did not necessarily mean a complete removal, so we are evaluating the PRA results from the standpoint of the potential improvement for a redundant instrument bus. And we intend on reporting on that in the final report.

MR. EBERSOLE: With respect to item VI.4, instrument lines, did you find that these three BWRs are in that unfortunate group that has common instrument headers, which if they fail throws both the indicating and response equipment to disarray so that neither of these safety systems or the operators know what is going on?

MR. GRIMES: No, sir. When you raised this question on a BWR-6 review about eight months ago, we were able to quickly determine that there were separate instrument caps for a BWR-6. I have not had as much success with the BWR-3s and 4s, but I do know that based on the instrumentation reviews, there is adequate instrumentation to cause a shutdown, even if you are to lose a complete train of a common type of instrument.

MR. EBERSOLE: Does that mean that if you lose that train in that particular place, then you are susceptible to the single-failure criterion; that you have to survive on a single functional channel?

MR. GRIMES: No, sir.

MR. EBERSOLE: You have redundant channels after the instrument line failures?

MR. GRIMES: Yes, sir.

MR. EBERSOLE: Thank you. Is that true of all PWRs that you've looked at?

MR. GRIMES: To the best of my knowledge, that's true. I don't know if I could answer that question for somebody like LaCrosse.

MR. RUSSELL: It's true for LaCrosse. We put in a separate water tap level.

MR. SIESS: Before we leave this item, do we have an answer to the question that was asked before? And if so, will you repeat the question? Let them repeat it and then we'll know.

MR. RAUSCH: You were asking about the dynamic capability of feedwater check valves and the reverse direction.

MR. EBERSOLE: Yes.

MR. RAUSCH: We do check. I believe everybody tests them in accordance with either the IST program or the LSJ requirements. They are leak tested. They are probably leak tested at accident pressure, not in full reverse pressure. However, that's not the point of leak tests.

All I can say is that it is a standard industry check valve that is a higher grade than any used anywhere else. This is not a unique issue to the nuclear power plant.

MR. EBERSOLE: You have no quantitative data that they will not disintegrate and fail?

MR. RAUSCH: We don't have quantitative data, but we have a number of events where you get instantaneous pressure reduction but that is very rare.

MR. EBERSOLE: You don't have any, because it requires a pipe break.

MR. RAUSCH: You can have large pressure changes in pumps starting transients.

MR. EBERSOLE: But that's gradual.

MR. RAUSCH: Somewhat gradual.

MR. SHEWMON: This is one of your wonderful instantaneous pipe breaks, too, Jess; is that right?

MR. EBERSOLE: Whatever it is.

MR. SHEWMON: That's never been observed, either. And let me add, never will.

MR. EBERSOLE: The graduality of the failure is fine.

MR. RAUSCH: That's just my opinion. I would think that's what would happen.

MR. EBERSOLE: I've never seen an analysis of its competence.

MR. SHEWMON: I'm looking for an analysis of if the pipe can break that way.

MR. EBERSOLE: However the pipe can break, there should be competence shown for these reverse feedwater checks. I never see that; what is that?

MR. SIESS: You haven't asked the question before.

MR. EBERSOLE: I've asked it a dozen times.

MR. RAUSCH: And there's also three valves. You have a propagating pressure wave but it would be reduced as you go through the valves.

MR. EBERSOLE: We have the parts of the upstream valves also going down to the second and third.

MR. RAUSCH: But the large pressure changes are seen in pumps burnout transients. They may not be the same.

MR. EBERSOLE: The same degree.

MR. RAUSCH: It will be over a few seconds.

MR. EBERSOLE: I think I would be inclined to want to know more about that.

MR. SHEWMON: Let's leave it at that.

MR. SIESS: Can Northeast add anything to the confusion?

MR. KACICH: I'm afraid not.

MR. SIESS: Okay. Chris, on to the next list.

MR. RUSSELL: Before we leave the last one, I don't want to leave a misimpression with the committee on the issue of redundant instrumentation in the control room or a redundant bus. That issue is being looked at partially with respect to Reg Guide 1.97, instrumentation to follow the course of an accident, and the need for redundancy.

We, in our review, determined that failure of the instrument bus in the control room -- while you would no longer have all the instrumentation in the control room for shutdown, there was adequate local instrumentation to accomplish the shutdown from outside the control room.

The issue of whether the staff will require redundant instrumentation in the control room or not is being looked at as part of the generic program, and I would not expect or would not recommend that that be considered as a part of the SEP. That is a broader issue affecting a large number of plants. It's also a very costly issue from the standpoint that many of these control rooms do not have room for additional instrumentation. So it should be looked at very carefully. So we would not get ahead of the generic program and make a decision on that in SEP.

The current criteria for these plants are met from the standpoint of the failure of the instrument bus for the vital AC bus and the ability to shut down for single failures.

The PRA issue looks at the reliability of various components and therefore assumes many failures and, therefore, is looked at in the PRA. We will be looking at that and the actions associated with it to determine what further action should be taken, if any.

MR. GRIMES: Now I'll go on to those issues requiring further evaluation with the potential for some sort of corrective action.

(Slide.)

These are the issues that are common to both Dresden and Millstone. To make another clarifying point with regard to the way these are organized, the commonality is only for Dresden and Millstone. In some cases, you will find issues on the list where they are not common to Oyster. Again, I have an issue here where it is selected -- I pointed out before there are certain aspects of radiology and fracture toughness that were considered. No action required in Dresden. The balance of them are covered here, under the further evaluation section.

I would also like to point out, in trying to p'ck up the consultants' comments, Dr. Hendrie in all cases made the comment that he felt that this was not worth pursuing. We responded on Oyster Creek and we will respond on Dresden and Millstone that the staff's information regarding the margins of safety associated with the design of these components is information that is valuable, especially as issues arise where you want to know how well qualified the safety systems are. So we feel it is worth the exercise required to go through and document the degree or the extent to which the changes in codes impact margins of safety.

Dr. Zudans remarked on topic II.4.B whether or not full closure of the turbine control valves is reasonable. The reason that it was worded the way it was, especially in Millstone's case where it's something that is being pursued, is it is our best understanding that that is a feasible test and it provides a better demonstration of the functional performance of these valves. So we have asked that the licensees evaluate it.

MR. SIESS: Chris, there are a couple of items here that we heard a lot about on Oyster Creek, and if they appear only in this list, I think we would like to have you say something about them. One is III.4.A and the other is IV.5.

MR. GRIMES: All right.

MR. SIESS: If they appear in later items, I'll defer, but if this is the only place they appear -- what about III.4.A?

MR. GRIMES: III.4.A is the same issue that was raised on Oyster Creek.

MR. SIESS: But it wasn't in this category in Oyster Creek because you had a position --

MR. GRIMES: That's correct. The licensee disagreed in the Oyster Creek case. Eventually, the licensee did agree. Both Dresden and Millstone made the same argument that the separation and redundancy, especially with the diversity associated with Millstone-2, provided support to Millstone-1 and should be sufficient to conclude that no further protection from turbine missiles is required.

Based on the arguments that we heard at Oyster Creek and based on the arguments of Dresden and Millstone going back and looking at what would be entailed in such a further evaluation or such a demonstration, the licensees in both cases have orally agreed that they will provide a demonstration that they can safely shut down the plant with one protected train.

Oyster's recommended resolution resolved two of their issues. They're going to put in a portable pump, provide a tap to the torus so they have a protected path to resolve the tornado missile issue. They managed to kill two birds with one stone.

In the case of Dresden, there were certain aspects of the tornado missile protection that we concluded no further action was required, in looking at specific systems that were not protected from tornado missiles, and those are identified here.

MR. SIESS: So if Dresden boils down to the diesel generator intake exhaust as being all that has to be looked at --

MR. GRIMES: That's true.

MR. SIESS: -- everything else is protected.

MR. GRIMES: Generally everything else is protected.

MR. SIESS: Dade?

MR. MOELLER: Going back -- and I didn't want to interrupt, but going back on the turbine missile thing, --

MR. SIESS: Let's see if anybody has any questions about this.

(No response.)

MR. MOELLER: You mentioned Zudans's comments, but he also said -- and I did not hear your response -- he asked the question can the main steam valves be subjected to this test without experiencing an undesirable transient.

MR. GRIMES: It's our understanding it can. The licensee did not initially agree with that. They were not sure if they could do it. That's why it ended up in a further evaluation section. We asked the licensees specifically in the case of Millstone to evaluate it.

MR. BAIN: If I could add a little bit to that, apparently, there is a misinterpretation between the types of valves. We presently do take the main steam stop valves fully closed once a week. We have to come down in power to 90 percent to do that. It's the control valves that give us a problem.

The problem is when you start closing them, the bypass valves start opening, and you essentially have to take a very severe power reduction if not down to zero to fully close the control valves. You essentially just keep dumping the steam to the condenser everytime you close the valves.

MR. SIESS: So what's the resolution? Obviously, the staff does not want to require something that produces a severe transient.

MR. GRIMES: That's correct.

MR. SIESS: And yet, you do want these valves tested to assure against 180 percent overspeed of the turbine.

MR. GRIMES: That's correct.

MR. SIESS: So if they cannot be tested without causing a severe transient, what is the solution?

MR. GRIMES: We have asked the licensees to demonstrate why their testing program is sufficient in view of the difference that has been proposed, which is full valve failure. And we accept whatever program they feel is sufficient.

MR. SIESS: Suppose it comes out that they cannot satisfy you that they can prove reliably that they can get to overspeed with some low probability? What is the possible fix, or have you looked that far ahead yet?

MR. GRIMES: We haven't looked that far

ahead. We feel, based on the generic discussions that have been going on with GE on the turbine missile issue, along with the discussions we have had with the licensees, that we will be able to work out an acceptance inspection program to insure sufficient overspeed protection.

MR. SIESS: Are these plants different in any significant way from any other boiling water reactor, in terms of protecting the turbine against overspeed?

MR. GRIMES: I would like the licensee to respond to that.

MR. SIESS: Commonwealth ought to know, because they have got a couple of other BWRs around.

MR. BAIN: I don't believe that the overspeed protection system itself is that dramatically different. However, the whole control system where it controls the turbine is very much different than what you would see on a newer plant.

We have an almost entirely mechanical system. The control valves are all mechanically connected to the bypass valves, so that means as soon as you close the control valve you start opening the bypass valves. The big difference just lies in the whole turbine control system. Mike Bain.

MR. EBERSOLE: In view of the latest approach to this 180 percent problem, is the staff now going to look in detail at the electo-hydraulic and other systems that have been formally out of bounds, in their view, regarded as control systems so to speak and not really safety systems?

MR. RUSSELL: The SEP has not been just to look at one system; it's to look at all systems that would cause the function.

MR. EBERSOLE: There's a point here --

MR. RUSSELL: We'll come back and speak to the 180 percent overspeed.

MR. EBERSOLE: There's a quick case in point. Is the electro-hydraulic control system. Does it require direct current to execute its trip function?

MR. BAIN: I don't think we can answer for the electro-hydraulic control system because that's not the system we have.

MR. EBERSOLE: Whatever system you have.

MR. BAIN: The system we have does require direct power.

MR. EBERSOLE: Where is that drive? Is it not from the non-safety battery; just a station battery?

MR. BAIN: From the station batteries.

MR. EBERSOLE: Therefore, it's not seismically competent, to begin with.

MR. BAIN: Yes, they are.

MR. EBERSOLE: The turbines are seismically competent? They come from the 1E batteries?

MR. BAIN: Yes.

MR. EBERSOLE: I see, thank you.

MR. GRIMES: Before I leave this slide, I'd also like to make a comment on topic III.5.A with regard to pipe whip effects. Dr. Zudans made a comment about the unreasonableness of the assumptions made by the licensee, and that is part of the reason for its further evaluation.

(Slide.)

The next slide is a continuation of the list for further evaluation, and I will discuss the topic V.5, thermal overload setpoints and bypass. I might also note it is an issue identical to Oyster Creek.

Topic V.5, the resolution we described on Oyster Creek is the same resolution we are pursuing on Dresden and Millstone.

MR. SIESS: That is a reliable --

MR. GRIMES: That's a reliable leak detection system that is predicated on pipe breaks inside containment. The III.5.A evaluation was recently submitted for Dresden, and whether or not we can take that evaluation and deduce the proper sensitivity for the system is something that we are getting to right now. We believe it can be readily resolved. Both licensees have orally agreed to evaluate leakage detection in the context of the III.5.A evaluation.

MR. SIESS: Chris, would it be a correct characterization of your position here that you are applying performance criteria rather than prescriptive criteria?

MR. GRIMES: Yes, sir.

MR. SIESS: And you would expect them to tell you how they meet the performance you're asking for and you will evaluate that response?

MR. GRIMES: Yes, sir.

MR. MOELLER: And again here, the question raised by Zudans is just part of the general idea.

MR. GRIMES: When we issued the draft report we said SSE qualifications should be one GPM in an hour, which was a target provided by Reg Guide 1.45. We concluded that trying to take such a system all the way up to Reg Guide 1.45 is not a fruitful exercise. These are the desired goals that we are really seeking, so we will pursue these goals.

I believe comments made by all the consultants with regard to this topic are resolved by that approach.

MR. SIESS: Thank you. Chris?

MR. GRIMES: Going back to the common issues for further evaluation, are there any other issues you would like to discuss specifically?

MR. SIESS: I had pointed out the ones we explored in some detail on Oyster Creek. Are there any others in that category on here? I didn't recognize them.

MR. GRIMES: I don't see any that -- of course, I've got the Oyster Creek agreements fresh in my mind, and I've managed to get the disagreements out and I don't recall -- .

MR. SIESS: A very healthy attitude. Okay, let's go on to --

MR. GRIMES: I would like to make a comment about VI.4, the leakage detection. That was an issue on Oyster Creek, that was a misunderstanding. The evaluation part of it will be to evaluate leakage detection capabilities that could be used to identify when to close the isolation valve. Coupled with that, procedures for the operator, to tell him what to look for in terms of the capability that is provided to know when to isolate the valves in those systems.

MR. SIESS: VI.4, -- what is the general title?

MR. GRIMES: It's the remote manual isolation capability. In the IPSARs it's identified as remote valves. It's a containment isolation issue.

MR. SIESS: Just containment isolation. Okay.

MR. GRIMES: I would also like to note that Dr. Bush agreed with the staff's approach to resolving topic VI.5, the leakage detection capability, and disagreed with the PRA's conclusion that it was not significant. That's the same basis we used to pursue the issue.

Now for the Dresden-specific evaluation. For the Dresden-unique evaluation issues, as I noted before, the common issue of providing protection from tornado missiles applies to Dresden, but there is a subset issue of the effects of tornado missiles on service water systems and the diesel generator and intake exhaust. That will probably be folded into the bigger issue and resolved there.

I also noted before the recirculation pump and supports seismic capability is a subset of the further evauation of seismic-related issues.

MR. EBERSOLE: I have a question. Since you have the isolation condensers, why does this get to be so important, since shutdown potential seems to be vested in them? Is it that the isolation condenser components including the water supply is not protected either? Don't you have an independent shutdown capability in the isolation condenser which alleviates the --

MR. RUSSELL: The issue for the isolation condenser is your ability to make up to the isolation condenser so you can boil off. In this case, condensate transfer pumps and pumps associated with providing the fluid up to the isolation condenser were all exposed. They proposed going to a portable pump which would be inside the reactor building, which would be protected such that they would have that make-up capability. It was the pump, not necessarily the water supply.

MR. EBERSOLE: You also used diesel pump supply.

MR. RUSSELL: That's correct, but the diesel was a fire pump and it was outside and it was exposed.

MR. EBERSOLE: It was exposed, too?

MR. RUSSELL: Correct. There were no protective pumps to provide water.

MR. GRIMES: If there aren't any other questions on the Dresden-uniques, I'll go on to the Millstone uniques. An interesting phenomenon occurred when I put this list together, it was obvious by the way the categories worked out that you can see that Millstone has an engineering analysis and Dresden fixes by procedure. I don't know whether that was just coincidence or that's the way the long list ended up.

A significant point here is a point that I had previously made about the II.4.F resolves topic IX.3. On topic II.3 on PNP*, roof loads, for both Dresden and Millstone.

MR. SIESS: I mentioned it.

MR. GRIMES: Are there any questions on the Millstone --

MR. MOELLER: A comment on the last item.

MR. GRIMES: The jet expansion model? That was an issue relating to -- let me get the slide.

(Slide.)

The staff's review of the jet impingement models used for Millstone concluded that the approach that Millstone used in its evaluation may be non-conservative. There were specific issues related to jet theory. The licensee agreed to go back and address each of the specific issues regarding the methods by which the model was applied.

The staff concluded that that would acceptably resolve that issue.

MR. SIESS: What is the issue? The forces exerted by the jet, or the angle of the jet, what area it covers, or both?

MR. GRIMES: A little bit of both. It was a lot of how to take jet theory and apply it to pipes and components. It is not all that exciting, but there were a lot of little holes that looked like they could be easily filled.

MR. SIESS: You know, it seems to me that the two most serious problems the SEP staff had was first, making considered judgments and the other was just bookkeeping.

MR. GRIMES: Bookkeeping has been a substantial job in preparing for this meeting.

MR. SIESS: Do you have this on the computer?

MR. GRIMES: No, sir, I should have. We do have all of the topic SERs on the computer, though. Those are easily traced.

Part of the problem with these issues is the categorization. Which category does it fall in sometimes changes from day to day. Are there any other questions about the Millstone-1 specific evaluation issues?

MR. MOELLER: If you would comment on the first one on the next page, V.12.A.

MR. GRIMES: The issue there was with regard to reviewing the capacity of the reactor water cleanup and condensate demineralizers with regard to limiting conditions for operation in the tech spec. That's why it's identified as a T.S., tech spec, issue.

The licensee has agreed to go back and evaluate this minimum reserve capacity requirements and evaluate that in the context of the tech spec limits, and to propose a tech spec change or justify not having to make a tech spec change.

We concluded that that would adequately resolve this issue.

MR. SIESS: That is the end of the category. Those are things that presumably will be looked at at the full-term operating license review.

MR. GRIMES: Now I will go into those issues with procedural or technical specification changes.

(Slide.)

As I get into both procedures and hardware, especially with regard to the procedural aspects, there are two issues that will be discussed under the "Licensee disagrees" list. So if you do not see them, we will get to them.

MR. SIESS: These are only the ones where there is no disagreement?

MR. GRIMES: That's correct.

MR. SIESS: The disagreements are lumped together at the end of this thing.

MR. GRIMES: First with regard to those issues that are common for both Dresden and Millstone, I pointed out before the remote manual isolation with regard to containment isolation has two parts to it, the evaluation leakage detection capability and procedures to provide for remote manual operation. So it's listed here again.

The battery out of service time issue is one with regard to the technical specification limits on having batteries out of service or inoperable. It was an issue that evolved out of the topic reviews out of Dresden and out of the PRA on Millstone. Both of them came together and we concluded that this was one where the Licensee should look at his tech spec limit, evaluate the actual time that he needs to have the battery out of service, and propose a limit for battery out of service time that is a little more reasonable.

MR. SIESS: Like two hours instead of seven days?

MR. GRIMES: Like hours instead of days. I really don't think we need to have two hours, but we certainly need to have something on that order of magnitude.

MR. EBERSOLE: Chris, when you look at the battery out of service time, do you also look in a matrix sense that all other safety functions which are serviced by the other battery had better not be in maintenance when that battery is out of maintenance?

MR. GRIMES: That's a bigger issue than just this issue. We tried to consider it in the context of the corrective actions that we have dealt with, but we have not got our arms around the bigger picture.

MR. RUSSELL: I must comment on that. The interpretation of operability for other comments includes the support systems necessary for the operability of that component. So in this instance we would say when a system that relies on the battery goes out of service, then that system has its own limiting condition for operation and allowable outage time. The battery also being out of service, it has its own limit, and whichever one is more restrictive would govern the battery because possibly of other systems in service.

The question you're asking, if this battery A is out of service, if something on train B which is needed is also out of service, whether that is looked at.

MR. EBERSOLE: Yes.

MR. RUSSELL: That is the generic issue that Chris has referred to. To the best of my knowledge, we don't specify interdependencies across trains. We look at the system and what's needed to support that particular system, but not multiple things being out at one time.

MR. EBERSOLE: This results in the fact that you can be totally incompetent and never know it. And I wonder when we are going to go back some 10 or 12 years and fix up what should have been done in the matrix system that far back and stop this nonsense.

MR. RUSSELL: Clearly it is an issue when you walk in and see a lot of red tags hanging on because there are components out of service, and the cumulative effect of all those components out of service at one time is to the best of my knowledge --

MR. SIESS: Let me get that clear. Suppose I've got a component that is in train A and train B, and the component in train A is out of service because it depends on the battery in train A and the battery is out of service. Do you mean I could go in and take that component out of service for maintenance?

MR. RUSSELL: No, not if they're the same component. For instance, if you're talking about the service water pump in train A and the service water pump in train B and you've got a diesel out of service, obviously you have to have service water and you've got to have the support systems for service water. Those are the same systems.

But if it's service water is in one system and that's in another system, and the PRA states it could serve as the function water, let's say condensate transfer for makeup, that is not looked at. But clearly the system function, you cannot have both trains of a system out, whether it's a pump or it's a supporting system to it.

So I don't know whether I've confused it or not.

MR. SIESS: I understand.

MR. EBERSOLE: The tech specs as presently handled do not embody system analysis to determine the true degradation of functions. They look in a compartmentalized sense.

MR. RUSSELL: That's correct. They look at the system function and not train function.

MR. EBERSOLE: They look at component and equipment function. They don't even look at components sometimes.

MR. RUSSELL: They require the system --

MR. EBERSOLE: I can have a relay beam maintained and I'll be dead in the water and never know it with the present system, because there is no system that's cross-relating these disabilities.

MR. RUSSELL: That activity puts the system out of service. Then you would fall into the tech spec requirement of having to maintain the system in service. The issue I was trying to describe is where you have one train, say, of system one and another tran of system two; in a PRA or a heat removal function those may be related, and you may have redundancy of function but not redundancy of system. And that is not looked at.

MR. SIESS: I think he disagreed with you, Jesse.

MR. WARD: Could I ask a question, Bill? Although this sort of thing apparently is not covered completely in the tech specs, to what extent might it be covered in individual Licensee's plant procedures? Do you have any idea at all?

MR. RUSSELL: I can only give those examples where I have been involved. In some cases the licensees are extremely cautious or conservative with respect to taking things out of service and what the effect is. The one that easily comes to mind was Shipping Port, where you had -- involved in that was more the Navy philosophy. I can't speak in general, but I believe that that aspect was looked very carefully at in the maintenance programs and taking things out of service to make sure you're not coming into a limiting condition for operation, and that is in fact a function of the onsite review committees and some of the aspect of turnover, which systems do you have, which systems do you not have.

So I believe it's looked at very carefully by the licensee. But the earlier statement that we look at it on a system level or a component level for it being out of service, for instance, there's one action specified if you have one diesel out of service, there's another action specified if you have another diesel out of service. Or if a diesel's out of service, you can't start the other one, you consider it out of service also.

MR. GRIMES: If there aren't any further questions, I'll go on to the Dresden specifics.

(Slide.)

Here I would like to specifically note that I'll discuss the primary coolant activity limits in the context that the Licensee disagrees on Millstone. Are there any questions about any of these issues?

(No response.)

Did you want to talk about paralleling the batteries?

MR. SIESS: I don't. Does anybody want to talk about paralleling the batteries?

MR. SHEWMON: Hurry on, please.

MR. GRIMES: The Millstone specific list.

(Slide.)

This was the coolant conductivity and chloride limits, was an issue on Oyster Creek that we resolved, and we've resolved it as well, I believe, on Millstone. The Licensee is currently evaluating the procedure that he uses in his present tech specs in relation to the limits required by Reg Guide 1.56, and he will propose a corrective action.

MR. SHEWMON: What's the status of the in-service inspection on Millstone's plant? Do they have a ten-year commitment to inspect the piping in a meaningful way in the primary, and when does that come about?

MR. BAIN: Yes, we just completed our first ten-year ISI during the 1980 refueling outage. That was one of the points noted during the plant description, and the results of the ISI were partly responsible for the long duration of the outage.

MR. SHEWMON: I see. I apparently asked the wrong question about what experience you had, because that didn't come up. Thank you.

MR. GRIMES: Are there any other questions about the Millstone specific procedural or tech spec issues?

(No response.)

If not, I'll go on to the hardware backfits.

(Slide.)

These are the issues for which we concluded hardware modifications either have been proposed or are being considered. A point to make here is, as I mentioned earlier, I doublecounted the diesel or turbine annunciators because that was a modification that was instituted prior to the integrated assessment and is complete. It may or may not have resulted from the integrated assessment review if they hadn't made that modification.

Another point to make is that on Millstone, with regard to the status indication alarms, they are currently evaluating a hardware modification and its impact on the reliability of the system and they are to come up with a proposed course of action, which may or may not involve additional indication and alarms.

MR. EBERSOLE: You're referring to 8.3?

MR. GRIMES: 8.3.B, yes, DC status indication and alarms.

MR. EBERSOLE: Does this mean we have at least got a status indication that gives us battery charge status?

MR. GRIMES: Yes, sir, we have battery charger status indication.

MR. EBERSOLE: No, I didn't say that. I said battery charge.

MR. RUSSELL: It does not indicate gravity. We have looked at the aspect of battery gravity on these plants. They do have pilot cells. They do weekly gravity tests. Either monthly or quarterly -- it varies between plants -- they check all the cell gravities. They also have procedures for checking the other gravities.

What we're talking about now is supervision on the breakers to make sure that you have a continuous circuit between the charger and the battery, the battery is in fact connected, and looking at DC voltage on the output of the charger, the amperage on the output of the charger, DC bus voltage if you run the battery, for instance, if you had a failure of the charger breaker or the charger itself, and wide-range battery amperage.

Those are essentially the issues we're looking at. We found rather substantial differences from plant to plant as to what is available. For instance, on Millstone we concluded they had the capability to monitor essentially all, with the exception of battery amperage, based on the existing design. And at the other case which was an extreme, they only had DC voltage and because of limitation of space in their control room they went to a local panel with an alarming function that alerted the operator to look at the level panel.

MR. EBERSOLE: But in the long run, you're still back to specific gravity observation on the pilot cell?

MR. RUSSELL: That's correct. From the standpoint of detecting state of charge of the battery, you have to use pilot cell gravity.

MR. EBERSOLE: Like from 50 years back or 100.

MR. SIESS: Tried and true.

MR. EBERSOLE: Tried and untrue.

Anything else on that list?

MR. RUSSELL: I might comment with respect to that. There's one additional thing we've identified in the SEP that is battery testing, in addition to gravities. We found that in half of the plants reviewed out of the ten plants we looked at, five of those ten were not adequately testing batteries, either by virtue of not performing a service discharge test or a test discharge to determine actual battery capacity.

In one case, upon testing they found that the battery did have cells which required replacement. That was at Ginna. At Dresden we concluded their testing was on a more frequent basis and the testing they are performing is comparable to the test discharge. So that we have looked at both aspects of DC systems.

MR. EBERSOLE: When they tested these, do you recall that they went along and laid their hands or something on the bus power connectors and determined that they were getting adequate conductivity? Normally these things sit on triple charge. They can degrade over months and you never know it until you need them.

MR. RUSSELL: The issue of high resistance connection from the standpoint of supervision of the breakers is looked at. It depends on how they hook up the discharge box, if they're using a resistor bank or how they're actually performing the test discharge and where they hook up. In some cases they actually hook up to the battery terminals; in other cases they hook up to a convenient location on the DC bus to discharge.

So that varies from plant to plant. When we look at testing, we only look at the battery capacity and the individual cell voltages and whether the cells reverse or not.

MR. SHEWMON: Jess, we're scheduled to go to 4:00 o'clock Saturday and I would love to make up a little time in this part and be able to have a quorum at 3:00 on Saturday.

MR. EBERSOLE: Okay.

MR. GRIMES: If there are no further questions on the common hardware backfits, I'll go to the Dresden specifics. As I mentioned before, the installation of scuppers to relieve ponding on the roof is common to Dresden and Oyster. Millstone is evaluating it in their integrated assessment.

Another interesting issue was on topic VI-4 on containment isolation. The Staff concluded that isolation valves on an ESF system should be leak-tested and they were excluded from leak-testing under Appendix J by definition. Licensee has agreed to perform tests on the valves in question.

Are there any questions on Dresden specifics?

(Slide.)

MR. GRIMES: If not, I'll go on to the Millstone specific. The high-low pressure interface issue between the reactor water cleanup system and the primary system; in the case of Oyster Creek and Dresden, it was an evaluation resolution on the relief capacity in the reactor water cleanup system.

Millstone has proposed to install an interlock.

(Slide.)

If there are not any questions about that issue, I'll go along to the "Licensee Disagrees" list. Both of those issues relate to technical specification requirements. I will discuss the reactor trip surveillance first, topic 10.A. The Staff's review concluded that the sliding scale surveillance requirement, if you will, in the tech specs for

Millstone, which allowed them on the basis of a reliability goal based on exposure time to go from a monthly surveillance to a quarterly surveillance, did not conform with current practice or the current tech specs.

When we addressed this issue to the Subcommittee we identified the issue, indicated it was under further evaluation. We have since gone back and determined that it applies equally to at least all of the three SEP boilers and maybe even a larger fraction of the operating BWR plants.

We indicated at the Subcommittee meeting that we do not really have a philosophical disagreement. We agree with the concept of a reliability-based surveillance interval, but there were some problems with its application. Because of the relaxation of the frequency, which is quite some time in the future, if ever, because the application of this change in frequency would require a certain exposure time without any failures and because it was only a concern related to how this is applied, as opposed to the concept that it was being proposed, the Staff is going to withdraw its recommendation and allow the procedure, if you will, to continue.

Part of the Staff's basis for accepting it in the first place, even though it wasn't an explicit acceptance nor was it an explicit rejection on the newer plants, was the fact that this was an approach which was desirable and we should go out and gather data and experience to be used to develop reliability-based surveillance frequencies.

The data that has been compiled to date supports the one-month interval that currently is required for all plants, PWR's and BWR's, for all plant protection systems. On the basis that the Licensee would have to amend his procedures to change the surveillance frequency and that that is something which could be reviewed in the context of a 50.59 change, we have concluded that we will allow the Licensee to continue with his current technical specification limits. Therefore, this issue should no longer be an issue of disagreement.

Are there any questions?

MR. SIESS: The Licensee can't change his frequency without getting NRC approval?

MR. GRIMES: No, sir. He can make a change, but the change would involve procedures, a change of procedures for performing tests. Currently it's one month intervals and the tech specs allow him to go to a quarterly test once he's reached his exposure time. He would have to in some fashion document his conclusion that he's met his criteria in order to go to the test.

A 50.59 change would be filed in his annual summary and it could be picked up at that time in terms of his Staff review, the basis for his conclusion, and the issues associated with the problems of applicability. Some of the problems we noted is, this is kind of a one-sided criteria. It says you go from one to three months. If you apply the data strictly, you could go from one month back to eight hours.

Another issue related in its application is, you compare data from like components. Does that mean all pressure sensors, does that mean all Berdone tubes, does it mean all relays, or just relays manufactured by a specific manufacturer with one model number?

Those are some of the problems that have led the Staff to conclude that the approach isn't acceptable for new plants. We do not believe that those issues warrant the burden of revising the technical specifications until such time as he can compile the experience for the application of this proposal.

MR. SIESS: So the Staff, and that means not just the SEP Staff, thinks this reliability-based frequency is a good idea, but it ought to be made a little more sophisticated after they get enough data.

MR. GRIMES: That's correct.

MR. SIESS: So he essentially meets current criteria as they are being developed.

MR. GRIMES: If a proposal were made on a new plant today using the same approach, it would be rejected for lack of experience, for lack of a demonstration that it could be applied properly.

MR. RUSSELL: I might add two points. One, Chris, if you could pass out -- it came up at the Subcommittee -- the paper by Jacobs which establishes the criteria. This was something that was requested. Also --

MR. SHEWMON: It's in a box on the other side of the table.

MR. RUSSELL: The other comment is, in this instance in looking at it the Staff concerns about application appear to be based upon concerns without experience that they are real. That is, the level of detail to which you provide like components, what is a failure, what is an unsafe failure, what is instrument drift -- all those issues were issues which were not answered well.

And while we don't have specific experience to say it's going to be misapplied, we don't have the experience that says it's going to be applied properly, either. In this instance I think the Staff assumes the burden of demonstrating what is there should not be there, as compared to -- it's like a change, and in this case we don't have specific facts that show that this is wrong or this is something which is unsafe.

It is a difference from current practice, however. In this case I think it should remain, rather than be deleted from the technical specifications.

MR. SIESS: That is, you have an option. You could arbitrarily refer to current practice, and you're not sure it's any better than what he's doing. And if you had the burden of telling him what he ought to do, you don't know.

MR. RUSSELL: That's correct.

MR. SIESS: And as I recall, the Licensee said that he had never reached the limit where he could go to the quarterly level. He is still testing monthly and is likely to stay there for quite a while.

MR. GRIMES: It appears from a recent LER he may have had to restart his clock.

MR. CASIG: We had to stay at the same restart, but that's correct.

MR. SIESS: So whether or not you did anything here is not going to change how the plant is operated for the next few years.

MR. GRIMES: That's correct.

MR. SIESS: Maybe the next ten, I don't know.

MR. GRIMES: Another point I would like to make with regard to this issue is that in the Jacobs paper which you've just been provided copies of, one feature which was not considered in his reliability aspect was the point brought up by Dr. Lipinski. The increased surveillance affecting potential failures in the system is not part of his reliability evaluation. Therefore, it is not appropriate to apply it downward to an increased frequency.

MR. SIESS: Lipinski made the point that operating experience shows there are mistakes made doing testing and so forth and have a significant contribution to risk, and that there had to be some kind of a tradeoff between too frequent testing, too frequent maintenance, and opportunities for mistakes, and reliability on demand. And nobody really approached this thing, and that is a generic issue that I think we ought to pass on to Mr. Ray's Subcommittee and then follow it up sometime.

MR. GRIMES: Oh, it's on the Licensee disagreement list because as of 5:00 o'clock yesterday afternoon we still had not issued a formal position. We were going to take it off of the Licensee disagreements list and indicate that this is an issue for which no further action is required, and document in the final report the basis.

The other issue of disagreement which was raised regards primary coolant activity limits. This was discussed extensively before the Oyster Creek Subcommittee. It's an issue that we have come to a resolution with Dresden. They have agreed to adopt the limits for equilibrium iodine and maximum iodine dose equivalent, and they will propose a sampling program to go along with that.

I apologize to the Millstone representatives if I stole their thunder on the previous issue, and I'll allow them to get back at me here.

(Slide.)

The issue in summary is the calculated offsite doses for a small line break, and in accordance with the standard review plan they exceed current criteria by a small fraction. For Millstone, they exceed Part 100, a little less for Oyster Creek.

The PRA concluded that the risk from this break was negligible. The PRA found that all LOCA's were negligible. The Staff felt that the limit on primary coolant activity that the Licensee did have really didn't do anything, it really should have a better basis, but that that basis need not be a plant-specific evaluation, as the Licensee proposes, but simply adopting the item limits in the standard tech specs and developing a plant-specific action to go along with those would be sufficient.

There are conservatisms in the analysis, and if you sharpen your pencil and quantify the conservatisms you can demonstrate much smaller doses. The issue is one of how much pencil-sharpening do you do, how much negotiation goes on in terms of what those conservatisms mean, and how they should be quantified.

That was an issue we thought was just not worth pursuing. So we have proposed and two out of the three plants have accepted the limits. And now I will allow Millstone to provide their counterproposal.

MR. BAIN: I would just like to add a couple of comments here. I would like to qualify the term "Licensee Disagrees." The reason it is "Licensee Disagrees" right now is not that we disagree with the revised tech spec iodine concentration; it's just that we have not yet agreed on what the appropriate value for that would be.

Just a matter of a couple of weeks ago, we received the NRC's SER for the failure of small line analyses. It's presently under review now. We think just from an initial look at it that there are a number of areas where we could make improvements on it.

For example, as you will see on the sheet being handed around now, we are presently looking at the break flow that was assumed. We would like to verify that that's accurate. We are going to evaluate the effect of the break on pressurization of the reactor building and consequently losing the effectiveness of the standby gas treatment system, which in itself will give you quite a substantial dose reduction.

One of those things we are looking at is the fact that the Staff assumed a four-hour cooldown following break. We would like to take a harder look at that with respect to our new emergency procedures guidelines. We would like to know what exactly is the operator action we would expect under those circumstances.

We may be in the situation where the recognizes that he has an unisolable break and he may elect to do alternative methods. Until we have a good handle on exactly what we think the operator would do, we are unable to determine what the realistic dose would be.

MR. SIESS: Now, if you're going to go at this with what Chris called a sharpened pencil, I guess, are you going to propose iodine limits such that when you analyze it you take into account more realistic assumptions and you will meet the 30 rem?

MR. BAIN: Well, in our first attempt at reaching agreement on this we are going to use the 10 percent guideline of Part 100 or 30 rem.

MR. SIESS: Okay. And if you cannot make the 30 rem, you would like to try to argue that something else is acceptable?

MR. BAIN: Yes. I guess the philosophy behind the ten percent guideline is it is applied on an event that is not as unlikely as say the double-ended LOCA. I think our position is, if you're postulating the failure of an instrument line within say a six or eight-inch section, that in itself is so unlikely we think it's inappropriate to apply the ten percent guideline. But as the first cut, we will try to meet the 30 rem dose guideline.

MR. SIESS: It seems to me there are two approaches here. The Staff is saying, take the tech spec iodine limits and let the doses fall where they may, we will just assume there are conservatisms and we won't worry whether it's 30 or 300 or something of that order.

The other approach is to make a realistic analysis up to a point, I suspect that it's not realistic after it gets outside of the building. I don't know how many assumptions you want to correct there. But to make a realistic analysis and say, I can meet the current criteria, which is a small fraction of the Part 100 dose, which the standard review plan says a small fraction and that is 10 percent or 30 rem.

I suppose I can see the two approaches. I don't think I can see anything in between them. One is a purely judgmental, sort of arbitrary, and the other one is an analysis. But I have the feeling when you make the analysis then you ought to come out with the answer that --

MR. GRIMES: It's quite conceivable that the analysis can be just as arbitrary.

MR. SIESS: Don't say that, Chris.

MR. GRIMES: The problem that we have with the concept is, one, that the assumptions that the Licensee intends to look at more carefully are the assumptions required for new plants today. They are assumptions which correspond with the acceptance criteria that is being used.

When we start backing off from those, we end up arguing specifics, and we felt that effort was not worth pursuing.

MR. SIESS: You're carrying my two cases a lot farther. You're saying you need to be completely arbitrary, which is what your proposal is, or you just --

MR. GRIMES: Individually arbitrary.

MR. SIESS: Selectively arbitrary.

MR. EBERSOLE: May I ask a question?

MR. SIESS: Yes.

MR. EBERSOLE: While you're analyzing the steam environment for dose effects out in the auxiliary building, I believe it is fair to say that you obtain a general purpose box.

MR. BAIN: No, that's not correct. It's as a result of our environmental equipment. We can close in all of our equipment.

MR. EBERSOLE: Was that done recently?

MR. BAIN: It's been done over the last couple of years.

MR. EBERSOLE: So now what sort of -- these are currently being called mild environments in our environmental qualification program. What do you call your environment?

MR. CASIG: That's essentially what we did with these enclosures. We effectively put this equipment in a mild environment by providing its own unique ventilation system in an airtight steel seismic enclosure.

MR. EBERSOLE: You made it a mild environment, haven't found out it wasn't that way.

MR. CASIG: Yes, sir. That was our alternative to replacing the equipment. So that is to my knowledge a one of a kind feature which to some degree influences our approach here.

MR. EBERSOLE: Did you do that around the switches?

MR. CASIG: Motor controls, instrument switches.

MR. EBERSOLE: Boxed it up? Well, that's very interesting, isn't it, Jerry.

Thank you.

MR. SIESS: Does that conclude your presentation?

MR. BAIN: Yes, it does.

MR. SIESS: Any other questions to the Licensee or Mr. Grimes on the single area of disagreement?

MR. GRIMES: Are there any other questions? I didn't --

MR. RUSSELL: There are two aspects that you should probably be highlighting. One is, we reviewed the last few years worth of data from Millstone with respect to what kind of activities they have actually been experiencing. Those activity levels are less than, by a reasonable margin, the current limitations which would be imposed based upon the standard tech spec iodine limits. That is, the .2 microcuries per gram and 4 microcuries per gram peak.

The second point is that activity in the coolant is indicative of degraded performance of the fuel. That is the only place you can get this kind of iodine activity. While current criteria backs into an activity limit from the standpoint of a conservative calculation, not unlike the Appendix K ECCS evaluations where you have conservatism, it is a deterministic cookbook by which the Staff determines what is acceptable.

The position we've taken is, we have argued that the current limits are sufficient, that is, we need not go below that, which if we followed the current deterministic approach, since we are calculating greater than Part 100, and the current criteria is a fraction of that, we've already relaxed by a factor of ten by considering that the standard technical specification limits are sufficient.

Based upon looking at past performance, we feel that would not create an operational restriction upon the facility, and if they were to reach those limits it would be indicative of some type of fuel failure which would have longer term effects from the standpoint of doses, for maintenance activity in the coolant system, as well as the consequence for an accident which released the activity contained in the coolant system.

Those are some of the issues which are side issues which are related to this level, and we feel that there should be some limit, realistic limit on reactor coolant activity. The present limit we do not feel is realistic. It is quite high and it would reach an offgas limit first.

It does need to be looked at, and we feel in this instance the limit associated with the standard technical specifications which are being used on the new plants today is appropriate.

MR. SIESS: Okay. The last item we have on the agenda is to give the two Licensees an opportunity to give us their opinions on the value, problems, et cetera, with the SEP integrated assessment. I will call on Commonwealth Edison first.

MR. SMITH: My name is Neal Smith from Commonwealth Edison.

I will go through the slides rather rapidly because most of the items have already been covered today. As was pointed out, the original scope of the SEP was to be a three-year review of 11 plants.

I think one of the major things we have learned from this review, which was supposed to have been done by the NRC Staff totally and we were just supposed to go along for the ride and enjoy it, was that the Staff needs a great deal of assistance from the Licensee in order to perform these reviews. It is not and cannot be a straight Staff-alone type review and update of our information.

(Slide.)

Dresden's present status, since we always like to go through bookkeeping, is we're basically in agreement with the Staff on all the topics. There are some open topics, but we think we know where we're going.

At this point in time Commonwealth Edison has made four modifications from the SEP already. We have committed to six additional modifications and five procedure changes.

(Slide.)

To be specific, the modifications we have made, we have gone through and tied down all our electrical equipment at all four plants. That we also did up at Zion.

We changed our procedures and control panels for the normal bypass run mode in the plant. We've added 125-volt disconnect buses and we've split the buses apart a little bit. Additional separation will be provided once the new buses arrive, and we will get them in completely separate fire zones.

The modifications we've committed to: We are going to upgrade the battery racks at Dresden 2. They've already been upgraded at Dresden 3 and Quad Cities. Dresden 2 has yet to be completed. Diesel generator protective trip bypasses are in the process of being put in. We will install roof parapets, scuppers. Additional DC monitoring in the control room will be installed in the process computers.

Installation of redundant isolation valves, which is something that Chris talked about earlier. Installation of an additional set of breakers. When we were reviewing the DC system, we wanted to make them more reliable by putting in additional breakers.

The procedures that we've committed to include revised flood procedures. We're going to modify our safe shutdown procedures. We've committed to system interlock shutdown cooling. We are including additional valves in our locked-closed list, and we've modified our in-service inspection of water control structures.

(Slide.)

We've done a number of major analyses and so has the Staff as a result of the SEP, and that's just a listing of the various ones we've done and the Staff. Unique with Dresden 2 was the SSRP, senior seismic review plan. As a result, the Staff has done a major portion, or their consultants have done a major portion, of the seismic reanalysis at Dresden 2, which has been borne by the utilities at most of the other units. There has been a great deal of interaction on that particular subject.

(Slide.)

Our experience to date is, we have spent approximately $2.6 million for studies and modifications which have been made to Dresden 2, and Dresden 3 and Quad Cities 1 have cost us approximately $1.3 million so far and that is for all four units. We project that our studies, when we get the final bill, will reach somewhere in the neighborhood of $3.6 million and that we will have spent Commonwealth Edison engineering man-years of about 10-1/2 man-years on the project.

MR. SHEWMON: Is that separate than the $3 million you're talking about? That's out of the company?

MR. SMITH: That's out of the company money.

MR. MOELLER: I find it interesting that you cost it more to study it than to fix it. Am I interpreting that correctly?

MR. SMITH: You've read that quite correctly. The statement was made earlier that Edison was going along in the process of fixing rather than analysis. We have done a lot of analysis. We have done a lot of work to convince the Staff that what we had at our units was in fact adequate. We probably would have spent our money quicker and gotten into it earlier than other people, because our philosophy is that they are safe to operate, they're safe to run, and rather than modify our plant, with our philosophy of, if we modify it at Dresden 2 we're going to do it at the four others, we would prefer to spend a few extra dollars with analysis to try to show that it really is not a problem. And in fact that is what we have been doing.

MR. MOELLER: Thanks.

MR. SMITH: I would just like to make a strong statement on Bill Russell's behalf. The program sort of floundered along until he took over and we went to the lead topic concept and we got the utilities heavily involved. At that point in time, the program really started to move forward, and because of that and the fact that Bill would cause people to make reasoned judgments, instead of having a standard review plan and saying, you don't meet point number 27, what are you going to do about fixing it, Bill would say, who cares, it's not an important point in the overall context of the plant.

He caused his reviewers, with his strong project management, to do some reasoned judgment, and I think the Staff has learned a lot by that. And in fact strong project management is a necessary item that we should be having.

(Slide.)

We are still performing some work on a number of topics. It has pretty well tapered down. Our tornado missiles we will do on a probabilistic study. For the intake and exhaust, we have committed to do a number of studies, and that's basically what these items are.

Our overall feelings are, we have spent quite a bit of money and for what we've got, which is basically this list, that there's got to be better ways of going about fixing and modifying the plants. A number of these procedure changes and modifications, when you look at them, are not very major. As you saw, we are not projecting huge dollars for total modifications to the plant.

MR. SHEWMON: I'm not sure what that last statement means. It seems to me one attitude for the utility would be, gee, if we now get our license it's good for the rest of the life of the plant or it's good for ten years, or we ought to do it every year. At some place, what are you saying with regard to future action in this area, given plants that may have to be looked at like this again over their 40-year life?

MR. SMITH: We feel that, given all the effort we have put forth for this program, that the amount of safety significant problems that we have found is extremely minimal. We also feel that, given the various generic activities that are being conducted -- the TMI activities, fire protection -- that in general almost all of these items -- the only one we don't think would have been picked up is the equipment anchorage, although I suspect that A-46 would have eventually picked that up also.

MR. SHEWMON: You're saying other activities of the NRC would have picked up almost all of these items?

MR. SMITH: That is correct, the NRC or the utilities as we go through our reviews.

MR. SHEWMON: Fine, thank you.

MR. AXTMANN: Does either the Staff or the utility try to compute a cost-benefit ratio on this exercise?

MR. SMITH: We have not.

MR. SIESS: Bill?

MR. RUSSELL: We are just now getting to the point where we have the data to do that. It is my view at this point that a number of issues were identified as a result of SEP's that are not being looked at in other programs, and we are collecting that data now based upon the five reviews we have completed to date.

We also feel that the approach we have used of looking at a hierarchy of action, that is looking at credit for non-safety systems, using procedures, augmented surveillance, other alternatives to hardware fixes, are appropriate, and I think some of that has contributed to the low impact of the cost, and the bulk of the improvement has been made in the procedures area generally in the case of the boiling water reactors.

That is not true, for instance, at Ginna, where we found that the original design did not consider wind loads beyond building code, 70 miles an hour, for that structure. They are in a much more costly program in evaluating their structural upgrading.

So I think there is merit in the reviews that have been conducted.

MR. SHEWMON: Dave, let me pursue one other thing in this. Chet, one of the things that comes up or will come up is what we do with regard to what is called SEP-III or something.

MR. SIESS: Right.

MR. SHEWMON: Which it seems is what we're talking about now, in a sense. What are the plans for bringing this up again on that?

MR. SIESS: I'll let Bill Russell tell us what the status is on SEP Phase III and what he wants us to do about it.

MR. RUSSELL: SEP Phase III would be subjected to review by the Committee and by the Committee for Review of Generic Requirements. We have not yet presented to the Commission the results of these five plant reviews. We are proposing to do that next week.

MR. SHEWMON: I guess my question is, is SEP-III in the planning stage or is it committed to?

MR. RUSSELL: It's still in the planning stage. There's been no commitment to it. The Commission has not yet had a proposal presented by the Staff. We will present that proposal to the Committee and to the Committee for Review of Generic Requirements prior to going before the Commission.

MR. SHEWMON: Are you scheduled for that or is it in limbo?

MR. RUSSELL: We estimate we would be ready to do that in the first quarter of the calendar year, with CRGR some time in the spring, and the ACRS Committee in the spring.

MR. SHEWMON: That's the '83 calendar year?

MR. RUSSELL: That's correct.

MR. SHEWMON: Dave?

MR. OKRENT: When you are looking at cost-benefit considerations, it seems to me one of the things that will enter is whether the uncertainty in one's knowledge of the risk has been changed by the process. If in fact having done it there is a considerable reduction in uncertainty in some areas, this represents in my opinion a reduction in risk, if you will.

In other words, your expected value will come out smaller, and that is a non-trivial benefit in my opinion. So one has to look at things besides the actual changes that were made.

For example, as Mr. Russell just indicated, until they looked they did not know whether any or all of the plants had some anomaly like he just referenced at Ginna vis a vis protection against wind. I am just saying that there are a variety of factors that have to be included in this.

MR. MOELLER: I wanted to follow up on the comment that SEP-III would be taken before the CRGR. In Dr. Isben's comments on, I believe, the Dresden 2 SEP review, he says, "Provision should be made for the active participation of the SEP Staff before the CRGR."

Am I then to understand that CRGR has not been involved in SEP-II?

MR. RUSSELL: That's correct. The CRGR has not been involved in the plant-specific reviews for SEP Phase II. They would be involved in a continuation of SEP, whether that's done by rulemaking or some other vehicle.

MR. MOELLER: Thank you.

MR. AXTMANN: Dave, in reply to your reply, does that not suggest that the ALARA considerations need to have two levels?

MR. OKRENT: You'll have to explain the question.

MR. AXTMANN: Well, I think the numbers are there to probably go through the exercise of the cost per reduction -- the cost per man-rem averted, right? And you are suggesting that the uncertainty in this is equally valuable, so --

MR. OKRENT: Let me put it this way. I could have postulated before the study that if we hadn't looked, there were several areas in which there might be in fact large risks. We don't know. At least, the uncertainty in our knowledge of these risks is large, and therefore if I put some kind of a distribution around a median and I did a calculation of the risks I would end up having a relatively large expected value of core melt or release or whatever you want to say, due to a variety of things that based on my existing knowledge I could not say how they had been dealt with.

When you have looked and you have satisfied yourself, for example, as they have, for example, that Dresden is reasonably close to what they might do today with regard to design for an earthquake, after you set the design basis knowing that they can reduce the uncertainty with regard to that potential contributor, and so you calculate a reduction in the risk from whatever it was you had before.

That is a non-trivial question. One of the big problems we face is the uncertainty in our knowledge, and there was a certain kind of uncertainty that affected these older plants, namely a lack of knowledge of quite what was in them.

MR. SIESS: Did Commonwealth finish?

MR. SMITH: Yes.

MR. SIESS: You can sit down. I don't think you're involved in this discussion right now.

Can we hear from Northeast Utilities?

MR. CASIG: Before I get into the vugraphs, I just want to make an observation. Not unlike Commonwealth, we have spent a number of internal man-hours to get to the point where we are. But I think it is worth noting that we started with 137 topics, boiled it down to one issue that we might have disagreement with the Staff on. And even if it comes down to a disagreement and we end up accepting the standard tech spec limit, in the big scheme of things I do not consider that particularly significant as an issue or a big ticket item, and I doubt that we could come up with any other list of 137 issues that we've discussed with the NRC Staff with that level of agreement.

The first vugraph I have just has a couple of notes with respect to the conduct of Phase II being different from our original expectations, the first one being that it was going to be largely an NRC Staff program; the second being that it was our understanding that there would be some amount of protection from what

I call interim backfits unless there was a safety problem; the third one being that we would be excluded from certain other NRC initiatives. As the program has evolved, I think the only item that fell into that category was the postponement of our update.

We also have a footnote in the vu-graph to the effect that this program was not formalized in the regulations.

(Slide.)

MR. KACICH: My purpose in presenting the next vu-graph is just to refresh everyone's memory of the original SEP objectives. There were five of them, and everyone can see them. I won't bother to read them off.

The last one is one of my own, to improve the basis for POL conversions. I have a vu-graph that gets back to our suggested answers to these. There was a question of whether we met these objectives. Also, in the interest of history, this has more or less been covered earlier today. I would summarize what I call the stages of SEP Phase 2, the first one being that it was an NRC program that lasted for approximately three years. During this period, not a whole lot was accomplished, probably due to the TMI 2 accident.

The next stage, the lead plant was proposed in the fall of 1980. That lasted for about three months, at which time the SEP licensees responded with the lead topic approach, which has essentially been since that point in time. The actual program has been a hybrid of the lead plant and lead topic in that most plants have been able to share individual information, and of course the plants are being taken through an integrated assessment in sequence and not as a group.

We make the observation that increased licensee involvement has been a key factor in accelerated rate of progress that has taken place since the fall of 1980, and that the licensees have benefitted significantly by evaluating topics concurrently and sharing information.

(Slide.)

MR. KACICH: In terms of what has happened thus far for Millstone, this vu-graph is essentially a summary of the different forms of what you have seen earlier today. The plant modifications that we have completed thus far, the first one is the seismic anchorage issue. That is common to virtually all of the SEP plants. The second one is some structural modifications regarding turbine building bracing that we have completed, and the installation of some new battery racks.

We have listed four modifications that we have committed to at this time, tornado missile protection, redundant pressure, interlock on reactor water cleanup systems, some additional isolation valves, and some blocking devices for some existing isolation valves.

Then I have a list of about half a dozen various procedural or tech spec changes we have committed to, which really have already been discussed previously this morning.

(Slide.)

MR. KACICH: Some general observations on Phase 2. Again, it was a relatively large resource expenditure as compared to our original expectations, some 30,000 internal man hours, or approximately 15 man years. Our consultant costs to date have totalled approxiately $1 million, and the hardware modifications that I mentioned previously cost $1.5 million.

In both the latter two categories, those costs are almost exclusively in the seismic area. Note that the schedule has been extended significantly beyond what we originally projected.

On the next point, the fact that the integration concept which in our view is a very positive concept and element of SEP was limited to strictly the SEP topics. Various attempts that we had made during the past couple of years to identify overlaps with other regulatory initiatives with SEP issues didn't generally meet with much success.

The next point I have noted is one that has been mentioned by most of the other utilities, that of strong management on the current SEP branch. We generally found if we could advance sound technical reasons to justify deviations from current criteria, that this branch was willing to listen to those.

As a logical outgrowth of that, we found that the judgments that were reached were based upon nuclear safety and not SRP criteria. We also found that there was a definite opportunity for consideration of plant unique features, and especially with these older general plants. I think that it is safe to say that they have more unique or one of a kind features in the industry.

Last, we have noted there were provisions for the licensee to utilize knowledge of the plant to implement the integration concept. I have to emphasize again there were limitations on this because there was an SEP bound put around where you could implement integration and where you could not, but in the concept of SEP we thought that was favorable.

MR. SIESS: I believe you told us at the subcommittee meeting what your resource expenditure had been on some other activities. Was it 7914 you mentioned?

MR. KACICH: I believe the information I had then was some statistics on initial capital cost, which is approximately $100 million, and the cost of backfits to date, which is approximately $173 million, and I contrast that with the $1.5 million.

MR. SIESS: I thought you spelled out one particular program in 7914. But that's all right. Don't bother.

MR. KACICH: You are right, Dr. Siess. I mentioned for both in 7902 and 14 anchor bolts and as built verification. We have expended $59 million thus far. We are almost done with it.

(Slide.)

MR. KACICH: Okay. The next vu-graph has our proposed answers to the objectives of the SEP. Did we create a documentation base? The answer is generally yes. Information is much more retrievable now than when we started the program. I think we did a reasonable job in getting a handle on where these plants are.

Did we provide the capability for integrated and balanced backfitting decisions? Again, in the context of SEP issues only, I think the objective has been met and is being met, and especially in light of our integrated structural evaluation program. I anticipate that it will continue to be met.

Did we identify any immediate safety concerns? It would be our opinion that there were not too many of them to find, but the opportunity existed within the program to do that, and the one example that comes to mind that I think is common to all the SEP plants is the seismic anchorage issue.

Did we reassess the safety adequacy of the plants? I have to answer that partially not. I have found this was the most difficult question to answer. I think that the SEP did a very good job of evaluating the issues that are summarized in the integrated assessment report, but there are a lot of other issues such as the TMI's and the USI's and the environmental qualification in the SER that were specifically eliminated from the scope of this review.

I think that comment is applicable to all of the SEP plants. One factor unique to Millstone was, it was the only plant that was in IREP and SEP. IREP had the same objective of the SEP in many respects in terms of assessing safety. And while we intended to use that data and the staff did use the data presented earlier, I don't know that we could make a statement anything beyond partially on did we actually assess the safety adequacy of the plant.

Did we efficiently use the available resources? Our answer to that is not really. Fifteen internal man years to us was a lot to find the issues we found.

MR. OKRENT: Do you have a proposal as to how one could have accomplished the objectives and efficiently use the available resources?

MR. KACICH: I think it is a lot easier to Monday morning quarterback.

MR. OKRENT: Even on Monday morning it could be helpful, in view of what you see, and if you are going to look on Monday morning, it would be well to look at ten plants, five plants, not only one, because there will be different views.

MR. STESS: How many of those 15 man years were used up in that first phase before you were on the lead topic part? If you had been on lead topic from the beginning, how much time?

MR. KACICH: I think in the neighborhood of 70 to 75 percent of that time, if we had had the current structure from the beginning, so it wasn't that high a percentage of it that was spent in the initial three years when we really didn't accomplish all that. There were a lot of bookkeeping efforts on our part.

MR. BENDER: Recognizing that there are lots of things in these other categories, do you think that the significance of the things that were looked at as compared with those you are still working on under other programs represent a major assessment of the status of the plant?

In other words, have we screened out so much in these other programs so that this part of it did not deal with the real issues?

MR. KACICH: Well, one piece of insight you can gain is the fact that if we spent $173 million on backfits for everything and only 1.5 of that was for SEP, either it wasn't a very good part or we were doing the wrong things.

I think the answer to that is a little bit of both. I think the other, as I contrast the SEP branch, our experience with the other technical branches is that here is a cookbook, go to it, and there wasn't much opportunity to either justify alternate approaches or to say, let's integrate this so that when we have a transmitter first we environmentally qualify it, then we seismically qualify it, then we bring it up so it doesn't get submerged, then we decide that it needs more redundancy.

We find there are cases when we backfit the same thing over and over again. So again, if we had had an opportunity to fix all of these issues now, we would not have had to spend $173 million to get there from here.

MR. BENDER: All right.

MR. KACICH: Dr. Okrent, I realized I hadn't responded to your question. Perhaps that was because it was the toughest one. Certainly, if we had an opportunity to start over, knowing what we know now, we could be smarter about which topics are not really worth looking at at all. I think the results of what we have found send some signals about if we are going to look any further, where we should look.

I just had one more vu-graph I would throw up by way of conclusion.

(Slide.)

MR. KACICH: One message that we got out of this program was, we would like to see the positive elements of Phase 2 incorporated into the regulatory process in general. The ones being the SRP is a starting point. If you meet it, fine. You are done. If you don't, that doesn't send a signal out to get the backfit mechanism going, but only that you should look harder and make a careful assessment of the situation.

The second one is, strong project management is a very important element in the regulatory interface process.

The second bullet I have listed is, we believe that integration should consider all plant modifications, not merely those that are SEP topics, and we would like to find a better way programmatically to be able to implement that concept.

The last point I wanted to mention was that if there is to be any extension of the existing program, I think it would be beneficial to formalize it by regulation.

MR. OKRENT: I would like to ask --

MR. SIESS: Do you really believe that?

MR. KACICH: Yes, sir.

MR. OKRENT: I would like to ask a question along the following lines. When the SEP program was first proposed, it had two parts from the philosophical point of view. One was this integrated approach, not making decisions unless they were really urgent questions until the end. The other was that the staff was going to do the work, and I can remember talking to Stello on this.

I questioned at that time whether it would be the staff that did this or it should be the licensee, because in fact back in around 1966, when the ACRS suggested that something like this might make some sense at some future time, we envisaged that it might be the licensees who were the ones who had the responsibility of looking at their plant to see that things are all right.

Now, let me ask, you think it would have been workable for SEP too, or it could be workable for some future kind of similar, not identical program, to put it in the hands of the licensees, and with only general guidelines agreed upon and, I guess, a time schedule agreed on, and that realistically the licensees would have come up with similar evaluations that we are getting, and have identified at least the bulk of the things that seemed to have been agreed upon by both, that these are worth doing, and so forth?

MR. KACICH: I think the answer to your question is, it is a matter of degree. How much control does the licensee have versus the NRC staff? I think the way it has worked out over the last several months, in particular, is pretty close to optimum, where we get a model of one plant in the NRC and that gives guidance to the rest of the utilities about the scope of the evaluation to be conducted.

I think an analogy that may have been used before is the case where we are the pilot or NRC is the copilot, or vice versa. It doesn't make any difference, as long as we are in the same plane. And as long as there is an understanding and a periodic check point to make sure both parties are in agreement as to how the program is being carried out, that that process would allow us to get the job done.

I think the way it has been handled, like I say, over the last few months, is probably fairly close to optimum.

MR. SIESS: I know in that period most of the safety evaluations have been done by the licensee.

MR. KACICH: On a percentage basis, that is true.

MR. SIESS: Some of the words you see in that NUREG are taken verbatim from the licensee's safety evaluation.

MR. RUSSELL: I might comment, if I could also coment on Dr. Okrent's question, I think that there are two occurrences which make me believe that the licensees can do the job, and that they should do it. First, we have been going along, and for the first four plants, the integrated assessments were done essentially by the staff with a lot of negotiation or discussion back and forth with the licensees.

In Millstone's case, the staff identified the differences, the things that flowed from the topic reviews. They had approximately 90 days, and at the end of that they made a submittal where they proposed what they felt was appropriate to do for their plant. There were also meetings going on in between and discussions, but essentially that process or the licensee looking at his plant and proposing came out very close to what the final document describes.

That is, there were very few areas that needed to be supplemented by additional submittals. Our audit review of that work indicated that we were looking at the same issues with the same perspective as to the relative importance. We have four more plants that are doing this, that are doing that now.

I think the test will be how well those reviews turn out and whether an audit of those reviews is sufficient.

With respect to the other part of the question, the quality of the safety analysis performed by the licensees, we had some initial false starts. There was some difficulty getting it going, but toward the end, we found that the quality was quite high, and that we could revert in fact to an audit role rather than a role of performing it. That is particularly important in SEP, where you are looking at a hierarchy of action, where you are considering non-safety systems because they are there and they can fulfill the function when you are looking at plant procedures and surveillance, and you are looking at the plant as a whole.

The only one who knows that plant well is the guy who runs it and operates it, and we found it was extremely important to have on the audit team the perspective of the resident inspector who is there on a daily basis and seen the plant. It was useful to have the perspective of the risk assessment analyst as well as the operating project manager and the project manager from my branch.

So, I think that what we are seeing is that licensees can do the job, and that the staff could move into an audit role. We also found out that the staff cannot do the job by itself, that you do not have sufficient knowledge of the plant or documentation of what exists. The plants are changing such that the documentation was not keeping up with what physically is in the plants.

MR. SIESS: Would the updated FSAR help you, or would that still not give you the knowledge of the plant to do what you need to do?

MR. RUSSELL: I think the FSAR update would help in areas that are potentially fruitful to look into. From the standpoint of identifying what has been done and what exists to prioritize areas that you look at, but I think you still need to have the involvement of the licensee and his operators, and particularly the operating staff.

We found that in most cases in meetings with the licensees, and particularly in the integrated assessment process, that the perspective of the operator, the operations supervisor, and in some cases the shift supervisors we met with, was a very good perspective to have to understand how they really operate.

I think the areas of procedural revision that have been described are a major improvement. In fact, some of the things which people sit back and talk about that go between licensing at the NRC and licensing on the part of the licensee's staff of how to do things which are ad hoc, when you translate that into a procedure that an operator who, when he is faced with the problem, who has had the benefit of somebody thinking about how to do it, is very useful.

The concept of using water from the spent fuel pool to use as makeup if you need it and the procedures for how to get it and the reliability for water supplies that we saw in the revisions at Pallisades and Ginna, I think, are very useful contributions.

MR. SIESS: Mr. Chairman, I think the subcommittee is ready to turn this back to you. I would like to make a couple of comments first. I would like to thank the licensees for their presentations today.

And I would especially like to thank Chris for putting it all together and not getting lost and not getting us lost too much.

I will have draft letters on the two plants later this afternoon, if you wish to take them up.

I will turn the meeting back to you, and donate one hour and 15 minutes. Does that mean that I can leave at 12:30 on Saturday?

MR. SHEWMON: Well, I was just about to get to that. I thank you very much, and I thank the participants for moving along in a timely manner.

Before we break for lunch, what I would like to do is, basically, we have got an hour and a half in schedule. After lunch, we will start at 2:00, and we will actually take what is scheduled from 2:00 to 3:30 on Saturday, but due to some things that are not quite ready with the staff, we will do it in inverse order, so we will start with prioritization of generic items with Mike Bender.

We will then go on to Jerry Ray for a memorandum of understanding, and then get to Dade Moeller's things. Then we will go back on the regular 3:30 to 6:45 schedule that is in the agenda after that.

(Whereupon, at 1:05 p.m., the Committee was recessed, to reconvene at 2:00 p.m. of the same day.)

AFTERNOON SESSION

(3:30 p.m.)

MR. SHEWMON: Could we begin. Would people sit down so we can begin.

On the advice of my chief counsel on schedule matters, we are moving the Zimmer plant item up to 3:30 and we will then, I guess, bump things down and to go to Subcommittee activities and such things on our own time after that.

Mike, do you want to introduce this?

MR. BENDER: Sure.

MR. SHEWMON: I would only admonish you and the speaker that this is scheduled for half an hour total, and that means that their comments are scheduled for 15, and we promise to fill up the rest of the time.

MR. BENDER: We're not planning on a long time.

THE REPORTER: I can't hear you.

MR. BENDER: Can you hear me now?

THE REPORTER: Yes, sir.

MR. BENDER: This matter of the Zimmer plant has been going on for a long time. I reported, I think last month, the Staff was contemplating some kind of regulatory action because of difficulties that appear to have shown up with the Zimmer plant. There is a long history, as you know, of this particular installation having difficulties in establishing a good inspection record and showing that the plant had been constructed in accordance with the agreements which it had made with the Regulatory Staff.

Recently, the NRC issued an order, a show-cause order, which is included in your folders under Tab 4.4. I'm not going to read through it, but I will just draw your attention to what I think is Section 4 of the show-cause order, which gives the reasons why the Zimmer plant should be shut down. Basically, it's a matter of getting the management to take a more responsible position on what they're doing, and I'm not going to go beyond that.

We have representatives from the I&E organization, I guess from Region III. Is that right?

MR. WARNICK: Right.

MR. BENDER: Bob Warnick from Region III is here to tell us what the situation is, and I think I'll just turn the subject matter over to him and ask him for a report.

(Slide.)

MR. WARNICK: Good afternoon, Mr. Chairman and members of the Committee. I'm Robert Warnick. I'm Director of the Office of Special Cases in Region III, and I'm responsible for Zimmer and Midland. With me is Darwin Hunter. He is the section chief in charge of Zimmer. We will try to be brief and keep within the time frame.

The first slide we have is a review of the chronology of major events that have occurred since the Subcommittee meeting was held in the Cincinnati Airport in February of '82.

MR. KERR: Excuse me. Is there some way that the man who is handling those slides can make it possible for those of us on the other side to see?

MR. SHEWMON: Please go on.

MR. WARNICK: In May, towards the end of May, May 27th, there were three quality control inspectors that were doused with water. CG&E stopped work because of that. This was on a Friday and they resumed work the following Monday after making all the workers at the plant sign a statement acknowledging the law we have on intimidation and harassment.

Then that was followed up with additional allegations of intimidation and harassment, and we ended up interviewing some 50 QC inspectors, approximately 50. And Mr. Kepler ended up by going down to the site and talking to the people at the site about this problem.

We have appeared at Congressional hearings in June and September, towards the end of June. And in July we received allegations regarding welders' qualifications, and we looked into these and as a result of that there were some 100 active welders that we required to be retested to prove their qualification.

MR. KERR: How many of the 100 passed the examination?

MR. WARNICK: All but two.

MR. KERR: Thank you.

MR. EBERSOLE: Had those two produced important welds that were not impossible of being validated?

MR. HUNTER: Generally, they had produced welds that need to be dispositioned. They're in the process now of identifying all the work that these individuals performed, all the work that all the individuals performed also.

MR. WARNICK: What we did, we said even if you passed the tests, we want you to go back and take a look at some of the work they did, to validate that they didn't learn while they were doing the work. So they're going back to look at the work of all the people.

MR. EBERSOLE: Is it not true that there is no nondestructive checking method available which will give you satisfactory evidence if the welders did it wrong, that there is no inspection technique that will show it's been improperly welded? That is, you cannot in the absence of knowledge of procedures qualify a weld by simple non-destructive testing?

For instance, you don't see the heat treatment or you don't see the temperature distributions or a host of other things; that none of this will show?

MR. SHEWMON: They're fusion welds, Jess, and I don't think there is any particular heat treatment on the ferritic materials involved.

MR. EBERSOLE: Isn't it true that NDT can be performed which will make it unnecessary to know how the weld was fabricated?

MR. HUNTER: One of the considerations that is being given is to develop a program to identify the first welds the individual put in and then do destructive testing of the first welds, determining whether or not they were qualified by a destructive test method, and then maintaining their qualifications through a continuation of the process through their lifetime on site.

This is being considered by the Licensee and when they have this program established, then we will review it and our people will review it to agree or disagree with that technique.

MR. EBERSOLE: Well, that's a destructive test.

MR. HUNTER: Yes, sir. I can't respond to the nondestructive tests. I might agree with you that that would be difficult, to provide destructive tests for a structural weld. That is not really -- NT may be difficult. NT may be impossible. UT may in fact not tell you what the consistency of the weld is.

MR. BENDER: We need to get this in the context. As I understand it, there are several kinds of welds that are being considered. Some are piping welds, some are structural welds. Are there any others?

MR. HUNTER: Generally, the site is built to ASME and AWS. The heating-ventilation is a slight difference in acceptance criteria, but it's generally an AWS type.

MR. BENDER: What you're trying to do is establish that the welders are qualified. Is there also an issue about whether they used the right materials?

MR. HUNTER: Yes, sir. The weld rod control is in question, also weld procedures historically have had problems.

MR. BENDER: So you have three things to consider. Even if the welders are qualified, if they used the wrong procedures they could be in trouble. They could be unqualified and use the right procedures and get good welds. So it is possible that the issue is procedures and materials and secondarily qualified welders. I don't know what the order is.

MR. SHEWMON: Harold, were you trying to say something to this?

MR. ETHERINGTON: No, I pass.

MR. SHEWMON: Chet?

MR. SIESS: If you went to another site under construction and picked 100 welders at random and gave them another test, how many do you think would fail?

MR. HUNTER: Our position was that they would all pass. We used the code requirements for qualifications and allowed them to come out of the field, step into an ideal situation in the test booth and qualify. And we gave them two coupons to qualify on. They should have passed within the two coupons. Some of the fellows were given three and passed, and then some of the fellows, of course, who didn't pass, two particular individuals, took more than three.

MR. SIESS: That's very interesting, but it wasn't the question.

MR. BENDER: Dr. Siess wanted to know whether, if you took 100 welders at some other site, would they have been qualified if you requalified them again?

nI would anticipate that unless they had developed some type of eye problem or some other physical problem, that they should have passed.

MR. BENDER: Do you have any history to base that on?

MR. SIESS: It would seem to me 98 percent passing was a good figure. These were people that had not been tested before, and 98 percent of them passed?

MR. HUNTER: No, they'd been tested before.

MR. BENDER: They just hadn't requalified, as I understand it.

MR. SIESS: Why, if these people had been qualified once and they failed the requalification, why are you so confident that another 100 from another site would all pass?

MR. SHEWMON: They had concern about the original qualification. Wasn't that why you went back?

MR. WARNICK: Yes. There were questions on the documentation of their qualification. That is why we questioned it and made them go back to retest.

MR. KERR: I guess I'm puzzled now. I thought in answer to his question you said all these were qualified welders.

MR. WARNICK: They were. They had been

certified by the Licensee's QA program saying that they were qualified. But we found problems with the documentation they reviewed.

MR. KERR: You were convinced that they were qualified, but you were convinced that the documentation was no good?

MR. WARNICK: No. We didn't know. The Licensee maintained that they were qualified.

MR. SHEWMON: "Qualified" is in quotes.

MR. WARNICK: Their documentation didn't support it and we told them they would have to go back and prove that they were qualified.

MR. ETHERINGTON: Does the code permit or provide for procedural deviations?

MR. WARNICK: Darwin, do you know the answer?

MR. HUNTER: Ask it again, sir?

MR. ETHERINGTON: Does the code make any provision for a procedure on deviations, like the weld was made with a liquid metal weld but it was not qualified?

MR. HUNTER: The prerequisite is that they comply with the code, and in some cases it's more restrictive than ASME.

MR. ETHERINGTON: Even though the welds are good, they have to be redone? Is that the position or not?

MR. HUNTER: If they cannot show qualification --

MR. ETHERINGTON: They have to show prior qualification?

MR. HUNTER: Yes, sir. And if it wasn't in a test booth, which is required by ASME, then they could provide the same testing in a destructive test of an initial weld and they could be qualified through the process from then on.

MR. ETHERINGTON: So then all the welds made would have to be redone?

MR. HUNTER: No, sir. The program would go back and determine the first welds they had performed, destruct potentially the first weld or welds. Then they would be qualified by their own process from then on. So it would only be a limited number of welds in most cases.

MR. SHEWMON: Max?

MR. CARBON: How do you decide whether to give them one coupon or two or three in order to qualify?

MR. HUNTER: We generally used the guidance in the ASME code. The ASME allows more than two, but with somebody who is in the field actively welding and pulling him into this shop where he's in a set of ideal conditions, he has all of the ideal conditions, two coupons we felt were adequate.

We might consider three coupons without a problem. Two coupons should have been adequate to qualify the individual.

MR. EBERSOLE: It seems the focus of the problem is who qualified these people.

MR. SHEWMON: There's more than this problem. Let's let him get through.

MR. WARNICK: Yes, I'd like to go through the chronology quickly, and then I'd like Mr. Hunter to talk about the deficiencies that have been identified.

The National Board of Boiler and Pressure Vessel Inspectors were invited to come in by the State of Ohio to conduct inspections on their behalf. They have conducted many inspections and their findings have been consistent with ours, or ours have been consistent with theirs.

On October 19th, we met with CG&E to discuss the problems we had identified during our inspections regarding catalytic incorporated.

(Slide.)

Darwin will talk more about these when he talks more about the deficiencies.

Because of our concerns identified at this point, the Licensee also recognized their problems and started scaling down their work effort. They laid off 450 craftsmen on October 6th.

We issued the order suspending construction on November the 12th. That was late on Friday. Then the following Monday they laid off 1240 personnel, of which 1,087 were craftsmen.

One part of the -- at that point, we are to the order. What I would like to do here is let Darwin talk about the deficiencies, and then I will come back and talk about the order of time permits, and then conclude by giving you the current status of the plant today. Darwin?

(Slide.)

MR. HUNTER: The slide indicates deficiencies that were continued to be identified. Realizing that the quality confirmation program, what I call the verification program, was designed to identify deficiencies, I would like to point out a couple of significant deficiencies that had impact. And to be very candid, we don't know as yet the overall impact of some of these deficiencies.

The first one on the list is weld procedures. There have been a number of problems with weld procedures, where essential variables were historically not controlled adequately. That includes the procedure, thickness of the weld, the thickness the individual was welding to, the temperature control of the weld, preheat requirements, current of the weld machine and voltage. These things are being specifically reviewed by the Licensee to establish impact.

The third item down is electrical cable tray and support installations.

MR. KERR: Excuse me. I can't tell whether you are saying that you know all of these things were done incorrectly or there are no records that exist to tell you whether they were or not. Which is the case?

MR. HUNTER: In this particular case as an example, they had 90 weld procedures. They reviewed the weld procedures. The weld procedures they used themselves in the field and trained the people to did not include all of the appropriate criteria required to do that weld in accordance with the codes and specifications.

MR. BENDER: Excuse me. If I were to go to other nuclear plants, would I find that the others are laid out chapter and verse?

MR. HUNTER: In my limited inspection of, in my case, modifications that were performed at operating facilities and looking at weld procedures and welding under that condition and talking with the technical people in my office, yes, sir, the weld procedures are laid out chapter and verse, step by step, because the code is very stringent on the way to install welds at the plant.

When I say codes and specs, I mean ASME and AWS. And they would in fact put their welds in in accordance with their procedures, yes. My answer is yes, we would find that.

MR. BENDER: You're telling me that information on the temperature of the interpasses and on the weld currents are all recorded and available?

MR. HUNTER: Yes, sir. Normally in a pre-weld setup on a checksheet of some sort that QC reviews, that would show that essential variables were controlled during the welding activity.

MR. SHEWMON: Let's let him get on, please.

MR. BENDER: o ahead.

MR. HUNTER: Electrical cable tray and support installations, specifically actually hardware holding the cable trays together and then also support welds and also support installations, which includes Nelson studs, have shown deficiencies.

Sacrificial shield welds, the next item, the radiographs, there's a problem with technique. But even moreso, obviously the welds themselves have problems with a slag inclusion that are in the welds, and the radiographs in some cases were performed in the as-welded condition and the radiographs are not adequate to really show the condition of the welds.

These were done with a piece of steel laying on the ground out in the field. They are now used as concrete forms. The radiograph is no longer -- the technique of radiograph of these particular welds is no longer available, because they are installed.

Now, whether or not they will decide to do UT's or NT's or what technique they will use to satisfy the code requirements of those welds, I don't know at this time.

Control rod drive systems, of course design control -- they are rebuilding generally the control rod drive hangers, and that system is being rebuilt now.

MR. BENDER: That's structural welds.

MR. HUNTER: Seismic upgrade and structural.

Electrical cable separation is a problem. It's not been completely identified yet, but they have problems with the specifications and also they're doing field walkdowns to determine the impact of the total problem.

Fire protection system seismic upgrade was done in 1979 and there is no evidence of QA nor Sargent & Lundy engineering involvement. That is being reviewed now. I'm not saying that the engineering cannot be provided today and it will not be a problem, but the fire protection system was mounted by Ginnel on the seismic class one cable tray supports and just clamped on there, and that needed to be a controlled activity and it was not.

MR. EBERSOLE: Pardon me. It's a good idea, I guess, but it's the first time I've heard about seismic fire protection requirements. The Staff has in general not required that.

MR. HUNTER: Their system was upgraded in 1979 so it wouldn't fall on something else.

MR. EBERSOLE: Oh, thank you.

MR. HUNTER: It in itself is not class one, but it is supported as a common mode failure item.

There's a problem with concrete and steel coatings, the application of the materials in the environmental material when they installed the coatings back in late 1970.

(Slide.)

Those generally show construction deficiencies that these people have identified that have been built into the facility, and they're going to have to be dispositioned.

Now, I got involved in Zimmer in January when we started an inspection program, which I haven't finished. But I looked at personnel qualifications and certifications in January of '82, and we had a problem with that. They weren't meeting all their own commitments and that is so documented in an inspection report.

We were having trouble with them identifying items and then taking appropriate corrective actions. We were having trouble with them not only with welder qualifications, but maintaining welder qualifications on their onsite welders. Today there's a problem still with upgrading of records. Then there's a problem, as indicated by this gentleman over here, weld material control, weld rod material control.

Then in August we looked at a specific subcontractor who was going to do rework activity and some other punchlist activities for continuing construction. We sent three people out and spent about three weeks, and when we had finished our audit of that group, realizing that they were under specific control of CG&E, under special controls established again by us in late 1981, we came back with findings relative to classification of essential work.

They had done work and they hadn't properly classified it. Therefore, the QC was not being performed in the manner we felt it should be. They lacked inspection and surveillance activities in some of those activities these people were doing. These people were reworking all the structural steel welds in the control room, for example. And these types of problems we found with their rework activity and removal of fire protection material so they could rework items and inspect items.

MR. SHEWMON: They were reworking them why?

MR. HUNTER: Because the structural steel welds generally had never been inspected after they'd been installed back in the seventies by Bristoe. After our investigation, we required them to inspect all structural welds. The welds would not meet ASME. They would not meet structural requirements, and they were having to rework them to bring them into the specs.

MR. BENDER: That's AWS requirements?

MR. HUNTER: Yes, in this particular case.

We had a couple more problems with identification and corrective action again, similar to not identifying something and not correcting it timely and not correcting it generically. Then we had some problems with records and audits. CG&E didn't actually audit this group prior to allowing them to go out in the field and work.

(Slide.)

MR. ETHERINGTON: What do you mean by "rework"?

MR. HUNTER: Rework? Okay. Part of the investigation of '81 required CG&E to perform certain activities where we had found problems. One of the areas where we found significant problems was in the AWS structural steel welding program. They were required to re-inspect all of the structural welds, generally speaking.

Then, speaking of the control room, it includes the drywell, the suppression pool, the control room, the reactor building. They have in fact, and they're in the process of re-inspecting some more, but generally they've completed re-inspection of the welds, and they found that these welds did not meet the specs they had committed to in their license.

MR. BENDER: Structural welds were originally inspected?

MR. HUNTER: That was based on the man being qualified, the man being right, and it being performed in accordance with the specifications.

MR. SIESS: In a physical sense, were they not in conformance? The wrong size?

MR. HUNTER: A number of items. Those are laid out in the monthly report that we've sent up.

MR. SIESS: Just give me one example.

MR. HUNTER: Overlap and lack of fusion, about 20 percent of the welds. That's the two that were unacceptable to the NRC. The profile, some undercuts, some minor things could be cut away, but we considered that very, very important.

The Kaiser head in fact bypassed an authorized nuclear inspection that they were doing in the field, and the ASME code requires that they be involved in the ASME code work up front, so that he can set up the hold points. They bypassed him by using a procedure that was not in accordance with their QA plan.

They had had stop work orders issued. CG&E issued stop work orders in the October-November time frame. The electrical cable installation, they are still having problems today. They were laying non-essential cables without adequate controls and they were getting them into essential cable trays without loading and separation, that type of thing.

Application of coatings are still a problem today. This is on concrete and structural steel. They weren't adequately controlling the temperatures, the mixtures, that type of thing.

Special process procedures. Even after they had reviewed all of their weld procedures toward the end of '81, they came up and re-reviewed them again and ended up with ten additional special weld procedures that had problems in them. Then they stopped that particular activity.

The National Board findings, as Bob mentioned, paralleled ours and showed problems in a number of areas, including procurement procedures, QC/QA involvement, that type of thing.

And then I spoke about rework activities. Generally, the major rework was the structural steel, although there was some work going on in ASME. Our position was, rework without knowing the original welder qualifications, the potential is that they're adding new overweld material that they may have to disposition later.

The main thing is the quality program. The verification program wasn't finished.

MR. BENDER: Evidently, you found this through your inspection. Who else is inspecting them?

MR. HUNTER: The National Board is doing ASME piping, and they're finding procurement problems. And of course the NRC is inspecting ASME and structural.

MR. BENDER: CG&E has some structural welding inspectors?

MR. HUNTER: Yes, sir. They have a specific group of certified weld inspectors.

MR. BENDER: Have they been letting shoddy work go through, CG&E inspectors, or do you know?

MR. HUNTER: I think after the first of the year, the response after the first of '82 is that the work is not what you would call shoddy. I think they lacked technical review to establish some criteria on welds and other things, and it was just getting ahead of them.

By stopping work, it will allow them to reassess the procedures, as an example, and they can restart this activity at some point in time with the appropriate controls established. Then the QC can do their job.

MR. BENDER: Thank you.

MR. KERR: Tell me a little something about welding. I get the impression that every organization who does welding has to write up their own procedures and these are all different, everybody has a different set. Is that right?

MR. HUNTER: Generally, that to some degree is true. ASME and AWS, the code has specific types of processes that are reviewed and approved by the site ASME. Generally, Sargent & Lundy would issue a specification saying that, the sacrificial shield welds would be put in a certain way, and then prior to the commencement of that job back in the late seventies in that case, they were required to write the special process procedures that could control those welds.

MR. KERR: Why are so many different procedures used? Why does everybody set up their own procedures? The ASME code says you have to have a procedure. It doesn't tell you what code you're supposed to have.

MR. HUNTER: It just says, if it falls in a certain category each major contractor like Kaiser would have their procedures written.

MR. KERR: How can you tell them that 10 or 12 procedures are missing when you go and look, because earlier you had found that some procedures were not there that should have been there, I thought.

MR. HUNTER: We found that there were some parts of some procedures that should have been there that weren't there. The weld procedures did not control all the essential variables required by ASME or the AWS code specs. When you take the procedure and weigh it against the evaluation sheets, you look for these seven points.

MR. KERR: This has been written by people who didn't know a bunch about the ASME code?

MR. HUNTER: This we will have to find out. We will decide. They were written by H.A. Kaiser as an example and reviewed by CG&E and reviewed and approved by Sargent & Lundy. They were required by spec to review all the processes, heat welding, et cetera.

MR. KERR: You have to assume they are ignorant, or they don't take ASME procedures seriously?

MR. HUNTER: They were either careless or not attentive to their job or something, yes, sir. If you get a bad weld, there are basically three people you can blame. The welder shouldn't have put it in in the first place. The supervisor shouldn't have allowed it --

MR. KERR: I'm not talking about welds, I'm talking about procedures. It's conceivable to me that a welder could do a good weld without having read a written procedure.

MR. HUNTER: He's trained to that in the test shop, so he knows all of the things to handle that. The point being that some of the voltages they were using, as some of the welds in the field would indicate, that I would not say a "welder" -- and I'm going to put that in quotes -- a welder couldn't put those in. A welder wouldn't put those in. He wouldn't walk away and leave that kind of work.

MR. BENDER: I don't want to cut this off, but I did make a commitment to the Chairman that we were going to do this in a half an hour. So I would like to have you just go ahead if you would.

MR. SHEWMON: Maybe to your conclusion. Go ahead.

MR. WARNICK: We are prepared to talk about the order if you would like us to. If you are running short of time, we will spend it any way you would like it. We have the order. Then we've got a slide showing what the status is today, and then we can take questions.

MR. SHEWMON: Mike?

MR. BENDER: Why don't you show us the status today, and then there is a couple of questions I would like to ask, and I imagine there are others.

MR. WARNICK: Following the issuance of the order, the first part of the order called for them to immediately stop work. Then the next step was to obtain an indepenient review organization, and they have obtained Bechtel to be their independent review organization. They have made a submittal to us, and we are in the process of reviewing that submittal. It has to be reviewed by the regional administrator. That is going on at the present time.

They have submitted a letter to us asking for clarification of some of the activities that they would like to proceed with, and in a meeting we held just after the issuing of the order, we told them that is the way we wanted them to do it. We wanted them to put any gray areas in writing. We would respond to them in writing, to keep it clear as to what they could and could not do. They submitted such a letter on November 22nd. We responded, approving eight activities, declining four activities, and then two activities they didn't give us enough information, so we said we will approve them on a case by case basis.

The only work that is going on in quality confirmation work and non-safety related work. They have currently -- Henry Kaiser has gone from about 2,000 people to about 800, and CG&E is down to about 750 people right now.

MR. BENDER: When we were out there in February of this year, we had the understanding then that I&E had reached an agreement with CG&E to do a certain amount of reinspection, and take whatever corrective measures were needed on account of that, and I had the distinct impression then that that program was going well, and that I&E was pretty comfortable with it. What happened?

MR. WARNICK: Yes, that is correct. We back in April of '81 -- one of the requirements that we imposed on the licensee was that they do what we call 100 percent reinspection. Kaiser QC would inspect. CG&E had to hire their own group of inspectors. They had to go out and inspect the same item. That went very well. They identified the problems. It proceeded until about, I think -- that was on the chronology slide. I believe that was around August.

They asked for relief in July to back down from 100 percent reinspection, and we concurred in that, and authorized them to back down, and they are currently at about -- it depends on what area, but on an average, they are out about 25 percent reinspection, and on a surveillance program, which is the normal way to do business, of about 10 percent.

We didn't have a problem with it. They were identifying problems and documenting problems.

MR. BENDER: Well, this particular action I wouldn't necessarily call precipitous, but it certainly seems like a reversal of the circumstance, and it suggests to me that there either was a breakdown in the organizational arrangement or somebody did not understand the situation to begin with. Which was it?

MR. WARNICK: I guess it was kind of -- you can't put your finger on any one thing. It is accumulation of effects. It was the fact that the quality confirmation program was identifying that they had a lot of hardware problems, they were trying to rework problems as they went, and we were not very comfortable with that, and then we went in and performed a new inspection on Catalytic and found they had some basic, fundamental problems that they had back in '81.

And from all of these things accumulating, we just said, we have got to take some drastic action to get their attention.

MR. BENDER: While I know that it is the expected practice to have these procedures well defined and to put enough quality control into the system and to make sure they are carefully followed, just from my familiarity with other plants, it is my suspicion that this is not the only plant that has gone through the mill and has some limitations like this. If I were to go to other plants, would I always find that the level of record that you are asking for here exists?

MR. WARNICK: I think that you would find it to a much greater degree. You might not find it 100 percent, but you would find it to a much greater degree than we found Zimmer. Yes, sir.

For instance, Midland, which you recognize. We have had problems there. We have not found the records problems at Midland that we found at Zimmer, like as a comparison.

MR. BENDER: Midland went through a somewhat similar kind of agonizing experience, maybe not from the standpoint of requiring reorganization, but I can think back as far as Dresden 1, for example, where I think even the controls were not exercised on some of the plants that are running.

My reason for asking does not have to do with what you are doing. You may very well have to. But I think it is important to understand that in putting these requirements into the plant, we are implying that the safety of the plant may be in jeopardy because you cannot re-establish quality. I would really like to know what your position is. Are you going to be able to establish the quality of this plant to the degree that is necessary by today's standards?

MR. WARNICK: What we are going to be able to do by the program that has been laid out, we are going to be able to identify whether problems do or do not exist, and the licensee is going to be required to resolve those problems that do exist.

MR. BENDER: Are they resolvable?

MR. WARNICK: Well, I imagine that -- I don't know, because they haven't identified them all, but we are monitoring that as it goes along.

MR. BENDER: Are the ones you have found so far resolvable? Let me put it that way.

MR. WARNICK: Well, I would say that is a hard question to answer. Yes, they are resolvable by either cutting out the work and redoing it or by some kind of testing program, or possibly an engineering evaluation, so I would say they are resolvable. It just might be expensive and time-consuming.

MR. BENDER: I see. Okay. Other questions?

MR. EBERSOLE: Isn't what you are saying is, you cannot just resolve it by non-destructive testing techniques? You have to have procedures, material usage, and history to get the qualification you need?

MR. WARNICK: First of all, we have to identify what the problems are. Then each problem has to be treated based on its own merits.

MR. EBERSOLE: Given the batch of welds for which I have no record of procedures or welder qualifications, but everything else looks good, do I have an acceptable set of welds?

MR. WARNICK: I don't know.

MR. EBERSOLE: I gather you would have said no, I don't have an acceptable set.

MR. WARNICK: It depends on what they do to prove that they have got an acceptable set of welds. In other words, what we are trying to do is not reach a conclusion prematurely.

MR. EBERSOLE: Well, is a necessary ingredient to a set of welds a history of the fabrication of the weld, including procedure and qualification?

MR. WARNICK: I don't think it is, but Darwin, do you want to expound on that?

MR. EBERSOLE: I think that is an issue that nobody agrees on very well.

MR. WARNICK: Somehow they have to be able to demonstrate that weld is good. There is more than one way to do that probably, but I am not the welding expert, so I really shoulin't be voicing an opinion in this area. That is why we have got our welding.

MR. BENDER: Is there anything in the record that says what kind of proof of adequacy is to be required?

MR. WARNICK: No, we haven't specified that. What we said is, you build the plant according to your commitments, according to your codes and standards, and we expect you to be able to demonstrate that it was built that way.

MR. BENDER: You can do that prior to the building of the plant, but the plant is what, 90 percent built?

MR. HUNTER: Ninety-eight, according to the licensee.

MR. BENDER: I think I have to ask whether there is any practicality to saying that a large part of it has to be redone. If a small part of it has to be redone, then I guess I would accept that you can follow the premise you are working under. But if a large part of it has to be redone, it looks to me like the practicality of doing it almost rules it out.

MR. WARNICK: I would agree with you.

MR. PENDER: So we are asking how you are going to establish, as is Mr. Ebersole. We are not asking different questions.

MR. HUNTER: As an example, we have examples where, let's say, they haven't met the ASME code. Basically, that is their license commitment, and we don't need to go any further than that. Also, it is an Ohio state law, and we don't need to go any further than that.

But let's say, for instance, that the quality confirmation program establishes the fact that material traceability is not there. Okay, and that is a requirement of the law, that is a requirement of 10 CFR 50 Part B at Criterion 8, and I know it is a problem that is looming, and we are looking it in the face. But let's say it's not there, or it could be welders are not qualified adequately, or it could be any number of things.

The first step, of course, is for the licensee to identify all those condition where he does not meet his license. Now, he may after he goes through this have to make a hard decision. He may have identified enough that that decision will be very difficult. But to decide whether or not he should go further, that is his decision.

Our point of view is, he will decide where he did not do it in accordance with the law and his commitments, and where he did not, he has to provide a comprehensive, detailed program to us to show us how he is going to meet equal to or greater than what he committed to for safety, or meet an adequate program. He may have to degrade safety, but NRR will have to prove that. The staff will have to prove that. Then it will go through all the throes.

MR. SHEWMON: A minute ago we were talking about materials whose spec couldn't be traced or welds whose pedigree couldn't be traced, and now you are talking about a procedure, not a program. I am confused. Procedure sounds to me like what they are going to do in the future, but it is all done. The question is, what do you do after it is all done?

MR. HUNTER: You establish what you did not do when you put in the structural steel. That is a verification program. You establish where you are.

Then, when you find out what you have not done in accordance with your commitment, then they have to show an alternate program of some type. It may include engineering analysis, NDT. After they provide that to us, then we --

MR. SHEWMON: Thank you.

MR. BENDER: Can I ask, how much is Sargent and Lundy involved in this thing? When we were out there early in the year, it appeared that Sargent and Lundy appeared on the scene when CG&E rang the bell.

MR. HUNTER: Sargent Lundy is still the AE and they are still imminently involved in engineering and any disposition that is being taken. Basically, as the AE, they are the licensee's authorized agent in its construction permit, if you will, in the FSAR, to make engineering evaluations. Unless they hire additional people or somebody else to take their place, generally, it is Sargent and Lundy, and then their own engineering group gets involved.

Generally, they are right on the scene.

MR. BENDER: I understood for a long time the construction by Kaiser was doing their own assessment and corrective actions?

MR. HUNTER: I am not sure I can respond to that yet, because it is a leading question trying to say who made the decisions on identifying non-conformances and at what level, and how does it occur.

MR. BENDER: There is a piece of paper I have seen that says that.

MR. HUNTER: We have got all levels of problems where they even voided identified problems. Then they were dispositioned locally without engineering input in some cases. In some cases, the engineering input was not adequate. It is a combination of those.

MR. BENDER: Mr. Chairman, I think we have heard enough to get a flavor of the situation. I don't think this is the place to go into it in great detail.

MR. SHEWMON: Greater detail.

MR. BENDER: I thought it would be wise for the Committee to hear firsthand as much of the information as we could, but I suspect we don't need to hear more today.

MR. SHEWMON: Thank you very much for the presentation.

That says 4:20, doesn't it? I see members of the Staff here. Forrest, can you handle the item on proposed NRC Reg. reform legislative requirements?

(Thereupon, at 4:25 p.m., the Committee went into Executive Session, to reconvene in open session this same day.)

OPEN SESSION

MR. SHEWMON: Okay, we are now ready for Sequoyah and hydrogen control. Carson?

MR. MARK: This won't go quite as neatly as Chet's presentation.

There was a subcommittee meeting on the present state of affairs as viewed by both TVA, the staff, considering Sequoyah, hydrogen control. There was a subcommittee meeting on Tuesday. Chet and I were the Committee members present. We had a very strong group of consultants, Lipinski, Catton, Gary Schott, Marty Sichel from Michigan, and Zenons Zudans, and we had presentations both from TVA and from the Staff.

As you will recall, Sequoyah is a little bit in the nature of a lead plant on this business of means of disposing of arbitrarily generated amounts of hydrogen. There are a number of other plants that are going to fall rapidly in line, like McGuire. Cook is already an ice condenser running. Grand Gulf is giving thought to this.

So, some of the things which we may find ourselves including in connection with Sequoyah may be somewhat generic, and some will not, because there is a lot of plant-specific features that have to be considered.

Now, I can give my personal response to what we have heard. This starts with the feeling that there has been a lot of good and persuasive work on the efficacy of igniters at Fenwal, at Livermore, at Whiteshell, and I believe also by -- I'm not sure if it's INPO or one of the industrial groups. Igniters work. They work apparently reliably on the order of 8 percent hydrogen mixtures, perhaps less, if the air is quiet. They work at smaller, leaner mixtures if the air is turbulent and stirred up. There is nothing terribly surprising about that.

The Sequoyah people who had a year or a year and a half ago a thing they called an interim distributed ignition source, IDIS, have moved toward what they call a permanent hydrogen mitigation system, PHMS, which differs from the interim one in a couple of respects. One is having more data behind them. The other is, they have changed the gadget to be used for the igniter from a General Motors glow plug to a thing they call Tayco, which I guess means the Taylor Company -- I'm not sure -- coil.

They like that for reasons which they will perhaps make clear to us, but I believe partly it is because it works at 120 volts, and that is a little more convenient. It has a lower specific energy density per unit area on the thing that does the igniting. It has more surface, and consumes somewhat higher power, total power. It is a tiny little gadget. It is about the size of a --

MR. SIESS: A what?

MR. MARK: It is about three inches long and an inch in diameter, and a coil of wire which is brought up to some fairly high surface temperature. The surface temperature has been measured on the outside of the coil. If it is at 1,500 degrees, everybody agrees that it ignites fairly lean mixtures of hydrogen.

MR. SHEWMON: Is this F?

MR. MARK: F. It probably ignites at lower temperatures, but the Staff is not quite so happy with the lower temperatures. They plan to distribute these things -- I have forgotten the exact number; it is 90 or so -- in the lower compartment, in the ice condenser, in the upper plenum of the ice condenser, and in the upper containment.

I think they have quite persuasive data that some of the pathological conditions one has heard about, such as accelerating flames down pipes, causing detonation in lean mixtures, which shouldn't detonate but might if you run a flame down a pipe and confine it, but those situations do not really exist in Sequoyah, and probably not in other reactor geometries either.

The detonation even of a detonable mixture is not the normal response to one of these rather gentle igniters. This, I think, is not surprising, either. In order to get a detonation, you have to start a shock wave, and these don't start a shock wave, and so what you get with even 20 percent hydrogen mixture is a deflagration, burning at some velocity, rather than detonation.

But, of course, even if you had a detonation in a finite fraction of the total atmosphere, this probably does not matter, with the possible exception of the effect of equipment that might be impinged by the high pressure wave. There has been a fair amount of study of the survivability of equipment essential for reaching cold shutdown. That sounds as if it was pretty important, but when you take a look at the containment, there isn't very much equipment that is essential for such a shutdown.

One of the main things are the igniters themselves. Do their cables stand up, and do the gadgets themselves stand up? And I think that part, at least, has been pretty well demonstrated. My own conclusion from what we have heard and what will be run through in a few moments is that a distributed ignition system is a reasonable approach to attempting to control the burning of hydrogen in case there should be a lot of hydrogen.

The rate at which the hydrogen comes can be varied from rather slow to quite fast, up to rates as fast as anyone can think of any excuse for, and that they can handle that. If you will remember, a year or two ago, there were suggestions that in addition to looking at such a system as this, people should also be careful to look at fogs, post-accident inerting with either halon or carbon dioxide or other stunts. I think it ought to be expected that one should be able to drop the need for people looking at alternatives unless they feel like it.

That is, if we say we want to use the set of igniters, we ask what evidence they have that they will work, and that they are placed correctly, and so forth, and not insist. I hope the Staff will get around to being able to drop their insistence on please study fogs or halon as well.

There is, therefore, to that extent, at least, something generic about the thoughts. I think we may have and perhaps even I am not sure to what extent i. the words we might use in commenting on the permanent mitigation system for Sequoyah. We are being asked to write a letter, because this is a condition on the Sequoyah license, that the Commission needs to be assured that Sequoyah has a system which may go on being used after their refueling outage which is, I think, within a matter of less than a month.

Excuse me, Paul. You had a question?

MR. SHEWMON: Yes. I was a little curious. We will hear about whether these things are to be run continuously or turned on on demand, and what that decision is? I get a nod.

MR. MARK: Yes, of course. I think questions of that sort and so forth, either the TVA people or the Staff will be able to tell us how they feel about them.

MR. SHEWMON: Fine.

MR. MARK: Unless there are other points --

MR. PLESSET: I have a point. What energy source will be used? There is a change in voltage now.

MR. MARK: There is a question there, and it will be discussed, and in the draft letter it is brought out. These things depend upon a source of alternating current. They are not rated that they may be run off of batteries. They will not work in the event of a blackout of AC power.

MR. PLESSET: Has that been taken account of?

MR. MARK: I think it needs to be given more thought than perhaps it may have yet been given. On the other hand, I think it is also true that they don't have to work like a bunch of control rods have to work to head off an ATWS.

MR. KERR: I am puzzled, because I thought the GM glow plugs ran off of AC, too, except they used transformers. So I don't see that there is any difference.

MR. MARK: There may not be any difference. I think it is merely a fact that one needs to --

MR. KERR: The implication Milt raised was, you ran these off of batteries, and I think you could, but I don't think TVA was proposing to do that.

MR. MARK: I think you are right. They could have run on 14 volts. These things take 120. They take a little more power than you would like to latch onto the batteries for any extended period of time. They also need to work very suddenly.

Chet, did you have points that you thought should have been brought out at this stage?

MR. SIESS: I guess there was one. I am not sure how pertinent it is, since we are only looking at Sequoyah, but there are some -- I think Sequoyah right now is the only licensee that has proposed to use other than the glow plug, so that is unique to Sequoyah.

MR. MARK: Some of the others are sticking with glow plugs.

MR. SIESS: I thought all the others were.

MR. NOVAK: Except for Watts Bar. I think TVA is --

MR. SIESS: But Cook is sticking with glow plugs, and FNP is in a different category.

MR. BENDER: Are we going to hear from them?

MR. SHEWMON: I suspect so, if we get to it.

MR. MARK: Jesse?

MR. EBERSOLE: With respect to the use of these glow plugs, is there -- I presume as hydrogen concentration rises, it gets to a point where combustion will occur with these glow plugs. Are there competitive igntion systems, which may be singular, which are more efficient in igniting hydrogen and will ignite in a common fashion a concentration of hydrogen lower than the glow plugs will ignite, and in essence scratch the distributed function of ignition?

MR. MARK: There may be, but I don't think one cares. There may be sparks which can ignite, perhaps all the way down to 5 percent.

MR. EBERSOLE: Let's say one big arc some place.

MR. MARK: Even a small spark may ignite hydrogen possibly to a level as low as 5 percent hydrogen, but then the pressure that goes with that is not a concern.

MR. EBERSOLE: David?

MR. OKRENT: If we have a permanent system that depends on AC, does that then put the complete blackout of AC power accident into a position of introducing the possibility of a sufficiently strong single burning of hydrogen for this type of containment that you might both open up a sizable opening, and also release substantial amounts of fission products, and thereby affect people's deliberations on source term and a variety of things of this sort?

MR. MARK: I do believe that the question of the state one would be in in the event of an alterating current blackout has not been discussed as much as it may need to be. Obviously, if the matter of the rate of hydrogen buildup in the absence of sparks and in the absence of glow plugs is a factor in what one wants to think about the state one is in, I think we are talking of being okay for hours, but I think that needs to be discussed, and I do not think it has been gone through to the extent that it may need to be.

So, I am not in disagreement. I think it is a good point.

MR. OKRENT: It could be that if this route is followed, one has to think of one kind of a source term for a large dry containment and another source term --

MR. MARK: If the hydrogen gets up to 15 or 18 percent, it is going to get up to a pressure that the containment is not built for.

MR. ETHERINGTON: Couldn't you run these

things off the AC bus?

MR. KERR: You are okay if the emergency AC is there.

MR. ETHERINGTON: I thought you meant off-site power.

MR. OKRENT: I said all AC power.

MR. MARK: Total AC. They will run off the diesels just fine.

MR. RAY: Well, how big is the power requirement? Will we hear that?

MR. MARK: We will hear it. It is about 500 watts per igniter, and there is about 90 of them.

MR. ETHERINGTON: You want no batteries, either?

MR. OKRENT: What I heard was that a particular system requires AC, and one of the low probability sequences that leads to core melt at one point or another is loss of AC for a sufficiently long time, which varies among reactors, but I am saying this could have ramifications that are broader than --

MR. SHEWMON: Why don't we get on to the presentation?

MR. MARK: I think we can present the presentations. They have heard this, and it would be very appropriate to comment.

MR. SHEWMON: Harold, were you trying to comment?

MR. ETHERINGTON: No.

MR. SHEWMON: Okay, let's get on.

MR. MARK: I think we proposed to have the TVA people present their position, and keep it in a tidy package. I will call on Larry Mills.

MR. MILLS: Thank you, Dr. Mark.

We previously stated that the operating license for both Unit 1 and 2 for Sequoyah Nuclear Plant has a condition requiring TVA to instal an alternate hydrogen control system following the first refueling outage of each unit.

Since October, 1981, at our last subcommittee meeting, we have made 12 major submittals to the NRC Staff in the form of quarterly reports in response to Staff questions. These various submittals have been made to support TVA's effort to support the hydrogen issue, and Unit 1 is now scheduled to restart on January 2nd, 1983, following the first refueling outage.

Today, you will be provided a general overview of our permanent hydrogen mitigation system and a description of the system. David Renfro, from our engineering design organization, will present the bulk of our material, and while David is talking, I do have one of the interim igniters, the glow plug, and I also have one of the coils that we are proposing for our permanent system, and if you all would like I can pass them around the table.

MR. SHEWMON: Please do.

MR. MOELLER: Would you repeat quickly which is which now?

MR. MILLS: The little one that Mr. Bender is holding in his hand there is the glow plug, which is part of our interim system. The one that Dr. Kerr has is the Tayco igniter, which is being proposed for our permanent system.

MR. MOELLER: Thanks.

MR. SHEWMON: Please begin.

MR. RENFRO: I am David Renfro, from TVA.

TVA has designed a permanent hydrogen mitigation system, as you have just heard. We have done a significant amount of research and analysis in support of this system over the past two years or so. Today we have been asked to present information on that system and on the research.

I would like to restrict the scope of my presentation to those two areas, and not discuss the analyses that we have done, because of the limited time available. I will try to condense my presentation. I think the time we were allowed has decreased somewhat from the original allotment, but I will try to answer all the questions that you have raised up to now.

I would like to spend about a minute discussing each of these things, for the permanent hydrogen mitigation system.

(Slide.)

MR. RENFRO: The concept, alternatives that we looked at, what the igniter looks like, the functional capability, how it is laid out, the fact that it is redundant, seismic, a little about the operating procedure, some of the testing that we will subject the igniter to in the plant, and finally, a mention of the tech specs.

(Slide.)

MR. RENFRO: First, I would just like to review the operating principle of deliberate ignition. It is basically very simple. The igniters do not operate all the time, but they are energized before any hydrogen will be released. This will be on an indication of inadequate core cooling. When the igniters are energized, if hydrogen is released, they will ignite lean mixtures of hydrogen and air. This is in order to achieve periodic or continuous burning, to improve the effectiveness of the heat sinks by smoothing out the peaks, and to avoid global burns.

If we are successful in this, moderate containment pressurization will be the result, instead of larger spikes from global burns.

(Slide.)

MR. RENFRO: This is a cutaway view of the igniter that is being passed around. Basically, it is a 120 volt igniter. TVA was the first utility to instal an igniter system. We recognized at that time that it was to be an interim system. We were using an existing circuit, and we plan to follow up with a more permanent system. Since we were designing a system from scratch, we set out to also develop an igniter from scratch. We specified 120 volts as one of the design criteria for that igniter, basically to avoid using the transformer that is associated with the lower voltage igniter and to simplify the design of the system.

It works on the same principle as the GM glow plug. They are both thermal igniters. They get hot, transfer the heat to the surrounding gas, causing ignition. The voltage is really the only big difference.

The igniter, as you can see, is larger. It is shaped in a coil, and it does require more power, but it does work on the same principle.

MR. MARK: Could you correct whatever I said about the power? What is it?

MR. RENFRO: Tayco is 120 watts.

MR. BENDER: What is the heating element?

MR. RENFRO: Nicrom wire.

MR. SHEWMON: And this is 500 per igniter?

MR. RENFRO: Yes, sir.

MR. SHEWMON: How many will you have?

MR. RENFRO: We currently have 64 planned. The Staff has requested that we add four more, so I guess we see an outside number of 68, so that would be 30 or 35 kilowatts.

MR. SHEWMON: I guess to somebody like TVA that is not a lot of power.

MR. RENFRO: It may not be a lot of power if you have all the 13 interties that we have, but if you were required to look at diesel backup -- excuse me, at DC backup, that is a lot of power.

MR. SHEWMON: Yes.

MR. AXTMANN: Why must they be energized before the hydrogen release?

MR. RENFRO: We would like to have them energized so that when any hydrogen is released, these things will be distributed throughout the containment, as I will go over in a minute, but we expect to be able to burn locally before the entire compartments fill up to that concentration, that uniform concentration that would give us a global burn.

We would like to have smaller, periodic burns rather than global burns. That is why we have the number of igniters we do. That is why we want to have them on before any hydrogen can be released. There are no adverse consequences to turning them on if you don't release hydrogen. So that is one of the advantages of the igniter system. The operator can feel free to turn them on whereas with an inerting system he may feel some constraints about purposely increasing containment pressure.

MR. MOELLER: Excuse me. What is the voltage for the glow plug?

MR. RENFRO: The GM glow plug runs on either 12 or 14 volts. This is a cartoon representation of the igniter assembly.

(Slide.)

MR. RENFRO: Basically, it is located in a junction box. The connections are made internally. We have a spray shield on top. The spray shield is actually about four times the area shown here, for those igniters that are located in the upper compartment and are exposed to the spray environment.

Let me briefly run through where we have igniters located and the number.

(Slide.)

MR. RENFRO: Basically, the hydrogen will be released in the lower compartment. This is where the reactor coolant system is located. We have located 22 igniters in this region. They are distributed at the different elevations. They are distributed radially. It is not shown very well here, but these igniters are distributed radially around the compartment.

The hydrogen, as I said, this is the primary region of burning. The hydrogen will first see this region. The mixture will flow through the ice condenser, lower inlet doors, through the ice bed, into this empty region at the top, empty of ice, I mean. There are 16 igniters located there.

Any steam that is present in this mixture will be removed in the ice bed so that the relative hydrogen concentration will be released in this upper plenum. So, our analyses and engineering common sense tells us that this will be the region where the hydrogen first becomes flammable. Our analyses have shown that most of the burns occur here, and in this compartment here (indicating).

However, we have to continue the good spatial coverage throughout the containment. We have included ten igniters in the upper compartment or in the dome, or in an intermediate elevation at these two lower above the air return fans to complete that loop.

In addition, there are 16 igniters located here in these dead-ended regions.

MR. MARK: Which of the ones you have just mentioned are exposed to spray?

MR. RENFRO: Currently, I said we had ten. These four are located above the spray headers, so these six, these four, and these two are not -- are. They are exposed to the spray, these six (indicating). These four are not.

MR. MARK: The ones in the top of the ice beds are not. The ones downstairs are just exposed to steam, not spray.

MR. RENFRO: That is correct.

The Staff has asked that we add four more igniters in roughly this elevation, two on this side, two on this side.

MR. SHEWMON: What brings the hydrogen down there in the eyes of the Staff or in the eyes of your analysis?

MR. RENFRO: This mixture is going to be cool when it comes out, so it may tend to fall here. The sprays are going, so there is some turbulence. There would be some current set up here, so we don't believe that necessarily all the hydrogen will immediately go up here. In fact, we think this is going to be a fairly well mixed region, but we did locate igniters here to try to catch it as it came out.

However, we believe that this is the most important place to locate igniters.

MR. SHEWMON: Okay.

MR. RENFRO: As I said, we feel like this is a fairly well mixed region. We don't feel that four more igniters are really required, but we have responded to the Staff's concern to increase the spatial coverage.

MR. EBERSOLE: Is this sort of a miniature cal rod heater? Is this exposed? It is a miniature cal rod heater. That is, the heating wire is internal.

MR. RENFRO: Yes, it is in the sheet with the nicrom wire inside, and it glow red hot.

MR. SHEWMON: Probably spaced by some magnesium oxide or something?

MR. RENFRO: Yes, there is some kind of insulator.

MR. EBERSOLE: What is the environmental qualification on the junction box?

MR. RENFRO: The junction box is a standard

Nema junction box, and I am not familiar with the particular environmental --

MR. EBERSOLE: Will it take the developed pressures in the containment?

MR. RENFRO: Yes.

MR. EBERSOLE: Where is the pressure breakdown? Is it at the box?

MR. RENFRO: I am not sure I understand what you mean by break.

MR. EBERSOLE: When you develop pressure in the containment, is the interior of the box not pressurized?

MR. RENFRO: No, the box is sealed.

MR. EBERSOLE: So the pressure breakdown is at the box?

MR. RENFRO: Yes.

In conclusion, I would like to say that based on the design of the system, the fact -- I had better not draw the conclusions until I am finished. Let's get back to the first slide.

(Slide.)

MR. RENFRO: It showed you where the system is. Now let me tell you a little bit about how it operates. The system is redundant. It has Train A, Train B as far as power goes. Two independent trains of controls. It is AC powered. It is backed by the diesels. There are only two igniters per circuit, so we feel like that adds another measure of independence. We don't feel like it is practical to place the batteries as backup for these igniters. We do not feel like the Sequoyah blackout is a likely event. We feel like there are other considerations in addition to hydrogen that would have to be dealt with for the station blackout, so we have chosen not to address that for the system.

The system is seismically supported. I went over the operating procedure just briefly at the beginning. It will be turned on before any hydrogen is released. The system operation is fairly straightforward. The controls are in the main control room. The operator is expected to be able to turn the system off manually when cold shutdown is achieved.

The system has undergone a preoperational testing. We have used 1,600 degrees Fahrenheit as the acceptance criterion. However, we have seen that both of the igniters are actually measuring around 700 degrees Fahrenheit or above. We feel like based on the research that we conducted, that there is plenty of margin in that circuit's criterion.

MR. SHEWMON: Would you tell me again what you just said about the temperature needed for ignition? Or did you say?

MR. RENFRO: I haven't said that.

MR. SHEWMON: Would you say it before you start saying what the right temperatures are then?

MR. RENFRO: Our testing has shown that in dry mixtures with no steam, the Tayco igniter had to reach a surface temperature of 1,200 degrees Fahrenheit. With high steam concentrations, it had to reach a temperature of 1,350 degrees Fahrenheit.

MR. SHEWMON: Where do you get 16 to 17 then?

MR. RENFRO: Sixteen was what TVA imposed as the acceptance criterion. We believe the igniter will operate at more than that, so we selected that to just make sure we didn't have any obvicus problems with the hookup of the system. This is a preop test conducted in the plant.

MR. SHEWMON: The 17 number comes from where?

MR. RENFRO: The 1,700 is proposed by the NRC Staff as the acceptance criterion in the preop test.

MR. SHEWMON: I hope the Staff doesn't get too carried away with the wonders of high temperature, because the reliability of these things has to get worse as it goes up there, and they do oxidize, and I would encourage you not to really push any higher than you need to, but let's push on.

MR. RENFRO: The system is designed for 120 volts. The maximum voltage it will see is around 130 volts. And we have conducted tests both above and below those voltage levels, so we believe we understand how the igniters would work at those voltage levels. We are not concerned about --

MR. SHEWMON: You missed my point. The point is, long-term degradation, not what it takes overnight.

MR. RENFRO: I understand that.

MR. MARK: Could you remind me, you think you will ignite in dry air hydrogen mixtures as low as 1,200 degrees. What kind of a mixture will you ignite at 6 percent, 5 percent, 10 percent?

MR. RENFRO: I don't think the percent mixture makes a lot of difference. We have shown ignition at several mixtures. The importance is how much moisture is there, how much steam is there. We have shown ignition in lean mixtures of 5 to 6 percent at the 1,200 degrees as long as the conditions are dry.

MR. MARK: Now you say you need to go to 1,350 when there is steam. How much steam?

MR. RENFRO: About 50 percent.

MR. MARK: One five?

MR. RENFRO: Fifty, five oh.

MR. MARK: That is about as high as you can burn it no matter what temperature.

MR. RENFRO: That is right. The 1,350 was the asymptope we talked about yesterday. That is about as high as you need for any flammable mixture.

MR. MARK: If you go to 60 percent steam, you tend to ignite it no matter what.

MR. RENFRO: That is correct.

MR. EBERSOLE: How do you know the boxes are hermetically sealed?

MR. RENFRO: They are sealed when they are installed. I am not familiar with the procedure. I don't believe they are pressure tested. We don't believe that even if they leak a little bit, that that is really of significant concern. They are really pressure sensitive components there. There is only an electrical connection made.

MR. SHEWMON: Why is it you want to go to 1,600 to operate these things?

MR. RENFRO: For margin. The margin under cooling conditions, either with air flow, steam flow, spray flow. These tests, the preoperational tests where we try to achieve the 16 or the 1,700 degrees are conducted in ambient atmospheres with no cooling, so that is to provide margins under accident conditions where cooling may take place.

MR. AXTMANN: How long have you tested them at such conditions, at 1,600?

MR. RENFRO: The longest test we have run are a week at 120 volts, followed by a week at 135 volts. We have done conduction tests up to 24 hours' duration.

MR. AXTMANN: There is no real long-term test?

MR. RENFRO: Not longer than one week. The same igniter has been exposed to a number of tests, so cumulatively it would be over a period of several weeks, but we have not tested any for months at a time, for example. We don't believe the hydrogen situation, any kind of conceivable accident is going to stretch on over a very extended period of time.

MR. AXTMANN: No, but they could wear out in the meantime.

MR. RENFRO: They are not even energized until we feel like we get what we call an energized event.

MR. SHEWMON: Have you decided how many weeks a year they have to be tested, once they are installed?

MR. RENFRO: No, not weeks per year. I believe the current proposed technical specifications require surveillance testing to be performed quarterly.

MR. SHEWMON: That means you turn them on, make sure they take the right current, and turn them off, or what?

MR. RENFRO: Yes. The preoperational test includes measuring the voltage and the current and the temperature. That is difficult to get access to all of these igniters. As I said, some are in the dome. We have to have scaffolding built on the crane, things like that. You have to get pretty close to them t measure their temperature.

MR. SHEWMON: Why?

MR. RENFRO: We are using optical temperature measurement techniques, and the instruments that we have been using, you have to be within five or ten feet. The plugs are not very big.

MR. EBERSOLE: The heatup time constant for these heaters is much shorter than that of the original. How many successive ignitions are you designing for? Because each time you ignite, they will go to a peak temperature and come back before they reignite. What is the peak temperature after each hypothetical ignition beyond the 1,700 degrees that you start with? A hundred degrees? Two hundred degrees? Three hundred?

MR. RENFRO: It is not very much. I don't believe we have seen very much temperature rise during the combustion, but certainly no more than 100.

MR. EBERSOLE: This represents the duration?

MR. RENFRO: Yes. As I said, we have done tests up to 24 hours in duration in flowing mixtures.

MR. EBERSOLE: No, no, I am talking about igniting.

MR. RENFRO: I am talking about in combustible mixtures, in ignition.

MR. EBERSOLE: You mean constant ignition?

MR. RENFRO: Constant or periodic ignition in constant mixtures.

MR. RAY: Are these custom designed for this purpose, or are they used elsewhere in the industry?

MR. RENFRO: They were developed from existing igniter technology by Tayco Engineering, who has developed heaters for application in outer space.

MR. RAY: So it is a unique application?

MR. RENFRO: This is a unique application of that technology. I am getting behind schedule.

MR. SHEWMON: We thought you were about done.

MR. RENFRO: We could drop the research completely. I am at your pleasure. I can show one or two slides on the research if you would like to hear that.

MR. SHEWMON: That is fine.

MR. RENFRO: Let me just conclude about the system. Based on the design of the system, the number and location of igniters we have, the fact that it is redundant and seismic, has a straightforward operating procedure, it has been tested before and after operation in the plant, we believe it is an improvement over the interim system, and it is TVA's conclusion that it is an adequate hydrogen control system for Sequoyah.

(Slide.)

MR. RENFRO: Let me change gears here just a little bit and talk about research. Let me just show the first slide and the last slide.

MR. SHEWMON: Yes, and let us ask questions.

MR. RENFRO: Basically, we conducted research at six facilities in cooperation with Duke Power and American Electric Power. We did some experiments in 1980 at Fenwal on the GM igniter. These were the first experiments we did. We basically were trying to answer the question, does thermal ignition work in the kind of hydrogen concentration mixtures, and accident environments that we might see, and the answer was, yes, it does for reasonable mixtures.

In cooperation with the same two utilities, and EPRI, we sponsored experiments at four facilities. At Whiteshell in Canada, we did two series of experiments. We looked again at igniter performance similar to Fenwal. This was of the GM and the Tayco igniter.

In a different vessel, a larger vessel, we looked at combustion phenomena. At Factory Mutual in Massachusetts, we did some small-scale tests on microfog effects. This was in preparation for further testing at Acurex in a larger vessel, where we looked at the effects of microfog and the effects of igniter location.

At Hanford, we did a set of containment atmospheric mixing, no combustion experiments in order to represent the lower compartment of an ice condenser plant scale geometrically. Scaled the blowdown. We used hydrogen steam blowdowns, and looked at the effects of natural circulation and forced circulation from the jet and from the fans that were sent to simulate the air circulation fans.

TVA has sponsored research at its Singleton Laboratory in the area of igniter durability.

MR. MOELLER: What is a microfog?

MR. RENFRO: I am not sure if microfog is a good technical term, but basically the experiments we ran were using several different nozzles in order to achieve droplets on the order of two to fifteen microns, so they are very small droplets when compared to regular containment sprays, fire protection nozzles, things like that.

MR. MOELLER: Thank you.

(Slide.)

MR. SHEWMON: These would tend to quench flames more easily than big drops?

MR. RENFRO: Yes. The experiments were carried out --

MR. SHEWMON: That is all. Thank you.

MR. RENFRO: We did see the larger the drops, the less effect on the flammability limits.

MR. MOELLER: I gather the microfog stays suspended.

MR. RENFRO: It would more than larger drops, but we really didn't study anything about suspension time.

Let me just summarize. From all of these six facilities, the conclusions of our research have shown the following, that igniters would burn lean mixtures in containment environments, that the effects of steam and turbulence are beneficial in reducing the pressure, that data from these experiments is self-consistent and does not conflict with the literature, that the pressure rises were always less than theoretical adiabatic, that minimum pressure rises were observed during transient tests where the flammable mixtures were introduced during the tests as they would be in a plant accident environment.

No detonations were observed, even at stoichametric and above stoichametric concentrations. Mixing in the lower compartment as modeled was good. Igniters are durable.

The overall conclusion of our research, we believe that the results of the research support deliberate ignition as an adequate method of hydrogen control. The overall conclusion of the analysis system development and research is that TVA believes that since the permanent hydrogen mitigation system is an adequate hydrogen control system that is supported by research and analysis, the Sequoyah operating license conditions have been satisfied.

Are there any questions?

MR. MARK: One question. Do you happen to know if we take one of the imagined accidents like S2D or whatever, how long a period is required to bring the total air volume up to a 10 percent hydrogen mixture, for example?

MR. RENFRO: I would really prefer not to talk about the analysis.

MR. MARK: Do you have a feeling for that? It is not in a matter of a minute or two.

MR. RENFRO: Oh, no, certainly not. It would be on the order of a couple of hours or three hours probably.

MR. MARK: It is that number that I was believing to be the case.

MR. RENFRO: We have seen release rates on the order of a pound a second, something like that. One or two pounds a second.

MR. MARK: And you can stand a global burn of 10 percent.

MR. RENFRO: The reason we had the distributed ignition was to prevent global burns.

MR. MARK: I understand, but your AC might be off for a while, and if you get to 10 percent and have a global burn, I think you are still alive. That is a question, not a statement.

MR. RENFRO: We have not analyzed that event. Global burns in the upper compartment, unless they are mitigated by the sprays, which are also on the diesel, would probably overpressurize the Sequoyah containment.

MR. MARK: Well, you are not overpressurized at 36 pounds, or perhaps even at 50. Ten percent will only give you about 50.

MR. SHEWMON: Is that adiabatic?

MR. MARK: That is adiabatic, and you don't get adiabatic pressures because of the radiation.

MR. RENFRO: That is correct. We haven't analyzed that particular accident.

MR. RAY: Let's suppose the extreme happens, and you have a blackout with hydrogen generation. How long would it take TVA to get a portable gasoline driven generator up to 3,500 kilowatts from somewhere else in the distribution system? More than an hour?

MR. RENFRO: I can't answer that. I don't know if there is anyone in the audience that can.

MR. RAY: I should think you have them available for emergency distribution purposes.

MR. KERR: What is the power requirement?

MR. RAY: Thirty-five kilowatts. You can buy one from Sears and get it.

MR. RENFRO: We don't believe that station blackout is a likely event.

MR. RAY: I know, but it is nice to have a trump card in case the hand goes that way.

MR. RENFRO: If we had a station blackout, I am not sure the hydrogen igniters would be the most important thing we would want to repower anyway. I think we would be more concerned about adding water to the core and preventing hydrogen.

MR. RAY: Well, you can't buy a portable generator for that purpose. It is miniscule.

MR. BENDER: The quarterly testing plan is what? You just turn them on and measure the power input to them, or what?

MR. RENFRO: What TVA has proposed is that we do just that. In the preop tests, we were going to record the voltage and the current at each of these 32 circuits, and also record the temperature. Now, in the surveillance test that will be done quarterly, we will go back and remeasure that voltage and current in each one of the circuits to compare that with the baseline measurements that were taken during the original preop test. We don't propose to go back and actually measure the temperature in each igniter because of the accessibility problem.

MR. BENDER: I am not arguing that you need to.

MR. SHEWMON: Has the Staff agreed to that plan?

MR. RENFRO: The Staff's last version of the SER agrees to the plan and goes on to say the Staff may require temperature of igniters to be measured at specified intervals. So in essence they have agreed partially, but have gone beyond that requirement.

MR. KERR: What is the color of these things at operating temperature?

MR. RENFRO: Redish orange.

MR. SHEWMON: Very red?

MR. KERR: I don't think it is very difficult to measure that. Why don't you look at them?

MR. SHEWMON: The oldest known optical. I don't know if the Staff would accept it or not.

MR. RENFRO: What we are using in the test is an optical pyrameter.

MR. MOELLER: Your presentation, of course, presents the conclusion that you have the problem solved. I am curious. I am sure you have a staff within TVA that has looked at this. I was wondering if this was the unanimous opinion of all those who are working on the problem, or if you have any of your scientific staff who have questions about the conclusions that you have presented to us.

MR. RENFRO: We haven't taken an opinion poll, but I don't believe there are any dissenting opinions. I believe that all the engineering staff believes this is an adequate control system. We do not foresee any major problems with its application for Sequoyah.

MR. MOELLER: Thank you.

MR. MARK: Thank you, Mr. Renfro. I think we had best move on, and call on Carl Stahle, who will introduce the rebuttal by the Staff.

MR. STAHLE: This is Carl Stahle. I am the NRC project manager. I will dispense with the few slides I have with respect to background, but I would like to make a few intoductory comments before the principal review.

I want to emphasize a number of points. First of all, when Unit 1 and Unit 2 were licensed for power, there was a mandate from the Commissioners themselves with respect to the hydrogen issue. I must emphasize again that it says that the Commission, as I read from this, must confirm that an adequate hydrogen control system for the plant is installed and will perform its intended function in a manner that provides adequate safety margins. That will be the subject of the meeting on December the 15th, and of course the Europeans' opinion on this will be of interest to ourselves as well as to the Commission.

I point out two documents that I think are of importance. One is provided by TVA. It is their executive summary report.

It is a summary of a vast amount of information and analysis that's been provided, and it is an executive summary report. The other document, of course, is our own SER supplement number 6 that states quite clearly our opinion and evaluation of the adequacy of the system.

I turn your attention to the last portion of supplement number 6; that is the conclusions. You will hear today a summary of the review, and there are two items that we consider open. One is, of course, the number of igniters in the compartment. We have suggested four additional igniters in the upper compartment, and we understand that TVA will go along with that recommendation.

The second portion deals with further tests that will be needed with respect to those igniters in the upper compartment itself. We do not believe there has been sufficient data accumulated on the igniters' performance in the kind of environment that they will during an accident. The staff will, of course, provide more detail on this as we go along.

With those few introductory remarks, I'll pass it on to the principal reviewer, Charlie Tinkler, who will give us a presentation of the staff's view on these matters.

MR. SHEWMON: Since you went over this at the subcommittee, please walk on up. Just develop what you need for the conclusions, and not all of it.

MR. TINKLER: This list represents our proposed agenda for this discussion. Briefly, we intend to go over a summary of the review areas, those remaining open items, confirmatory items that the staff sees. We will tell you what's new since January 81, what have we learned from the research, a comparison of the permanent hydrogen mitigation system versus the interim distributive ignition system. We will briefly discuss AC power dependence of the PHMS and overall staff conclusions.

(Slide.)

This viewgraph summarizes the major areas of the staff review for which favorable findings have been reached subject to the satisfactory resolution of two items. These include the nature of the PHMS design, hydrogen control research conducted by both the industry and the NRC, the consideration of the spectrum of the degraded core accidents, containment hydrogen analysis, structural capacity of Sequoyah and essential equipment survivability.

(Slide.)

And all of these things are on the slide. As previously stated, the staff sees two remaining open items which we would hope to address by license conditions. The first is a requirement to increase the number of igniters by four in the upper compartment. The intent is to improve the coverage in that region of the containment. We would propose that with staff prior approval of location, that this work be completed by startup upon the second refueling outage.

The second item is a requirement to perform additional testing of the Tacyo igniter. We feel that additional testing should be required to demonstrate that Tayco igniters will reliably ignite lean mixtures of hydrogen in a spray environment, and we would expect that testing to be completed by September of 83.

MR. KERR: Is there some reason to think that any igniter will ignite in a spray environment?

MR. TINKLER: The vast bulk of combustion and igniter testing performed in the past two years has been performed with either a spark igniter or the GM glow plug igniter, and those igniters have performed in combustion tests in spray environments.

MR. SHEWMON: What do you mean by spray as opposed to fog? If you play a hose on it, it probably won't work.

MR. TINKLER: What we mean by spray is a spray environment representative of the Sequoyah upper compartment.

MR. SHEWMON: Is that a nozzle aimed at it, or having a fog around it?

MR. TINKLER: We would expect that the majority of the spray droplets would have reached terminal velocity, that the spray pattern would be relatively uniform and that there would be turbulence induced by de-acceleration of spray droplets.

MR. BENDER: What is the source of the droplets? Are you presuming this is in the steam environment?

MR. TINKLER: These are the containment spray droplets; the 500 microns. I'm not referring to micro-fog; I'm referring to the droplets produced by the containment spray nozzles.

MR. SHEWMON: So presumably these things won't be located in the direct path of the spray? But you want to know whatever turbulence would bring to them of this is of concern to you? Is that right?

MR. TINKLER: That is correct.

MR. MARK: Let's see, the four you're asking for will be directly in the path of the spray.

MR. TINKLER: Well, they're not directly in the path in that there are spray shields over all the igniters located below the spray headers. Now, if one were to compute a supposed angle of spray trajectory, I suppose you could determine a certain percentage that they directly impinge, but that would presume knowing conditions much better than we think anyone does.

MR. MARK: There will at least be a half a dozen or so igniters that are not in the line of any spray.

MR. TINKLER: There are four igniters above the spray header.

MR. MARK: And the air in the upper compartment will be beautifully mixed by the action of the spray so the upper igniters will really have a very good chance to work.

MR. TINKLER: That is true. And we are not proposing that the unit not start up because of uncertainties regarding spray tests with igniters. We believe there is a level of confidence that says those igniters, or at least some of those igniters in that region will work to reliably ignite lean mixtures.

But given that this is a principal component of the hydrogen mitigation system, we feel like the majority of the igniters in that upper compartment should be demonstrated to work.

MR. MARK: I'm just thinking that with the nice mixing with the spray you almost only need one. What do you mean by a lean mixture?

MR. TINKLER: Six percent or less.

MR. MARK: Less than six?

MR. TINKLER: The test data that has been compiled to date, the tests that have been compiled and performed to date indicate that the mixtures for dynamic test with the continuous injection of hydrogen and steam almost certainly ignites hydrogen before six percent is reached. I hate to cite six percent as a dividing line. It may be -- I'm quite sure one could tolerate the combustion of seven percent hydrogen, but I cite that number in comparison to 10 percent.

MR. KERR: But you must know what you want TVA to demonstrate. What sort of mixture must they demonstrate?

MR. TINKLER: I would cite as a target six percent hydrogen. Now, if one could demonstrate through analysis that you could tolerate the combustion of a mixture not quite so lean, then that would be an acceptable alternative.

MR. MOELLER: When you tested the plugs and igniters, were they covered with a spray shield?

MR. TINKLER: Yes. In one instance the utility reported to us that the glow plug igniter simply was turned upside down in the vessel with the sprays operating and with the injection of hydrogen and steam. But in general, they were in vessels with a spray shield.

MR. MOELLER: I guess what my thought was, I wondered if this interferes with the circulation of air around the plug.

MR. TINKLER: There were some concerns stated over that matter by, I believe, consultants to the ACRS.

(6:00 p.m.)

MR. TINKLER: The staff is inclined to believe that in the upper compartment the mixing would be rather vigorous and the effects of the spray shield would probably not be too large.

MR. MOELLER: It would probably not be too large, but it's an assumption.

MR. TINKLER: Well, --

MR. MOELLER: I'm just curious. Have tests been done to really show --

MR. TINKLER: Tests have been done with the spray shield in place. It did not indicate that the spray shield had any damaging effects or limiting effects on the combustion process.

MR. MOELLER: That's what I wanted to hear.

MR. SHEWMON: Please go on.

(Slide.)

MR. TINKLER: We listed several confirmatory items in the SER. I'd like to briefly go over the items and the programs we expect would address them. Local detonations -- the staff has stated that we agree with TVA that the probability of detonations is remote in the Sequoyah containment and need not serve as a licensing basis for the PHMS.

But we do intend to perform some additional confirmatory work to determine the consequences of presumed detonations. We expect that we will continue to look at the various containment codes and their capability to calculate combustion events.

(Slide.)

We expect to continue investigation of equipment survivability for various accidents and analytical assumptions, review the performance of large-scale combustion tests at the Nevada test site as an important confirmatory item, as well as the continued study of combustion phenomena by the Office of Research through Sandia National Laboratory.

(Slide.)

What is new since January 81? Probably not a whole lot new. Most of the items we cite are merely confirmations of things we believed to be true before. That is, we can achieve reliable ignition of lean hydrogen-air steam mixtures under dynamic conditions. The tests have provided confirmation that containment mixing is adequate. Further confirmation that the threats from detonations are small. This confirmation is derived from experience in several areas. The above-cited reliable ignition and mixing, continued Sandia investigation of detonations has demonstrated the difficulty in initiating and propagating detonations under a variety of conditions.

Earlier calculations on assumed upper plenum detonations have been revised. Earlier Sandia performed calculations published in NUREG 2385, which indicated that containment pressure loadings exceeded acceptable impulsive load values for the containment based on a conservative structural model. Refined calculations indicate that containment integrity is not threatened.

We repeat, this is with an assumed detonation; not one that was calculated to occur.

MR. MOELLER: Are the fans in the containment on emergency power?

MR. TINKLER: Yes, sir.

MR. EBERSOLE: Do you not have large amounts of polyurethane insulation in your ice rack containment area? Is that fully encapsulated?

MR. TINKLER: Yes, it is.

MR. EBERSOLE: Does it breathe with respect to the containment atmosphere?

MR. TINKLER: It does not directly breathe with respect to the containment atmosphere, I believe.

MR. EBERSOLE: Would you argue that hydrogen combustion in the area where the ice pack is now would not communicate with that polyurethane?

MR. TINKLER: It is extremely unlikely.

During the review of the interim ignition system and the interim distributive ignition system some very conservative calculations were performed which assumed a flame to stand at one location for 45 minutes. Which is fairly preposterous.

MR. EBERSOLE: There would be no pressure differential on that.

MR. TINKLER: In the calculations --

MR. EBERSOLE: I'm thinking about a puff of flame igniting -- it has one important polyurethane --

MR. TINKLER: We have no reason to believe that's a problem. As an additional measure we have required all ice condenser owners to terminate actuation of the air handling systems which cool the ice condensers so that hot mixtures would not be drawn in the cooling ducts of the ice condenser itself, and that is a part of the emergench procedures guidelines.

MR. MARK: The main effect of burning your polyethylene, Jesse, would be to exhaust the oxygen so you couldn't burn any hydrogen.

MR. SIESS: Please go on.

(Slide.)

MR. TINKLER: A comparison of the permanent versus the interim hydrogen igniter systems shows a difference in the power distribution systems. The PHMS has two trains, 16 circuits per train, two igniters per circuit, actuated from the main control room. The IDIS ran off the three emergency lighting circuits, 15 igniter circuits controlled from the aux building.

To briefly summarize the igniter characteristics and a comparison of the igniter locations.

(Slide.)

A very short viewgraph on dependence. The staff's position is that the power supply to the PHMS is acceptable, and specifically that a backup battery system for the PHMS is not required. The basis is that the PHMS is designed for most recoverable severe accidents, and that a loss of all AC power is not a dominant contributor to risk.

MR. MOELLER: When you say not dominant, how much of a contributor is it?

MR. TINKLER: Perhaps Dr. Butler would like to address this.

MR. BUTLER: We were relying on some of the results from the RSSMAP studies which concluded that the dominant contributors were four or five items including the S2D sequence. None of these dominant ones included in the loss of all AC power. The loss of all AC power situation, we are about a decade down in probability.

MR. KERR: Did that take into account that the loss of all AC power could trigger early containment rupture? This is not your conventional loss of AC power, necessarily.

For example, you wouldn't get this in the large dry containment at all.

MR. BUTLER: It might be helpful to follow through briefly a sequence where you have loss of all AC power. TVA has done some analysis of this in response to a staff request, and as the vessel water level dries up where the water starts, just beginning to uncover the core, if you take that as your time zero and follow through the sequence after that, it takes around another 15 minutes or 20 minutes beyond that for the water level in the core to come down to about one-third of core height.

At about that time, you start overheating the upper section of the fuel and will probably just begin to produce metal-water reaction in the core.

Now, you have around 15 minutes or so of that kind of activity, beyond which you will experience the core slump scenario. We consider that clearly no longer a recoverable situation and beyond the design requirements of this mitigation system.

Now, in that 15-minute period, the water level going from one-third down to core slump, the amount of hydrogen that escapes from the primary system through the PORV or high point vents into the containment has been calculated by TVA to be a little over 30 pounds.

Now, if that were to be ignited by an inadvertently-actuated ignition system, that produces quite a tolerable pressure rise.

MR. KERR: You're telling me, then, that the hydrogen that will be produced by itself would not overpressure the containment?

MR. BUTLER: For those recoverable sequences. If the amount of hydrogen that is transferred into the containment is beyond what can be tolerated by the containment, those sequences are not recoverable anyway in the sense that you would have proceeded to full core melt.

MR. KERR: But it seems to me this could have a significant effect on risk. That's why I asked if you had looked at it. The time at which you get containment rupture it seems to me is likely to have some significant effect on risk, and if you can burn the hydrogen it seems to me you are likely, even though you may get complete core melt, to contain fission products for a while and give them a chance to decay, whereas if you get an overpressurization early on it seems to me that that might have an influence on risk.

I certainly haven't done the calculation, but that's why I asked the question. It appears to me that there could be a difference.

MR. NOVAK: This is Tom Novak on the Staff.

We did discuss this specific point with the consultants at Sandia. It is my understanding that the difference in the time periods between loss of containment is relatively small. In other words, if you assume I am not going to have any AC and I'm going to have a full core melt and I just say, what's the difference on whether I fail it because I worry about the hydrogen or not, that difference in time is not important.

MR. KERR: You've looked at it. I am puzzled that there's not more difference in that.

MR. NOVAK: Perhaps because of the specific application at Sequoyah, the difference in time you buy between worrying about the containment going or not going because of hydrogen is something less than an hour.

MR. KERR: If that's the case, fine.

MR. SHEWMON: Onward.

MR. MARK: Do you have anything else, Mr. Tinkler?

(Slide.)

MR. TINKLER: My summary conclusion slide says that the PHMS is acceptable for an interim period pending completion of ignition testing with the Tayco igniters and is subject to installation of four more igniters in the upper compartment. I would like to repeat that further confirmatory testing by the Staff and the EPRI is needed and will be performed at the Nevada test site.

MR. MARK: What will be the objective of this further testing that is needed?

MR. TINKLER: To resolve any concerns --

MR. MARK: The spray business?

MR. TINKLER: That arise as a result of most of our combustion testing and equipment survivability testing having been performed in small-scale vessels.

MR. MARK: I forget if you actually mentioned your conclusion with respect to equipment survivability. Does the Staff have one? Perhaps I just missed it.

MR. TINKLER: I stated earlier that, with the exception of two open items, the Staff has reached favorable findings on all of those items.

MR. MARK: I think that is all we had planned.

Paul?

MR. NOVAK: Dr. Shewmon, I have one more comment. I know the Committee has not yet had an opportunity for an early submittal of discussions earlier. I do feel I would just like to point out for the Committee's benefit -- it will just take a moment or two -- that the Staff has re-evaluated its position as it was expressed earlier in the week.

If you would look at the presentation in terms of the required testing, when we talked to the Subcommittee on Tuesday of this week we were looking for a demonstration that the Tayco heaters, the ones planned to be installed, be shown to maintain the surface temperature on the order of 1300 degrees in a spray environment that we would predict or expect to be there in the upper containment of Sequoyah.

My view is that the Subcommittee and consultants gave us enough to think about with regard to whether or not this Tayco heater would be even subject to quenching in that environment, we went back and we looked at our own position and the data that we had that suggested that simply running a spray test and showing that for those environments you would maintain 1500 degrees.

We modified our view to the point that it said, if you believe these igniters are going to work, ignition is the proof of principle. So if you look at it some time later and see a difference in our position, it is in fact that, that we believe now that the most straightforward way to demonstrate the useability of this ignition system is to demonstrate that the Tayco igniter would operate in an environment, in an accident environment, that is under a spray environment.

MR. SHEWMON: Would you also look when you get into that whether or not somebody could stand, once he had voltage and current readings, with a pair of binoculars and see if it was just there and if it might work as well for a temperature indication?

MR. NOVAK: I'm sure we're open to those suggestions.

MR. MARK: Is there a place in which this ignition check that you just described, Tom, can straightforwardly be done?

MR. NOVAK: Yes, there is. In fact, we did talk to our research people and there are facilities available in an early time frame at Sandia National Laboratories for spray tests of the Tayco igniter which could be performed.

MR. MARK: And one could put on a hat of the sort TVA is thinking about and simply ask the question, with the sprays turned on does it kick off six or seven percent hydrogen?

MR. NOVAK: Yes. But let me caution you, because it is very difficult to get one simple test run where you do take all the conditions. People will argue about you have the exact spray that you are looking for, do you have the distribution you are looking for. It is going to be a give and take.

I don't think I can say quickly I can run a test that will quickly demonstrate it unless you can stick it on a pot of water.

MR. MARK: You have a chamber within which spray can be introduced, igniters can be introduced, you can demonstrate that in the course of a few weeks.

MR. NOVAK: In my judgment, that's what I'm looking for, yes, sir.

MR. RENFRO: Mr. Chairman, if I could have just one moment to show one more slide that relates to this.

MR. SHEWMON: Fine.

MR. RENFRO: I really didn't want to get back up here, but I figured you all hadn't seen any examples of my artwork, so I would let you.

(Slide.)

This summarizes an argument that I will try to lead you through and tell you what spray testing TVA has done, so that you can know what the situation is. We are talking about doing tests in a spray environment that simulates the upper compartment. I guess there is some question about how turbulent the upper compartment really is.

TVA made an effort to run small-scale tests using a single nozzle and an igniter assembly, with turbulence simulated by a fan, to simulate the upper compartment conditions, and was unsuccessful in satisfying the Staff with these types of tests. So I don't believe we're going to be able to run a simple test, as might have been described just a few moments ago, and truly simulate upper compartment turbulence.

Let me tell you what we have done. We have run tests -- even though the igniter has a spray shield, we have run tests to look at the cooling effect from turbulence that may swirl these fairly high containment spray droplets up underneath the spray shield. We've done tests both with the spray shield in place, using fans to provide this turbulence. We were unable to satisfy the Staff that we had accurately simulated the upper compartment turbulence levels.

We have done other -- being unable to do this, we've done other tests where we completely removed the spray shields, the direct impingement spray shields on the igniters. We feel like we have a good handle on the cooling effects of spray due to direct impingement. These numbers are shown over here on the side.

MR. SHEWMON: Would you back out of in front of the numbers. Thank you.

MR. RENFRO: If one removes the spray shield, this is the mass flux expected in the containment. Taking the total flow rate divided by the area, you get about one gpm per square foot. If you take that mass flux, using a single nozzle at the right elevation to simulate that flux, pass it directly over the igniter without any spray shield, we saw these temperature results:

At 120 volts AC, which as I said this is the minimum this system will operate at -- we expect slightly higher voltage during normal operation. But at any rate, the system could tolerate 20 percent direct spray where 100 percent was the containment condition and still maintain the Staff-proposed surface temperature of 1500 degrees, which has quite a bit of margin in it.

We can take 60 percent direct spray, maintain the 1350 which would seem to be the maximum temperature required even at high steam environments. We believe the temperature is actually somewhat lower at which ignition would actually occur, so we believe there is some margin even in this 1350.

TVA also in addition during these direct spray tests modified the spray shield. As I said earlier, the spray shield used to cover an angle of about 20 or 25 degrees. We have enlarged it to cover an angle of 50 degrees. So any spray in either turbulence would have to come in at an angle that's more horizontal than vertical.

We have shown that even given this spray shield and a more horizontal than vertical turbulence, up to 60 percent of the total vertical possible mass flux could be tolerated and still maintain the 1350. So we feel we've done direct spray tests which tell us how the igniter cools, we've been responsive in enlarging the spray shield to what we believe according to our engineering judgment, given the location and the expected turbulence levels in containment, would more than adequately protect the igniter in the spray environment. And we believe it would continue to function.

MR. SHEWMON: Do you feel you understand what it is the Staff would require for additional tests?

MR. RENFRO: We have some information on the tests that Mr. Novak was referring to. That information showed that the flow rates achievable in the particular vessel were not as high as 100 percent and the velocity --

MR. SHEWMON: It's not as high as 100 percent?

MR. RENFRO: No, which we were able to achieve in our tests.

In addition, the velocity at the igniter plane was higher than the te minal velocity, which was another concern. The Staff-proposed facility had two of the shortcomings that the Staff has found in our own tests.

We feel like small-scale tests that would adequately simulate upper compartment turbulence, which is the real matter at hand, would be difficult to define or difficult to carry out with reasonable acceptance.

MR. KERR: Do I take it your answer is no or yes?

MR. RENFRO: I'm sorry, maybe I missed the question.

MR. KERR: I thought he asked whether you understood what the Staff wanted you to test.

MR. RENFRO: We understand that. The Staff would like us to simulate the upper compartment turbulence. I don't believe that was the question, though.

MR. SHEWMON: One of the jokes around here is: Go get me a rock. I don't know what a rock is, but bring me something and I'll tell you if it's a rock.

Now, the question is, have you been sent out after a rock? Your last answer was, we're supposed to simulate turbulence, and that is a rock.

MR. RENFRO: We brought back about a half a dozen rocks and the Staff has proposed rock number three or rock number four.

We admit that it is a difficult problem to simulate upper compartment turbulence due to spray in a small-scale test. That is where we find the concern. We could conduct such a test, but we are not convinced that an acceptance criterion could be defined that would really mean anything.

MR. SHEWMON: Does the Staff want this done on a facility they have more familiarity with?

MR. NOVAK: Let me explain. The question was asked of me, did the Staff -- was there a facility that the Staff knew about today where you could perform a Tayco ignition test. I didn't mean to suggest that the capability of that scale test would solve all of the questions that were put on the table.

What I was trying to say and suggesting is that when we looked at the residual question regarding the efficacy of this Tayco heater to work, the question was in the spray environment. And I think one has to recognize that this spray environment is truly a header spray with all the containment sprays on. I think one comes away with the feeling that this is really a rain shower.

MR. SHEWMON: And as you turn some off --

MR. NOVAK: You need sprays for good mixing. You don't want to turn the sprays off. You want to demonstrate --

MR. SHEWMON: I didn't say all; I said some.

MR. NOVAK: The question then is, is there a way we can get to the bottom answer of the question. Can we get a test that suggests that these Tayco heaters would in fact ignite lean mixtures of hydrogen in the environment post-accident?

I am not convinced that the Staff would say that the facility that we have available to us at Sandia would answer our question. What we're saying is we believe there is a range of testing that could be done, and we have suggested that you have until September of '83 to accomplish these things.

In response to Dr. Mark, I was talking about tests --

MR. SHEWMON: Can you tell what the specifications for this rock would be ahead of time, or are they going to bring in three more rocks?

MR. NOVAK: You have your rocks and I have my rocks.

I'm not suggesting that this is not a difficult phenomena to understand.

MR. SHEWMON: It sounds like you're saying, I don't know what the rock would look like yet.

MR. NOVAK: Let me say this. Let me say if I look at two or three different rocks I've got a sensitivity study and I will make a judgment based on that.

MR. KERR: Well, Mr. Novak, what is the deficiency in the tests that TVA has run up to now?

MR. NOVAK: I would like Dr. Butler to answer that.

MR. KERR: You said you were going to make some judgments on the basis of new tests. Are you also going to ask him to tell you what your judgments are once you do those?

MR. NOVAK: You asked me what was my judgment with regard to what would be an acceptable test.

MR. KERR: No, I say what is the deficiency in the test that TVA has run in your view.

MR. NOVAK: Would you accept --

MR. KERR: I would be interested in your view. I would be interested in his, too, but maybe the Staff's view is monolithic on this. If so, I'm willing to listen to a spokesman.

MR. NOVAK: All right, I'll give you my view. My view is, when I look and listen to the arguments on both sides of the table, the technical arguments, the people that are looking at this thing have been looking at it long and hard for a year, and I come away with the view that if you can get away from the argument I think that a demonstration test of the Tayco heater in a spray environment will solve our questions today and next year.

That is the way I look at it. I didn't want to get into -- I can't at this time specify the specifics. But I just think that from a resolution point of view we could be here next year argument.

MR. BENDER: Wasn't the test that TVA described in a spray environment? What's different about it and the one you want them to run?

MR. NOVAK: There are differences.

MR. BENDER: Maybe we ought to get that clarified.

MR. SHEWMON: You sounded like you didn't think they'd run any spray environment tests yet.

MR. BENDER: Mr. Chairman, let's just get the differences.

MR. SHEWMON: I don't think he can give them.

MR. MARK: The tests run have measured temperature of the igniter without having the hydrogen around to check ignition. I believe that what Tom is telling us is he'd like to see a spray on, the heck with the temperature; does it or does it not ignite.

MR. KERR: Is that the issue? These were run without hydrogen?

MR. NOVAK: The ones with the Tayco --

MR. KERR: The TVA tests were run without hydrogen, so they did not test ignition; is that right?

MR. MARK: They tested cooling.

MR. KERR: Some are saying yes and some are saying no, if I interpret the test correctly.

MR. RENFRO: The TVA test did study cooling. It measured cooling with a thermocouple. No hydrogen was present.

MR. KERR: You haven't measured actual ignition?

MR. RENFRO: We correlated the surface temperature in the spray tests and they were measured in combustion tests.

MR. KERR: Is that the problem as far as you're concerned, Mr. Novak, that they didn't actually measure ignition?

MR. NOVAK: I would agree that to reach resolution I would prefer to go with an ignition test and a number of additional tests to measure temperatures of the heating element.

MR. SHEWMON: Do we know what a spray is? Is that easy to specify? There seem to be sprays and sprays. Some tests are sprays and others aren't adequate sprays.

MR. NOVAK: I think there is a spray test that we could specify that would satisfy our requirements.

MR. SHEWMON: But you haven't yet.

MR. NOVAK: Well, we haven't put it down on a piece of paper, but I do think we're very close to having it. We have worked hard with TVA. We are very close to a range of additional tests that we thought would do it. So it isn't a question of us going back and thinking about it. I think we're very close to having what we consider to be a range of spray that would cover a reasonable estimate of what the environment would be in the upper compartment of an ice condenser.

MR. SHEWMON: Carson, I guess as Chairman of the Subcommittee and the one who has to draft this letter, do you wish to hear the Staff discussion of the inadequacies of the TVA spray test, or did you hear that in the Subcommittee?

MR. MARK: Oh, look. I think we have really heard as much as is useful, Paul.

TVA tests with spray measured temperature. If they had managed to measure a temperature of 1500 degrees, the Staff would have gone home happy because they think 1500 is the magic number. They admit that under some circumstances you can ignite at lower temperatures, and TVA found lower temperatures and TVA cannot prove that the temperature will not be affected by the spray and go down, and in fact it will. They think it will still ignite at 1350. I guess I imagine it will, too, but I don't really know.

Tom's last statement, which was new and not, I believe, gone over with the Subcommittee, was that they can think of a test with a variety of sprays, that they would probably like to try two or three intensities, and if the Tayco thing ignites, cooled to whatever extent it might be by that spray, then they would feel that really covers the point that needs to be covered.

MR. NOVAK: Hopefully for all time.

MR. MARK: And if they have an apparatus -- and that's why I asked the question that way -- an apparatus in which this could be done, I think it would be a very worthwhile thing to do, so that everybody comes out saying, that's fine.

I believe that TVA is not well prepared to combine spray and ignition in the apparatus that they have in their hands. Am I right, Mr. Mills?

MR. MILLS: Yes.

MR. MARK: They can measure temperature of the spray, they can turn enough water on, higher or lower, and they have done a lot of ignition things, but not where they have the facility.

MR. SHEWMON: Okay. Are there any more things? I can see on the agenda, "TVA-NRC Comments." Have we covered that or not?

MR. MILLS: We don't have any additional comments, Dr. Shewmon, unless there's questions.

MR. EBERSOLE: Why as a practical matter, on this troublesome topic of the sprays, was this allowed to arise? That would just set the whole flap to rest.

MR. MARK: You have to burn the hydrogen outside the tube.

MR. MILLS: I did mean to mention, Mr. Ebersole, but if you recall the looks of this Tayco igniter, the temperatures that we were talking about are surface temperatures. When you look at it and talk about a tube, that's almost a tube. We know the temperatures inside of those coils are higher than they are on the surface, anyway.

MR. EBERSOLE: Sure. That depends on the refined calculation of the differential, of course. But if you had the damn thing in a tube in the first place, you'd solve a lot of problems.

MR. SHEWMON: Let's not re-engineer it at 6:30.

MR. RENFRO: This is David Renfro.

We did try to have a compromise between overshielding the igniters, so you wouldn't see the containment environment, and shielding of the overhead spray.

MR. SHEWMON: Okay. Do you have any closing comments?

MR. NOVAK: No, sir. I think we've tried to express our views. We have some technical comments, but I think it's too late in the evening.

(Laughter.)

MR. MARK: So far as the Staff is concerned, it is prepared to take its recommendation to the Commission that the PHMS or whatever it's called may be put in action at Sequoyah and go back to work?

MR. NOVAK: Yes.

MR. MARK: There are still a few things you'd like to see done?

MR. NOVAK: Yes. We strongly support the concept. We think it will work. We just would like to make sure that we don't have to come back here later.

MR. MARK: I think that brings us as far as I suppose we could get, Paul.

MR. SHEWMON: Okay. Do I feel a groundswell to read some letters or a groundswell to quit?

Why don't we take that as enough groundswell and adjourn for the day.

(Whereupon, at 6:35 p.m., the meeting was adjourned.)

* * *

NUCLEAR REGULATORY COMMISSION

This is to certify that the attached proceedings before the

____

in the matter of: ACRS/272nd General Meeting

Date of Proceeding: December 9, 1982

Docket Number: ____________________

Place of Proceeding: Washington, D. C.

were held as herein appears, and that this is the original transcript thereof for the file of the Commission.

Jane N. Beach

Official Reporter (Typed)

Jane N. Beach

Official Reporter (Signature)

COMMONWEALTH EDISON COMPANY

DRESDEN UNIT 2

TYPE: GE BWR-3

RATED THERMAL POWER: 2527 MWt

RATED ELECTRICAL OUTPUT: 834 MWE GROSS

COOLING MODE: ONCE THROUGH KANKAKEE/ILLINOIS RIVER;
AFTER 1971 COOLING LAKE

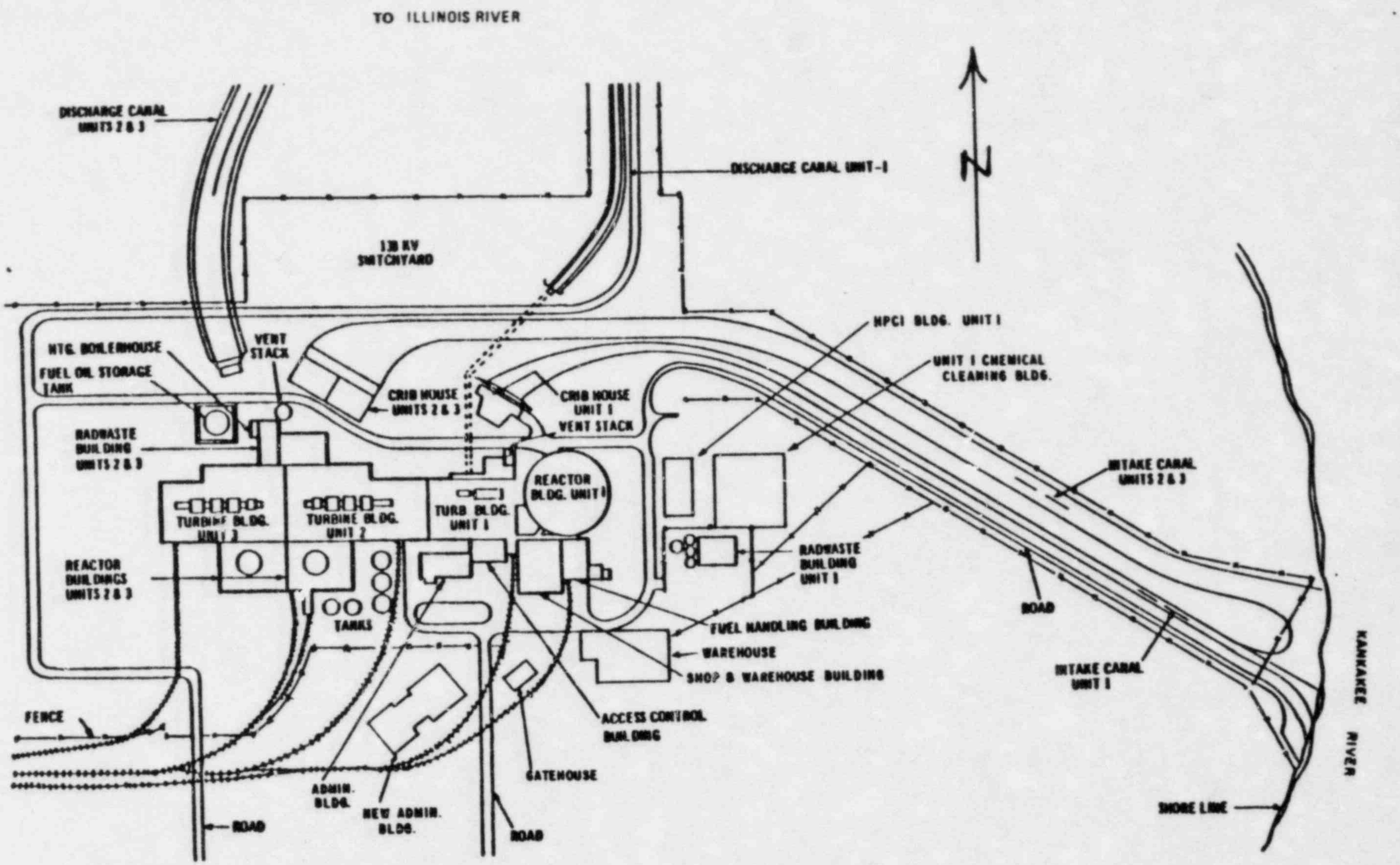
HISTORY:

NOVEMBER	1959	DRESDEN 1 OPERATING LICENSE
JANUARY	1966	CONSTRUCTION PERMIT ISSUANCE
DECEMBER	1969	PROVISIONAL OPERATING LICENSE, BEGIN FL
JANUARY	1970	INITIAL CRITICAL
AUGUST	1970	COMMERCIAL SERVICE
JANUARY	1971	DRESDEN 3 OPERATING LICENSE
AUGUST	1971	1275 ACRE COOLING LAKE IN-SERVICE
NOVEMBER	1972	APPLICATION FOR FTOL CONVERSION
	1973	MODIFIED OFF GAS SYSTEM
	1979	SECURITY
	1980-83	TMI MODS
	1982	HIGH DENSITY SPENT FUEL RACKS

FOR: ACRS FULL COMMITTEE MEETING - DECEMBER 9, 1982
T. J. RAUSCH

5309N

T1


TO ILLINOIS RIVER
DISCHARGE CANAL UNITS 2 & 3
DISCHARGE CANAL UNIT-1
N
138 KV SWITCHYARD
HTG. BOILERHOUSE
FUEL OIL STORAGE TANK
VENT STACK
CRIB HOUSE UNITS 2 & 3
CRIB HOUSE UNIT 1
VENT STACK
HPCI BLDG. UNIT 1
UNIT 1 CHEMICAL CLEANING BLDG.
RADWASTE BUILDING UNITS 2 & 3
REACTOR BLDG. UNIT 1
TURBINE BLDG. UNIT 3
TURBINE BLDG. UNIT 2
TURB BLDG. UNIT 1
INTAKE CANAL UNITS 2 & 3
REACTOR BUILDINGS UNITS 2 & 3
RADWASTE BUILDING UNIT 1
TANKS
ROAD
FUEL HANDLING BUILDING
WAREHOUSE
SHOP & WAREHOUSE BUILDING
INTAKE CANAL UNIT 1
KANKAKEE RIVER
FENCE
ACCESS CONTROL BUILDING
GATEHOUSE
ADMIN. BLDG.
NEW ADMIN. BLDG.
SHORE LINE
ROAD
ROAD

PLOT PLAN

COMMONWEALTH EDISON

DRESDEN UNIT 2

PLANT FEATURES

BWR-3 - 2 LOOP 20JP RECIRCULATION SYSTEM MG SET FLOW CONTROL

3 ELECTRIC FW PUMPS

MARK I CONTAINMENT - TORUS SUPPRESSION POOL AND WATER SOURCE

TYPICAL ECCS - HPCI STEAM DRIVEN

4 - 33 1/3% LPCI PUMPS

2 - 100% CORE SPRAY PUMPS

ADS - 4EMR + COMBINED S/RV

ISOLATION CONDENSER - PASSIVE DECAY HEAT REMOVAL

SEPARATE SHUTDOWN COOLING SYSTEM

5309N

COMMONWEALTH EDISON

OPERATING HISTORY OF DRESDEN 2

MWE HRS. GENERATED - LIFE OF PLANT = 51,828,113

CAPACITY FACTOR 57.249

AVAILABILITY 78.06%

YEAR	AVAILABILITY	MWE HRS.	CAP. FAC.
1970 (AS OF APRIL 13 @ 2325)	47.79%	1,252,204	24.82%
1971	65.01%	2,806,520	38.41%
1972	59.67%	3,370,476	46.00%
1973	87.58%	5,256,417	71.94%
1974	63.79%	3,594,104	42.19%
1975	55.13%	3,130,632	42.65%
1976	76.01%	4,610,359	62.93%
1977	71.90%	3,760,955	51.47%
1978	94.15%	6,013,057	82.30%
1979	81.56%	5,211,895	71.33%
1980	93.32%	4,866,244	66.42%
1981	60.09%	3,610,449	49.41%
1982 (THRU SEPT.)	91.71%	4,344,801	79.52%

FOR THE YEAR OF 1980, THE AVAILABILITY OF UNIT 2 AT DRESDEN WAS THE HIGHEST PERCENTAGE IN THE ENTIRE WORLD FOR A NUCLEAR PLANT.

5309N

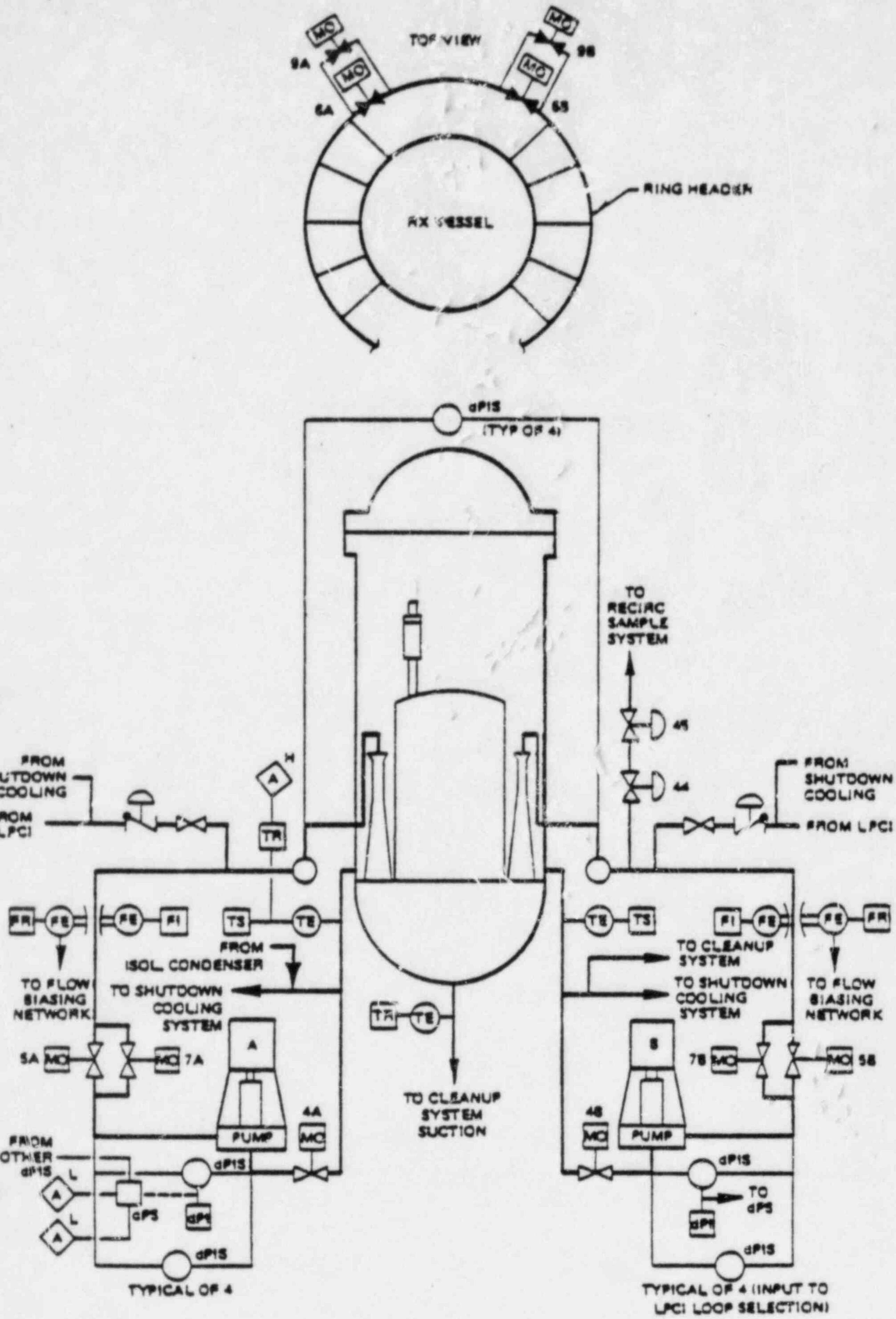
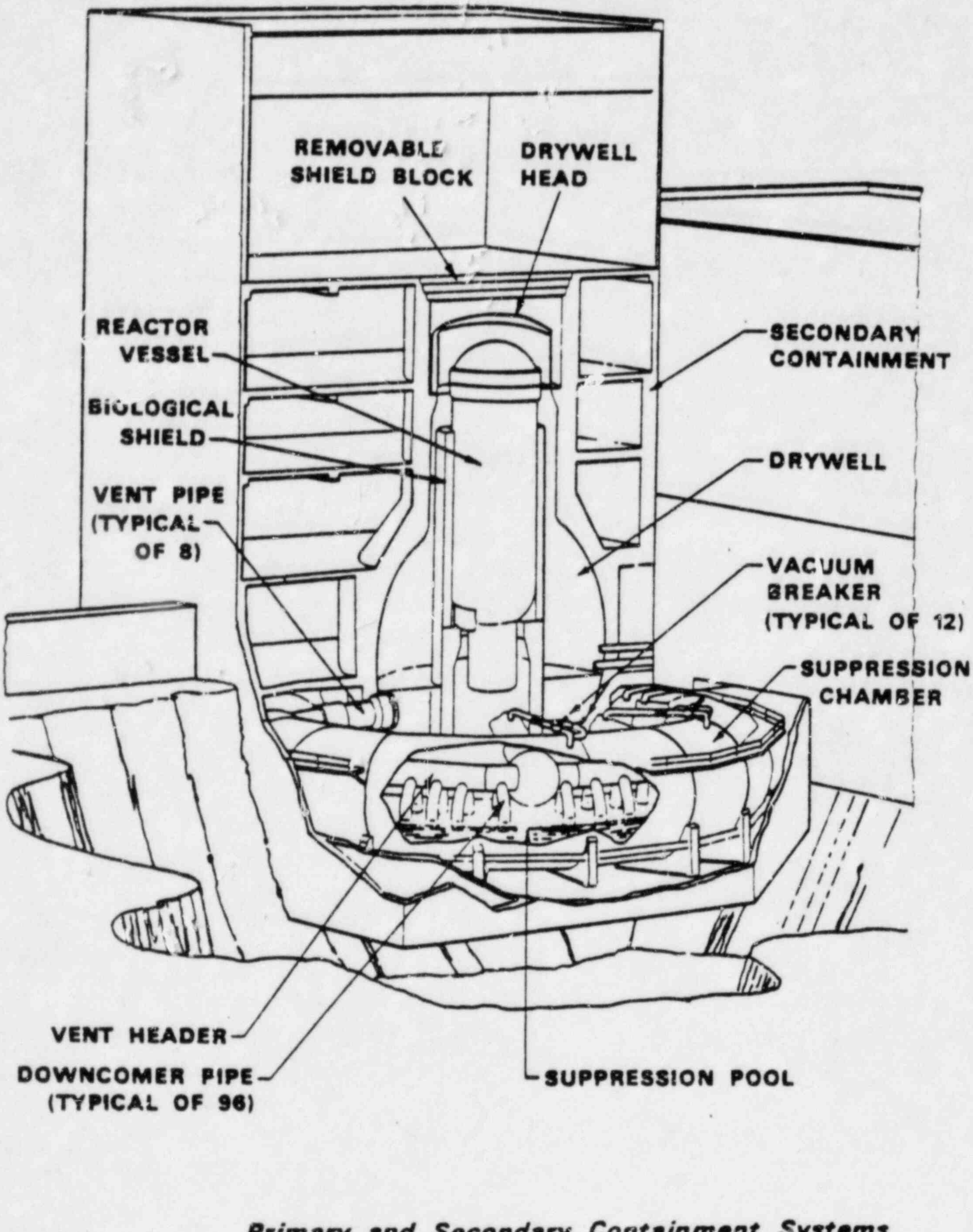


Figure 2. Recirculation System Schematic



Primary and Secondary Containment Systems

COMMONWEALTH EDISON

DRESDEN UNIT 2

EMERGENCY CORE COOLING SYSTEM SUMMARY

Function	Number of Pumps	Design Coolant Flow	Effluent Pressure Range	Required Electrical Power	Additional Backup Systems
Core Spray[1]	2-100%	4500 gpm @ 90 psid (1 Pump)	260 psig to 0 psig	Normal aux power or emer diesel generator	2nd core spray subsystem and LPCI subsystem
LPCI[1]	4-33%	8000 gpm @ 200 psid 14,500 gpm @ 20 psid (3 pumps)	275 psig to 0 psig	Normal aux power or emer diesel generator	Core spray subsystems and 4th LPCI pump
HPCI[2]	1-100%	5600 gpm constant	1125 psig to 150 psig	DC battery system for control[3]	Automatic pressure relief plus core spray and LPCI

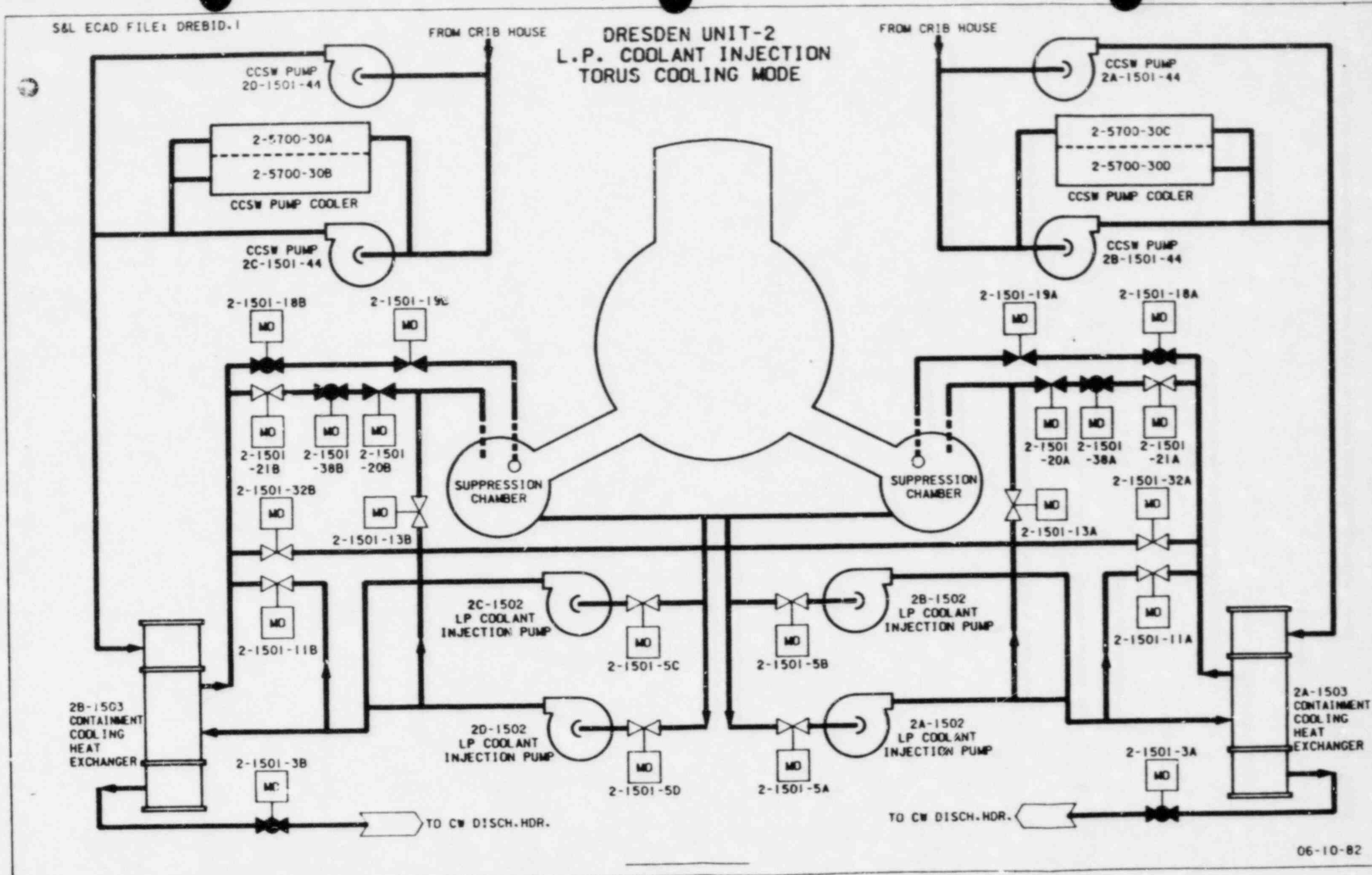
[1]Automatic start-up of the core spray and LPCI systems is initiated by: (1) reactor low-low water level and reactor low pressure, or (2) drywell high pressure.

[2]Automatic start-up of the HPCI system is initiated by: (1) reactor low-low water level, or (2) drywell high pressure.

[3]Reactor steam-driven pump.

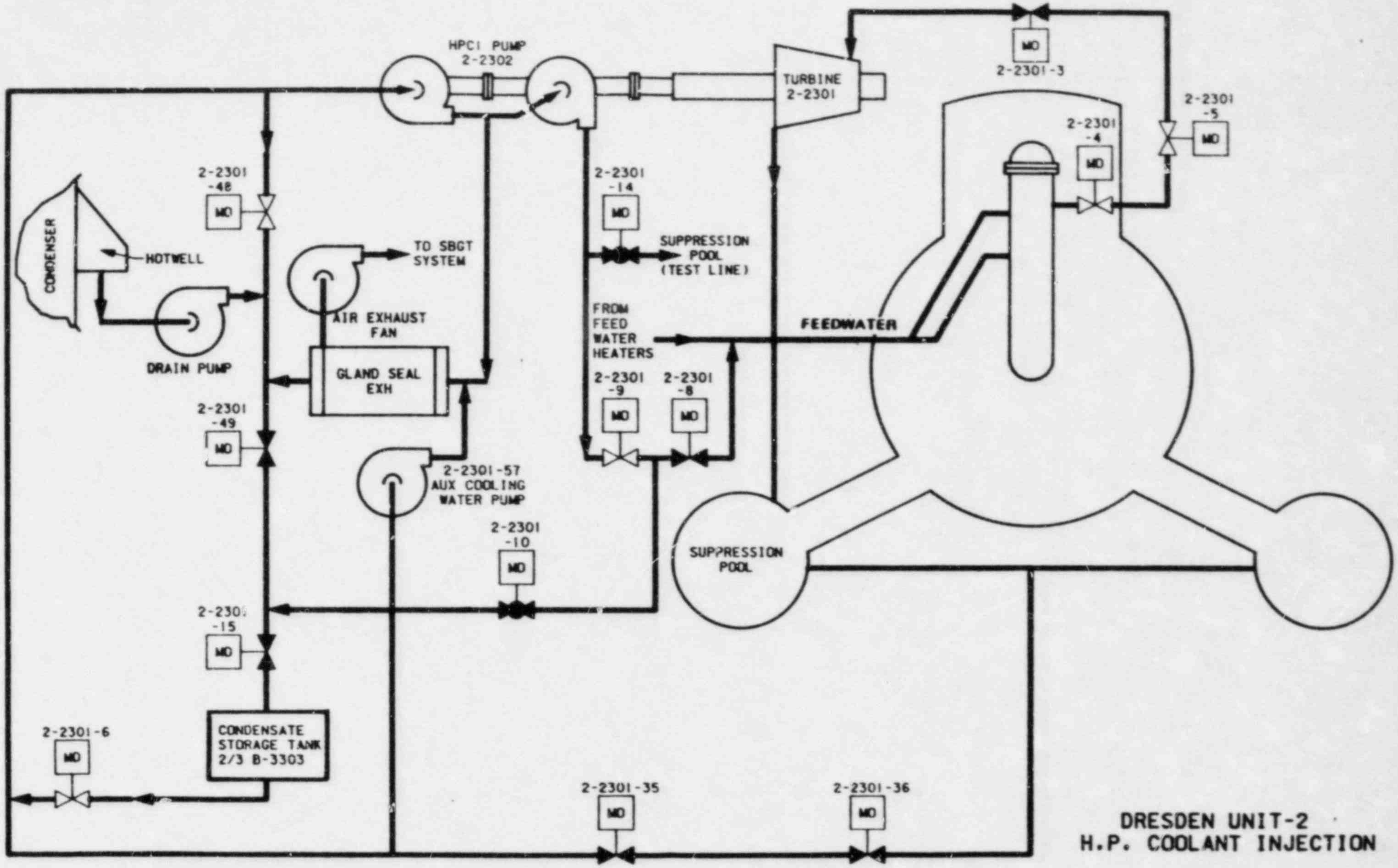
ADS - 4 Electromatic Relief Valves plus Target Rock Combined S/RV

- Initiates on (1) drywell high pressure, (2) reactor low-low water level, (3) 120 second timer (4) CS or LPCI running
- Also provides Automatic Pressure Relief on Reactor High Pressure.



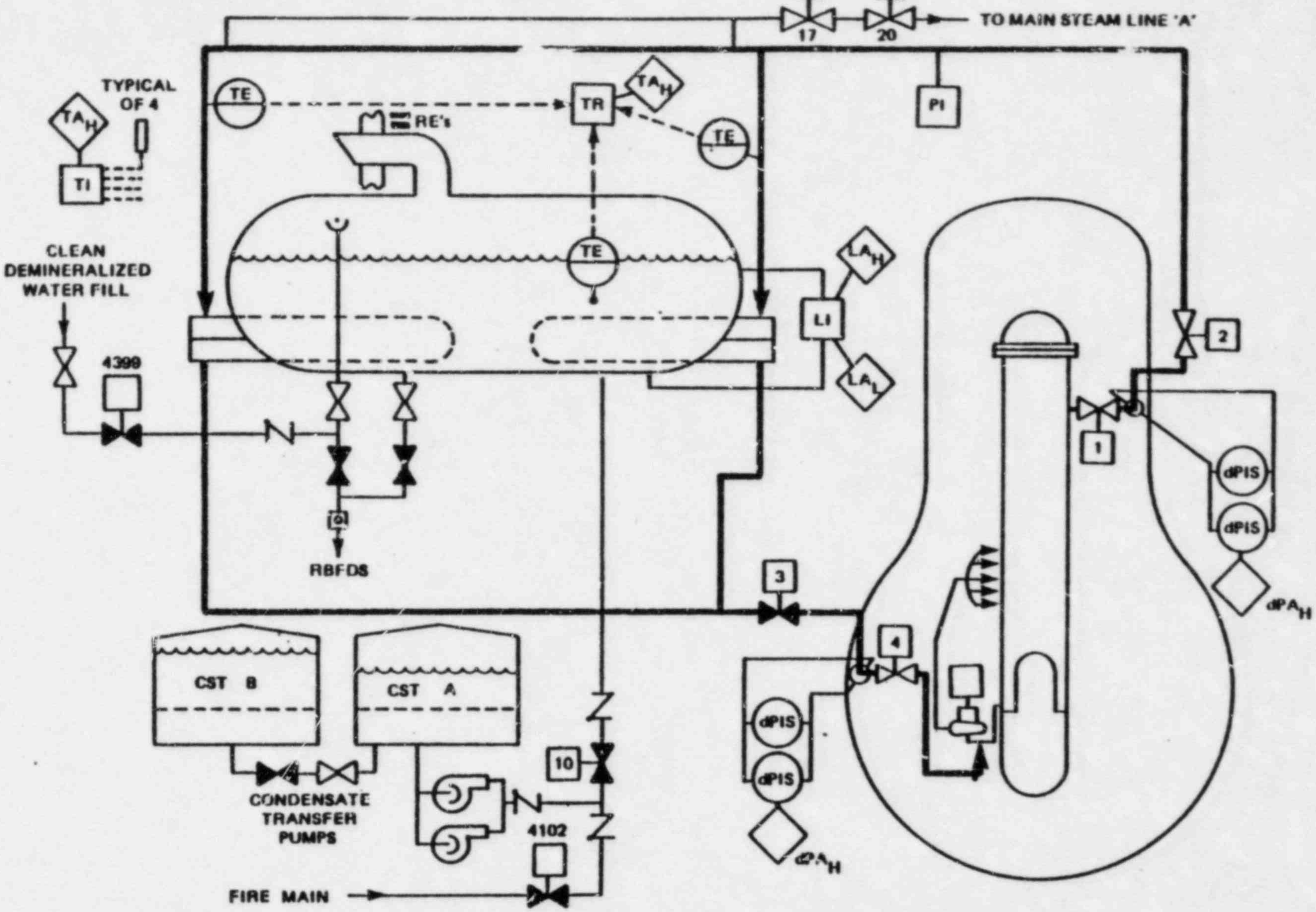
- Shown in Suppression Pool Water or Spray Cooling Mode
- LPCI Reflood Capability through Unbroken Recirculation Piping (Not Shown)
- Also can provide Drywell Spray Cooling (Not Shown)

S&L ECAD FILE: DREBID.1

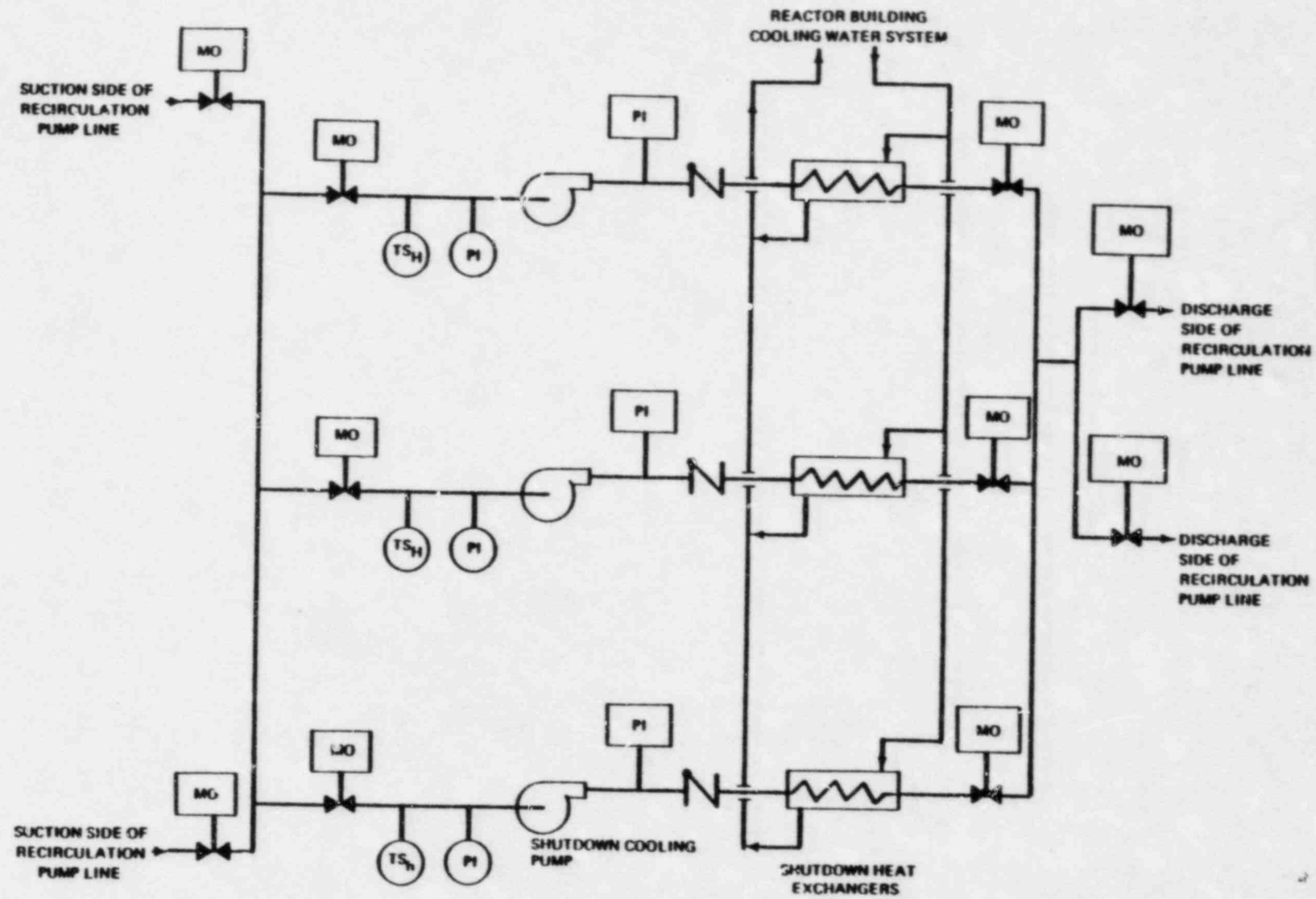


DRESDEN UNIT-2
H.P. COOLANT INJECTION

06-10-82



Isolation Condenser System



SHUTDOWN COOLING - PIPING DIAGRAM

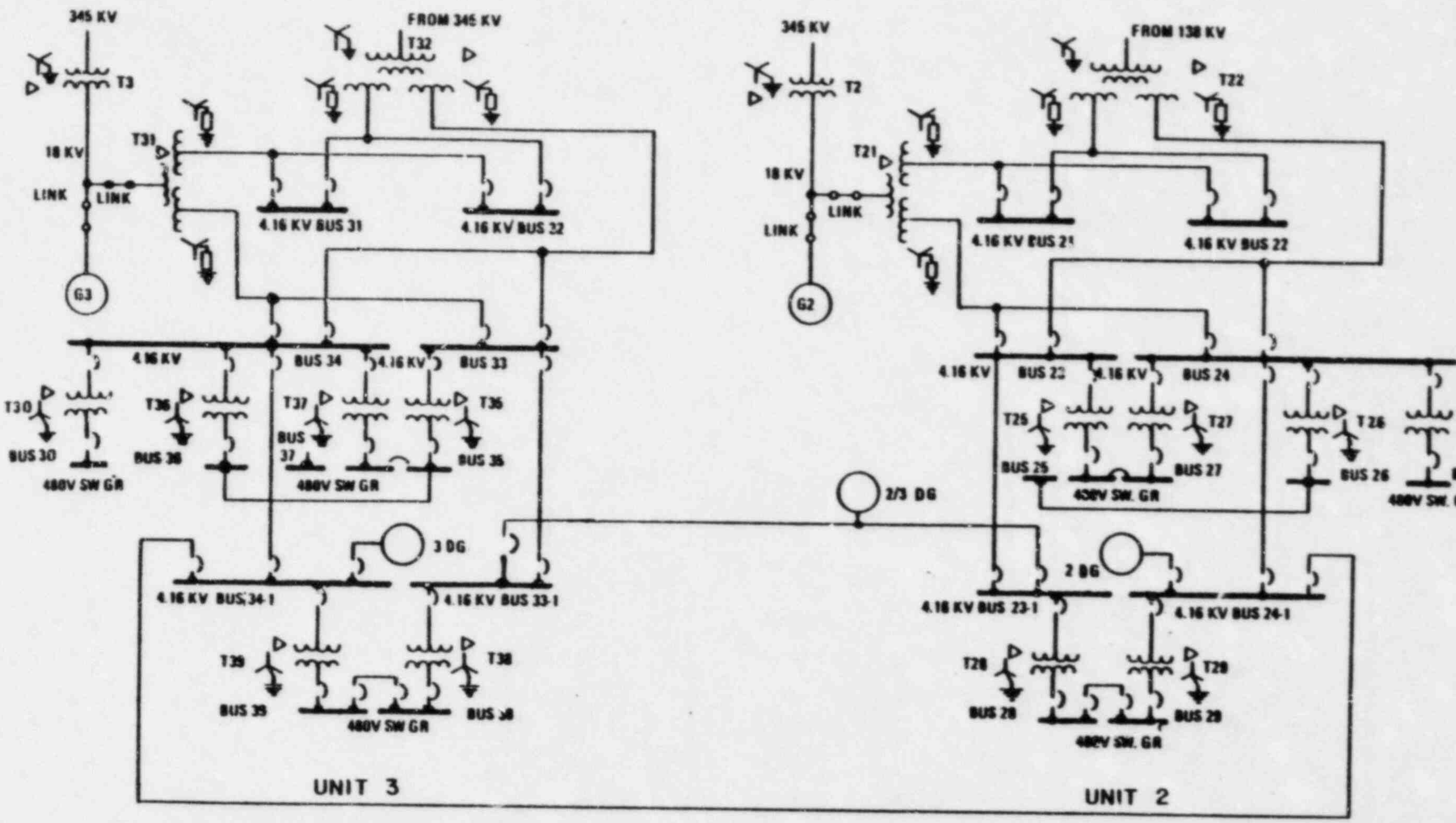


FIGURE 8.2.2:3 AUXILIARY ELECTRICAL SYSTEM - 4160 VOLT AND 480 VOLT

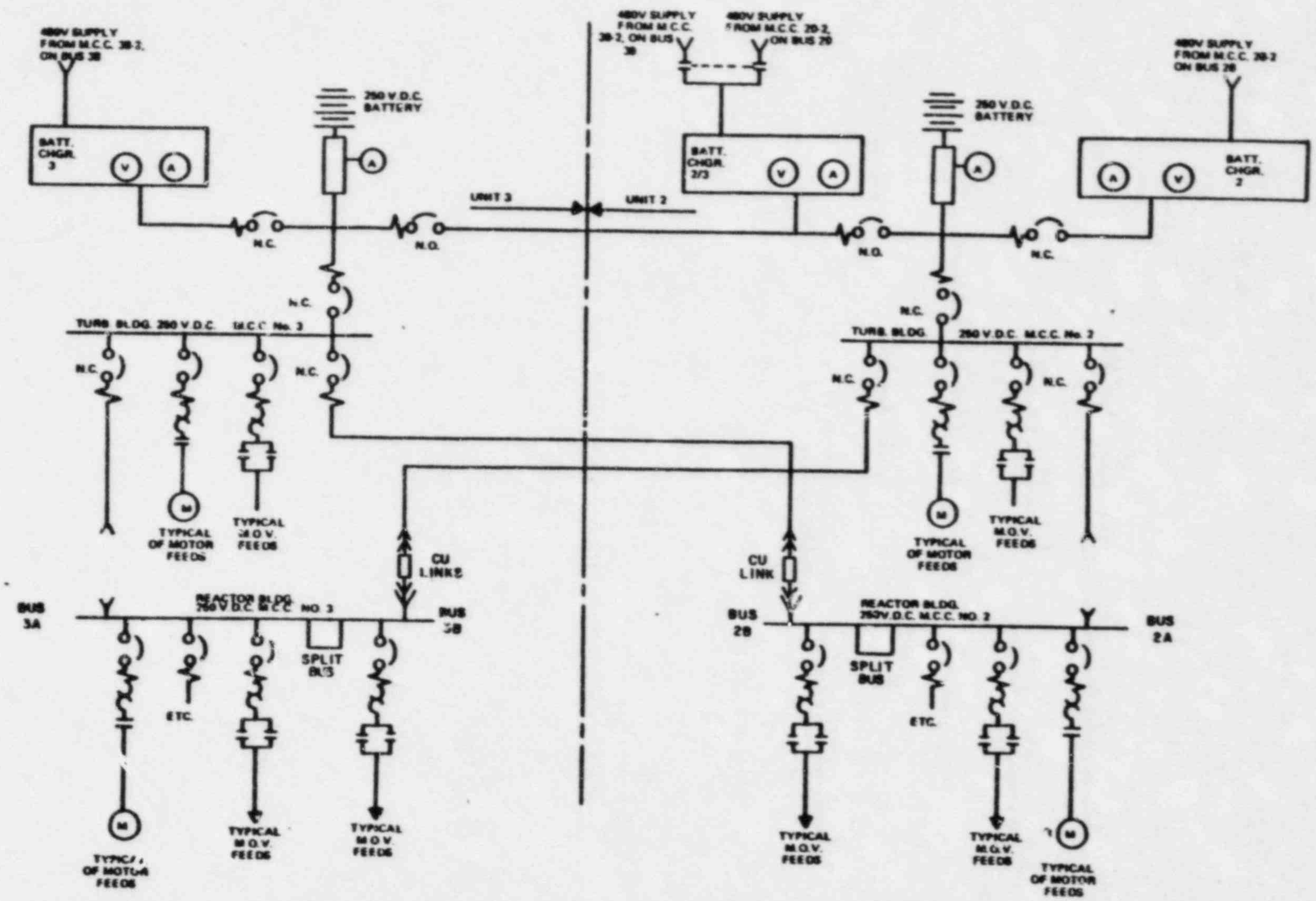


FIGURE 8.2.2:1 250 V DC STATION BATTERY SYSTEM

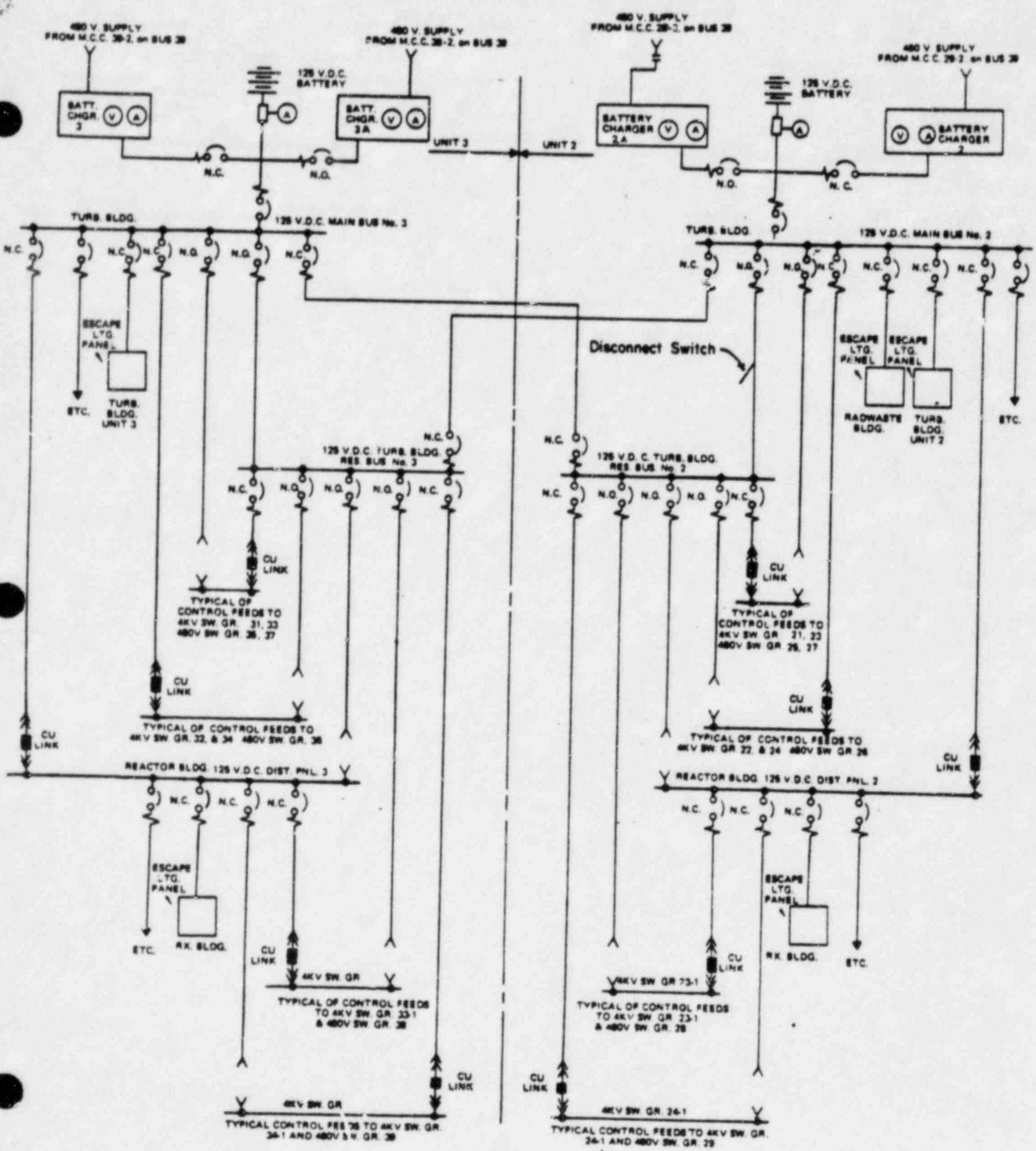


FIGURE 8.2.2:2 125 VDC SYSTEM

ACRS FULL COMMITTEE

DECEMBER 9, 1982

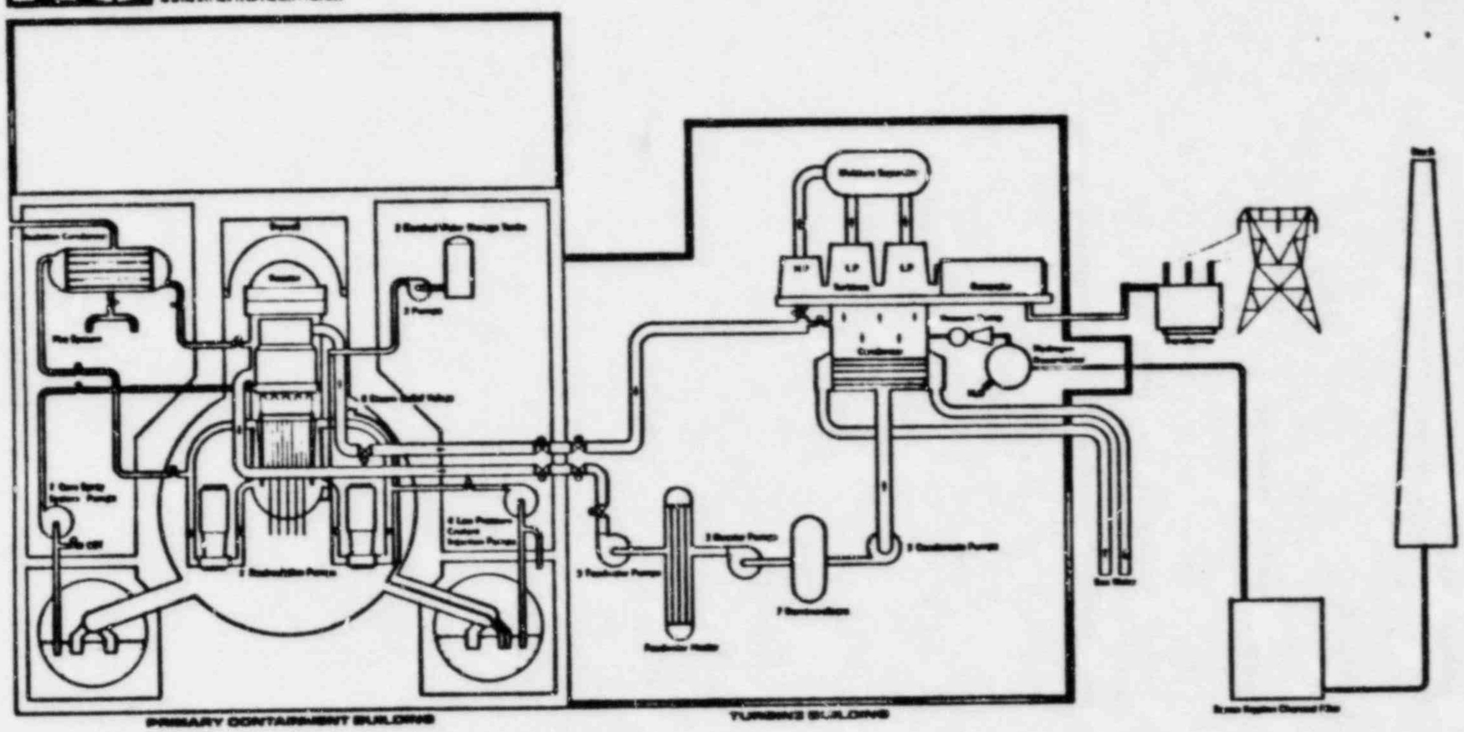
MILLSTONE UNIT NO. 1

NORTHEAST UTILITIES

T2

NORTHEAST UTILITIES

Millstone I



MILLSTONE UNIT 1

PLANT FEATURES

- o GENERAL ELECTRIC BWR-3
  - 2011 MW Thermal, 680 MW Electric
  - Mark 1 Pressure Suppression Containment
  - Constructed by EBASCO
  - 2 Loops With Jet Pumps
  - 3 Electric Feedwater Pumps
  - Once-Thru Cooling With Long Island Sound
- o ONSITE EMERGENCY POWER SYSTEM
  - Diesel Generator
  - Gas Turbine Generator (Power For FWCI)
- o EMERGENCY CORE COOLING SYSTEMS
  - Feedwater Coolant Injection System (FWCI)
  - Two 100% Core Spray Pumps
  - Four 33% LPCI Pumps
  - Automatic Pressure Relief System (4 APR Valves)
  - Isolation Condenser
- o 100% TURBINE BYPASS CAPABILITY
  - Plant Will Ride Out Full Load Reject Without Scram
  - Turbine Runback To House Load

MILLSTONE UNIT 1 SEP

UNIT HISTORY

CONSTRUCTION AND OPERATION

CONSTRUCTION START:	MAY 1966
INITIAL CRITICAL:	OCTOBER 26, 1970
INITIAL ON-LINE:	NOVEMBER 29, 1970
COMMERCIAL OPERATION:	DECEMBER 1970
100% POWER:	JANUARY 3, 1971
APPLICATION FOR FTOL	SEPTEMBER 1, 1972

MAJOR OUTAGES

	START DATE	DURATION (DAYS)
FIRST REFUEL:	SEPTEMBER 1, 1972	189
1ST. F.W. SPARGER REPLACEMENT	APRIL 18, 1973	102
SECOND REFUEL:	SEPTEMBER 1, 1974	63
THIRD REFUEL:	SEPTEMBER 14, 1975	35
FOURTH REFUEL:	OCTOBER 1, 1976	60
FIFTH REFUEL:	MARCH 10, 1978	36
SIXTH REFUEL:	APRIL 28, 1979	61
SEVENTH REFUEL:	OCTOBER 4, 1980	197
TURBINE OUTAGE:	APRIL 21, 1981	57
EIGHTH REFUEL:	SEPTEMBER 11, 1982	69

MILLSTONE UNIT 1 SEP

UNIT PERFORMANCE

PERFORMANCE STATISTICS (LIFE TO DATE)

MWE GENERATED:	45,077,796 (GROSS)
CAPACITY FACTOR:	63.3%
AVAILABILITY:	71.9%

ANNUAL CAPACITY FACTORS

YEAR	CAPACITY FACTORS (%)	INDUSTRY AVERAGE
1970 (DEC. ONLY)	25.9	----
1971	63.2	58.9
1972	54.9	54.3
1973	33.2	57.2
1974	63.1	57.5
1975	68.4	58.6
1976	65.6	56.8
1977	83.4	62.9
1978	80.5	65.2
1979	73.0	58.9
1980	58.5	56.0
1981	43.6 (1)	59.9
1982 (TO 10/82)	79.5 (2)	60.0 (EST.)

(1) DUE TO BOTH REFUELING AND TURBINE OUTAGES.

(2) ACHIEVED WITHOUT LP TURBINE 'A' & 'B' 14TH STAGE BUCKETS INSTALLED.

MILLSTONE UNIT 1 SEP

UNIT PERFORMANCE

PERFORMANCE STATISTICS (LIFE TO DATE)

MWE GENERATED:	45,077,796 (GROSS)
CAPACITY FACTOR:	63.3%
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1975	68.4	58.6
1976	65.6	56.8
1977	83.4	62.9
1978	80.5	65.2
1979	73.0	58.9
1980	58.5	56.0
1981	43.6 (1)	59.9
1982 (TO 10/82)	79.5 (2)	60.0 (EST.)

(1) DUE TO BOTH REFUELING AND TURBINE OUTAGES.

(2) ACHIEVED WITHOUT LP TURBINE 'A' & 'B' 14TH STAGE BUCKETS INSTALLED.

MILLSTONE UNIT 1

SYSTEMATIC ASSESSMENT OF LICENSEE PERFORMANCE (SALP)

SALP RESULTS - JULY, 1982 AND OCTOBER, 1982

"Overall, We Find The Management Attention At Your Facilities Is Aggressively Oriented Toward Nuclear Safety."

And

"Effective Use Of Ample Resources Has Resulted In A High Level Of Performance In Operational Safety And Construction Activities."

MILLSTONE UNIT 1

SYSTEMATIC ASSESSMENT OF LICENSEE PERFORMANCE (SALP)

SALP RESULTS - OCTOBER 1982

Functional Area	Category 1	Category 2	Category 3
1. Plant Operations	X		
2. Radiological Controls	X		
3. Maintenance	X		
4. Surveillance	X		
5. Fire Protection	X		
6. Emergency Preparedness	X		
7. Security And Safeguards		X	
8. Refueling	X		
9. Licensing Activities	X		

Category 1: Reduced NRC attention may be appropriate. Licensee Management ... aggressive and oriented toward nuclear safety ... high level of performance with respect to operational safety is being achieved.

Category 2: NRC attention should be maintained at normal levels. Licensee resources are adequate ... satisfactory performance with respect to operational safety is being achieved.

Category 3: Both NRC and licensee attention should be increased. ... weaknesses are evident ... minimal satisfactory performance ... is being achieved.

XV-16 & 18 PRIMARY COOLANT ACTIVITY LIMITS

DRESDEN 2 - 4.31 & 32
MILLSTONE 1 - 4.35 & 36
OYSTER CREEK - 4.36 & 37

- DOSE RESULTS (SRP) EXCEED CRITERIA
- PRA CONCLUDED RISK NEGLIGIBLE - LOCA DOES NOT DOMINATE
- STAFF POSITION - ADOPT BWR STS IODINE LIMITS AND ESTABLISH PLANT-SPECIFIC ACTION REQUIREMENTS
- CONSERVATISM IN ANALYSIS TECHNIQUE DOES NOT WARRANT HARDWARE OR FURTHER EVALUATION
- MILLSTONE DISAGREES - ESTABLISH PLANT-SPECIFIC LIMITS BASED ON MORE REALISTIC CALCULATION

XV-3 MCPR ANALYSIS WAS BASED ON AN INITIAL POWER OF 100% INSTEAD OF 102%

MILLSTONE 1 - 4.34

- THE LICENSEE HAS ANALYZED THIS TRANSIENT FOR RELOAD 8 USING THE NRC-APPROVED ODYN CODE. ALTHOUGH THE INITIAL POWER LEVEL USED WAS 100%, AN UNCERTAINTY FACTOR OF 1.044 WAS USED.
- NO ACTION REQUIRED

<u>XV-1</u> FEEDWATER CONTROLLER FAILURE MAY BE A LIMITING TRANSIENT FOR FUEL DESIGN LIMITS REQUIRING OPERABILITY LIMITS FOR TURBINE BYPASS

DRESDEN 2 - 4.30
MILLSTONE 1 - 4.33
OYSTER CREEK - 4.35

- WILL BE HANDLED AS PART OF THE RELOAD.
- PRA INDICATES LOW IMPORTANCE TO RISK
- NO ACTION REQUIRED

IX-5 EFFECTS OF LOSS OF VENTILATION ON EQUIPMENT FUNCTION AND HYDROGEN ACCUMULATION

DRESDEN 2 - 4.29.1 & 2
MILLSTONE 1 - 4.32.1-4
OYSTER CREEK - 4.34(3) & (4)

- DRESDEN WILL EVALUATE THE BATTERY ROOM (H_2 ACCUMULATION) AND DIESEL GENERATOR ROOM FOR CONSEQUENCES - IDENTIFY CORRECTIVE ACTION, AS NECESSARY

- DRESDEN LPCI/CORE SPRAY ROOM VENTILATION CAN BE MANUALLY RESTORED - NO ACTION REQUIRED

- MILLSTONE WILL PROVIDE ADDITIONAL INFORMATION AND ANALYSES TO JUSTIFY NO LOSS OF FUNCTION FOR LPCI/CORE SPRAY PUMP, FWCI, AND DIESEL GENERATOR ROOMS AND MANUAL REINITIATION IN THE TURBINE BUILDING

- MILLSTONE WILL EVALUATE CONSEQUENCES FOR INTAKE STRUCTURE/SERVICE WATER SYSTEM AND ANY NECESSARY CORRECTIVE ACTIONS

VIII-3.B DC/BATTERY INDICATIONS AND ALARMS IN CONTROL ROOM ARE INADEQUATE

DRESDEN 2 - 4.23.3 (4.28)
MILLSTONE 1 - 4.30
OYSTER CREEK - 4.32

- PRA CONCLUDED RISK SIGNIFICANCE HIGH FOR DRESDEN AND LOW FOR MILLSTONE (SYSTEM DIFFERENCES)
- BATTERY CURRENT IDENTIFIES LOADING CONDITIONS DURING AN EVENT
- LICENSEES AGREED TO INSTALL INDICATIONS AND ALARMS

VIII-3.B TECHNICAL SPECIFICATION LIMIT FOR A FAILED OR "OUT OF SERVICE" BATTERY ARE NOT CONSISTENT WITH THE STS - MILLSTONE PRA CONCLUDED A 50% REDUCTION IN OUTAGE WOULD REDUCE CORE MELT FREQUENCY ABOUT 2.5%

DRESDEN 2 - 4.21.4
MILLSTONE 1 - 4.30

- LICENSEES HAVE AGREED TO PROVIDE APPROPRIATE OUTAGE LIMITS WHICH CONSIDER TIME REQUIRED FOR MAINTENANCE AND CORRECTIVE ACTION

VIII-3.A BATTERY SERVICE TESTS DO NOT CONFORM TO IEEE 450-1975, IEEE 308-1974, BTP ICSB-6, AND THE STS

DRESDEN 2 - 4.27
MILLSTONE 1 - 4.29

- MILLSTONE WILL MODIFY THE EXISTING TECHNICAL SPECIFICATION TESTING REQUIREMENTS
- DRESDEN WILL DEMONSTRATE EXISTING TEST EQUIVALENT OR MORE SEVERE (COMPLETE 12/06/82)

VIII-2 OPERATIONAL AND TESTING EXPERIENCE INDICATE TURBINE GENERATOR FAILURES ARE ASSOCIATED WITH MAINTENANCE PROBLEMS

MILLSTONE 1 - 4.28.3

- LICENSEE HAS AGREED TO REVIEW MAINTENANCE PROGRAM AND, IF NECESSARY, MODIFY TO INCLUDE PREVENTIVE MAINTENANCE

VIII-2 DIESEL AND TURBINE GENERATORS HAVE INADEQUATE ANNUNCIATORS AND DO NOT BYPASS PROTECTIVE TRIPS DURING ACCIDENT CONDITIONS

DRESDEN 2 - 4.26.1 & 2
MILLSTONE 1 - 4.28.1, 2, 4 & 5
OYSTER CREEK - 4.31(1) & (2)

- ANNUNCIATOR MODIFICATION COMPLETE - NO ACTION REQUIRED

- TRIPS THAT PREVENT DAMAGE NEED NOT BE BYPASSED

- PRA CONCLUDED RISK SIGNIFICANCE LOW

- LICENSEES AGREED TO INSTALL SPECIFIED BYPASSES ON OTHER TRIPS

VIII-2 EMERGENCY AC POWER ANNUNCIATORS DO NOT MEET IEEE 279-1971 CRITERIA

DRESDEN 2 - 4.26.1
MILLSTONE 1 - 4.28.5
OYSTER CREEK - 4.31(1)

- MODIFICATIONS PREVIOUSLY REVIEWED AND COMPLETED
- NO FURTHER ACTION REQUIRED

VII-3 LOSS OF THE INSTRUMENT AC (IAC) BUS WOULD RESULT IN LOSS OF INDICATION IN THE CONTROL ROOM OF FLOW, TEMPERATURE LEVEL, AND/OR PRESSURE OF SYSTEMS REQUIRED TO SHUT DOWN THE REACTOR

MILLSTONE 1 - 4.26

- ISSUE REVIEWED IN RESPONSE TO IE BULLETIN 79-27 - SUFFICIENT INSTRUMENTATION LEFT FOR SAFE SHUTDOWN

- PRA CONCLUDED REMOVAL OF ABTs WITH A REDUNDANT IAC BUS WOULD RESULT IN A 10% REDUCTION IN CORE MELT FREQUENCY - UNDER EVALUATION

VIII-1.A OPERATING PROCEDURES SHOULD BE DEVELOPED TO PROTECT CLASS 1E SYSTEMS UNDER NON-ACCIDENT CONDITIONS IF A DEGRADED GRID VOLTAGE CONDITION OCCURS

MILLSTONE 1 - 4.27

- LICENSEE AGREED TO DEVELOP SUCH PROCEDURES
- BALANCE OF ISSUES WILL BE ADDRESSED BY MPA B-23 (DEGRADED GRID PROTECTION)

VII-3 SHUTDOWN COOLING SUSCEPTIBLE TO SINGLE FAILURE OF SHARED DIESEL AND SPES TEMPERATURE INTERLOCK NOT TESTED

DRESDEN 2 - 4.25.3 & 4

- PROCEDURES REVIEWED IN SHARED SYSTEMS EVALUATION (VI-10.B) - NO ACTION REQUIRED
- LICENSEE COMMITTED TO TEST INTERLOCK (PRA - AVAILABILITY INCREASE 15%)

VII-1.A RPS CHANNELS ARE NOT ISOLATED FROM THEIR RESPECTIVE POWER SUPPLIES

DRESDEN 2 - 4.24.3
MILLSTONE 1 - 4.25.2
OYSTER CREEK - 4.27(2)

- LICENSEES HAVE AGREED TO PROVIDE CLASS 1E PROTECTION

VII-1.A FLUX MONITORING SIGNALS (IRM, LPRM, AND APRM) ARE NOT ISOLATED FROM THE PROCESS RECORDERS INDICATORS AND COMPUTER (IEEE 279-1971)

DRESDEN 2 - 4.24.1 & 2
MILLSTONE 1 - 4.25.1
OYSTER CREEK - 4.27(1)

- LICENSEES WILL DEMONSTRATE ADEQUATE ISOLATION TO ASSURE FAULTS WILL NOT DISABLE FLUX MONITORS

- MILLSTONE WILL DEMONSTRATE BY TEST

VI-10.B NO INTERLOCKS TO PREVENT PARALLEL OPERATION OF SHARED BATTERY SYSTEMS AND BYPASS OF DG 2/3

DRESDEN 2 - 4.23.1

- LICENSEE AGREED TO PROVIDE PROCEDURES TO PREVENT PARALLELING DURING PLANT OPERATION
- MAY PROPOSE APRALLELING FOR HIGH-RESISTANCE FAULT DETECTION BECAUSE OF DETECTION EQUIPMENT LIMITATIONS (POTENTIAL DISAGREEMENT)
- PROCEDURES MODIFIED TO PREVENT DG 2/3 BYPASS

VI-10.A RTS CHANNEL CHECKS, FUNCTIONAL TESTS AND CALIBRATION FREQUENCIES DIFFER FROM THE STS

MILLSTONE 1 - 4.24

- RELIABILITY GOAL BASED ON "EXPOSURE TIME" FOR LIKE COMPONENTS
- ONE-SIDED CRITERIA - FREQUENCY ONLY DECREASES
- FLAWS IN APPLICATION
- APPLIES TO ALL BWRs

VI-10.A NOT ALL SENSORS OR COMPLETE CHANNEL RESPONSE TIMES ARE TESTED (BETWEEN CHANNEL TRIP AND DE-ENERGIZATION OF THE SCRAM RELAY)

DRESDEN 2 - 4.22
MILLSTONE 1 - 4.24.3
OYSTER CREEK - 4.26.1

- LIMITED PRA INDICATED THAT THE ISSUE HAS LOW SAFETY SIGNIFICANCE BECAUSE THE TESTING IS CONCERNED WITH EVENTS ON THE ORDER OF SECONDS AND PRA HAS SHOWN THAT RESPONSE TIMES ON THE ORDER OF MINUTES IS SUFFICIENT.
- NO ACTION REQUIRED

VI-7.C.1 DISCONNECT LINKS AND TIE BREAKERS CONNECT REDUNDANT BUSES

DRESDEN 2 - 4.21.2 & 3

NON-CLASS 1E SWITCHGEAR (480V #27) RECEIVES POWER FROM A CLASS 1E SOURCE (DIV I #24)

DRESDEN - 4.21.5

- LICENSEE WILL PROVIDE PROCEDURES AND ADMINISTRATE CONTROLS TO ASSURE ISOLATION OF REDUNDANT BUSES
- LICENSEE WILL EVALUATE THE CLASS 1E/ NON CLASS 1E CONNECTION WITH A SHORT-CIRCUIT ANALYSIS TO ASSURE COORDINATED BREAKER FUNCTION

VI-7.C.1 AUTOMATIC AND MANUAL BUS TRANSFERS EXIST WHICH COULD ALLOW TRANSFER OF FAULTED LOADS

DRESDEN 2 - 4.21.1
MILLSTONE 1 - 4.23.1 & 2
OYSTER CREEK - 4.25(1)

- LICENSEES WILL EVALUATE EXISTING DESIGNS AND IDENTIFY ANY NECESSARY CORRECTIVE ACTIONS
- DRESDEN WILL VERIFY PROTECTIVE RELAYS FOR SHARED SYSTEMS AND PERFORM SHORT-CIRCUIT ANALYSES

VI-7.A.4 TEST DATA (JAPAN) SUGGESTS CENTRAL FUEL BUNDLES OF A BWR-3 CORE MAY RECEIVE LOW SPRAY FLOW

DRESDEN 2 - 4.20
MILLSTONE 1 - 4.22
OYSTER CREEK - 4.26.1

- THE ISSUE IS BEING REVIEWED INDEPENDENTLY OF SEP AS A MATTER RELATED TO GENERIC ISSUE A-16.

- THE JAPANESE DATA FOR A BWR/5 MAY ONLY BE APPLICABLE TO A BWR/4 AND A BWR/5 BECAUSE THEIR NOZZLE DESIGN IS SIMILAR AND IS DIFFERENT FROM A BWR/3 NOZZLE.

- GE HAS INFORMED THE STAFF THAT ANALYSES CAN BE PERFORMED TO SHOW THAT EVEN FOR LIMITING CASES OF A BWR/3 WITH CORE SPRAY ASSUMED TO FLOW DOWN PERIPHERAL CHANNELS, THE CALCULATED PEAK CLAD TEMPERATURES WILL NOT EXCEED THE 10 CFR 50.46 LIMIT OF 2200°F.

- NO ACTION REQUIRED

VI-7.A.B CORE SPRAY ROOM COOLER TESTING IS NOT REQUIRED IN THE TECHNICAL SPECIFICATIONS

MILLSTONE 1 - 4.21.1

LPCI TESTING DOES NOT DEMONSTRATE EMERGENCY SERVICE WATER SYSTEM (ESWS) WILL START TO COOL HEAT EXCHANGERS

MILLSTONE 1 - 4.21.2

- LICENSEE WILL PROVIDE EVALUATION DEMONSTRATING CS PUMP COOLING IS NOT ESSENTIAL.

- THE ESWS IS MANUALLY INITIATED.

- TECHNICAL SPECIFICATION 3/4-5.B AND STATION PROCEDURE SP623.19 ESTABLISH SURVEILLANCE REQUIREMENTS OF THE ESWS TO MAINTAIN A HIGH SYSTEM AVAILABILITY.

- STATION PROCEDURE OP506 DIRECTS THE OPERATOR TO PLACE THE ESWS IN OPERATION, IN ACCORDANCE WITH OPERATING PROCEDURE 322, WHEN THE SUPPRESSION CHAMBER TEMPERATURE APPROACHES 90°F AND PLANT LOAD CONDITIONS PERMIT.

- ACCORDING TO IREP LOCA SEQUENCE 2 (THE CONTAINMENT HEAT REMOVAL FAILS AND ALL OTHER FUNCTION SUCCEED). THE OPERATOR WILL HAVE ABOUT 20 HOURS TO START THE CONTAINMENT HEAT REMOVAL FUNCTION, THAT IS, START THE ESWS, TO AVOID CONTAINMENT OVERPRESSURE AND CONSEQUENT LOSS OF CORE-COOLING CAPABILITY.

- NO ACTION REQUIRED

VI-6 EXEMPTIONS FOR RBCCW AND AIRLOCK LEAK TESTING

DRESDEN 2 - 4.19

- BEING REVIEWED AS PART OF APPENDIX J, 10 CFR 50

- CORRECTIVE ACTION INDEPENDENT OF SEP

VI-4 LOCAL MANUAL ISOLATION VALVES AND LACK OF EXCESS FLOW CHECKS

MILLSTONE 1 - 4.20.5
OYSTER CREEK - 4.22.4

- LINES MONITOR ESSENTIAL CONTAINMENT PARAMETERS
- PRA CONCLUDES LEAKAGE NEGLIGIBLE TO RISK
- NO ACTION REQUIRED

VI-4 LOCKS ARE NOT PROVIDED FOR MANUAL ISOLATION VALVES

DRESDEN 2 - 4.18.1
MILLSTONE 1 - 4.20.1
OYSTER CREEK - 4.22.1

SAME TEST, VENT AND DRAIN LINES HAVE ONLY A SINGLE ISOLATION VALVE OR A VALVE AND CAP

DRESDEN 2 - 4.18.6
MILLSTONE 1 - 4.20.2

RBCCW ISOLATION VALVES ARE NOT LEAK TESTED

DRESDEN 2 - 4.18.2

INSUFFICIENT INFORMATION TO ESTABLISH ISOLATION PROVISIONS FOR SPECIFIED BRANCH LINES

MILLSTONE 1 - 4.20.7

- LICENSEES HAVE AGREED TO PROVIDE LOCKS AND REDUNDANT ISOLATION VALVES FOR SPECIFIED LINES
- DRESDEN WILL INSTALL TEST TAPS FOR LEAK TESTING
- MILLSTONE WILL EVALUATE ISOLATION PROVISIONS ON BRANCH LINES AND IDENTIFY ANY NECESSARY CORRECTIVE ACTION

VI-4 LEAKAGE DETECTION CAPABILITY FOR REMOTE MANUAL VALVES

DRESDEN 2 - 4.18.2
MILLSTONE 1 - 4.20.3
OYSTER CREEK - 4.22.2

ADMINISTRATIVE CONTROLS FOR LOCKED-CLOSED VALVES

DRESDEN 2 - 4.18.1
MILLSTONE 1 - 4.20.1

- LICENSEES WILL EVALUATE LEAKAGE DETECTION CAPABILITIES
- LICENSEE WILL PROVIDE PROCEDURES FOR REMOTE MANUAL OPERATION AND ADMINISTRATIVE CONTROLS FOR LOCKED-CLOSED VALVES
- DRESDEN REVIEW IDENTIFIED ISOLATION VALVES (RBCCW) EXCLUDED FROM LEAKAGE TESTING - LICENSEE AGREED TO INSTALL TEST TAPS

VI-4 TWO CHECK VALVES IN SERIES ARE USED FOR CONTAINMENT ISOLATION OF THE FEEDWATER SYSTEM VICE MOTOR-OPERATED VALVE OUTSIDE CONTAINMENT

BOTH ISOLATION VALVES OUTSIDE CONTAINMENT

DRESDEN 2 - 4.18.4 & 5
MILLSTONE 1 - 4.20.6 & 4
OYSTER CREEK - 4.22.5 & 3

- HIGH PRESSURE HEATER DISCHARGE VALVES PROVIDE BACKUP ISOLATION CAPABILITY.
- EXISTING FEEDWATER CHECK VALVES ARE SUBJECT TO LOCAL LEAK RATE TESTING TO INSURE THEIR FUNCTIONABILITY.
- LIMITED PRA FOR PALISADES CONCLUDED LITTLE IMPROVEMENT WOULD BE OBTAINED BY HAVING ONE VALVE INSIDE AND ONE OUTSIDE BECAUSE THE PROBABILITY OF FAILURE OF BOTH VALVES IS GREATER THAN THE PROBABILITY OF PIPE FAILURE BETWEEN THE CONTAINMENT AND THE FIRST ISOLATION VALVE.
- ISOLATION RELIABILITY WOULD NOT BE SIGNIFICANTLY IMPROVED BY ADDING A REMOTE MANUAL VALVE.
- NO ACTION REQUIRED

V-12.A REQUIREMENTS TO ASSURE MINIMUM RESERVE CAPACITY IN RWCU AND CONDENSATE DEMINERALIZERS SHOULD BE INCLUDED IN THE TECHNICAL SPECIFICATIONS

MILLSTONE 1 - 4.19.2

- LICENSEE WILL EVALUATE RESERVE CAPACITY AND PROPOSE TS CHANGE OR JUSTIFY NOT DOING SO.

V-12.A TECHNICAL SPECIFICATIONS DO NOT MEET THE LIMITS ESTABLISHED IN REGULATORY GUIDE 1.56 FOR CONDUCTIVITY AND CHLORIDES OF THE REACTOR VESSEL WATER AND CONDUCTIVITY OF THE FEEDWATER

MILLSTONE 1 - 4.19.1
OYSTER CREEK - 4.20

- THE LICENSEE HAS PROPOSED TO REVISE THE EXISTING TECHNICAL SPECIFICATIONS FOR CHLORIDES AND CONDUCTIVITY TO BE CONSISTENT WITH REGULATORY GUIDE 1.56 OR WILL PROVIDE JUSTIFICATION FOR NOT DOING SO.

V-11.A RWCV SYSTEM DOES NOT INCLUDE INTERLOCKS TO PREVENT OVERPRESSURE FROM RCS

DRESDEN 2 - 4.16
MILLSTONE 1 - 4.18
OYSTER CREEK - 4.19

- DRESDEN HAS DEMONSTRATED SUFFICIENT RELIEF CAPACITY AND ACCEPTABLE CONSEQUENCES OF STUCK-OPEN VALVE - NO ACTION REQUIRED
- MILLSTONE WILL INSTALL INTERLOCK

V-10.B SAFE SHUTDOWN PROCEDURES - SHUTDOWN OUTSIDE THE CONTROL ROOM AND SHUTDOWN USING SAFETY SYSTEMS

DRESDEN 2 - 4.25.1 & 2
MILLSTONE 1 - 4.17
OYSTER CREEK - 4.18

- SHUTDOWN OUTSIDE THE CONTROL ROOM ADDRESSED BY APPENDIX R (FIRE PROTECTION) REVIEW

- OTHER PROCEDURAL CHANGES WILL BE RESOLVED BY TMI I.C.1 GENERIC SYMPTOM - ORIENTED PROCEDURES

V-6 REACTOR VESSEL MATERIAL SURVEILLANCE AND UPPER SHELF ENERGY

DRESDEN 2 - 4.14

OYSTER CREEK - 4.17

- CECo REQUEST FOR TS CHANGE BEING REVIEWED AS A ROUTINE LICENSING ACTION

- NO FURTHER ACTION REQUIRED

V-5

INSUFFICIENT INFORMATION TO CONCLUDE ON CONTROL OF INTERSYSTEM LEAKAGE

MILLSTONE 1 - 4.16.2
OYSTER CREEK - 4.16.3

- PRA FOR DRESDEN 2 AND OYSTER CREEK CONCLUDED THAT THIS WAS NOT A SIGNIFICANT CONTRIBUTOR TO RISK.
- MILLSTONE 1 HAS ACTIVITY MONITORS ON THE CCW SYSTEM AND EFFLUENT MONITORS TO IDENTIFY SUCH LEAKAGE.
- NO ACTION REQUIRED

V-5 PRIMARY COOLANT LEAKAGE DETECTION SYSTEMS ARE NOT TESTED IN ACCORDANCE WITH CURRENT CRITERIA

DRESDEN 2 - 4.13.3
MILLSTONE 1 - 4.16.1
OYSTER CREEK - 4.16.2

- PROCEDURES DEMONSTRATE OPERABILITY
- NO ACTION REQUIRED

V-5

LEAKAGE DETECTION SYSTEMS DO NOT MEET SENSITIVITY OR SEISMIC DESIGN CRITERIA (SSE)

DRESDEN 2 - 4.13.1 & 2
MILLSTONE 1 - 4.16.1
OYSTER CREEK - 4.16.1

STAFF POSITION

- EVALUATE SENSITIVITY IN CONJUNCTION WITH III-5.A
- DEMONSTRATE RELIABLE SYSTEM
- PROVIDE PROCEDURES FOR SEISMIC EVENTS (MINIMUM)

- LICENSEES HAVE AGREED TO EVALUATE IN CONJUNCTION WITH III-5.A
- DRESDEN ORALLY AGREES IN CONCEPT - SPECIFICS TO BE DETERMINED

IV-2 INSUFFICIENT INFORMATION TO COMPLETE SINGLE - FAILURE ANALYSIS OF THE CONTROL ROD SYSTEM

MILLSTONE 1 - 4.15
OSYTER CREEK - 4.15

- ADDITIONAL INFORMATION PROVIDED
- DRESDEN 2 ANALYSIS SHOWS XV-8 TRANSIENTS BOUNDING
- NO ACTION REQUIRED

III-10.A ESF VALVES NOT IN EMERGENCY POSITION DO NOT BYPASS THERMAL OVERLOAD PROTECTION DEVICES

DRESDEN 2 - 4.12.1
MILLSTONE 1 - 4.14
OYSTER CREEK - 4.14(1)

LIMIT SWITCH MUST BYPASS TORQUE SWITCH TO INITIATE VALVE MOVEMENT

DRESDEN 2 - 4.12.2
OYSTER CREEK - 4.14(1)

- LICENSEE WILL EVALUATE TRIP SETPOINTS AND ADJUST OR BYPASS AS NECESSARY
- DRESDEN ORALLY INDICATED EVALUATION COMPLETE
- TORQUE SWITCHES - CURRENT CRITERIA MET

III-8.A NO LOOSE-PARTS MONITORING PROGRAM FOR PRIMARY SYSTEM

DRESDEN 2 - 4.11
MILLSTONE 1 - 4.13
OYSTER CREEK - 4.14(1)

- 31 LOOSE PARTS INCIDENTS RESULTED IN DAMAGE IN 9 CASES AND NEGLIGIBLE CONSEQUENCES
- LOOSE PARTS CAN USUALLY BE DETECTED DURING REFUELING
- PRA CONCLUDED NEGLIGIBLE EFFECT ON RISK
- BACKFITTING WILL BE CONSIDERED IN IMPLEMANTATION OF RG 1.133
- NO ACTION REQUIRED

III-7.B SIGNIFICANCE OF IDENTIFIED CODE CHANGES AND COMBINATIONS OF LOADS

DRESDEN 2 - 4.10
MILLSTONE 1 - 4.12
OYSTER CREEK - 4.12

- LICENSEES WILL EVALUATE SPECIFIC CHANGES IDENTIFIED ON SAMPLING BASIS

- MILLSTONE WILL ADDRESS WITH AN "INTEGRATED STRUCTURAL ASSESSMENT" TO RESOLVE ISSUES FROM FROM II-3.B, II-4.F, III-2, III-3.A, III-4.A, AND III-6.

III-6 LPCI AND CONTAINMENT SPRAY HEAT EXCHANGERS MAY NOT BE ADEQUATELY RESTRAINED FOR SEISMIC EVENTS

MILLSTONE 1 - 4.11.3

ANCHORS FOR TRANFORMERS AND CONTROL ROOM PANELS MAY PREVENT SLIDING OR OVERTURNING

MILLSTONE 1 - 4.11.4
OYSTER CREEK - 4.LL(3)

- NNECo PROVIDED ADDITIONAL INFORMATION TO JUSTIFY THE ADEQUACY OF THE DESIGN
- STAFF IS CURRENTLY REVIEWING THE ELECTRICAL ANCHORAGE SUBMITTAL
- NO ACTION REQUIRED

III-6 SEISMIC QUALIFICATION OF CABLE TRAYS

DRESDEN 2 - 4.9.3
MILLSTONE 1 - 4.11.6
OYSTER CREEK - 4.11(5)

- SEP OWNER'S GROUP PROGRAM TO DEFINE ANALYTICAL METHODS

- PLANT-SPECIFIC IMPLEMENTATION

III-6 FUNCTIONALITY OF SAFETY-RELATED ELECTRICAL EQUIPMENT

DRESDEN 2 - 4.9.4
MILLSTONE 1 - 4.11.5
OYSTER CREEK - 4.11(4)

- SEP OWNER'S GROUP PROGRAM FOR EQUIPMENT QUALIFICATION WILL BE INTEGRATED INTO THE DEVELOPMENT AND IMPLEMENTATION OF USI A-46.

- NO ACTION REQUIRED

III-6 SEISMIC CAPABILITY OF MOTOR-OPERATED VALVES

DRESDEN 2 - 4.9.2(1)
MILLSTONE 1 - 4.11.2

SEISMIC CAPABILITY OF REACTOR INTERNALS

DRESDEN 2 - 4.9.2(2)
MILLSTONE 1 - 4.11.8
OYSTER CREEK - 4.11(2)

- LICENSEES WILL EVALUATE CAPACITIES AND SUBMIT RESULTS
- DRESDEN WILL DEMONSTRATE APPLICABILITY OF OYSTER CREEK ANALYSIS

III-6 SEISMIC CAPABILITY OF ESF PIPING SUPPORTS

DRESDEN 2 - 4.9.1 & 2
MILLSTONE 1 - 4.11.7
OYSTER CREEK - 4.11(1)

- ISSUE BEING RESOLVED IN CONJUNCTION WITH IE BULLETIN 79-14 - NO ACTION REQUIRED

- DRESDEN - EVALUATION OF SEISMIC CAPABILITY OF THE RECIRCULATION PUMPS AND THEIR SUPPORTS - LICENSEE HAS ORALLY AGREED TO ANALYZE FOR NRC LOADING CONDITION

III-5.B JET EXPANSION MODEL FOR ISOLATION CONDENSER BREAK EFFECTS MAY BE NON-CONSERVATIVE

MILLSTONE 1 - 4.10.2

- LICENSEE AGREED TO EVALUATE THE SPECIFIC CONCERNS AND SUBMIT RESULTS

III-5.B MODERATE ENERGY PIPE BREAKS WOULD CAUSE EXCESSIVE FLOODING IN THE REACTOR AND TURBINE BUILDINGS

MILLSTONE 1 - 4.10.1

- AN ANALYSIS OF THE MODERATE ENERGY SYSTEMS INDICATES THAT:
  - FLOODING IN THE TURBINE BUILDING (CONDENSER BAY) WOULD AFFECT THE FEEDWATER COOLANT INJECTION SYSTEM, BUT THE REST OF THE ECCS WOULD REMAIN AVAILABLE FOR PLANT SHUTDOWN.
  - FLOODING IN THE REACTOR BUILDING (CORNER ROOMS) DOES NOT PREVENT SAFE SHUTDOWN.
- THE WETTING OR SPRAYING OF SAFETY-RELATED ELECTRICAL EQUIPMENT IS BEING ADDRESSED GENERICALLY AS PART OF THE ENVIRONMENTAL QUALIFICATION PROGRAM OF ELECTRICAL EQUIPMENT (USI A-24).
- NO ACTION REQUIRED

III-5.B NO STRESS DATA PROVIDED FOR CONTAINMENT PENETRATION PIPE SEGMENT - PIPE BREAKS IN THIS SEGMENT OR A BREAK DOWNSTREAM DAMAGING THE OUTBOARD ISOLATION VALVE WITH A FAILURE OF THE INBOARD VALVE WOULD BE UNISOLABLE.

DRESDEN 2 - 4.8
MILLSTONE 1 - 4.10.3
OYSTER CREEK - 4.10(1)

- PRA CONCLUDED LOCA FREQUENCY OF THIS TYPE IS ABOUT 2 x 10^{-7}/RY - RANDOM VALVE FAILURES DOMINATE

- NO ACTION REQUIRED

III-5.A INADEQUATE EVALUATEION OF JET IMPINGEMENT AND PIPE WHIP EFFECTS

DRESDEN 2 - 4.7.1 , 2 & 4
MILLSTONE - 4.9.2 & 3
OYSTER CREEK - 4.9(2) & (3)

- LICENSEES WILL EVALUATE SPECIFIC ISSUES IDENTIFIED AND SUBMIT RESULTS

III-4.B TURBINE DISASSEMBLY AND INSPECTIONS ARE NOT CONDUCTED AT APPROXIMATELY THREE YEAR INTERVALS

DRESDEN 2 - 4.6
MILLSTONE 1 - 4.8
OYSTER CREEK - 4.7

- GE GENERIC INSPECTION FREQUENCY PROGRAM UNDER REVIEW
- PROPOSE FREQUENCY BASED ON TEST RESULTS
- DRESDEN PROPOSAL SUBMITTED
- MILLSTONE TO EVALUATE TESTING OF THE TURBINE CONTROL VALVES

III-4.A SYSTEMS REQUIRED FOR SAFE SHUTDOWN ARE NOT PROTECTED FROM TORNADO MISSILES

DRESDEN 2 - 4.5
MILLSTONE 1 - 4.7
OYSTER CREEK - 4.6

- PROVIDE AT LEAST ONE PROTECTED TRAIN TO ACHIEVE SAFE SHUTDOWN - EVALUATE AND IDENTIFY ANY NECESSARY CORRECTIVE ACTION

DRESDEN 2

- ESWS WILL BE ADDRESSED BY TMI III.D.3.4
- BATTERIES IN PROTECTED AREA (CONCRETE BLOCK)
- ASSURE DG LOSS OF INTAKE OR EXHAUST WILL NOT IMPAIR FUNCTION

III-3.C INSPECTION FREQUENCY OF INTAKE/DISCHARGE STRUCTURES AND FLOW REGULATING STATION DO NOT COMP'Y WITH CURRENT CRITERIA

DRESDEN 2 - 4.4.2
OYSTER CREEK - 4.5.1

- II-4.D CONCLUDED ROCK FOUNDATION FOR INTAKE/DISCHARGE STRUCTURES IS SOUND
- FLOW REGULATING STATION IS NOT SAFETY-RELATED
- NO ACTION REQUIRED

III-3.C INSPECTION OF WATER CONTROL STRUCTURES IS NOT FORMALIZED, DOES NOT PROVIDE FOR INSPECTIONS AFTER EXTREME EVENTS, OR CONDUCTED BY QUALIFIED ENGINEERING PERSONNEL

DRESDEN 2 - 4.4.3
MILLSTONE 1 - 4.6.3
OYSTER CREEK - 4.5.4

- LICENSEES AGREED TO MAKE APPROPRIATE MODIFICATIONS TO EXISTING INSPECTION PROCEDURES

III-3.A PMH WAVE ACTION MAY CAUSE STRUCTURAL DAMAGE

MILLSTONE 1 - 4.5.1

INSUFFICIENT INFORMATION TO DETERMINE WHETHER GROUNDWATER LOADS WERE CONSIDERED IN CORRECT LOAD COMBINATIONS

MILLSTONE 1 - 4.5.2

- STRUCTURAL EFFECTS WILL BE ADDRESSED IN III-7.B
- LOAD COMBINATIONS WILL BE EVALUATED ON A SAMPLING BASIS

III-2 INSUFFICIENT INFORMATION TO DETERMINE EFFECTS OF FAILURE OF NON-QUALIFIED STRUCTURES ON OTHER STRUCTURES

MILLSTONE 1 - 4.4.3
OYSTER CREEK - 4.3.3

- LICENSEE WILL EVALUATE EFFECTS OF FAILURE AND IDENTIFY ANY NECESSARY CORRECTIVE ACTION

III-2

NO EVALUATION OF TORNADO WIND LOADS ON COMPONENTS OUTSIDE QUALIFIED STRUCTURES

DRESDEN 2 - 4.3.3
MILLSTONE 1 - 4.4.4
OYSTER CREEK - 4.3.4

NO EVALUATION OF ROOF CAPACITIES FOR TORNADO WIND LOADS

DRESDEN 2 - 4.3.4
MILLSTONE 1 - 4.4.5
OYSTER CREEK - 4.3.6

UNABLE TO DETERMINE HOW WIND LOADS WERE INCLUDED IN LOAD COMBINATIONS

DRESDEN 2 - 4.3.5
MILLSTONE 1 - 4.4.6
OYSTER CREEK - 4.3.8

- LICENSEES WILL EVALUATE STRUCTURAL CAPACITIES, OR, IF NECESSARY, FAILURE CONSEQUENCES
- MILLSTONE WILL ADDRESS IN III-7.B

III-2 CAPABILITY OF VENTILATION STACK TO WITHSTAND DESIGN-BASIS TORNADO WIND LOADS (360 MPH)

DRESDEN 2 - 4.3.2
MILLSTONE 1 - 4.4.2
OYSTER CREEK - 4.3.2

- MILLSTONE WILL EVALUATE CAPABILITY IN CONJUCNTION WITH III-7.B
- DRESDEN MINIMUM CAPABILITY APPROXIMATELY 255 MPH (2×10^{-6}) PLUS CONSEQUENCES LIMITED NO ACTION REQUIRED

III-2 CAPABILITY OF REACTOR BUILDING SUPERSTRUCTURE TO WITHSTAND DESIGN-BASIS TORNADO WIND LOADS (360 MPH)

DRESDEN 2 - 4.3.1
MILLSTONE 1 - 4.4.1
OYSTER CREEK - 4.3.1

- MILLSTONE WILL EVALUATE CAPABILITY IN CONJUNCTION WITH III-7.B
- DRESDEN MINIMUM CAPABILITY APPROXIMATELY 160 MPH (3×10^{-5}) PLUS CONSEQUENCES LIMITED - NO ACTION REQUIRED

III-1 INSUFFICIENT INFORMATION TO CONCLUDE STRESS LIMITS AND PRESSURE/TEMPERATURE RATINGS FOR VALVES, PUMP DESIGN REQUIREMENTS AND TANK STRESS REQUIREMENTS ARE COMPARABLE TO CURRENT REQUIREMENTS.

MILLSTONE 1 - 4.3.3-5
OYSTER CREEK - 4.2

- LICENSEE WILL EVALUATE MARGINS OF SAFETY BASED ON DIFFERENCES ON A SAMPLING BASIS
- DESIGN BASIS TO BE INCLUDED IN FSAR UPDATE

III-1 INSUFFICIENT INFORMATION TO CONCLUDE ON FRACTURE TOUGHNESS AND RADIOGRAPHY

DRESDEN 2 - 4.2.1 & 2
MILLSTONE 1 - 4.3.1 & 2
OYSTER CREEK - 4.2

- PROVIDE EVALUATION IN FSAR UPDATE

DRESDEN 2 - RSCS, RBCCW, AND RWCV (4.2.2(1))

- SYSTEMS ARE OF LOW IMPORTANCE TO SAFETY
- FRACTURE TOUGHNESS DATA UNAVAILABLE
- NO ACTION REQUIRED

II-4.F

BUILDING PILE CAPACITY AND SSE EFFECTS ON THE SOIL STRENGTH FOR THE TURBINE AND GAS TURBINE BUILDINGS

MILLSTONE 1 - 4.2.1 & 2

SWS & ESWS COMMON PIPE SUPPORTED ON UNSUITABLE PEAT MATERIAL

MILLSTONE 1 - 4.2.3

- LICENSEE WILL EVALUATE IN III-7.B INCLUDING ANY NECESSARY SOIL INVESTIGATIONS

II-3.B DESIGN BASIS GROUNDWATER INCREASED FROM 514 TO 517 FT. MSP

DRESDEN 2 - 4.1.1
OYSTER CREEK- 4.4(2)

- SEP TOPIC III-3.A CONCLUDED STRUCTURAL INTEGRITY WOULD BE MAINTAINED AT WATER LEVELS UP TO 517 FT. MSL.
- NO ACTION REQUIRED

II-3 PMH FLOOD LEVEL AND WAVE EFFECTS MAY CAUSE INLEAKAGE OR STRUCTURAL DAMAGE

MILLSTONE 1 - 4.1.1 & 2
OYSTER CREEK - 4.1(7)

PMP MAY CAUSE EXCESSIVE ROOF LOADS

DRESDEN 2 - 4.1.3
MILLSTONE 1 - 4.1.7
OYSTER CREEK - 4.1(9)

- LICENSEE WILL EVALUATE EFFECTS OF INLEAKAGE ON SAFE SHUTDOWN CAPABILITY
- MILLSTONE STRUCTURAL EFFECTS WILL BE EVALUATED IN III-7.B
- DRESDEN WILL INSTALL SCUPPERS TO PREVENT ROOF PONDING

II-3 FLOOD EMERGENCY PLANS DO NOT ADEQUATELY PROVIDE SAFE SHUTDOWN PROCEDURES

DRESDEN 2 - 4.1.4
MILLSTONE 1 - 4.1.6
OYSTER CREEK- 4.1(4) & (6)

- LICENSEE WILL MODIFY FLOOD EMERGENCY PLAN TO ASSURE CAPABILITY TO ACHIEVE SAFE SHUT-DOWN IN EVENT OF SEVERE FLOODING CONDITIONS OR UPON LOSS OF ULTIMATE HEAT SINK.

II-3 PONDING, LOCAL FLOODING AND WAVE EFFECTS MAY CAUSE A LOSS OF SYSTEMS IN THE RADWASTE, CONTROL AND GAS TURBINE BUILDING AND THE DIESEL FUEL OIL TRANSFER PUMPS

MILLSTONE 1 - 4.1.3-5

- CREDIT FOR EXISTING FLOODGATES
- SAFETY-RELATED SYSTEMS ELEVATED WITH LOCAL FLOOR GRATES
- SYSTEMS IN WATER-TIGHT ROOMS
- SHUTDOWN CAN BE ACHIEVED AND MAINTAINED BY USE OF THE ISOLATION CONDENSER AND DIESEL-DRIVEN FIRE PUMPS. (FLOOD PROTECTED WITH SUPPLY FOR 12 HOURS.)
- THE FUEL OIL TRANSFER PUMPS ELECTRICAL MOTORS ARE ONLY 1.3 FT. BELOW THE CONSERVATIVELY ESTIMATED PMH WAVE ACTION HEIGHT.
- UNDER SECTION 4.1.6, FLOOD EMERGENCY PROCEDURES WILL BE REVISED TO ADDRESS SHUTDOWN WITH A LOSS OF OFFSITE POWER AND FAILURE OF THE FUEL OIL TRANSFER PUMPS.
- NO ACTION REQUIRED

ISSUE SUMMARIES*

DRESDEN 2

&

MILLSTONE 1

* INCLUDES COMMON OYSTER CREEK ISSUES

LICENSEE DISAGREES

MILLSTONE 1

VI-1C.A	REACTOR TRIP SYSTEM SURVEILLANCE FREQUENCIES (4.24)
XV-16 & XV-18	PRIMARY COOLANT ACTIVITY LIMITS (4.35 & 36)

MILLSTONE 1

V-11.A HIGH/LOW PRESSURE INTERLOCK (RWCU)
OC-4.19, D2-4.16*, M1-4.18

DRESDEN 2

II-3 PMP ROOF LOADS - INSTALL SCUPPERS
OC-4.1(9), D2-4.1.3, M1-4.1.7*

VI-4 LEAKAGE TEST TAPS
D2-4.18.2

HARDWARE

COMMON

VI-4	LOCKS FOR MANUAL ISOLATION VALVES OC-4.22.1, D2-4.18.1 & 3, M1-4.20.1
VI-4	SECOND ISOLATION VALVE D2-4.18.6, M1-4.20.2
VII-1.A	ISOLATE RPS FROM POWER SUPPLY OC-4.27(2), D2-4.24.3, M1-4.25.2
VIII-2	DIESEL/TURBINE GENERATOR ANNUNCIATORS (COMPLETE) OC-4.31(1), D2-4.26.1*, M1-4.28.5*
VIII-2	DIESEL/TURBINE GENERATOR TRIP BYPASSES OC-4.31(2), D2-4.26.2, M1-4.28.1, 2 & 4
VIII-3.B	BATTERY/DC STATUS INDICATION AND ALARMS OC-4.32, D2-4.28 & 4.23.3, M1-4.30

ISSUES WITH HARDWARE BACKFITS

MILLSTONE 1

V-12.A	COOLANT CONDUCTIVITY & CHLORIDE LIMITS (TS) OC-4.20, M1-4.19.1
VIII-1.A	DEGRADED GRID PROTECTION FOR CLASS 1E M1-4.27
VIII-2	TURBINE GENERATOR MAINTENANCE M1-4.28.3

DRESDEN 2

VI-7.C.1	DISCONNECT LINK PROCEDURES AND ADMINISTRATIVE CONTROLS FOR BREAKERS D2-4.21.2 & 3
VI-10.B	ADMINISTRATIVE CONTROLS TO PREVENT PARALLELING DC SYSTEMS AND "BYPASS" DG 2/3 DURING OPERATION D2-4.23.1 & 2
VII-3	SHUTDOWN COOLING INTERLOCK TESTS D2-4.25.4
XV-16 & XV-18	PRIMARY COOLANT ACTIVITY LIMITS OC-4.36 & 37, D2-4.31 & 32, M1-4.35 & 36*

PROCEDURES & TECHNICAL SPECIFICATIONS

COMMON

II-3	FLOODING EMERGENCY PROCEDURES OC-4.1(4) & (6), D2-4.1.4, M1-4.1.6
III-3.C	WATER CONTROL STRUCTURE INSPECTIONS OC-4.5.4, D2-4.4.3, M1-4.6.3
VI-4	VALVE LOCK ADMINISTRATIVE CONTROLS D2-4.18.1, M1-4.20.1
VI-4	PROCEDURES FOR REMOTE MANUAL ISOLATION OC-4.22.2, D2-4.18.2*, M1-4.20.3*
VIII-3.A	BATTERY SERVICE TESTS (TS) D2-4.27, M1-4.29
VIII-3.B	BATTERY "OUT OF SERVICE" TIME (TS) D2-4.21.4, M1-4.30

ISSUES WITH PROCEDURAL

OR TECHNICAL SPECIFICATION

CHANGES

V-12.A	RWCU/CONDENSATE DEMINERALIZER CAPACITY (TS) M1-4.19.2
VI-4	BRANCH LINE ISOLATION CAPABILITY M1-4.20.7
VI-7.A.3	CS PUMP COOLER TESTING M1-4.21.1
IX-5	INTAKE/SWS LOSS OF VENTILATION M1-4.32.4

MILLSTONE 1

II-3	EVALUATE CONSEQUENCES OF PMH FLOOD LEVEL OC-4.1(7), M1-4.1.1 & 2
II-3	PMP ROOF LOADS OC-4.1(9), D2-4.1.3*, M1-4.1.7
II-4.F	CAPABILITY OF PILE SUPPORTS M1-4.2.1 & 2
II-4.F	SWS & ESWS BURIED PIPING M1-4.2.3
III-1	DESIGN LIMITS FOR VALVES, PUMPS, AND TANKS OC-4.2, M1-4.3.3-5
III-2	REACTOR BUILDING SUPERSTRUCTURE - WIND LOADS OC-4.3.1, D2-4.3.1*, M1-4.4.1
III-2	VENTILATION STACK - WIND LOADS OC-4.3.2, D2-4.3.2*, M1-4.4.2
III-2	EVALUATE FAILURE OF NON-QUALIFIED STRUCTURES OC-4.3.3, M1-4.4.3
III-3.A	EVALUATE STRUCTURAL DAMAGE FROM PMH WAVE ACTION M1-4.5.1
III-3.A	GROUNDWATER LOAD COMBINATIONS M1-4.5.2
III-5.B	JET EXPANSION MODEL M1-4.10.2

DRESDEN 2

III-4.A	TORNADO MISSILES - SWS & DG INTAKE/EXHAUST D2-4.5.1(2) & 4.5.3
III-6	RECIRCULATION PUMP & SUPPORTS D2-4.9.2(3), M1-4.11.7*
VI-7.C.1	CLASS 1E ISOLATION D2-4.21.5

III-10.A THERMAL OVERLOAD SETPOINTS/BYPASS
OC-4.14(1), D2-4.12.1, M1-4.14

V-5 LEAKAGE DETECTION RELIABILITY & SENSITIVITY
OC-4.16.1, D2-4.13.1/2 & 4.7.3, M1-4.16.1 & 4.9.1

VI-4 REMOTE MANUAL ISOLATION VALVE LEAK DETECTION
OC-4.22.2, D2-4.18.2*, M1-4.20.3*

VI-7.C.1 AUTOMATIC TRANSFER OF FAULTED LOADS
OC-4.25(1), D2-4.21.1, M1-4.23.1 & 2

VII-1.A FLUX MONITORING ISOLATION
OC-4.27(1), D2-4.24.1 & 2, M1-4.25.1 (TEST)

IX-5 BATTERY VENTILATION - HYDROGEN
OC-4.34(4), D2-4.29.1, M1-4.32.2

IX-5 LPCI/CS/FWCI/DG-LOSS OF VENTILATION EFFECTS
OC-4.34(3), D2-4.29.2, M1-4.32.1, 2 & 3

<u>FURTHER EVALUATION</u>

<u>COMMON</u>

III-1 EVALUATE RADIOGRAPHY AND FRACTURE TOUGHNESS
OC-4.2, D2-4.2.1 & 4.2.2(2)*, M1-4.3.1 & 4.3.2

III-2 EVALUATE FAILURE OF COMPONENTS OUTSIDE QUALIFIED STRUCTURES
OC-4.3.4, D2-4.3.3, M1-4.4.4

III-2 EVALUATE CAPACITY OF ROOF DECKS
OC-4.3.6, D2-4.3.4, M1-4.4.5

III-2 COMBINATION OF WIND LOADS
OC-4.3.8, D2-4.3.5, M1-4.4.6

III-4.A ENSURE SAFE SHUTDOWN CAPABILITY FOR TORNADO MISSILES
OC-4.6.4, D2-4.5.4, M1-4.7

III-4.B TURBINE INSPECTION PROGRAM
OC-4.7, D2-4.6, M1-4.8

III-5.A JET IMPINGEMENT REEVALUATION
OC-4.9(2), D2-4.7.1, M1-4.9.2

III-5.A PIPE WHIP EFFECTS
OC-4.9(3), D2-4.7.2 & 4, M1-4.9.3

III-6 MOTOR OPERATED VALVE SEISMIC CAPABILITY
D2-4.9.2(1), M1-4.11.2

III-6 RPV INTERNALS SEISMIC CAPABILITY
OC-4.11(2), D2-4.9.2(2), M1-4.11.8

III-6 QUALIFICATION OF CABLE TRAYS
OC-4.11(5), D2-4.9.3, M1-4.11.6

III-7.B EVALUATE DIFFERENCES IN ORIGINAL DESIGN CRITERIA
OC-4.12, D2-4.10, M1-4.12

ISSUES REQUIRING

ADDITIONAL EVALUATION

WITH POTENTIAL FOR

BACKFIT

MILLSTONE 1

II-3	LOCAL FLOODING M1-4.1.3, 4.1.4, 4.1.5
III-5.B	MODERATE ENERGY PIPE BREAK EFFECTS M1-4.10.1
III-6	LPCI/CSS HEAT EXCHANGER RESTRAINTS M1-4.11.3
III-6	ELECTRICAL EQUIPMENT ANCHORS OC-4.11(3), M1-4.11.4
IV-2	REACTIVITY CONTROL SINGLE FAILURE OC-4.15, M1-4.15
V-5	INTERSYSTEM LEAKAGE OC-4.16.3, M1-4.16.2
VI-4	INSTRUMENT LINES OC-4.22.4, M1-4.20.5
VI-7.A.3	ESWS TESTING M1-4.21.2
VII-3	LOSS OF INSTRUMENT BUS M1-4.26 (UNDER EVALUATION)
XV-3	LOSS OF LOAD INITIAL POWER M1-4.34

DRESDEN 2

II-3.B	DESIGN BASIS GROUNDWATER (514 TO 517 FT. MSL) OC-4.4(2), D2-4.1.1
III-1	FRACTURE TOUGHNESS DATA (RSCS, RBCCW, RWCU) OC-4.2(2), D2-4.2.2(1), M1-4.3.2*
III-2	REACTOR BUILDING SUPERSTRUCTURE - WIND LOADS OC-4.3.1, D2-4.3.1, M1-4.4.1*
III-2	VENTILATION STACK - WIND LOADS OC-4.3.2, D2-4.3.2, M1-4.4.2*
III-3.C	INTAKE & DISCHARGE INSPECTION FREQUENCY OC-4.5.1, D2-4.4.2
III-4.A	SWS VENTILATION - TORNADO MISSILES OC-4.6.4, D2-4.5.1(1), M1-4.7*
III-4.A	BATTERIES - TORNADO MISSILES D2-4.5.2, M1-4.7*
III-10.A	TORQUE SWITCH BYPASS OC-4.14, D2-4.12.2
V-6	REACTOR VESSEL MATERIAL SURVEILLANCE OC-4.17, D2-4.14
V-11.A	HIGH/LOW PRESSURE INTERLOCKS (RWCU) OC-4.19, D2-4.16, M1-4.18*
VI-6	RBCCW & AIRLOCK LEAK TESTING D2-4.19
VII-3	SAFE SHUTDOWN - SINGLE FAILURE D2-4.25.3
IX-5	LPCI/CS VENTILATION - SINGLE FAILURE OC-4.34(3), D2-4.29.2(1), M1-4.32.1*

VIII-2 AC ANNUNCIATORS IEEE STD. 279-1971 (MODS COMPLETE)
OC-4.31(1), D2-4.26.1*, M1-4.28.5*

XV-1 TURBINE BYPASS FOR FEEDWATER CONTROLLER FAILURE
OC-4.35, D2-4.30, M1-4.33

NO ACTION

COMMON

III-5.B	UNISOLABLE BREAKS OUTSIDE CONTAINMENT OC-4.10(1), D2-4.8, M1-4.10.3
III-6	ESF ELECTRICAL EQUIPMENT FUNCTIONALITY OC-4.11(4), D2-4.9.4, M1-4.11.5
III-6	ESF PIPING SUPPORTS OC-4.11(1), D2-4.9.1*, M1-4.11.7
III-8.A	LOOSE-PARTS MONITORING OC-4.14(1), D2-4.11, M1-4.13
V-5	LEAKAGE DETECTION TESTABILITY OC-4.16.2, D2-4.13.3, M1-4.16.1
V-10.B	SAFE SHUTDOWN PROCEDURES OC-4.18, D2-4.25.1 & 2, M1-4.17
VI-4	TWO CHECK VALVES FOR ISOLATION (FEEDWATER) OC-4.22.5, D2-4.18.4, M1-4.20.6
VI-4	BOTH VALVES OUTSIDE CONTAINMENT OC-4.22.3, D2-4.18.5, M1-4.20.4
VI-7.A.4	CORE SPRAY NOZZLE EFFECTIVENESS OC-4.24, D2-4.20, M1-4.22
VI-10.A	RESPONSE TIME TESTING OC-4.26.1, D2-4.22, M1-4.24.3

ISSUES NOT

REQUIRING BACKFIT

AS A RESULT OF SEP REVIEW

MILLSTONE

V-10.B (4.17) - SHUTDOWN PROCEDURES
1.0

VI-7.A.3 (4.21) - CSS/ESW TESTING
1.0

VI-7.C.1/VII-3 (4.23) - BUS TRANSFERS, LOSS OF INSTRUMENT BUS
0.84

VI-10.A (4.24) - RPS TESTING
1.0

IX-3 (4.31) - SERVICE WATER NONREDUNDANT PIPE FAILURE
1.0

XV-3 (4.34) - LOSS OF LOAD INITIAL POWER
1.0

DRESDEN 2

V-11.B (4.17) - SHUTDOWN COOLING INTERLOCK TESTING
MEDIUM

VI-7.C.1 (4.21) - DISCONNECT/LINK BREAKERS PROCEDURES
LOW

VI-10.B (4.23) - PARALLELING BATTERIES
LOW

VII-3 (4.25) - SHUTDOWN PROCEDURES
LOW

XV-16 (4.31) - SMALL LINE BREAK CONSEQUENCES
LOW

VII-1.A	RPS ISOLATION DRESDEN (4.24) - LOW MILLSTONE (4.25) - 1.0
VIII-2	DIESEL/TURBINE ANNUNCIATORS AND BYPASSES DRESDEN (4.26) - LOW MILLSTONE (4.28.5) - 0.995
VIII-3.A	BATTERY TESTING DRESDEN (4.27) - HIGH (IF EXISTING TEST INADEQUATE) MILLSTONE (4.29) - BEYOND SCOPE (QUALITATIVE)
VIII-3.B	DC SYSTEM MONITORING DRESDEN (4.28) - HIGH MILLSTONE (4.30) - 0.987
IX-5	LOSS OF VENTILATION DRESDEN (4.29) - LOW MILLSTONE (4.32) - 1.0
XV-1	FEEDWATER CONTROLLER FAILURE WITHOUT BYPASS DRESDEN (4.30) - LOW MILLSTONE (4. 33) - 1.0
XV-18	MAIN STEAM BREAK CONSEQUENCES DRESDEN (4.32) - LOW MILLSTONE (4.36) - 1.0

ISSUES ADDRESSED BY PRA*

III-5.B	UNISOLATABLE PIPE BREAK OUTSIDE CONTAINMENT DRESDEN (4.8) - LOW MILLSTONE (4.10) - INFORMATION NOT AVAILABLE
III-8.A	LOOSE PARTS MONITORING DRESDEN (4.11) - LOW MILLSTONE (4.13) - 1.0
III-10.A	THERMAL OVERLOAD BYPASSES DRESDEN (4.12) - MEDIUM MILLSTONE (4.14) - 0.996
V-5	PRIMARY COOLANT LEAKAGE DETECTION DRESDEN (4.13) - LOW MILLSTONE (4.16.1) - 0.98
V-11.A	HIGH/LOW PRESSURE ISOLATION (RWCU) DRESDEN (4.16) - LOW (IF RELIEF WORKS) MILLSTONE (4.18) - 0.991
VI-4	CONTAINMENT ISOLATION DRESDEN (4.18) - LOW MILLSTONE (4.20) - 1.0
VI-10.A	RESPONSE TIME TESTING DRESDEN (4.22) - LOW MILLSTONE (4.24.3) - 1.0

* DRESDEN CHARACTERIZED AS LOW, MEDIUM OR HIGH
MILLSTONE RATIO OF NEW TO OLD RISK

DRESDEN 2

II-4.E	DAM INTEGRITY
II-4.F	SETTLEMENT OF FOUNDATIONS
III-3.A	EFFECTS OF HIGH WATER LEVEL ON STRUCTURES
IV-2	REACTIVITY CONTROL SYSTEMS
V-4	PIPING AND SAFE-END INTEGRITY
V-12.A	WATER PURITY AND BWR PRIMARY COOLANT
VI-7.A.3	ECCS ACTUATION SYSTEM
VIII-1.A	POTENTIAL EQUIPMENT FAILURES ASSOCIATED WITH DEGRADED GRID VOLTAGE
IX-3	STATION SERVICE AND COOLING WATER SYSTEMS
XV-3	LOSS OF EXTERNAL LOAD, TURBINE TRIP, LOSS OF CONDENSER VACUUM, CLOSURE OF MAIN STEAM ISOLATION VALVE

MILLSTONE 1

V-6	REACTOR VESSEL INTEGRITY
V-11.B	RESIDUAL HEAT REMOVAL SYSTEM INTERLOCK REQUIREMENTS
VI-6	CONTAINMENT LEAK TESTING
VI-10.B	SHARED ENGINEERED SAFETY FEATURES

XV-13	SPECTRUM OR ROD DROP ACCIDENTS (BWR)
XV-14	INADVERTENT OPERATION OF EMERGENCY CORE COOLING SYSTEM AND CHEMICAL AND VOLUME CONTROL SYSTEM MALFUNCTION THAT INCREASES REACTOR COOLANT INVENTORY
XV-15	INADVERTENT OPENING OF A PWR PRESSURIZER SAFETY/ RELIEF VALVE OR A BWR SAFETY/RELIEF VALVE
XV-19	LOSS-OF-COOLANT ACCIDENTS RESULTING FROM SPECTRUM OF POSTULATED PIPING BREAKS WITHIN THE REACTOR COOLANT PRESSURE BOUNDARY
XV-20	RADIOLOGICAL CONSEQUENCES OF FUEL-DAMAGING ACCIDENTS (INSIDE AND OUTSIDE CONTAINMENT)
XVII	OPERATIONAL QUALITY ASSURANCE PROGRAM

VII-2	ENGINEERED SAFETY FEATURES SYSTEM CONTROL LOGIC AND DESIGN
VII-6	FREQUENCY DECAY
VIII-4	ELECTRICAL PENETRATIONS OF REACTOR CONTAINMENT (DRESDEN EQUIVALENT)
IX-1	FUEL STORAGE (MILLSTONE EQUIVALENT)
IX-6	FIRE PROTECTION
XIII-2	SAFEGUARDS/INDUSTRIAL SECURITY
XV-4	LOSS OF NONEMERGENCY AC POWER TO THE STATION AUXILIARIES
XV-5	LOSS OF NORMAL FEEDWATER FLOW
XV-7	REACTOR COOLANT PUMP ROTOR SEIZURE AND REACTOR COOLANT PUMP SHAFT BREAK
XV-8	CONTROL ROD MISOPERATION (SYSTEM MALFUNCTION OR OPERATOR ERROR)
XV-9	STARTUP OF AN INACTIVE LOOP OR RECIRCULATION LOOP AT AN INCORRECT TEMPERATURE, AND FLOW CONTROLLER MALFUNCTION CAUSING AN INCREASE IN BWR FLOW RATE
XV-11	INADVERTENT LOADING AND OPERATION OF A FUEL ASSEMBLY IN AN IMPROPER POSITION (BWR)

III-10.C	SURVEILLANCE REQUIREMENTS ON BWR RECIRCULATION PUMP AND DISCHARGE VALVES
IV-1.A	OPERATION WITH LESS THAN ALL LOOPS IN SERVICE
IV-3	BWR JET PUMP OPERATING INDICATIONS
V-10.A	RESIDUAL HEAT REMOVAL SYSTEM HEAT EXCHANGER TUBE FAILURES
VI-1	ORGANIC MATERIALS AND POST ACCIDENT CHEMISTRY
VI-2.D	MASS AND ENERGY RELEASE FOR POSTULATED PIPE BREAK INSIDE CONTAINMENT (MILLSTONE EQUIVALENT)
VI-3	CONTAINMENT PRESSURE AND HEAT REMOVAL CAPABILITY (MILLSTONE EQUIVALENT)
VI-7.C	EMERGENCY CORE COOLING SYSTEM (ECCS) SINGLE-FAILURE CRITERION AND REQUIREMENTS FOR LOCKING OUT POWER TO VALVES, INCLUDING INDEPENDENCE OF INTERLOCKS ON ECCS VALVES
VI-7.C.2	FAILURE MODE ANALYSIS (EMERGENCY CORE COOLING SYSTEM)
VI-7.D	LONG-TERM COOLING PASSIVE FAILURES (E.G., FLOODING OF REDUNDANT COMPONENTS)
VII-1.B	TRIP UNCERTAINTY AND SETPOINT ANALYSIS REVIEW OF OPERATING DATA BASE

TOPIC	TITLE
II-1.A*	EXCLUSION AREA AUTHORITY AND CONTROL
II-1.B	POPULATION DISTRIBUTION
II-1.C	POTENTIAL HAZARDS OR CHANGES IN POTENTIAL HAZARDS DUE TO TRANSPORTATION, INSTITUTIONAL, INDUSTRIAL, AND MILITARY FACILITIES
II-2.A	SEVERE WEATHER PHENOMENA
II-2.C	ATMOSPHERIC TRANSPORT AND DIFFUSION CHARACTERISTICS FOR ACCIDENT ANALYSIS
II-3.A	HYDROLOGIC DESCRIPTION
II-4	GEOLOGY AND SEISMOLOGY
II-4.A*	TECTONIC PROVINCE
II-4.B	PROXIMITY OF CAPABLE TECTONIC STRUCTURES IN PLANT VICINITY
II-4.C*	HISTORICAL SEISMICITY WITHIN 200 MILES OF PLANT
II-4.D	STABILITY OF SLOPES
III-4.C	INTERNALLY GENERATED MISSILES
III-4.D	SITE-PROXIMITY MISSILES (INCLUDING AIRCRAFT)
III-7.D	CONTAINMENT STRUCTURAL INTEGRITY TESTS
III-8.C	IRRADIATION DAMAGE, USE OF SENSITIZED STAINLESS STEEL, AND FATIGUE RESISTANCE

TOPICS WHICH MEET
CURRENT CRITERIA OR
ARE ACCEPTABLE ON
"ANOTHER DEFINED BASIS"*

* THESE TOPICS ARE IDENTIFIED BY ASTERISKS

TOPICS NOT APPLICABLE (CONT.)

SEP Topic No.	SEP title	Reason for deletion of topic
XI-2	Radiological (Effluent and Process) Monitoring Systems	Being resolved under generic activities A-02, "Appendix I." (See "Basis for Deletion" in Appendix A under Topic XI-2.)
XV-2	Spectrum of Steam System Piping Failures Inside and Outside Containment (PWR)	Not applicable to BWRs.
XV-6	Feedwater System Pipe Breaks Inside and Outside Containment (PWR)	Not applicable to BWRs.
XV-10	Chemical and Volume Control System Malfunction That Results in a Decrease in Boron Concentration in the Reactor Coolant (PWR)	Not applicable to BWRs.
XV-12	Spectrum of Rod Ejection Accidents (PWR)	Not applicable to BWRs.
XV-17	Radiological Consequences of Steam Generator Tube Failure (PWR)	Not applicable to BWRs.
XV-23	Multiple Tube Failures in Steam Generators	Not applicable to BWRs.
XVI	Technical Specifications	Will be addressed after completion of the integrated assessment.

TOPICS NOT APPLICABLE

SEP Topic No.	SEP title	Reason for deletion of topic
* II-4.E	Dam Integrity	Not applicable to site.
III-3.B	Structural and Other Consequences (e.g., Flooding of Safety-Related Equipment in Basements) of Failure of Underdrain Systems	Not applicable to site because site does not have a system whose function is to lower the groundwater table.
III-7.A	Inservice I pection, Including Prestressed Concrete Containments With Either Grouted or Ungrouted Tendons	Not applicable to this unit's containment design.
III-7.C	Delamination of Prestressed Concrete Containment Structures	Not applicable to this unit's containment design.
III-8.B	Control Rod Drive Mechanism Integrity	Review published as NUREG-0479, "Report on BWR Control Rod Drive Failures."
III-10.B	Pump Flywheel Integrity	Not applicable to BWRs.
V-1	Compliance With Codes and Standards	Reviewed under inservice inspection/inservice test program.
V-2	Applicability of Code Cases	Not applicable at this time; to be reviewed for any future modifications using references to Code Cases.
V-3	Overpressurization Protection	Not applicable to BWRs, based on operating experience.
V-7	Reactor Coolant Pump Overspeed	Not applicable to BWRs.
V-8	Steam Generator Integrity	Not applicable to BWRs.
V-9	Reactor Core Isolation Cooling System (BWR)	Not applicable to this facility design.
VI-2.C	Ice Condenser Containment	Not applicable to this unit's containment design.
VI-7.A.1	Emergency Core Cooling System Reevaluation To Account for Increased Reactor Vessel Upper-Head Temperature	Not applicable to BWRs.
VI-7.A.2	Upper Plenum Injection	Not applicable to BWRs.
VI-7.B	Engineered Safety Feature Switchover From Injection to Recirculation Mode (Automatic Emergency Core Cooling System Realignment)	Not applicable to BWRs.
VI-7.C.3	Effect of PWR Loop Isolation Valve Closure During a Loss-of-Coolant Accident on Emergency Core Cooling System Performance	Not applicable to BWRs.
VI-7.F	Accumulator Isolation Valves Power and Control System Design	Not applicable to BWRs.
VI-9	Main Steam Line Isolation Seal System (BWR)	Not applicable to this facility design.
VII-7	Acceptability of Swing Bus Design on BWR-4 Plants	Not applicable to this facility design.
IX-4	Boron Addition System (PWR)	Not applicable to BWRs.
X	Auxiliary Feedwater System	Not applicable to BWRs.
XI-1	Appendix I	Being resolved under generic activities A-02, "Appendix I," and B-35, "Confirmation of Appendix I Models." (See "Basis for Deletion" in Appendix A under Topic XI-1.)

*MILLSTONE 1 & OYSTER CREEK

GENERIC TOPICS DELETED

SEP Topic No.	SEP Title	TMI, USI, or SEP No.	TMI, USI, or SEP Title
II-2.B	Onsite Meteorological Measurements Program	TMI II.F.3 TMI III.A.1	Instrumentation for Monitoring Accident Conditions Improve Licensee Emergency Preparedness - Short Term
II-2.D	Availability of Meteorological Data in the Control Room	TMI II.F.3 TMI III.A.1 TMI I.D.1	Instrumentation for Monitoring Accident Conditions Improve Licensee Emergency Preparedness - Short Term Control Room Design Reviews
III-8.D	Core Supports and Fuel Integrity	USI A-2	Asymmetric Blowdown Loads on Reactor Primary Coolant System
III-9	Support Integrity	USI A-12 USI A-7 USI A-24 USI A-46 SEP III-6 SEP V-1	Fracture Toughness of Steam Generator and Reactor Coolant Pump Supports Mark I Containment Long-Term Program Environmental Qualification of Safety-Related Equipment Seismic Qualification of Equipment in Operating Plants Seismic Design Considerations Compliance With Codes and Standards (10 CFR Part 50, Section 50.55a)
III-11	Component Integrity	USI A-46 USI A-2 SEP III-6	Seismic Qualification of Equipment in Operating Plants Asymmetric Blowdown Loads on Reactor Primary Coolant Seismic Design Considerations
III-12	Environmental Qualification of Safety-Related Equipment	USI A-24	Qualification of Safety-Related Equipment
* V-4	Piping and Safe-End Integrity	USI A-42	Pipe Cracks in Boiling Water Reactors
V-13	Waterhammer	USI A-1	Waterhammer
VI-2.A	Pressure-Suppression-Type BWR Containments	USI A-7	Mark I Containment Long-Term Program
VI-2.B	Subcompartment Analysis	USI A-2	Asymmetric Blowdown Loads on Reactor Primary Coolant System
VI-5	Combustible Gas Control	TMI II.B.7 USI A-48	Analysis of Hydrogen Control Hydrogen Control Measures and Effects of Hydrogen Burns on Safety Equipment
VI-7.E	Emergency Core Cooling System Sump Design and Test for Recirculation Mode Effectiveness	USI A-43	Containment Emergency Sump Reliability
VI-8	Control Room Habitability	TMI III.D.3.4	Control Room Habitability Requirements
VII-4	Effects of Failure in Nonsafety-Related Systems on Selected Engineered Safety Features	USI A-47 USI A-17	Safety Implications of Control Systems Systems Interactions in Nuclear Power Plants
VII-5	Instruments for Monitoring Radiation and Process Variables During Accidents	TMI II.F.1 TMI II.F.2 TMI II.F.3	Additional Accident Monitoring Instrumentation Identification of and Recovery From Conditions Leading to Inadequate Core Cooling Instruments for Monitoring Accident Conditions
IX-2	Overhead Handling Systems (Cranes)	USI A-36	Control of Heavy Loads Near Spent Fuel Pool
XIII-1	Conduct of Operations	TMI I.C.6 TMI III.A.1 TMI III.A.2	Procedures for Verification of Correct Performance of Operating Activities Improve Licensee Emergency Preparedness - Short-Term Improving Licensee Emergency Preparedness - Long-Term
XV-21	Spent Fuel Cask Drop Accidents	USI A-36	Control of Heavy Loads Near Spent Fuel Pool
XV-22	Anticipated Transients Without Scram	USI A-9	Anticipated Transients Without Scram
XV-24	Loss of All AC Power	USI A-44	Station Blackout

* MILLSTONE 1 & OYSTER CREEK

SEP SUMMARY*

DRESDEN 2 & MILLSTONE 1

- TOPICS DELETED
- TOPICS MEETING OR EQUIVALENT TO CURRENT CRITERIA
- TOPICS ADDRESSED BY PRA

- INTEGRATED ASSESSMENT
  - ISSUES REQUIRING NO BACKFIT
  - ISSUES REQUIRING FURTHER EVALUATION
  - ISSUES REQUIRING PROCEDURAL OR TECHNICAL SPECIFICATION CHANGES
  - ISSUES REQUIRING HARDWARE BACKFITS
  - ISSUES WITH DISAGREEMENT

* COMMON AND UNIQUE TO DRESDEN 2 & MILLSTONE 1

SUMMARY

PHASE II TOPICS - 137

	DRESDEN 2	MILLSTONE 1
GENERIC TOPICS DELETED	19	20
PLANT SPECIFIC DELETED	30	31
TOPICS REVIEWED	88	86
TOPICS ACCEPTABLE	54	48
INTEGRATED ASSESSMENT		
TOPICS	34	38
ISSUES	72	87

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RISK ANALYSIS OF OYSTER CREEK, DRESDEN-2, AND MILLSTONE-1 SEP ISSUES

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BASIS OF EVALUATION

- OYSTER CREEK AND DRESDEN-2:

  QUALITATIVE ANALYSIS OF IMPACT OF RESOLUTION OF EACH ISSUE ON DOMINANT CORE MELT SEQUENCES.

- MILLSTONE-1:

  QUANTITATIVE ANALYSIS OF CHANGE IN CORE MELT FREQUENCY, EXPOSURE, AND RISK FROM RESOLUTION OF EACH ISSUE.

IREP MILLSTONE-1 PRA USED FOR BASE CASE:

- APPLIES DIRECTLY TO MILLSTONE-1.

- OYSTER CREEK AND DRESDEN-2 FAIRLY SIMILAR TO MILLSTONE-1. CHANGES MADE TO MILLSTONE-1 FAULT TREES TO REPRESENT OTHER PLANTS FOR QUALITATIVE CONSIDERATION.

OYSTER CREEK/DRESDEN-2 CLASSIFICATION OF ISSUE IMPORTANCE

CLASSIFICATION	CRITERION
HIGH	RESOLUTION OF ISSUE DOMINATES VALUE OF TOP EVENT OF A DOMINANT "PLANT" FAULT TREE OR DOMINANT SEQUENCE EVENT.
MEDIUM	RESOLUTION OF ISSUE IMPACTS BUT DOES NOT DOMINATE VALUE OF DOMINANT FAULT TREE OR DOMINANT SEQUENCE EVENT.
LOW	RESOLUTION OF ISSUE HAS NO IMPACT ON VALUE OF TOP EVENT OF DOMINANT FAULT TREE OR DOMINANT SEQUENCE EVENT.

SEP COMPARATIVE RISK RESULTS

ISSUE		IMPORTANCE DRESDEN-2	OYSTER CREEK	MILLSTONE-1 (Δ CORE MELT)
III-8.A	LOOSE PARTS	LOW	LOW	0%
III-10.A	MOV THERMAL OVERLOAD BYPASS	MEDIUM	MEDIUM	1%
VI-4	CONTAINMENT ISOLATION	LOW	LOW	0%
VIII-3.B	DC INSTRUMENTATION	HIGH	HIGH	0.6%

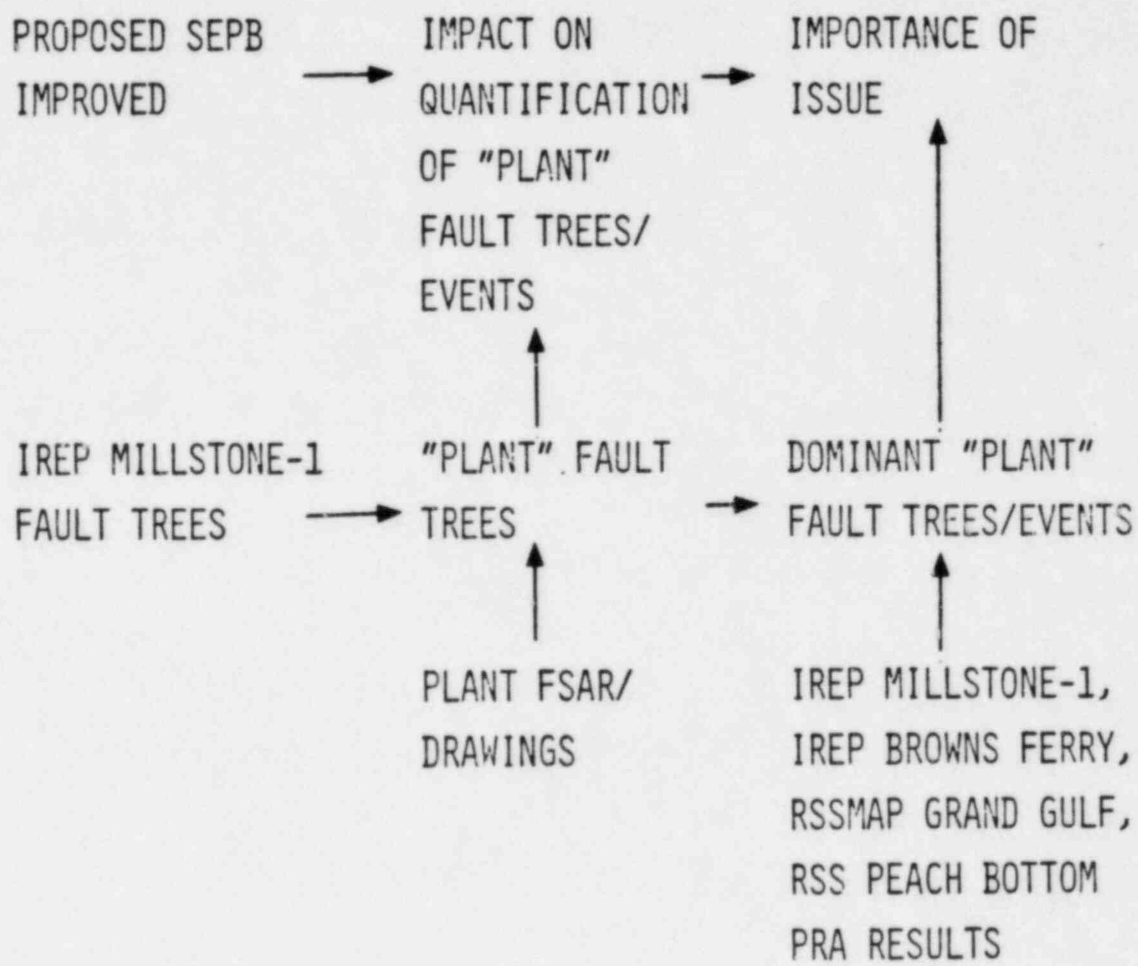
OBJECTIVE:

EVALUATE THE SEP ISSUES FOR OYSTER CREEK, DRESDEN-2, AND MILLSTONE-1 BASED ON THE IMPACT THEIR RESOLUTION WOULD HAVE ON PROBABILISTIC CALCULATIONS OF RISK.

SCOPE:

THOSE ISSUES WHICH WERE WITHIN THE SCOPE OF WELL ESTABLISHED PRA TECHNIQUES.

OYSTER CREEK/DRESDEN-2 METHODOLOGY



"PLANT" = DRESDEN-2 OR OYSTER CREEK

DOMINANT FAULT TREE OR EVENT WOULD

APPEAR IN DOMINANT ACCIDENT SEQUENCES.

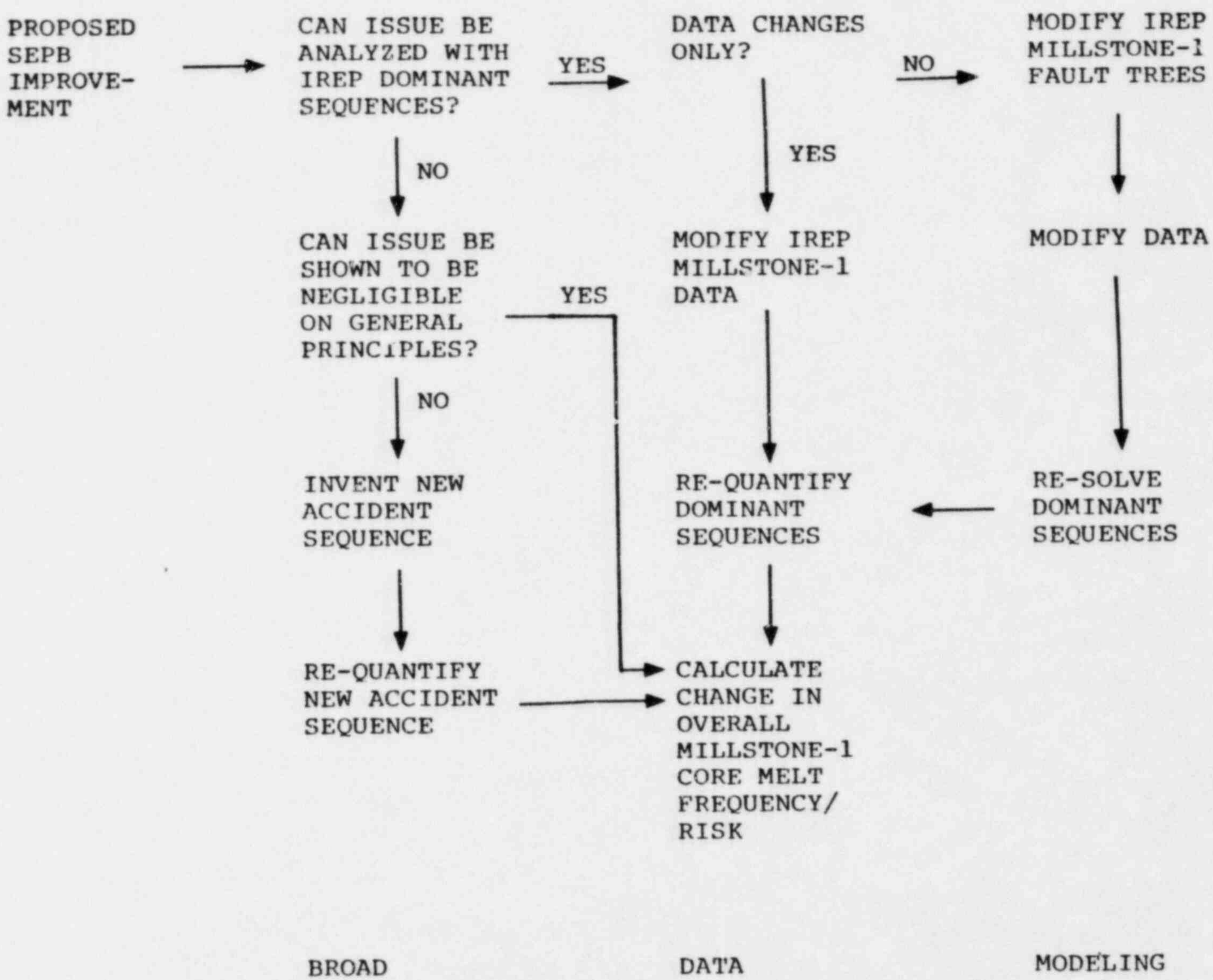
MILLSTONE-1 ANALYSIS:

RE-CALCULATED RESULTS OF IREP MILLSTONE-1 PRA INCORPORATING RESOLUTION OF EACH SEP ISSUE.

CATEGORIES OF MILLSTONE-1 ISSUE ANALYSIS

CATEGORY	DESCRIPTION
DATA	ISSUE AFFECTS ONLY BASIC EVENT DATA. NEW CUT SETS NOT REQUIRED.
MODELING	ISSUE AFFECTS DESIGN OF SYSTEM AND SYSTEM FAULT TREE. NEW CUT SETS WERE GENERATED.
BROAD	ISSUE NOT ANALYZED WITH IREP ACCIDENT SEQUENCES. ASSESSMENT MADE ON GENERAL PRINCIPLES OR INVENTION OF NEW SEQUENCES.

MILLSTONE-1 METHODOLOGY



RESULTS OF MILLSTONE-1 ANALYSIS

ISSUE	CONCERN	DECREASE IN CORE MELT FREQUENCY (1) $(R\text{-}YR)^{-1}$	DECREASE IN EXPOSURE (2) (MAN-REM/R-YR)	NEW RISK/ OLD RISK
III-5.B	PIPE BREAK OUTSIDE CONTAINMENT	(3)		
III-8.A	LOOSE PARTS	0.0	0.0	1.0
III-10.A	MOV THERMAL OVERLOAD PROTECTION	$3x10^{-6}$	3	0.996
V-5	LEAK DETECTION	$3x10^{-6}$	16	0.98
V-10.B	COLD SHUTDOWN	0.0	0.0	1.0
V-11.A	RWCU LOCA	$4x10^{-7}$	3	0.991
VI-4	CONTAINMENT PENETRATIONS	0.0	0.0	1.0
VI-6	CONTAINMENT LEAK TESTING	0.0	0.0	1.0
VI-7.A.3	TESTING OF ECCS	0.0	0.0	1.0
VI-7.C.1 / VII-3	REDUNDANCY OF ELECTRICAL BUSES	$3x10^{-5}$	90	0.84
VI-10.A	TESTING OF RPS	0.0	0.0	1.0
VII-1.A	ISOLATION OF RPS	0.0	0.0	1.0
VIII-2	BYPASSING GAS TURBINE TRIPS	$1x10^{-6}$	3	0.995
VIII-3.A	BATTERY TESTING	(4)		

RESULTS OF MILLSTONE-1 ANALYSIS (Cont.)

ISSUE	CONCERN	DECREASE IN CORE MELT FREQUENCY (1) $(R\text{-}YR)^{-1}$	DECREASE IN EXPOSURE (2) (MAN-REM/R-YR)	NEW RISK/ OLD RISK
VIII-3.B	DC BUS INSTRUMENTATION	1.7×10^{-6}(5) 7.4×10^{-6}(6)	2(5) 8(6)	0.997(5) 0.987(6)
IX-3	PIPE BREAK SINGLE FAILURE IN SWS, TBSCCW	0.0	0.0	1.0
IX-5	VENTILATION	0.0	0.0	1.0
XV-1	TRANSIENTS WITH TURBINE BYPASS UNAVAILABLE	0.0	0.0	1.0
XV-3	MCPR, LOSS OF EXTERNAL LOAD	0.0	0.0	1.0
XV-18	MAIN STEAM LINE BREAK	0.0	0.0	1.0

(1) TOTAL CORE MELT FREQUENCY = 3×10^{-4}/REACTOR-YEAR.

(2) TOTAL EXPECTED EXPOSURE = 550 MAN-REM/REACTOR-YEAR.

(3) INFORMATION TO ANALYZE THIS ISSUE NOT RECEIVED FROM UTILITY.

(4) ISSUE COULD REDUCE BATTERY UNAVAILABILITY, AT MOST, BY A FACTOR OF 16. EFFECT ON RISK OUTSIDE SCOPE OF THIS ANALYSIS.

(5) WITHOUT DECREASE IN MAINTENANCE UNAVAILABILITY.

(6) WITH DECREASE IN MAINTENANCE UNAVAILABILITY.

RESULTS OF DRESDEN-2 ANALYSIS

Issue	System/Component	Change in Unavailability q_{new}/q_{old}	Appears in Dominant Fault Tree/Event	Affects Top Event	Importance
III-5.B	Pipe break outside containment	---	No	No	Low
III-8.A	Transients	1.0 (transient frequency)	Yes	No	Low
III-10.A	Valves in all ECCS	0.86 (1 valve)	Yes	Yes	Medium
V-5	Small LOCA	1.0 (LOCA frequency)	No	No	Low
V-11.A	RWCU LOCA	$1.2x10^{-6}$	No	---	Low*
V-11.B	Shutdown Cooling	0.85 (shutdown cooling)	Yes	Yes	Medium
VI-4	Containment integrity	---	No	---	Low
VI-6	Containment integrity	---	No	---	Low
VI-7.C.1	AC and DC power	1.0 (AC or DC)	Yes	No	Low
VI-10.A	Reactor Trip System, Engineered Safety Features	1.0 (RTS)	Yes	No	Low
VI-10.B	AC and DC power	1.0 (DC power)	Yes	No	Low

*If pressure relief valve sufficiently sized. High importance if not sufficiently sized.

RESULTS OF DRESDEN-2 ANALYSIS

Issue	System/Component	Change in Unavailability q_{new}/q_{old}	Appears in Dominant Fault Tree/Event	Affects Top Event	Importance
VII-1.A	Reactor Trip System	1.0 (RTS)	Yes	No	Low
VII-3	Cooldown procedures	---	No	No	Low
VIII-2	AC power	0.98 (1 Diesel)	Yes	No	Low
VIII-3.A	DC power	6.5×10^{-2}** (1 battery)	Yes	Yes	High
VIII-3.B	DC Power	0.19 (1 bus)	Yes	Yes	High
IX-5	Ventilation	---	No	No	Low
XV-1	Power Conversion System	1.0	Yes	No	Low
XV-16	Offsite doses	---	No	---	Low
XV-18	Offsite doses	---	No	---	Low

**If present battery testing is totally ineffective.

RESULTS OF OYSTER CREEK ANALYSIS

Issue	System/Component	Change in Unavailability q_{new}/q_{old}	Appears in Dominant Fault Tree/Event	Affects Top Event	Importance
III-8.A	Transi ts	1.0 (Transient Frequency)	Yes	No	Low
III-10.A	Valves in Most Systems	0.86 (1 valve)	Yes	Yes	Medium
IV-2	Reactor Trip System	1.0	Yes	No	Low
V-5	Small LOCA	≥0.24 (LOCA Frequency)	No	---	Low
V-10.B	Residual Heat Removal Procedures	1.0 (RHR)	Yes	No	Low
V-11.A	Interfacing Systems LOCA	---	No	---	Low
VI-4	Containment Integrity	---	No	---	Low
VI-7.A.3	Emergency Condensers	1.0 (Emergency Condensers)	Yes	No	Low
VI-7.C.1	AC Power	0.85 (AC Power)	Yes	Yes	Medium

RESULTS OF OYSTER CREEK ANALYSIS

Issue	System/Component	Change in Unavailability q_{new}/q_{old}	Appears in Dominant Fault Tree/Event	Affects Top Event	Importance
VI-10.A	Reactor Trip System, Engineered Safety Features	1.0 (RTS)	Yes	No	Low
VII-1.A	Reactor Trip System	1.0 (RTS)	Yes	No	Low
VII-1.B	Setpoints for Several Systems	0.93 (1 Sensor)	Yes	No	Low
VII-2	Breakers for Several Systems	0.71 (1 Breaker)	Yes	No	Low
VII-3	Vital Instrumentation	0.36 - 1.2×10^{-4} (Vital AC Panel)	Yes	No	Low
VIII-2	AC Power	0.98 (1 Diesel)	Yes	No	Low
VIII-3.B	DC Power	~0.25 (1 Bus)	Yes	Yes	High
VIII-4	Containment Integrity	---	No	---	Low
XV-16	Offsite Doses	---	No	---	Low
XV-18	Offsite Doses	---	No	---	Low
XV-19	Offsite Doses	---	No	---	Low

Control and Instrumentation

Edited by C. S. Walker

Reliability of Engineered Safety Features as a Function of Testing Frequency

By I. M. Jacobs*

[Editor's Note: *Nuclear Safety* is pleased to present this paper by Mr. Jacobs in that it is a significant and original contribution that endeavors to lead the way to more reliable design of *all* safety systems.]

Abstract: The reliability of an engineered safety system is highly dependent on the frequency of tests performed to demonstrate its operability. Thus the frequency of tests becomes a design consideration of utmost importance. When the system is new, the operator must rely primarily on the designer's recommended test frequency. With actual in-service experience, the operator is able to regulate the test frequencies to attain an overall reliability goal. Under certain limiting conditions, there is clearly an optimum test frequency; more frequent or less frequent testing will degrade reliability. Techniques of modeling have been developed to solve safety-system reliability problems. The models serve as the means to bridge the gap between the uncertainty of design decisions and the stark reality of actual application.

Engineered safety systems are standby systems. They are tested periodically to confirm that they are operable and then returned to standby status. Although some failures of components in standby systems are self-annunciating, there are other unsafe failures that are not revealed until the next periodic test. The longer the interval between tests, the higher the probability that a failure has occurred since the last test. However, testing the system too frequently may take it out of service too much or even wear it out, both of which lead to decreased reliability.

Recently there have been reliability goals proposed on critical systems. To be meaningful these proposed goals must be in force throughout the lifetime of the nuclear power plant. Accordingly the goals are of concern to the design engineer at the conceptual stage, as well as to the plant operator, who must demonstrate continued conformance.

This paper deals with the general subject of testing of engineered safety systems and specifically with the following areas:

1. The time interval between tests as a design consideration.
2. Optimizing the availability by proper selection of the time interval between tests.
3. Adjusting the time interval between tests on the basis of field failure-rate information to assure conformance to a reliability goal over the nuclear power plant lifetime.

The terms "reliability" and "availability" are used throughout this paper. When reliability is used in a qualitative sense, it implies quality and integrity. When reliability is used in a quantitative sense, it refers to the classic definition, which embraces the concept of probability of survival for a finite time. Availability is the probability that a given system is operational at some unspecified future instant in time, and it takes account of downtime for repair work. The two terms are interrelated, and frequently availability may be treated as an average reliability. The meanings will be clarified as used here in their proper context.

Testing Frequency as a Design Consideration

A good designer chooses his basic components wisely and applies them conservatively within their

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ratings. In the interest of overall reliability, he endeavors to keep his design simple, easy to understand, and easy to test. In the interest of economy, he strives to keep the system in reasonable balance from the standpoint of reliability. Finally, he tries to imagine his system as it will be installed in an operating reactor plant and adjusts his design to the environments that exist there throughout the useful lifetime of the plant.

In addition, the design engineer must be the first one to be concerned with the thoroughness and frequency of system tests. First, he must design the system so that it can be adequately tested. The ease with which the test can be performed must in some measure be commensurate with the expected frequency of the test, and the designer must accordingly make provisions for the tests. Second, the recommendations of the designer as to the testing program must be passed along to the plant operator. This helps to assure that the design intent for the system is not thwarted before the operator can accumulate operating and failure-rate experience on his plant.

THE MODEL

Perhaps the concept of testing frequency as a design consideration can best be conveyed through the medium of an example problem. For this we assume that the designer is given the task of designing a reactor protection system with a goal of 10^{-5} or less probability of failure. His first conceptual design may be the simple reactor protection system of Fig. 1.

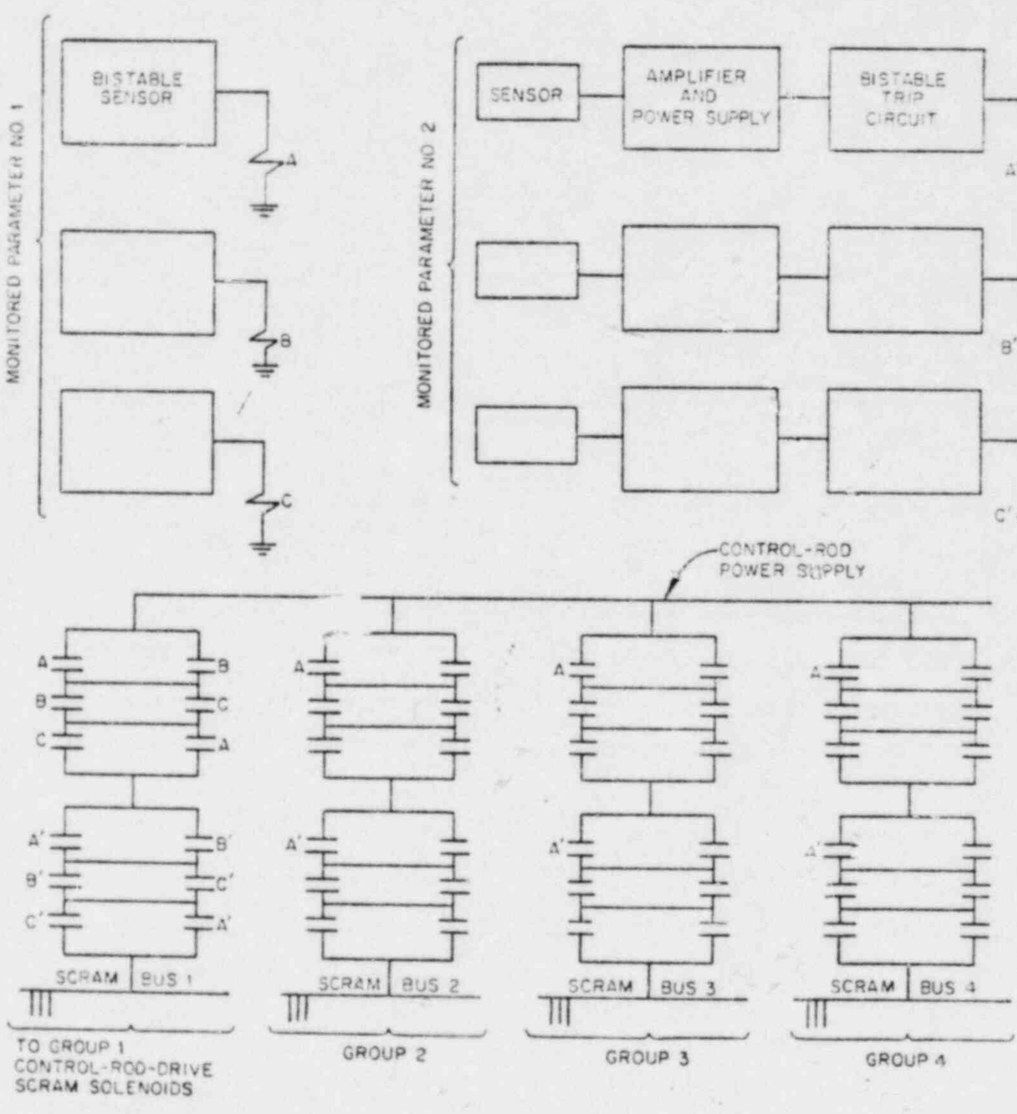


Fig. 1 A simple reactor protection system for monitoring two parameters.

normally called a two-out-of-three, or majority, logic system. In Fig. 1 three channels of bistable sensors are shown monitoring parameter No. 1. Parameter No. 2 is monitored by three other channels, each channel consisting of a sensor, an amplifier with its associated power supply, and a bistable trip circuit. In both cases the channel output to the logic is a signal that deenergizes an individual relay coil whose many contacts are arranged in the two-out-of-three logic. When both monitored parameters are within preassigned limits, all relay coils are energized, all the relay contacts are closed, and power is furnished to all four scram buses. Under those conditions the control rods are restrained from scramming. If the measured parameter falls outside preassigned limits, all three channels detect this change, all three bistable trip circuits assume their safe or relaxed state, the relay coils deenergize, the relay contacts open, all four scram buses are deenergized, and the control rods scram. There is an obvious redundancy. The system is tolerant of failure if at least two devices are operable in each circuit or system.

THE ASSUMPTIONS

To formulate a tractable model, the problem must have definite bounds. The following assumptions are therefore made:

1. The three channels from sensor through the relay magnetic circuit are independent; i.e., a failure in one channel in no way changes the probability of failure in another channel.
2. All relay contacts are independent of everything except the state of the relay coil itself, i.e., energized or deenergized.
3. The individual control rods are independent. Failure of sufficient independent control rods to be of significance from the standpoint of safety has such a low probability as to be of no concern.
4. The control rods are distributed between the four scram buses so that loss of any two buses (failure to scram) is of no concern.
5. Based on the monitored parameter being outside preassigned limits, the system is successful if the voltage on two or more buses drops to zero.
6. Component parts have a constant failure rate.
7. Immediately following a test, there are no failures in the system.

THE MATHEMATICS

There are three channels. The probability that a channel is "good" for the interval between tests is p. The probability that it is "failed" is q, where $p + q = 1$. Use of the binomial expansion of

$$(p + q)^3 = 1 \tag{1}$$

yields

$$p^3 + 3p^2q + 3pq^2 + q^3 = 1 \tag{2}$$

where p^3 = probability that exactly three channels are good

$3p^2q$ = probability that exactly two channels are good and exactly one is failed

$3pq^2$ = probability that exactly one channel is good and exactly two are failed

q^3 = probability that exactly three channels are failed

It is more convenient to calculate the probability of system failure than the probability of system success. Therefore, based on the rules of conditional probability, the expression for the probability of system failure is

$$\text{Prob }(F) = \text{Prob }(F|q^3)q^3 + \text{Prob }(F|3pq^2)3pq^2 + \text{Prob }(F|3p^2q)3p^2q + \text{Prob }(F|p^3)p^3 \tag{3}$$

where Prob $(F|q^3)$ is the probability of system failure given that exactly three channels have failed.

If exactly three channels have failed, system failure is a certainty. Therefore

$$\text{Prob }(F|q^3) = 1 \tag{4}$$

Likewise, if exactly two channels have failed and exactly one is good, failure is still a certainty. Therefore

$$\text{Prob }(F|3pq^2) = 1 \tag{5}$$

If exactly one channel has failed and exactly two are good, two particular relay contacts must open in each scram bus in order for that bus to successfully scram. If each contact has a reliability of r, the probability that a particular bus will scram is r^2 and the probability that it will fail to scram is $(1 - r^2)$. There are four scram buses; so all the possible combinations can be evaluated by forming a binomial expansion of

$$[r^2 + (1 - r^2)]^4 = 1 \tag{6}$$

which yields

$$(r^2)^4 + 4(r^2)^3(1 - r^2) + 6(r^2)^2(1 - r^2)^2 + 4r^2(1 - r^2)^3 + (1 - r^2)^4 = 1 \tag{7}$$

where $(1 - r^2)^4$ is the probability that exactly four buses fail to scram and $4r^2(1 - r^2)^3$ is the probability that exactly three buses fail to scram. Thus

$$\text{Prob }(F|3p^2q) = (1 - r^2)^4 + 4r^2(1 - r^2)^3 \tag{8}$$

since failure is defined as three or more buses failing to scram.

Finally, we consider the case where all three channels are known to be good. The probability that both of a given pair of contacts will fail to open is $(1 - r^2)$. The probability that all three pairs of contacts will fail to open is $(1 - r^2)^3$. Then, forming a binomial expansion of

$$\{(1 - r^2)^3 + [1 - (1 - r^2)^3]\}^4 = 1 \qquad (9)$$

yields

$$[(1 - r^2)^3]^4 + 4[(1 - r^2)^3]^3[1 - (1 - r^2)^3] + \ldots = 1 \qquad (10)$$

where $[(1 - r^2)^3]^4$ is the probability of exactly four buses failing to scram and $4[(1 - r^2)^3]^3[1 - (1 - r^2)^3]$ is the probability of exactly three buses failing to scram. Thus

$$\text{Prob}\,(F|p^3) = [(1 - r^2)^3]^4 + 4[(1 - r^2)^3]^3[1 - (1 - r^2)^3] \qquad (11)$$

Now the expression for the probability of failure may be written as

$$\text{Prob}\,(F) = q^3 + 3pq^2 + [(1 - r^2)^4 + 4r^2(1 - r^2)^3]3p^2q + \{[(1 - r^2)^3]^4 + 4[(1 - r^2)^3]^3[1 - (1 - r^2)^3]\}p^3 \qquad (12)$$

by substituting the results of Eqs. 4, 5, 8, and 11 in Eq. 3.

THE ALLOCATION

Prob (F) in Eq. 12 may be evaluated for various values of r and q since p is the complement of q. The results of the evaluation are shown in Fig. 2 as plotted on a log–log scale. The Prob (F) is shown as the ordinate and q, the probability of a channel failure, as the abscissa for a family of values of r, the probability that a relay contact successfully opens its circuit.

Two things of importance become evident from the plot. If the design goal is 10^{-5} or less for Prob (F), values of r less than approximately 0.87 are totally unacceptable. Furthermore, values of r greater than approximately 0.98 do not improve system reliability in the vicinity of 10^{-5} probability of system failure. Thus any pair of compatible values for r and q that can be selected from the shaded area is acceptable. Inasmuch as an r of 0.98 for a relay contact is probably readily achievable, point A is a reasonable choice for a design point. This corresponds to an r of 0.98 and a q of 1.65×10^{-3} or a p of 0.99835.

At this point the designer must make a tentative selection of a relay and a bistable sensor that satisfies the performance requirements of his system and determine the failure rate that applies to each. We assume for the purposes of this example that the relay contact has an unsafe failure rate, λ_r, of 0.01×10^{-6}/hr and the bistable sensor, including the associated relay coil, has an unsafe failure rate, λ_s, of 10×10^{-6}/hr. The unsafe failure rate is the overall failure rate multiplied by a factor to adjust for the decimal fraction of the failure modes that are unsafe to the application under study.

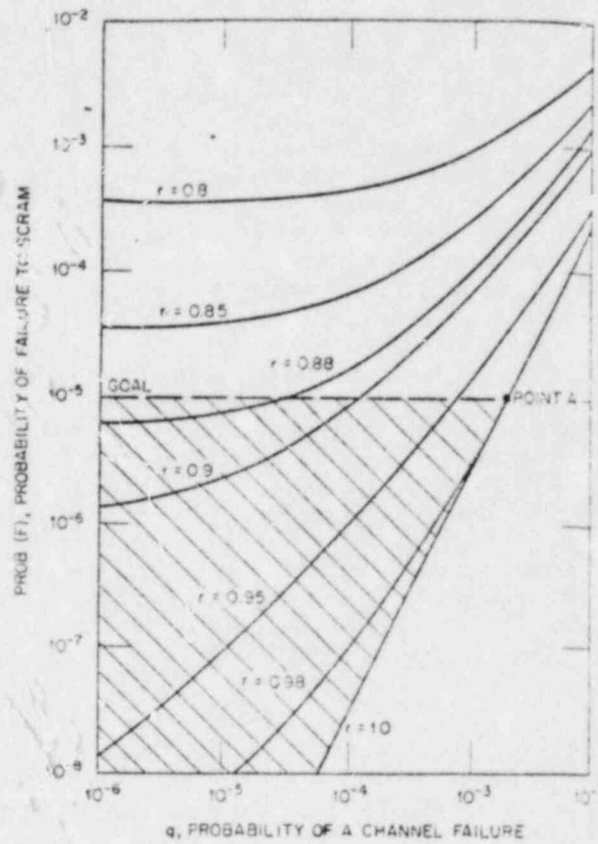


Fig. 2 Graph of Prob (F) as function of q for various values of r.

The designer is now prepared to examine the test intervals that are compatible with his circuit and component selection. If the failure rate is λ and the interval between tests is τ, the average reliability for the interval is $1 - \lambda(\tau/2)$ for small values of $\lambda(\tau/2)$. From this relation the time interval between tests (τ_r) for the relay to have a required reliability of 0.98 becomes

$$1 - \frac{\lambda_r \tau_r}{2} = 0.98$$

and thus

$$\tau_r = 4 \times 10^6 \text{ hr}$$

or 456 years between tests of the relay contact. For the bistable sensor with a required reliability of 0.99835, that is

$$1 - \frac{\lambda_s \tau_s}{2} = 0.99835$$

the interval between tests is

$$\tau_s = 330 \text{ hr}$$

At this point the designer must make a judgment. He must weigh the operational difficulties that may be associated with performing a test every 330 hr against the alternate opportunities for improved bistable sensors with lower failure rates. He may wish to reconsider his original system configuration to see whether another logic choice is more appropriate. Finally, when he does select a test interval, he must make provisions so that the test can be performed at that frequency without undue burden on the plant operator.

Other design trade-offs are attractive. Consider, for example, the use of the sensor–amplifier–bistable combination shown in Fig. 1 in place of the single bistable sensor. The sensor–amplifier portion of the circuit is characterized by the fact that it puts out a continuous signal. Furthermore, if the channel fails in an unsafe mode, this fact would either be alarmed or become readily apparent by virtue of the fact that its reading disagreed with the readings of the other two channels monitoring the same parameter. An unsafe failure in such a channel should be discovered almost as soon as it occurs, certainly within an hour. The failure rate of the sensor–amplifier combination may be substantially higher than that of the simpler bistable sensor it replaces. We will assume for the purposes of this illustration that the analog sensor–amplifier (including power supply) portion of the channel has an unsafe failure rate of λ_1, where λ_1 is 100×10^{-6}/hr, and an equivalent test interval, τ_1, of 1 hr. We will also assume that the failure rate of the associated bistable trip circuit is λ_2, where λ_2 is 10×10^{-6}/hr. The test interval for the trip circuit, τ_2, is to be determined. The reliability equation is

$$\left(1 - \frac{\lambda_1\tau_1}{2}\right)\left(1 - \frac{\lambda_2\tau_2}{2}\right) = 0.99835$$

and from this it can be approximated that

$$\frac{\lambda_1\tau_1}{2} + \frac{\lambda_2\tau_2}{2} = 0.00165$$

Solving for τ_2 gives

$$\tau_2 = \frac{0.00330 - \lambda_1\tau_1}{\lambda_2} = 320 \text{ hr}$$

between tests of the bistable trip circuit.

The benefit of the trade-off is that the bistable trip circuit may be designed for convenient and simple electrical testing, whereas the bistable sensor, though simple and reliable, requires an actual perturbation in the parameter being measured or the synthetic substitution of an equivalent signal, either of which may be very difficult to accomplish.

DISCUSSION

A comment about the design is in order at this point. The relay-contact matrix portion of the system may very well be overly complex in comparison with the balance of the circuit. There are many redundant relay contacts; in fact, there are so many that any one contact set is not really very important to the system. The 456-year interval between tests is, of course, absurd, and the designer may wish to investigate other alternate systems with the view of taking more advantage of the inherent high reliability of the components. The three safety channels are probably the ultimate limitation on system reliability. For this reason the logic portions of the circuit should have a high order of reliability in order to realize the full reliability potential of the safety channels.

A comment about the mathematical model is also in order. The relay contacts were assumed to be independent of each other. The designer should satisfy himself that this is true; for example, he should be sure that a given relay contact could stick closed and not in any way influence another contact on the same relay to stick closed also. In addition, it was assumed that there was no way for power to be applied to a scram bus except through relay contacts. Other inadvertent short-circuit paths around each contact matrix should be considered as having some probability, and the test should be devised so that they can be detected.

The particular design of Fig. 1 is not represented as being a good or even practical design. As it stands it suffers from false scrams due to loss of power from the power supply to the scram bus. The design was chosen because its mode of operation is clearly self-evident and it serves as a convenient illustration of the analysis technique. The actual design process is an iterative one. The designer, having learned about the trade-off potentials in this example, must evaluate other designs in order to choose the one that best satisfies all the constraints that are imposed on him.

A mathematical model can be developed to calculate either the average reliability over the test interval or the minimum reliability expected at the end of the test interval. If the various components in a system undergo tests at different frequencies, as is often the case, the concept of average reliability as used in the foregoing example leads to a much more realistic and tractable model than the model based on minimum reliability. The maximum effect on the expected probability of failure is a factor of 2. If this is considered to be significant, the reliability goal should be adjusted accordingly and the average reliability concept used throughout the model.

Optimum Test Interval

The availability of a system is a function of the length of the interval between thorough tests performed on the system. In general, the more frequent the tests, the higher the availability because the system is not allowed to remain in a failed state for long periods of time. However, it is sometimes necessary or desirable to disable the system during the actual test. For example, the sensor may have to be disconnected from the real process variable and a dummy signal substituted. Or, for emergency cooling systems, it may be necessary to exercise the system by pumping water but bypass the water to a sump. In a one-out-of-two reactor protection system, it may be necessary to actually bypass a channel to test it. The Institute of Electrical and Electronics Engineers' Criteria for Nuclear Power Plant Protection Systems, No. 279, makes allowance for such a contingency.

Where any portion of the system is disabled in order to perform a test, an immediate conflict of purpose develops. If the test requires a fixed time to perform and the frequency of the test is increased, the point may be reached where more frequent testing will take the system out of service more total time than that time which could accumulate from unrevealed failures. This suggests that there may be an optimum interval between tests, and such is indeed the case.

THE PROBLEM

Figure 3 illustrates the effect of testing on system availability. In part *a* of Fig. 3, the system is tested once each τ_1 hours. The test requires t hours to complete, and during that time the system is rendered inoperative. The system fails at a constant rate λ. The availability is unity immediately following a test and decreases exponentially until the next test, at which time the availability falls to zero for the duration of the test.

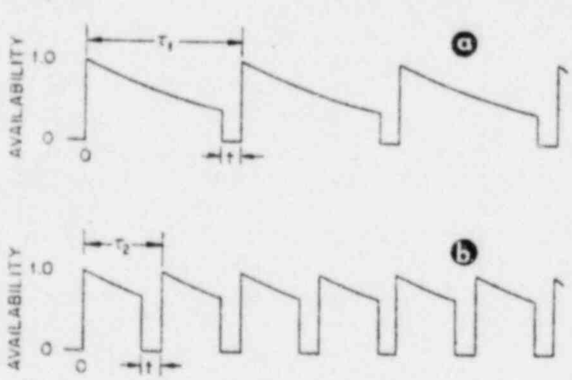


Fig. 3 Example of the effect of test interval on availability.

In part *b* of Fig. 3, the interval between tests is shortened to τ_2, but the duration of the test remains constant. Because the failure rate is constant, the availability degrades along the same curve as in part *a* of Fig. 3, but it does not degrade to as low a level.

Obviously, if the interval between tests is shortened until it is equal to the time to perform the test, the system would be on test all the time and the availability would be zero. If the interval between tests is extremely long, the system is allowed to degrade to a very low level of availability and to remain there for a long time, and this leads to low overall availability. Intuitively, this suggests that there may be a test interval that is optimum for a given system failure rate and test duration to maximize availability.

THE SOLUTION

We will consider exactly one cycle of the repeating operation shown in Fig. 4. The availability of the system is the probability that the system will be operational at any point in future time. The probability that the system is good can be written as

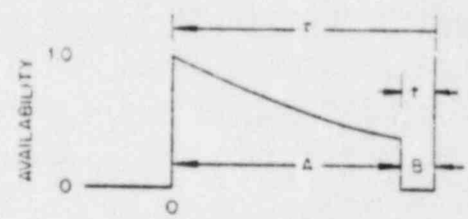


Fig. 4 One cycle of test interval.

$$P(S) = P(S|A)\ P(A) + P(S|B)\ P(B) \qquad (13)$$

where $P(S)$ is the probability that the system is good, $P(S|A)$ is the probability that the system is good given that the random point in future time falls in time domain A, $P(A)$ is the probability that the random point in future time falls in time domain A, etc. The probability that the system is good if the random point in future time is in time domain B is zero because the system is known to be inoperative during test. Thus

$$P(S|B) = 0 \qquad (14)$$

The probability that the random point in future time falls in time domain A is

$$P(A) = \frac{\tau - t}{\tau} \qquad (15)$$

since all times are equally probable.

The probability that the system is good if the random point in future time is in time domain A is taken to be the average reliability over the interval given by

$$P(S|A) = \frac{1}{\tau - t} \int_0^{\tau - t} e^{-\lambda x}\, dx \qquad (16)$$

Integration and evaluation yield

$$P(S|A) = \frac{1}{\lambda(\tau - t)} \left[1 - e^{-\lambda(\tau - t)}\right] \qquad (17)$$

Substitution of Eqs. 14, 15, and 17 in Eq. 13 yields

$$P(S) = \frac{1}{\lambda\tau} \left[1 - e^{-\lambda(\tau - t)}\right] \qquad (18)$$

Equation 18 shows the availability of the system to be a function of the three parameters λ, τ, and t, as expected. Figure 5 shows a plot of Eq. 18 evaluated for two cases: (1) $\lambda = 10^{-4}$/hr, $t = 1$ hr, and (2) $\lambda = 10^{-5}$/hr, $t = 1$ hr. The unavailability, $1 - P(S)$, is plotted rather than $P(S)$ in order to show the results better. The curves dip through a minimum, indicating that under the conditions specified there is a test interval that leads to the optimum availability. As the failure rate decreases, the optimum test interval becomes longer.

OPTIMIZATION

The optimum test interval can be determined more expeditiously than by plotting the curve of unavailability vs. test interval, as was done in Fig. 5. We assume that λ and t are known, fixed constants of the system, differentiate Eq. 18 with respect to τ, and set the result equal to zero. Thus

$$\frac{dP(S)}{d\tau} = \frac{1}{\lambda\tau^2} \left[e^{-\lambda(\tau - t)} (1 + \lambda\tau)\right] - \frac{1}{\lambda\tau^2} = 0 \qquad (19)$$

This transcendental equation is not readily solved explicitly for τ. However, it can be manipulated to the form shown in the following equation and evaluated:

$$e^{-\lambda\tau} + \lambda\tau\, e^{-\lambda\tau} = e^{-\lambda t} \qquad (20)$$

The result of this evaluation is shown in Fig. 6, where λt is plotted against $\lambda\tau$. If λ and t are known, the value of τ for optimum availability can be determined. For example, if λ is 10^{-4} failure per hour and t is 1 hr, the product λt is 10^{-4}. The value of $\lambda\tau$ corresponding to a λt of 10^{-4} is 1.4×10^{-2}, and τ is 140 hr. This corresponds to the apparent minimum point on the curve for $\lambda = 10^{-4}$ shown in Fig. 5.

Equation 20 can be solved explicitly for τ if the exponential terms are approximated by the series

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots \qquad (21)$$

Approximating Eq. 20 by the series and neglecting all terms higher than second order yield

$$\tau^2 = 2t \left(\frac{1}{\lambda} - \frac{t}{2}\right) \qquad (22)$$

In general, $1/\lambda \gg t$, so with little error

$$\tau = \sqrt{\frac{2t}{\lambda}} \qquad (23)$$

Equation 23 is an approximate solution for the optimum τ. The λt vs. $\lambda\tau$ curve derived from Eq. 23 is plotted in Fig. 6 and labeled "Approximate Solution." It compares very favorably with the "Exact Solution" for values of $\lambda\tau$ less than 0.1. At $\lambda\tau = 0.1$, the error is 6.7%. For most practical values of λ, τ, and t, the approximate solution for τ found in Eq. 23 is adequate.

DISCUSSION

The result applies to any nonredundant system directly. Examples are systems that must be bypassed in order to perform the test. In this case the bypass could be an electrical bypass that prevented the sensors monitoring the chosen parameter from transmitting their signal or it could be an electrical bypass at the output that prevented the final safety device from actuating. The bypass need not be electrical, however; for example, a flow of cooling water or a hydraulic actuating fluid might be diverted during test and rendered incapable of performing its function.

The result applies equally well to any redundant system in which the level of redundancy is reduced

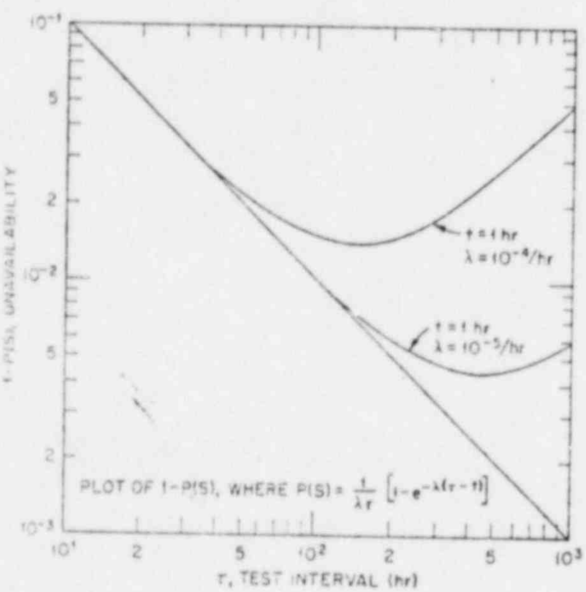


Fig. 5 Unavailability vs. test interval.

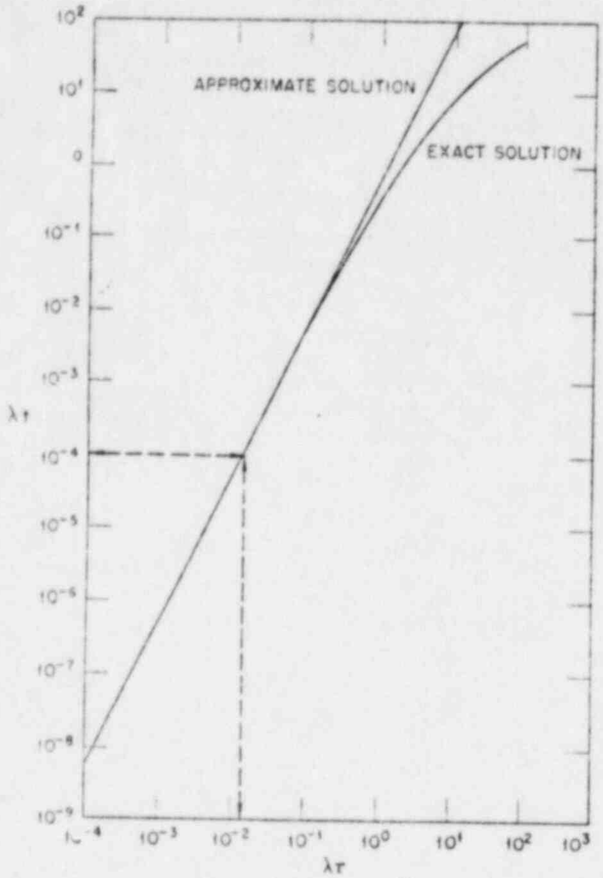


Fig. 6 Plot of λt vs. λτ.

during test. For example, if one channel of a one-out-of-two system is bypassed for test, it becomes a one-out-of-one system, and safety is impaired for the duration of the test. In any one-out-of-n system, the availability is highest when the availability of each channel is the highest; so the results can be applied to each channel independently.

In majority logic situations, bypassing in order to test is unusual. If a two-out-of-three system is tested, it usually becomes a one-out-of-two system for the duration of the test. In this condition safety is enhanced slightly, and the results of Eq. 23 do not apply.

Perhaps the most interesting observation is that there is truly a test interval that is optimum on a system that is disabled during test. With this in mind, it is not conservative to formulate the test interval on the assumption of a higher than expected failure rate, and once the test interval is properly formulated, it is not conservative to test more frequently. A reexamination of Fig. 5 illustrates the point. If a best estimate of the failure rate is $\lambda = 10^{-5}$/hr, assuming a failure rate of $\lambda = 10^{-4}$/hr for the sake of a "conservative" estimate of the test interval actually leads to a lower availability.

The straight line of Fig. 5 represents the envelope or limit for all the family of curves having the same test time (t) but various failure rates. In other words, for a fixed duration of test (t), once the test interval (τ) is chosen, an upper limit on the availability that can be obtained is automatically set, even if the failure rate for the system is zero.

Some consideration should be given to the test duration (t) since keeping it short increases availability. Consideration must be given during design to the methods of testing to keep the test duration short; however, it must not be shortened unduly so as to encroach on thoroughness.

Field Failure Data and Test Intervals

When engineered safety equipment is installed in the field, the plant operator has responsibility for conducting the tests recommended by the designer. These tests present an opportunity to verify the design and add to the store of information on actual in-service failures. If the tests are properly designed and the data carefully recorded, the results can be used to

1. Certify that a given reliability allocation has been met.
2. Provide a basis for lengthening (or shortening) the interval between tests.
3. Provide a useful source of in-service data that can be fed back to the designer to strengthen his basis for reliability prediction.

UTILIZATION OF FIELD DATA

For this discussion of field data, we will assume that there are many identical bistable trip circuits throughout the reactor plant. When a failure is observed, the failed unit is repaired or replaced so that the number of trip circuits in service remains constant. The operator records the number of failures, and, after the plant has been in operation for a while, he can draw some conclusions from his data. If there are n identical trip units that have each operated for an elapsed time T with a grand total of r failures, the expected failure rate is approximately

$$\lambda = \frac{r}{nT} \qquad (24)$$

The result is not very satisfying or useful unless many failures have been observed, which is usually not the case.

If the concept of confidence limit is introduced, useful results can be obtained even with zero failures. The failure rate can be obtained by the formula[1]

$$\lambda_\alpha = \frac{\chi^2_{2r+2,\alpha}}{2nT} \qquad (25)$$

where n = total number of units in service
T = time the equipment has been in service
α = confidence limit on the parameter λ
λ = failure rate of the unit
r = total number of failures
$\chi^2_{2r+2,\alpha}$ = chi-square distribution evaluated at $2r + 2$ degrees of freedom at the α confidence limit

Example 1: Fifty identical trip units have operated for 10,000 hr with no failures. What is the failure rate that will not be exceeded 95% of the time?

Solution: From tables of the χ^2 distribution, the χ^2 statistic with two degrees of freedom at the 95% level is 5.99. Therefore

$$\lambda_{0.95} = \frac{5.99}{(2)(50)(10,000)} = 5.99 \times 10^{-6}/\text{hr}$$

Example 2: After 10,000 hr with no failures, one failure is incurred in the next 10,000 hr. The χ^2 statistic with four degrees of freedom at the 95% level is 9.49. Therefore

$$\lambda_{0.95} = \frac{9.49}{(2)(50)(20,000)} = 4.75 \times 10^{-6}/\text{hr}$$

Note that the failure rate decreased even though a failure occurred in the interval.

At this point the operator can compare the observed failure rate with that predicted by the designer. If the observed failure rate is higher than the designer predicted on a component that was the limiting item on the reliability of the system, the operator may choose to shorten the interval between tests. If the observed failure rate is substantially less than the predicted failure rate, the operator may rightfully petition to increase the interval between tests in the overall interest of availability and economy.

GRAPHICAL AID

The solution to the problem can be simplified and reduced to a graphical procedure. If the designer expects the component to have an average reliability (availability) of R,

$$R = 1 - \frac{\lambda\tau}{2} \qquad (26)$$

for the case where $\lambda\tau \ll 1$, λ is the failure rate, and τ is one-half the interval between tests. Solving for λ gives

$$\lambda = \frac{2(1 - R)}{\tau} \qquad (27)$$

and substituting $2(1 - R)/\tau$ for λ_α in Eq. 25 and solving for the expression $nT(1 - R)$ yield

$$nT(1 - R) = \frac{\tau \chi^2_{2r+2,\alpha}}{4} \qquad (28)$$

Figure 7 is a plot of the number of failures against M, where

$$M = nT(1 - R) \qquad (29)$$

for a family of values of τ with a confidence level of 0.95. Values for r, n, and T are obtained from operational records. Given R, the design reliability goal, the value of the factor M is calculated and plotted against r. For example, if the reliability goal is 0.992 and three components have operated for 2000 hr with no failures, M is approximately 50, and point 1 of Fig. 7 is plotted accordingly.

With the elapse of time, more points can be plotted. If the plotted points are connected, they form a stair-step curve that always moves up and to the right. The position of the last plotted point is significant in determining the allowable interval between tests. For example, point 1, plotted very early in plant life, falls just to the right of the τ = 24-hr curve; so a test every 24 hr is acceptable. Point 3 falls to the right of the τ = 336-hr curve; so the operator can, with the same degree of confidence that his reliability goal is being met, lengthen the test interval to 2 weeks. Finally, at point 7 and beyond, the test interval can be stretched to 1 month. If each independent channel or component meets its goal, the overall goal will also be met.

The curves of Fig. 7 can be applied to any group of items under test which are believed to be from the same population and which follow the exponential failure law. For a particular test in which the reliability goal and the number of components on test are fixed, the scale of the curve can be adjusted so that the number of failures is plotted directly against time to simplify the data-reduction process still further.

DISCUSSION

In compiling the data for the plot, only unsafe failures are of concern. Safe failures, by definition, do not prevent the equipment from functioning. In addition, safe failures, even on standby equipment, usually are self-annunciating and thus are not concealed until the next periodic test.

The larger the population of components under test, the sooner significant results can be inferred from the data. For this reason it would be highly desirable to pool all the failures and total the exposure hours on all identical devices used throughout the industry before using Eq. 25 to calculate a failure rate. Of course, good judgment must be exercised to assure that the components are truly from the same population and that they operate in similar environments and with similar stresses.

Without recourse to a mathematical model of the system, demonstration of compliance with a 10^{-5} probability of failure goal for a reactor protection system would be a formidable task. For a single system, n is unity. When using the relation $M = nT(1 - R)$,

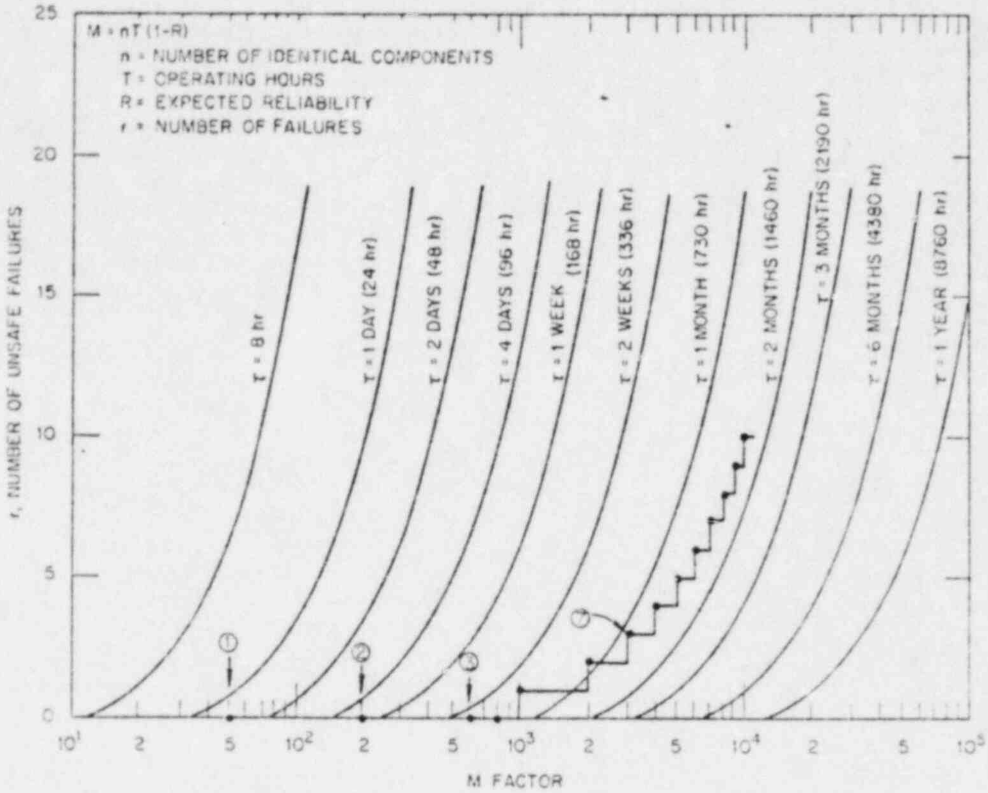


Fig. 7 Graphical aid in the selection of an adequate interval between tests.

operational data would have to be accumulated for a period of 10^{-6} hr (114 years) before M would be 10, the lowest value plotted on the scale of Fig. 7. If there were no failures in 114 years of operation, the operator might be justified in reducing the test frequency of the whole system to approximately once every 8 hr. System failure in this case is a true failure in its capability to scram, not the failure of an individual component or channel. Statisticians several hundred years from now may be able to draw some binding conclusions from centuries of operational data, but this is not very gratifying to today's plant operator, who must make decisions and exercise judgment now. Confidence in the system must be gained by having confidence in the failure rates of the components making up the system and by having confidence that the mathematical model truly represents the interrelations between the components and the system.

Confidence in the mathematical model is increased if the system is inherently easy to represent mathematically. Frequently this end is best served by constructing the mathematical model first and then designing the system to emulate the model. In general, this practice leads to simple, uncluttered systems with the highest degree of independence of failure events, and thus the predictions based upon the mathematical model are more credible.

Conclusions

Plant safety starts with good designs, and good design is the proper application of knowledge. Testing is the means by which new knowledge is generated. Thus it behooves the designer to consider the testing program for his system from the outset of design.

The testing program serves a dual function:

1. It assures that the inherent reliability the designer intended for his system is maintained throughout the plant lifetime.
2. It serves as a source of in-service field-failure data much needed by the designer to guide each new design.

The reliability analyst should be prepared to challenge the traditional ways of establishing testing programs to see whether they are indeed optimum in a well-integrated system design. The real payoff comes when greater safety is achieved simultaneously with simpler systems and less demanding testing programs.

Reference

1. ARINC Research Corporation, *Reliability Engineering*, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1964.

COMMONWEALTH EDISON

SYSTEMATIC EVALUATION PROGRAM

DRESDEN 2

PURPOSE: NRC WAS TO REVIEW 11 NUCLEAR PLANTS (OLDEST PLANTS AND THOSE WITH POL'S) AGAINST SAFETY CONCERNS EXPRESSED IN THE STANDARD REVIEW PLAN. COMPLETION OF SEP IS TO FORM A DOCUMENTATION BASIS FOR SAFETY ASPECTS OF PLANT.

STARTED: NOVEMBER 1977 WITH 137 TOPICS

- 47 TOPICS DELETED - NOT APPLICABLE OR BEING RESOLVED GENERICALLY.

- 90 TOPICS REVIEWED DURING SEP

ACRS FULL COMMITTEE MEETING ON SEP
DECEMBER 9, 1982
NEIL P. SMITH

5310N

Smith T8

PRESENT STATUS

DRESDEN IS PRESENTLY IN THE INITIAL PHASES OF INTEGRATED ASSESSMENT. THE PRESENT TOPIC STATUS IS:

COMPLETE AGREEMENT	72	TOPICS
TENETENTIVE AGREEMENT PENDING CE SUBMITTAL	2	TOPICS
CE PERFORMING STUDIES	6	TOPICS
NRC TO REVIEW CE SUBMITTAL	8	TOPICS
OPEN	2	TOPICS
TOTAL	90	TOPICS

RESULTS FROM TOPIC REVIEWS DONE TO DATE

COMMONWEALTH EDISON HAS:

MADE 4 MODIFICATIONS

COMMITTED 6 ADDITIONAL MODIFICATIONS

5 PROCEDURE CHANGES

5310N

COMMONWEALTH EDISON

DRESDEN

MODIFICATION MADE:

ELECTRICAL EQUIPMENT ANCHORAGE

NORMAL-BYPASS SWITCH TO NORMAL-NORMAL

125V D.C. DISCONNECT ADDED

125V D.C. BUS SEPARATION

MODIFICATIONS COMMITTED TO:

BATTERY RACK SEISMIC UPGRADE

DIESEL GENERATOR PROTECTIVE TRIP BYPASS

ROOF PARAPETS TO PREVENT PONDED WATER ACCUMULATION

ADDITIONAL D.C. SYSTEM MONITORING IN THE CONTROLROOM

INSTALLATION OF REDUNDANT ISOLATION VALVES

INSTALLATION OF ADDITIONAL 125V D.C. BATTERY BREAKERS.

PROCEDURES CHANGE COMMITTED TO:

REVISE FLOOD PROCEDURES

MODIFY SAFE SHUTDOWN PROCEDURES

TEST SHUTDOWN COOLING INTERLOCKS

INCLUDE MORE VALVES ON LOCKED CLOSED LIST

MODIFY INSERVICE INSPECTION OF WATER CONTROL STRUCTURES

MAJOR ANALYSES

DRESDEN 2

1. MASS AND ENERGY RELEASE TO CONTAINMENT FOLLOWING STEAM LINE BREAK
2. CONTAINMENT LINER INTEGRITY ANALYSIS
3. CONTAINMENT ELECTRICAL PENETRATIONS FAULT STUDY.
4. SHORT CIRCUIT AND FAILURE ANALYSES OF CLASS IE SYSTEMS.
5. REACTOR PROTECTION SYSTEM ISOLATION DEVICES.
6. TORNADO MISSILE ANALYSES.

NRC

1. SEISMIC CAPABILITY OF STRUCTURES.
2. SEISMIC ANALYSIS OF VARIOUS PIPING SYSTEMS AND COMPONENTS.
3. ENGINEERED SAFETY FEATURES DESIGN.
4. VENTILATION SYSTEMS.
5. WIND AND TORNADO LOADINGS.
6. CODE CHANGES FOR STRUCTURES AND COMPONENTS.
7. ATMOSPHERIC TRANSPORT AND DIFFUSION CHARACTERISTICS.

EXPERIENCE TO DATE

COMMONWEALTH EDISON HAS SPENT APPROXIMATELY 2.6 MILLION DOLLARS FOR STUDIES TO SUPPORT THE SYSTEMATIC EVALUATION PROGRAM. THE MODIFICATIONS WHICH HAVE BEEN MADE TO DRESDEN 2 AS A RESULT OF SEP HAVE ALSO BEEN OR ARE BEING MADE AT DRESDEN 3 AND QUAD CITIES 1 AND 2, IF APPLICABLE.

MODIFICATIONS RESULTING FROM SEP HAVE COST COMMONWEALTH EDISON 1.3 MILLION DOLLARS.

COMMONWEALTH EDISON BELIEVES THE STRONG PROJECT MANAGEMENT OF MR. RUSSELL HAS CAUSED SEP TO MOVE FORWARD AND FOR THE STAFF TO MAKE REASONED JUDGMENTS.

TOPICS COMMONWEALTH EDISON

STILL PERFORMING WORK ON

TOPIC NO	TITLE
III-4.A	TORNADO MISSILES
III-6	SEISMIC DESIGN CONSIDERATIONS
III-10.A	THERMAL-OVERLOAD PROTECTION FOR MOTORS OF MOTOR-OPERATED VALVES
VI-7.C.1	APPENDIX K - ELECTRICAL INSTRUMENTATION AND CONTROL (EI&C) RE-REVIEWS
VI-10.B	SHARED ENGINEERED SAFETY FEATURES, ONSITE EMERGENCY POWER, AND SERVICE SYSTEMS FOR MULTIPLE-UNIT FACILITIES
VII-1.A	ISOLATION OF REACTOR PROTECTION SYSTEM FROM NON-SAFETY SYSTEMS, INCLUDING QUALIFICATION OF ISOLATION DEVICES
IX-5	VENTILATION SYSTEMS
XV-16	RADIOLOGICAL CONSEQUENCES OF FAILURE OF SMALL LINES CARRYING PRIMARY COOLANT OUTSIDE CONTAINMENT

MILLSTONE UNIT 1

SEP Topic XV-16, Failure of Small Lines Outside Containment

- NRC SER Dated November 10, 1982 Presently Under Review. Potential Areas For Refinement of Dose Calculations Include:
  - Estimate of Break Flow
  - Effectiveness of Standby Gas Treatment System
  - Possible Alternate Operator Action
  - Duration of Release

T8

ACRS FULL COMMITTEE

DECEMBER 9, 1982

MILLSTONE UNIT NO. 1

NORTHEAST UTILITIES

T8

CONDUCT OF PHASE II SIGNIFICANTLY DIFFERENT FROM ORIGINAL PLANS

- o NRC STAFF PROGRAM vs. LICENSEE PROGRAM
- o PROTECTION FROM INTERIM BACKFITS ABSENT IMMEDIATE SAFETY PROBLEM
- o EXCLUDED FROM OTHER NRC INITIATIVES
- o PROGRAM NOT FORMALIZED IN THE REGULATIONS

ORIGINAL SEP OBJECTIVES

- o CREATE DOCUMENTATION BASE
- o CAPABILITY FOR INTEGRATED AND BALANCED BACKFITTING DECISIONS
- o IDENTIFY IMMEDIATE SAFETY CONCERNS
- o REASSESS SAFETY ADEQUACY
- o EFFICIENTLY USE AVAILABLE RESOURCES
- o IMPROVE BASIS FOR POL CONVERSIONS

STAGES OF SEP PHASE II

- NRC PROGRAM (3 YEARS)
- LEAD PLANT (3 MONTHS)
- LEAD TOPIC (2 YEARS SO FAR)
- ACTUAL PROGRAM HAS BEEN HYBRID OF LEAD PLANT AND LEAD TOPIC
- INCREASED LICENSEE INVOLVEMENT KEY FACTOR IN ACCELERATED RATE OF PROGRESS
- LICENSEES HAVE BENEFITTED SIGNIFICANTLY BY EVALUATING TOPICS CONCURRENTLY

MILLSTONE 1

PLANT MODIFICATIONS

COMPLETED

- o SEISMIC ANCHORAGE
- o SEISMIC STRUCTURAL MODIFICATIONS
- o NEW BATTERY RACKS

COMMITTED

- o TORNADO MISSILE PROTECTED SHUTDOWN METHOD
- o REDUNDANT PRESSURE INTERLOCK ON RWCU SYSTEM
- o ADDITIONAL ISOLATION VALVES
- o LOCKING DEVICES FOR ISOLATION VALVES

PROCEDURE OR TECH SPEC CHANGES

- o KEEP FLOOD DOOR TO GT BUILDING CLOSED
- o REVISED ISI FOR WATER CONTROL STRUCTURES
- o REVISED FLOOD EMERGENCY PROCEDURE
- o REVISE PROCEDURE FOR SHUTDOWN FROM OUTSIDE CONTROL ROOM
- o TECH SPECS FOR WATER QUALITY
- o REVISED BATTERY TESTING

OBSERVATIONS ON PHASE II

- o LARGE RESOURCE EXPENDITURE
  - INTERNAL MANHOURS - 30,000
  - CONSULTANT COSTS - $1.0 MILLION
  - HARDWARE MODIFICATIONS - $1.5 MILLION
- o EXTENDED SCHEDULE
- o "INTEGRATION" CONCEPT LIMITED TO APPLICABLE SEP TOPICS
- o STRONG PROJECT MANAGEMENT
- o JUDGMENTS BASED UPON NUCLEAR SAFETY, NOT SRP CRITERIA
- o CONSIDERATION OF PLANT UNIQUE FEATURES
- o PROVISIONS FOR LICENSEE TO UTILIZE ITS KNOWLEDGE OF THE PLANT TO IMPLEMENT "INTEGRATION" CONCEPT

ORIGINAL SEP OBJECTIVES

- o CREATE DOCUMENTATION BASE
  - Generally Yes
- o CAPABILITY FOR INTEGRATED AND BALANCED BACKFITTING DECISIONS
  - In The Context Of SEP Issues Only, Objective Is Being Met
- o IDENTIFY IMMEDIATE SAFETY CONCERNS
  - Generally Yes
- o REASSESS SAFETY ADEQUACY
  - Partially Met
- o EFFICIENTLY USE AVAILABLE RESOURCES
  - Not Met
- o IMPROVE BASIS FOR POL CONVERSIONS
  - Generally Yes

CONCLUSIONS

- o INCORPORATE POSITIVE ELEMENTS OF PHASE II INTO THE REGULATORY PPOCESS

  - SRP IS ONLY A STARTING POINT
  - STRONG PROJECT MANAGEMENT

- o INTEGRATION SHOULD CONSIDER ALL PLANT MODIFICATIONS, NOT ONLY SEP TOPICS

- o FORMALIZE ANY POTENTIAL NEW PROGRAM BY REGULATION

CHRONOLOGY OF EVENTS SINCE ACRS SUBCOMMITTEE MEETING ON FEBRUARY 18, 1982
AT CINCINNATI AIRPORT

FEBRUARY 24, 1982	CIVIL PENALTY PAID
MAY 27, 1982	THREE QC INSPECTORS DOUSED
MAY 28, 1982	CG&E STOPPED CONSTRUCTION BECAUSE OF DOUSING
JUNE 1, 1982	WORK RESUMED AFTER WORKERS ACKNOWLEDGED LAW
JUNE 10, 1982	CONGRESSIONAL HEARING
JUNE 29, 1982	ALLEGED CONTINUING INTIMIDATION AND HARASSMENT - MEETING WITH QA/QC INSPECTORS
JULY 1982	ALLEGATIONS RE WELDER QUALIFICATIONS
AUGUST 1, 1982	REDUCE 100% REINSPECTION EFFORT
AUGUST 4, 1982	OI ASSUMED RESPONSIBILITY FOR INVESTIGATION
AUGUST 10, 1982	NATIONAL BOARD MEETING - DISCUSSED INTERIM REPORTS

T10

August 25, 1982	First Monthly Status Report Prepared (For July)
September 14, 1982	Congressional Hearing
September 16, 1982	Cincinnati Environmental Advisory Committee Hearing
October 19, 1982	Meeting with CG&E to Discuss Inspection Findings Re Catalytic, Inc.
October 26, 1982	CG&E Laid Off 450 Craftsmen
November 12, 1982	Issued Order to Show Cause and Order Immediately Suspending Construction
November 15, 1982	CG&E Laid Off 1,240 Personnel (1,087 Craftsmen)
November 17, 1982	Meeting with CG&E Re Order
November 26, 1982	CG&E Response to Order - Requests Approval of Bechtel
December 2, 1982	CG&E Submittal and Request for Comments Transmitted to Interested Parties
December 7, 1982	CG&E Consented in Writing to the Order

DEFICIENCIES THAT CONTINUE

IDENTIFIED BY LICENSEE QUALITY VERIFICATION PROGRAM

- WELD PROCEDURES
- MATERIAL TRACEABILITY
- ELECTRICAL CABLE TRAY AND SUPPORT INSTALLATIONS
- SACRIFICIAL SHIELD WELD RADIOGRAPHS AND WELDS
- DESIGN CONTROL
  - CONTROL ROD DRIVE SYSTEM HANGERS
  - ELECTRICAL CABLE SEPARATION
  - FIRE PROTECTION SYSTEM SEISMIC UPGRADE
  - CONTROL PANEL WIRING SEPARATION
  - SEISMIC CLEARANCE
  - SMALL BORE PIPING DYNAMIC ANALYSIS
- CONCRETE AND STEEL COATINGS

IDENTIFIED BY NRC INSPECTION

- PERSONNEL QUALIFICATIONS AND CERTIFICATIONS
- CORRECTIVE ACTION SYSTEM AND PROCEDURES
- MAINTENANCE OF WELDER QUALIFICATIONS
- RECORDS CONTROL
- WELD MATERIAL CONTROL
- CG&E MANAGEMENT CONTROLS - CATALYTIC, INC. (STOP WORK ORDER ISSUED)
  - INITIATION AND CLASSIFICATION OF ESSENTIAL WORK
  - INSPECTION AND SURVEILLANCE
  - NONCONFORMING CONDITIONS AND CORRECTIVE ACTIONS
  - RECORDS AND AUDITS

OTHER ITEMS

- AUTHORIZED NUCLEAR INSPECTOR (ANI) INVOLVEMENT WITH ASME WORK

- STOP WORK ORDERS

  ELECTRICAL CABLE INSTALLATION (10/12/82)

  APPLICATION OF COATINGS (10/12/82)

  SPECIAL PROCESS PROCEDURES - ADDITIONAL (11/1/82)

- NATIONAL BOARD FINDINGS

- REWORK ACTIVITIES

ORDER IMMEDIATELY SUSPENDING CONSTRUCTION

IV.A. STOP SAFETY RELATED CONSTRUCTION

IV.B. (1) INDEPENDENT ORGANIZATION TO PERFORM REVIEW OF MANAGEMENT OF ZIMMER PROJECT

(A) INDEPENDENT ORGANIZATION TO BE APPROVED BY REGIONAL ADMINISTRATOR

(B) RECOMMEND COURSE OF ACTION BASED ON INDEPENDENT REVIEW (TO BE APPROVED BY R.A.)

(2) (A) SUBMIT UPDATED COMPREHENSIVE PLAN TO VERIFY QUALITY OF CONSTRUCTION (TO BE APPROVED BY R.A.)

(B) SUBMIT COMPREHENSIVE PLAN FOR CONTINUATION OF CONSTRUCTION (TO BE APPROVED BY R.A.)

(3) R. A. MAY RELAX SECTION IV.B

CURRENT ZIMMER ACTIVITIES

.	NOVEMBER 22, 1982	CG&E REQUEST FOR CLARIFICATION OF SCOPE OF ACTIVITIES SUSPENDED BY THE ORDER AND CONCURRENCE OF 14 ACTIVITIES
.	NOVEMBER 30, 1982	REGION III RESPONSE TO ABOVE REQUEST FOR CONCURRENCE
		EIGHT ACTIVITIES APPROVED
		TWO ACTIVITIES TO BE REVIEWED CASE BY CASE
		FOUR ACTIVITIES NOT ALLOWED AT THIS TIME
.	ONGOING	QUALITY CONFIRMATION PROGRAM -- NO REWORK
		NON SAFETY RELATED WORK CONTINUES
.	PERSONNEL	H. J. KAISER AS OF DECEMBER 8, 1982
		237 CRAFTS
		567 NON-MANUAL

ACRS MTG ON
SEQUOYAH

I. SUMMARY OF REVIEW AREAS

II. OPEN ITEMS/NEW LICENSE CONDITIONS

III. CONFIRMATORY ITEMS

IV. WHAT'S NEW SINCE JANUARY 1981

V. PHMS vs IDIS

VI. AC POWER DEPENDENCE OF PHMS

VII. CONCLUSION

T15

SEQUOYAH PERMANENT HYDROGEN MITIGATION SYSTEM (PHMS)

REVIEW ELEMENTS

- o PHMS DESIGN
- o HYDROGEN CONTROL RESEARCH
  - o COMBUSTION
  - o MIXING
  - o DETONATIONS
- o DEGRADED CORE ACCIDENTS & HYDROGEN GENERATION
- o CONTAINMENT HYDROGEN ANALYSIS
- o SEQUOYAH STRUCTURAL CAPACITY
- o ESSENTIAL EQUIPMENT SURVIVABILITY

OPEN ITEMS/NEW LICENSE CONDITIONS

I. REQUIREMENT TO INCREASE NUMBER OF IGNITERS (4) IN UPPER COMPARTMENT

- o IMPROVED COVERAGE
- o WITH STAFF PRIOR APPROVAL OF LOCATION, TO BE COMPLETED BY STARTUP FOLLOWING THE SECOND REFUELING OUTAGE

II. REQUIREMENT TO PERFORM ADDITIONAL TESTING OF THE TAYCO IGNITER

- o DEMONSTRATION THAT TAYCO IGNITERS WILL RELIABLY IGNITE LEAN MIXTURES OF H_2 IN A SPRAY ENVIRONMENT BY SEPTEMBER 1983

CONFIRMATORY ITEMS
RES/NRR/EPRI·PROGRAMS

1) LOCAL DETONATIONS

- o RES - HYDROGEN BEHAVIOR PROGRAM (4Q 83)
  - o ASSESS POTENTIAL FOR AND CONSEQUENCES OF LOCAL DETONATIONS, INCLUDING MISSILE GENERATION (CSQ CODE)
- o NRR - REVIEW OF GRAND GULF HYDROGEN IGNITER SYSTEM II (2Q 83)
  - o CSQ CALCULATIONS FOR ICE CONDENSER SUBCOMPARTMENTS

2) CLASIX/COMPARE CODE WORK

- o NRR - CONTAINMENT HYDROGEN ANALYSIS REVIEW (4Q 83)
  - o DEVELOP STANDARD PROBLEM SET FOR EVALUATING COMPUTER CODE FOR DEGRADED CORE ACCIDENTS
- o RES - HYDROGEN BEHAVIOR PROGRAM (4Q 83)
  - o HECTR/COMPARE/CLASIX BENCHMARK CALCULATIONS
  - o EVALUATION OF MODELS AND ASSUMPTIONS

3) EQUIPMENT SURVIVABILITY FOR SPECTRUM OF ACCIDENTS

- o RES - HYDROGEN BEHAVIOR PROGRAM (4Q 83)
  - o HECTR-BASED P/T PROFILES
- o RES - HYDROGEN BURN SURVIVABILITY (4Q 83)
  - o EVALUATIONS OF THERMAL AND PRESSURE LOADINGS ON EQUIPMENT
- o NRR - HYDROGEN BURN SURVIVAL PROGRAM (SNL) (3Q 83)
  - o ANALYTICAL ASSESSMENT OF THERMAL RESPONSE MODELS FOR VARIOUS SAFETY EQUIPMENT

4) COMBUSTION EFFECTS AT LARGE SCALE

- o RES/EPRI - HYDROGEN COMBUSTION AND CONTROL DEMONSTRATION EXPERIMENTS (1Q 84)
  - o EVALUATION OF COMBUSTION EFFECTS IN NTS FACILITY, INCLUDING TAYCO IGNITER PERFORMANCE AND EQUIPMENT SURVIVABILITY

5) COMBUSTION PHENOMENA

- o RES - HYDROGEN BEHAVIOR PROGRAM (1Q 84)
  - o FLAME ACCELERATION STUDIES AT SANDIA "FLAME" FACILITY

RESULTS OF RECENT RESEARCH

- CONFIRMATION OF RELIABLE IGNITION OF LEAN H_2-AIR-STEAM MIXTURES UNDER DYNAMIC CONDITIONS
- CONFIRMATION THAT WITH FANS AND SPRAYS OPERABLE CONTAINMENT MIXING IS ADEQUATE
- CONFIRMATION THAT THREATS FROM DETONATIONS ARE SMALL
  - RELIABLE IGNITION AND MIXING
  - CONTINUED SANDIA INVESTIGATION OF DETONATIONS
  - UPPER PLENUM DETONATION CONSEQUENCES RE EVALUATED
    - NUREG/CR-2385 EXCEEDED ACCEPTABLE IMPULSIVE LOAD VALUE BASED ON CONSERVATIVE STRUCTURAL MODEL
    - REFINED CALCULATIONS INDICATE CONTAINMENT INTEGRITY NOT THREATENED

PERMANENT vs INTERIM HYDROGEN IGNITER SYSTEMS

IGNITER POWER DISTRIBUTION

- PHMS - 2 TRAINS, 16 CIRCUITS/TRAIN, 2 IGNITERS/CIRCUIT, ACTUATED FROM MAIN CONTROL ROOM
- IDIS - 3 EMERGENCY LIGHTING CIRCUITS, 15 IGNITERS/CIRCUIT, CONTROLLED FROM AUX. BUILDING

IGNITER CHARACTERISTICS

PARAMETERS	TAYCO	GM GLOW PLUG
POWER SUPPLY	120 VOLTS	14 VOLTS
SURFACE AREA	10.9 IN^2	0.6 IN^2
POWER DENSITY	48 W/IN^2	200 W/IN^2
SURFACE TEMP	1710 °F	1850 °F
POWER/IGNITER	500 WATTS	120 WATTS

IGNITER LOCATIONS	PHMS	IDIS
LOWER COMP.	22	12
UPPER PLENUM	16	4
UPPER COMP.	10	16 (3)
DEAD ENDED COMP.	16	13
	64	45

DEPENDENCE OF PHMS ON A.C. POWER

STAFF POSITION

BACK-UP BATTERY SYSTEM FOR THE PHMS IS NOT REQUIRED

BASES

- o PHMS - DESIGNED FOR MOST RECOVERABLE SEVERE ACCIDENTS
- o LOSS OF ALL A.C. POWER - NOT A DOMINANT CONTRIBUTOR TO RISK

CONCLUSION

- PHMS IS ACCEPTABLE FOR INTERIM PERIOD PENDING COMPLETION OF IGNITION TESTING WITH TAYCO IGNITERS AND SUBJECT TO INSTALLATION OF FOUR MORE IGNITERS IN UPPER COMPARTMENT

- ALSO, FURTHER CONFIRMATORY TESTING BY STAFF AND EPRI IS NEEDED AND WILL BE PERFORMED

BRIEFING OUTLINE

I. CHRONOLOGY

II. REVIEW OF PERMANENT HYDROGEN MITIGATION SYSTEM

III. OPEN ISSUES

IV. CONFIRMATORY ITEMS

V. LICENSE CONDITIONS

CHRONOLOGY

SER ISSUED	MARCH 1979
LOW POWER LICENSE ISSUED	FEBRUARY 29, 1980
FULL POWER LICENSE ISSUED	SEPTEMBER 17, 1980
TVA EXECUTIVE SUMMARY REPORT ISSUED	SEPTEMBER 27, 1982
SSER #6 ISSUED	DECEMBER 1982

ORIGINAL LICENSE CONDITION

HYDROGEN CONTROL MEASURES (SECTION 22.2.II.B.7

(1) BY JANUARY 31, 1981, TVA SHALL BY TESTING AND ANALYSIS SHOW TO THE SATISFACTION OF THE NRC STAFF THAT AN INTERIM HYDROGEN CONTROL SYSTEM WILL PROVIDE WITH REASONABLE ASSURANCE PROTECTION AGAINST BREACH OF CONTAINMENT IN THE EVENT THAT A SUBSTANTIAL QUANTITY OF HYDROGEN IS GENERATED.

(2) FOR OPERATION OF THE FACILITY BEYOND JANUARY 31, 1982, THE COMMISSION MUST CONFIRM THAT AN ADEQUATE HYDROGEN CONTROL SYSTEM FOR THE PLANT IS INSTALLED AND WILL PERFORM ITS INTENDED FUNCTION IN A MANNER THAT PROVIDES ADEQUATE SAFETY MARGINS.

(3) DURING THE INTERIM PERIOD OF OPERATION, TVA SHALL CONTINUE A RESEARCH PROGRAM ON HYDROGEN CONTROL MEASURES AND THE EFFECTS OF HYDROGEN BURNS ON SAFETY FUNCTIONS AND SHALL SUBMIT TO THE NRC QUARTERLY REPORTS ON THAT RESEARCH PROGRAM.

CURRENT LICENSE CONDITION

HYDROGEN CONTROL MEASURES (SECTION 22.2.11.B.7)

(1) PRIOR TO STARTUP FOLLOWING THE FIRST REFUELING OUTAGE, THE COMMISSION MUST CONFIRM THAT AN ADEQUATE HYDROGEN CONTROL SYSTEM FOR THE PLANT IS INSTALLED AND WILL PERFORM ITS INTENDED FUNCTION IN A MANNER THAT PROVIDES ADEQUATE SAFETY MARGINS.

(2) DURING THE INTERIM PERIOD OF OPERATION, TVA SHALL CONTINUE A RESEARCH PROGRAM ON HYDROGEN CONTROL MEASURES AND THE EFFECTS OF HYDROGEN BURNS ON SAFETY FUNCTIONS AND SHALL SUBMIT TO THE NRC QUARTERLY REPORTS ON THAT RESEARCH PROGRAM.

(A) TVA SHALL AMEND ITS RESEARCH PROGRAM ON HYDROGEN CONTROL MEASURES TO INCLUDE, BUT NOT BE LIMITED TO, THE FOLLOWING ITEMS:

1) IMPROVED CALCULATIONAL METHODS FOR CONTAINMENT TEMPERATURE AND ICE CONDENSER RESPONSE TO HYDROGEN COMBUSTION.

2) RESEARCH TO ADDRESS THE POTENTIAL FOR LOCAL DETONATION.

3) CONFIRMATORY TESTS ON SELECTED EQUIPMENT EXPOSED TO HYDROGEN BURNS.

4) NEW CALCULATIONS TO PREDICT DIFFERENCES BETWEEN EXPECTED EQUIPMENT TEMPERATURE ENVIRONMENTS AND CONTAINMENT TEMPERATURES.

5) EVALUATE AND RESOLVE ANY ANOMALOUS RESULTS OCCURRING DURING THE COURSE OF ITS ONGOING TEST PROGRAM.

(B) A SCHEDULE FOR CONFIRMATORY TESTS SHALL BE PROVIDED BY TVA CONSISTENT WITH THE REQUIREMENT TO MEET SECTION (22)D.(2) OF THE LICENSE.

PERMANENT HYDROGEN MITIGATION

SYSTEM

PRINCIPAL REVIEW AREAS

- PHMS DESIGN
- HYDROGEN CONTROL RESEARCH
  - COMBUSTION
  - MIXING
  - DETONATIONS
- DEGRADED CORE ACCIDENTS & HYDROGEN GENERATION
- CONTAINMENT HYDROGEN ANALYSIS
- SEQUOYAH STRUCTURAL CAPACITY
- ESSENTIAL EQUIPMENT SURVIVABILITY

OPEN ISSUES

- PERFORMANCE OF TAYCO IGNITERS IN CONTAINMENT UPPER COMPARTMENT
- NUMBER AND LOCATION OF IGNITERS IN UPPER COMPARTMENT

CONFIRMATORY ITEMS

ANALYTICAL

LOCAL DETONATIONS

CLASIX/COMPARE CODE WORK

EXPERIMENTAL

EQUIPMENT SURVIVABILITY

COMBUSTION EFFECTS AT LARGE SCALE

COMBUSTION PHENOMENA

PROPOSED LICENSE CONDITIONS
FOR UNIT 1

FOUR (4) ADDITIONAL IGNITER UNITS SHALL BE INSTALLED IN THE SEQUOYAH UNIT 1 CONTAINMENT UPPER CONTAINMENT COMPARTMENT IN LOCATIONS ACCEPTABLE TO THE NRC STAFF PRIOR TO STARTUP FOLLOWING THE SECOND REFUELING OUTAGE.

ADDITIONAL TESTS SHALL BE PERFORMED ON THE TAYCO IGNITER TO DEMONSTRATE THAT THE IGNITERS WILL MAINTAIN AN ADEQUATE SURFACE TEMPERATURE IN A SPRAY ENVIRONMENT SUCH AS THAT EXPECTED IN THE UPPER COMPARTMENT OF THE ICE CONDENSER CONTAINMENT. THESE TESTS SHALL BE COMPLETED BY SEPTEMBER 1983.

PERMANENT HYDROGEN MITIGATION SYSTEM

CONCEPT

ALTERNATIVES

TAYCO IGNITER/ASSEMBLY

FUNCTIONAL CAPABILITY

SYSTEM LAYOUT

REDUNDANT/SEISMIC

OPERATING PROCEDURE

PREOP TEST

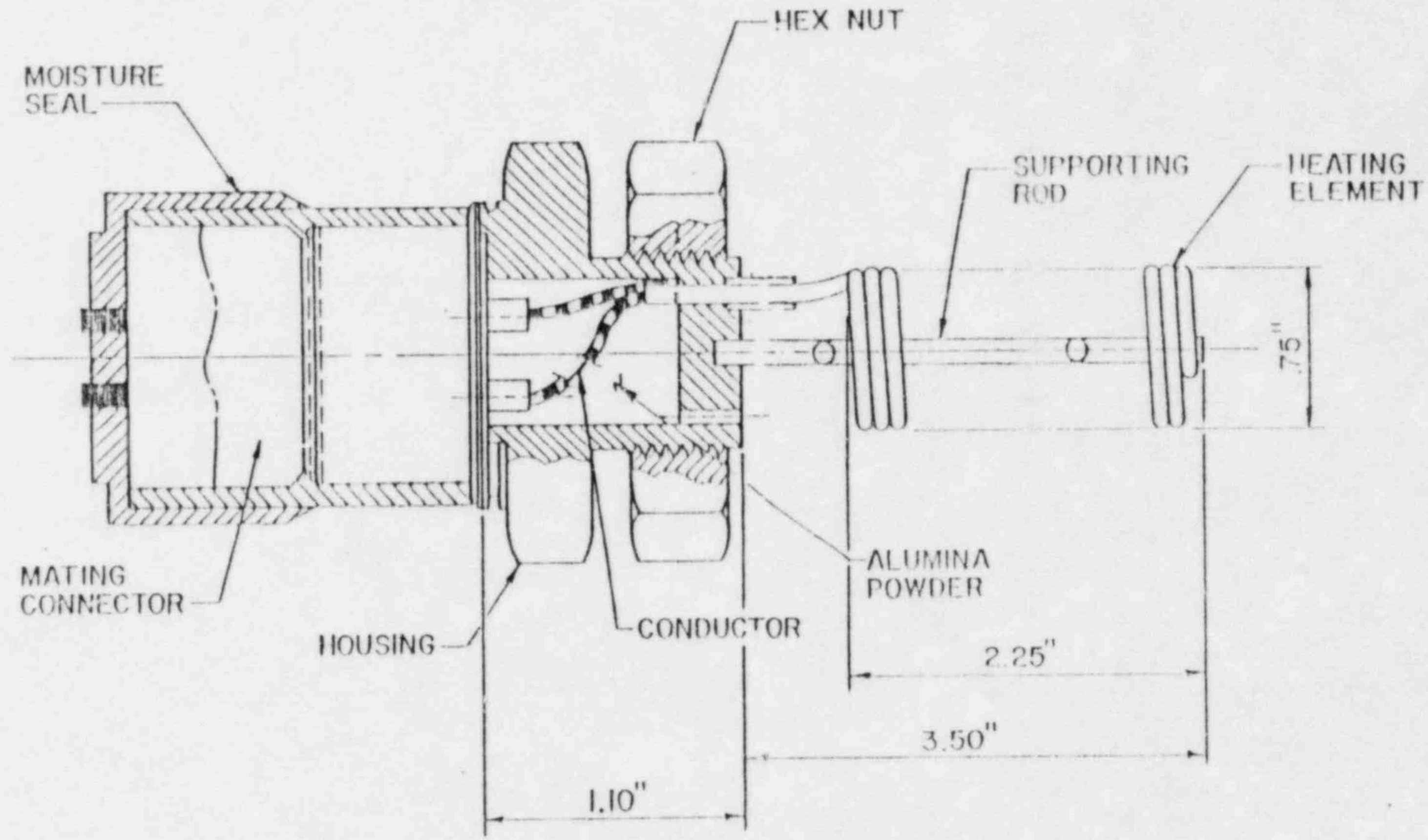
SURVEILLANCE TEST

TECH SPECS

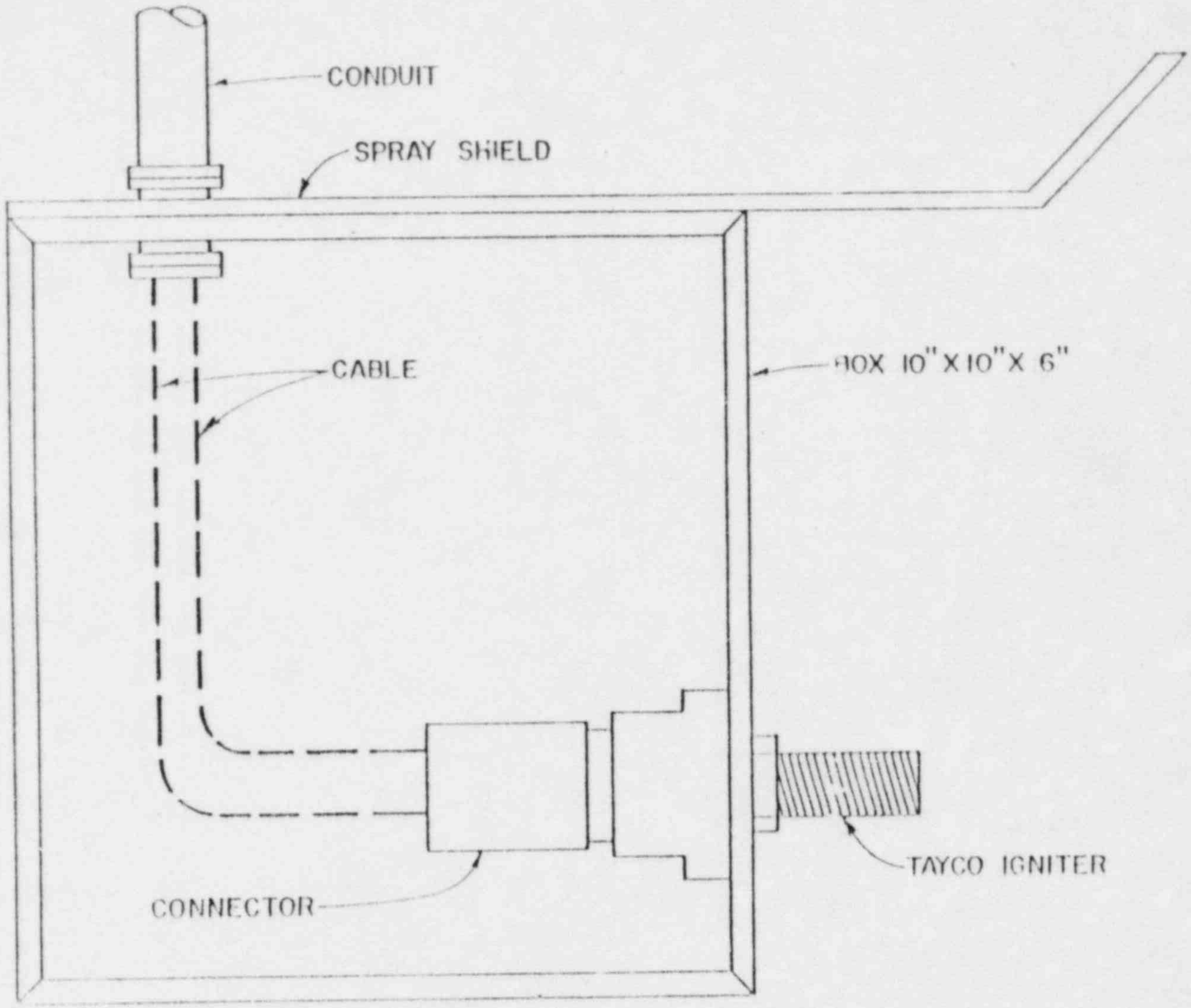
T/2

OPERATING PRINCIPLE

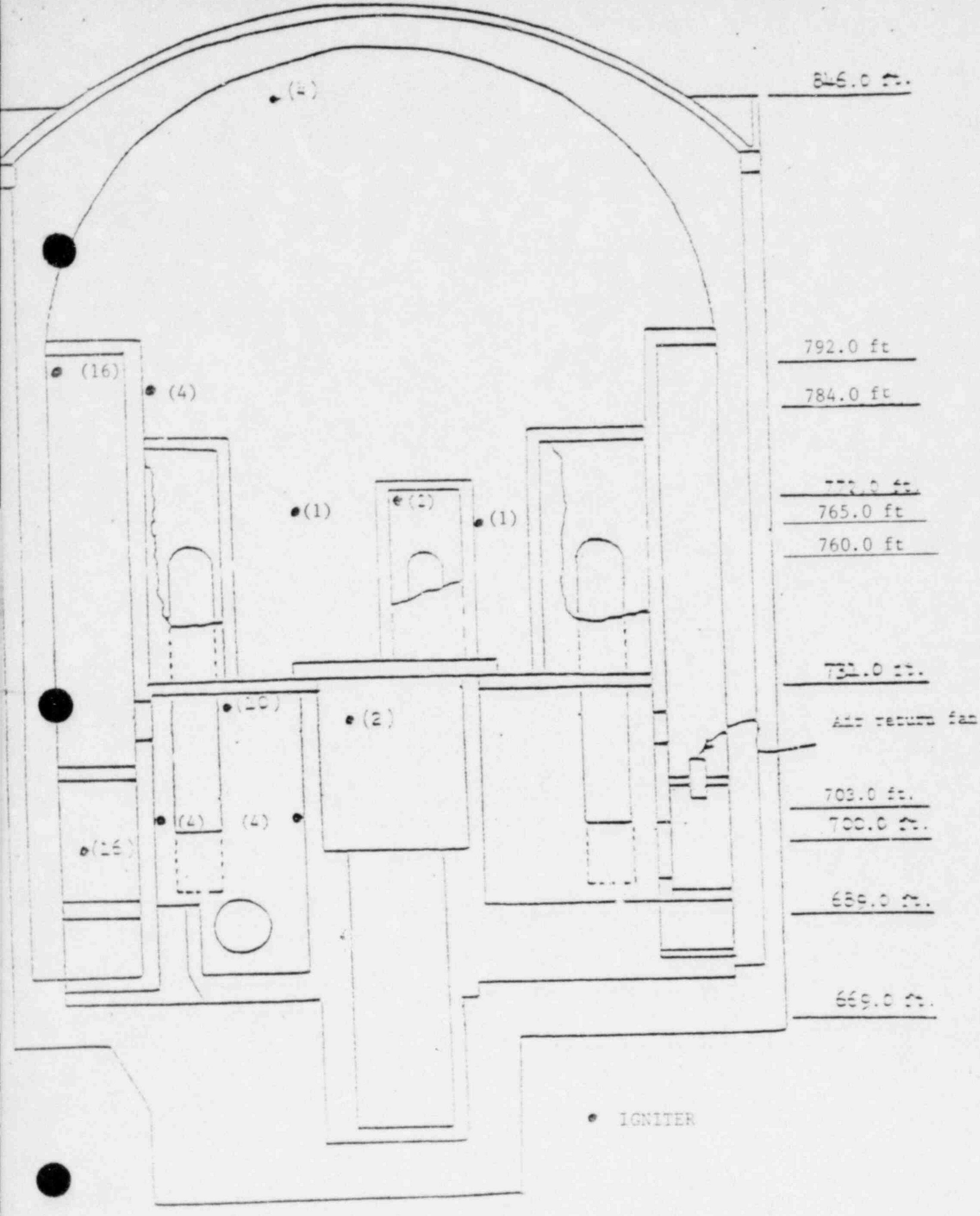
- ENERGIZED BEFORE H_2 RELEASE
- IGNITE LEAN H_2 - AIR MIXTURES
- ACHIEVE PERIODIC/CONTINUOUS BURNING
- IMPROVE EFFECTIVENESS OF HEAT SINKS
- MODERATE CONTAINMENT PRESSURIZATION



TAYCO THERMAL IGNITER



TAYCO IGNITER ASSEMBLY



ELEVATION VIEW - IGNITERS

CONCLUSION

THE PERMANENT HYDROGEN MITIGATION SYSTEM IS

AN ADEQUATE HYDROGEN CONTROL SYSTEM FOR SEQUOYAH

ICE CONDENSER UTILITY-SPONSORED RESEARCH

FENWAL - GM IGNITER COMBUSTION PROOF-TESTING

ICE CONDENSER UTILITY/EPRI-SPONSORED RESEARCH

WHITESHELL - TAYCO/GM IGNITER PERFORMANCE

- INTERMEDIATE SCALE COMBUSTION PHENOMENA

FACTORY MUTUAL - MICROFOG EFFECTS

ACUREX - IGNITER LOCATION

- MICROFOG EFFECTS

HANFORD - CONTAINMENT ATMOSPHERIC MIXING

TVA-SPONSORED RESEARCH

SINGLETON - IGNITER DURABILITY

FENWAL

GM IGNITER COMBUSTION PROOF-TESTING

PARAMETERS:

- 134 FT^3 SPHERICAL VESSEL
- PREMIXED/TRANSIENT
- STEAM/SPRAY
- FAN
- P/T/GAS SAMPLING
- H_2: 5-12 V/O
- STEAM: 0-40 V/O

FENWAL

GM IGNITER COMBUSTION PROOF-TESTING

CONCLUSIONS:

GM IGNITER RELIABLE

IGNITION IN STEAM/SPRAY

ΔP LESS THAN ADIABATIC

MINIMUM ΔP DURING TRANSIENT INJECTION (SEQUENTIAL BURNS)

NO DETONATION

WHITESHELL

TAYCO/GM IGNITER PERFORMANCE

PARAMETERS:

- 17 L SPHERICAL VESSEL
- PREMIXED
- STEAM/NO SPRAY
- FAN
- P/T/IGNITER SURFACE T/GAS SAMPLING
- H_2: 4-15 V/O
- STEAM: 0-60 V/O

WHITESHELL

CONCLUSIONS:

- TAYCO AND GM IGNITERS RELIABLE
- IGNITION IN UP TO 60 V/O STEAM
- TURBULENCE ENHANCES LEAN BURNING
- ΔP LESS THAN ADIABATIC
- CONSIDERABLE MARGIN BETWEEN REQUIRED IGNITION TEMPERATURE AND NORMAL OPERATING TEMPERATURE FOR BOTH IGNITERS

WHITESHELL

INTERMEDIATE-SCALE COMBUSTION PHENOMENA

1. LEAN MIXTURES
2. LAMINAR SPHERICAL DEFLAGRATIONS
3. EFFECTS OF FAN- AND GRATING-INDUCED TURBULENCE
4. EXTENDED GEOMETRY

COMMON PARAMETERS:

SPARK IGNITER

223 FT^3 SPHERICAL VESSEL

OR SPHERE ATTACHED TO 20 FT BY 1 FT PIPE

PREMIXED

STEAM/NO SPRAY

FAN

VARIABLE IGNITER LOCATION

P/T/GAS SAMPLING

WHITESHELL

INTERMEDIATE-SCALE COMBUSTION PHENOMENA

CONCLUSIONS:

- OBSERVED LFLs AGREE WITH LITERATURE
- Δ P LESS THAN ADIABATIC
- HIGH CONCENTRATIONS OF STEAM REDUCE ΔP
- TURBULENCE ENHANCES LEAN BURNING
- NO DETONATION EVEN AT STOICHIOMETRIC MIXTURES AND ABOVE

FACTORY MUTUAL

SMALL-SCALE EVALUATION OF VARIOUS MICROFOG DROPLET SIZE, DENSITY, AND TEMPERATURE EFFECTS ON LFL IN PREPARATON FOR ACUREX INTERMEDIATE-SCALE TESTS

PARAMETERS:

- SPARK/GM IGNITER
- 8 FT^3 CYLINDRICAL TUBE (3.5 FT HIGH x 0.5 FT DI[illegible]
- MICROFOG NOZZLES
- FLAME DETECTION/DROPLET DENSITY/GAS SAMPLING
- DROPLET SIZE: 2-15 MICRONS
- CONCENTRATION: 0.002-3 V/O
- TEMPERATURE: 20-70°C

FACTORY MUTUAL

CONCLUSIONS:

- AT ROOM TEMPERATURE, DENSE MICROFOGS CAUSE ONLY A SLIGHT INCREASE IN LFL

- AT ELEVATED TEMPERATURES, MICROFOGS CAUSE LARGER EASE IN LFL

- MICROFOGS WITH LARGER DROPLETS MUST BE MUCH MORE E TO HAVE SAME EFFECT ON LFL

ACUREX

PHASE 1 - IGNITER LOCATION

PHASE 2 - MICROFOG EFFECTS

COMMON PARAMETERS:

- GM IGNITER
- 630 FT^3 CYLINDER (17 FT HIGH x 7 FT DIAM)
- STEAM
- NO FAN
- T/P/FLAME DETECTION/GAS SAMPLING

ACUREX

CONCLUSIONS:

- Δ P LESS WHEN IGNITER WAS LOWER (NEARER SOURCE) OR IN TURBULENCE
- IN PREMIXED TESTS, MICROFOG DID NOT REDUCE ΔP - HEAT SINK EFFECT INSIGNIFICANT
- IN TRANSIENT TESTS, MICROFOG DID REDUCE ΔP - TURBULENCE ENHANCED LEAN BURNING

HANFORD

CONTAINMENT ATMOSPHERIC MIXING

PARAMETERS:

- NO COMBUSTION
- He USED INSTEAD OF H_2 IN MOST TESTS
- 30,000 FT^3 CYLINDRICAL VESSEL
- LOWER COMPARTMENT OF ICE CONDENSER CONTAINMENT MODELLED
- SMALL BREAK LOCA MODELLED
  - 2" PIPE BREAK - HORIZONTAL
  - 10" PRESSURIZER RELIEF TANK VENT - VERTICAL
- T/VELOCITY/GAS SAMPLING

HANFORD

CONTAINMENT ATMOSPHERIC MIXING

CONCLUSIONS:

MIXING IN POSTACCIDENT CONDITIONS IS VERY GOOD

- 2-3 V/O MAXIMUM DIFFERENCE DURING RELEASE PERIOD
- < 1 V/O MAXIMUM DIFFERENCE 20 MINUTES AFTER RELEASE PERIOD

JET MIXING IS MOST IMPORTANT EFFECT

FORCED AND NATURAL CIRCULATION ALSO CONTRIBUTE TO MIXING

SINGLETON

IGNITER DURABILITY

PARAMETERS:

- CYCLING
- ENDURANCE
- COMBUSTION
- SPRAY

SINGLETON

CONCLUSIONS:

- TAYCO IGNITER DURABLE
- TAYCO IGNITER WOULD BE OPERABLE IN ACTUAL SPRAY ENVIRONMENT

RESEARCH CONCLUSIONS

IGNITERS WOULD BURN LEAN MIXTURES IN CONTAINMENT ENVIRONMENTS

EFFECTS OF STEAM AND TURBULENCE ARE BENEFICIAL

DATA IS CONSISTENT AND DOES NOT CONFLICT WITH LITERATURE

PRESSURE RISES WERE LESS THAN THEORETICAL

MINIMUM PRESSURE RISES OBSERVED DURING TRANSIENT TESTS

NO DETONATIONS WERE OBSERVED

MIXING IS GOOD

IGNITERS ARE DURABLE

CONCLUSION

RESULTS OF RESEARCH SUPPORT DELIBERATE IGNITION AS AN ADEQUATE METHOD OF HYDROGEN CONTROL

OVERALL CONCLUSION:

SINCE THE PERMANENT HYDROGEN MITIGATION SYSTEM IS AN ADEQUATE HYDROGEN CONTROL SYSTEM SUPPORTED BY RESEARCH AND ANALYSIS, THE SEQUOYAH OPERATING LICENSE CONDITIONS HAVE BEEN SATISIFIED.