UNITED STATES
NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF: **DOCKET NO:**

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

COMBINED MILLSTONE NUCLEAR POWER STATION
UNIT 3/RELIABILITY AND RPOBABILISTIC
ASSESSMENT SUBCOMMITTEE MEETING

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BEFORE THE
UNITED STATES
NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

COMBINED MILLSTONE NUCLEAR POWER STATION
UNIT 3/RELIABILITY AND PROBABILISTIC
ASSESSMENT SUBCOMMITTEE MEETING

Howard Johnson's Conference Center
Yankee Trader West Room
Windsor Locks, Connecticut

Wednesday, August 29, 1984

The committees and subcommittees convened at 8:00 a.m., Dr. William Kerr presiding.

ACRS MEMBERS PRESENT:

DR. CHESTER SIESS
DR. CARSON MARK
MR. CARLYLE MICHELSON
DR. FORREST REMICK
DR. WILLIAM KERR
DR. DAVID OKRENT
MR. JESSE EBERSOLE

N U MEMBERS PRESENT:

MR. ROBERT BUSCH
MR. RICHARD WERNER
MR. JAMES CROCKETT
MR. WILLIAM COUNSIL
MR. RICHARD LAUDENAT
DR. FREDERICK SEARS
MR. JOHN OPEKA

CONSULTANTS:

MR. ALLEN CAMP
DR. CHARLES MUELLER
DR. PAUL POMEROY
MR. MYER BENDER
MR. MICHAEL BOHM

MR. SAM DURAISWAMY, Designated Federal Employee
MR. RICHARD SAVIO, Staff
MR. WANG, Staff

PROCEEDINGS

DR. KERR: We will continue with the Subcommittee meeting on Millstone 3. I will assume that all those preambles for yesterday's meeting are applicable to today's meeting. You will remember that there were a few items on yesterday's agenda that we did not cover completely, and I would propose to treat those with questions this morning.

I would first ask the members of the Subcommittee if there are any further questions on the ATWS issue that should be raised.

(No response.)

DR. KERR: I hear none at this point, so let me go to control room design and habitability or remote shutdown capability.

Are there questions that you want to raise?

Mr. Remick.

MR. REMICK: I have a question on the control room design review. Specifically has it been completed and were there any specific findings that might lead to any modifications of the control room as we saw it yesterday?

MR. ROBY: My name is Arnold Roby, and I am the system manager for generation electrical engineering.

I will respond to your question, and I am also prepared to address the two open questions that remained following yesterday's meeting, one on degraded voltage considerations and the second one of course was on the probability or the possibility of cross-ties between units.

DR. KERR: Please do.

MR. ROBY: The response to the question on CRDR is that by and large we have completed our reviews and work is completed for Millstone Unit 3. The schedule calls for a finalization of that completion, certainly within the next several months.

The CRDR reviews by and large have shown or demonstrated the adequacy of our design considerations for the control board. In one or two instances, there were minor changes. There were changes to labeling, there were changes to coloring, or there were changes to the scaling on instrumentation indications, but overall, the control board has proved to be very adequate, even given the review of the CRDR.

MR. REMICK: Thank you.

MR. EBERSOLE: May I ask a question?

In the control room design review, I guess I could say that the most important function that it will perform is to enable the operator to monitor and review to accomplish safe shutdown in more or less normal condition of operation, not post-accident. It is the fact that you can shut down when you can shut down when you have to for whatever reason, and in doing that, I think you list approximately nine or ten or a dozen-odd systems that are critical to the safe accomplishment of that shutdown.

It is interesting to me that over all these years that these systems have never been looked upon, as are ECCS systems, in an integrated pattern. They are scattered, both physically out in the plant, they are scattered on your control board, there is no sense of unity or integration of these critical shutdown functions.

Do you follow me?

MR. ROBY: Yes, I understand your question.

DR. KERR: And your question is --?

MR. EBERSOLE: My question is do you have any intent to attempt to better illustrate to the operator which of the systems must be functional to execute and carry on a safe shutdown, not with a LOCA, just an everyday matter?

DR. ROBY: Yes, those concerns are addressed of course in the Task Analysis Reviews which are done for the control boards. In those Task Analysis, the evaluations actually identify all the operations that an operator has to perform, and the way in which he has to do it to deal with all of those situations.

From that Task Analysis then arises the evaluations which demonstrate the adequacy of equipment placement, equipment availability, instrumentation availability, to address that particular function. It is from those evaluations that of course the placement of control switches, the coloring schemes that we use, are all decided to be adequate or in need of some modification.

MR. EBERSOLE: Well, that speech contained absolutely nothing with respect to what you are going to do to attempt to unify these functions by color code or whatever.

DR. KERR: That's not a question, that's a statement.

MR. EBERSOLE: Well, let me ask, do you disagree?

MR. ROBY: Do I disagree it's a statement?

MR. EBERSOLE: No, do you disagree that you have no unified presentation of these functions by the control board?

DR. KERR: You can feel free to disagree if you like.

MR. ROBY: I disagree.

MR. EBERSOLE: Well, I guess that will remain a continuing issue.

DR. KERR: Mr. Okrent.

DR. OKRENT: In some power plants and in the research and development world there have been efforts underway to assist the control room crew in diagnosing relatively more complex events. The Seabrook plant, for example, has a kind of a prioritization scheme, alarms.

Others have been looking at other things.

I'm not quite sure I understand what the short- and long-term technical point of view in this regard is for Millstone 3, whether you think the current approach with your developing functional or symptomal emergency operating guidelines and so forth, whether the SPDS is adequate or whether you think other things should be seriously examined.

If the latter, I would be interested in knowing what, and in what time scale.

MR. ROBY: We have of course included in the Millstone 3 design the provision of an SPDS which identifies the critical functions, and I am sure you are well enough acquainted with what it does and how it does it, enough not to require any further information from me.

Hand-in-hand of course with the SPDS goes operator training programs which really attempt -- which really provides the information that operators would require to prevent them getting a mind set for particular scenarios for which they are provided information which has the adverse consequence of removing them from having a free thinking ability for other events.

I think hand-in-hand with SPDS with the instrumentation that we supply, the procedures that are available to him, and with the training programs that he is given, this enables the control room operating staff to have a full and accurate cognizance of all plant events for which they are required to take action or be aware of.

DR. OKRENT: So your current program is pretty much it? You think it is satisfactory?

MR. ROBY: It has many layers associated with it, and in that respect it is satisfactory, yes.

DR. OKRENT: Well, now, let me take a look at a couple of things and see how you react.

There are ideas for signal validation, one or two different ones. I don't think they are currently in your scheme of things.

MR. ROBY: Yes, they are.

DR. OKRENT: Oh, they are?

MR. ROBY: Yes, they are.

DR. OKRENT: How are they done?

MR. ROBY: The SPDS information fed to the operator has signal validation associated with it. Each of the parameters which is input-- Many of the parameters which are input to those critical safety functions are validated, and in fact the information is presented to the operator as either validated, invalid or validated. So he is aware when he sees that information of the accuracy of it, and the extent of course to which he should be cognizant.

DR. OKRENT: What is the approach used for validation in your SPDS?

MR. ROBY: We run a true-logic processes which compare the signals with one another which, through simple logic, then evaluates what other plant processes should be seen as a result of this particular signal. If those two don't match up, then of course there is obviously a disconnection or wrong information being provided.

So it's a comparison and also a logic process.

DR. OKRENT: So if they don't line up he is told there is an inconsistency?

MR. ROBY: Insofar as the information is available on the SPDS concerned. He of course then would use his control board instruments.

DR. OKRENT: Which may equally have the inconsistency?

MR. ROBY: Insofar as some may be fed from the same sensors, that is correct. But insofar as there is a much greater resource of information, individual information on the control board, he should be able easily to confirm his suspicions from the SPDS.

DR. OKRENT: Do you have any opinions on the pros and cons of alarm prioritization?

MR. ROBY: The main thing about alarms, prioritization or not, is that basically they provide some unambiguous displays to the operator, that we don't

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suddenly surround him with so many alarms and so many colors and priorities that he is more confused about the situation than is made clear to him.

We believe that the process that we have used in Millstone 3 attempts to meet the process of clarifying the plant conditions. We have employed an exhaustive color-coding system, as you will have observed during your plant walk-through, but the presentation of the alarms, the ways in which they are grouped and their proximity to other information that he should be made aware of are all in a really honest attempt to use them as clarification to him.

DR. OKRENT: But there is no alarm suppression, as I understand it, or this sort of thing?

MR. ROBY: Not by color coding or not by different tones or whatever else may have been used in some other plants.

DR. OKRENT: I guess I'm wondering-- I'll just give a couple of examples of potential developments in the field.

People talk about response trees, for example. You get into a problem, you could display to the operator the seemingly success paths assuming there aren't some failures, one or more of them. Have you looked at all at the merits of that sort of approach?

MR. ROBY: I'm not quite sure that I understand what your question is.

DR. OKRENT: Given a loss of some-- Well, let's just say you have signs of a small LOCA. There are various success paths for keeping things under control. That's a simple one; there are more complicated ones. And in a sense, part of that is in your EPG.

MR. ROBY: Yes.

DR. OKRENT: There may be situations that EPGs haven't been able to cover, and so forth, and I'm trying to see whether you have an active program to explore beyond what I now understand you to have, or whether you feel this is really adequate.

MR. ROBY: We have of course a simulator available for each of these units.

DR. OKRENT: Yes.

MR. ROBY: And we can use that to input situations and conditions which either demonstrate the adequacy of the procedures that we have or of course have the ability to identify their weaknesses.

We also can input situations which are abstract which contain numerous failure scenarios to identify the very features I think that you're talking about.

DR. OKRENT: By the way, do you have some kind of special EPG, given a severe earthquake?

MR. ROBY: I would have to defer that question to

Mr. Crockett.

MR. CROCKETT: Dr. Okrent, yes, we do have an emergency procedure to deal with an earthquake, which will be in place.

DR. OKRENT: That's a very general kind of description I must say.

How does it differ from an EPG.... Let me assume you're given a severe earthquake; you are going to trip your turbine. I mean you could say well, it's just like a turbine trip, or something. What is different about it?

MR. CROCKETT: Different from the ERG-based procedure?

DR. OKRENT: Yes, the procedure with EPG, yes.

MR. CROCKETT: The procedure is an emergency procedure that deals— In the event of an earthquake as felt or sensed by the operators, it requires them to take a number of actions, and primarily that action is based on looking at the plant status and looking at damage in the plant to see if we have had any damage from the earthquake.

DR. OKRENT: But that's I find a sort of narrow set of objectives to take, given a severe earthquake. Given a severe earthquake, I'm not sure you know which information in the plant is reliable enough, in very good shape to know which of the non-seismic equipment may or may not have malfunctioned or was subject to damage in some way, and even, if it's severe enough, some of the nominally seismic Class 1, I don't know how you know what the operator should trust and in fact, I guess there is some evidence which I've only heard by word of mouth, when they get severe enough you don't know how much you should trust the operator.

So I'm a little curious. What does it mean to say you have an emergency procedure guideline for a severe earthquake? Your answer is sort of too blithe for me.

MR. CROCKETT: Two points. First, we have instrumentation in the plant, our seismic monitoring instrumentation. That procedure requires that the operator run those tapes and provide those tapes for analysis to determine the actual g level.

Secondly, we do operate the plant in accordance with the technical specification and under that procedure, it's the responsibility of the shift supervisor to verify that our technical specification operability and indeed also the surveillance requirements are satisfied for the equipment necessary to operate the plant.

DR. OKRENT: You are giving me words but you really haven't, in my opinion, been responsive to whether he is able to even do those things, given-- I'm talking about an SSE. I'm talking about a somewhat less probable earthquake, you know, the kind that we saw yesterday might be tickling Mr. Kennedy's fragilities, and he has a long list of things that are not on his fragility curves either.

MR. CROCKETT: I guess the best way I can respond to that is that because of the way the emergency operating procedures are written, and they are symptom-oriented, that in the event of the severe earthquake they will lead you into a symptom-oriented emergency response procedure to deal with any of the accident states that are covered by the emergency procedures.

DR. OKRENT: You see, implicit in the statement is the assumption that the information given to the operator will be such as to lead him correctly. And I'm asking how hard you have looked.

But let me leave it at that for now for both the applicant and the staff.

DR. KERR: Are there further questions on this issue?

(No response.)

DR. KERR: This brings us to AC/DC power system reliability. Are there questions about that?

(No response.)

MR. ROBY: Would you like that I should address those questions, the two open questions at this time?

DR. KERR: After I determine whether there are questions.

I see none.

Go ahead and address the two open questions.

MR. ROBY: The first question which arose yesterday really centered around the testing program that the plant has to identify the operability of plant equipment under degraded or low voltage conditions.

I think essentially that was Dr. Okrent's question.

DR. OKRENT: And mal-design.

MR. ROBY: I'm sorry?

DR. OKRENT: Mal-design, as showed up recently in Indian Point 3.

MR. ROBY: I understand. I will deal with that one as well.

The second question, as I understood it, related to the considerations for establishing electrical cross-connections between the Millstone units and thus enabling one of the unit's path sources to support another unit.

I think that was Mr. Ebersole's question.

MR. EBERSOLE: Yes.

MR. ROBY: Fine.

Regarding the first question, we do have an extensive program to demonstrate the adequacy of the plant equipment and its performance under degraded or upset voltage concerns.

DR. OKRENT: Excuse me. Could I focus the question?

Why did the undervoltage situation that developed in Millstone in operation not show up in the pre-op or operational tests?

MR. ROBY: The one you're referring to, which of course takes us back to 1973, there were -- and it may have been and I guess ultimately all of us would have to agree that there was a loophole in the protection defenses that were provided in nuclear plants to protect against voltage conditions which were present on the grid system but were not sustained at a level to provide assurance that the safety-related equipment would perform its function. The whole of this question on degraded voltage centers around that loophole.

In fact, it was a very painful period personally for me as Millstone was the unit that experienced it. However, prior to that time the protection arrangements that were included in nuclear plants to deal with these conditions were essentially no voltage protection schemes. They had voltage settings that were so low that one could almost immediately say the grid, the outside sources could never sustain themselves at those levels.

The event that arose at Millstone at that time arose because of a particular grid-loading pattern and generation pattern which allowed, on the loss of one unit, one large generating unit, the voltage to go to a level which could not or would not in fact sustain the correct operation of some of the equipment which was required for that unit.

Remember that although this was safeguard equipment, some safeguard equipment is used during normal shutdown functions. And it was in attempting to use that equipment that we discovered that it was inoperable.

Now that was how this arose. Does that answer your question?

DR. OKRENT: No, it doesn't, except partly.

What I'm really interested in knowing is in your opinion is there now a testing program for all electrical-related equipment which is sufficiently stringent that it covers the various combinations of events that might be of importance, and not only cover the no voltage and the full voltage, for example, but the variety of things that might be of interest so that in your testing program, in fact, you have carefully examined situations that might arise in degraded situations, and in ill-timing situations, in things going off and on as they might in an actual event, and so forth, to satisfy yourself that in fact your system will still be able to provide AC power where it is needed, or DC power?

MR. ROBY: The testing program for Millstone 3 fully meets the requirements you have enumerated.

DR. OKRENT: So it would just be an astonishingly remote situation that anything should occur--

MR. ROBY: -- which we have not tried to foresee. Yes, that's true.

DR. OKRENT: And you are able to simulate in a rather direct degree the kind of loading patterns that might occur under a range of accident conditions including things where not everything started and things start and went off, and so forth and so on?

MR. ROBY: Yes. As a matter of fact, I was prepared to address that somewhat more closely for the very considerations that you're talking about, remembering of course that the grid system is not available at low voltage levels for us to use it as a test vehicle.

I can tell you that it is done. I can spend a few minutes explaining to you how we do it.

DR. OKRENT: Well, let Mr. Ebersole take over.

MR. EBERSOLE: I was just going to say that this matter is really just a part of a generic problem where we have long had a hangup, believing that the only matter that we have to consider is the totality of the functional failure, and we don't look at the graduality of it, or the oscillatory characteristics of the failure as it goes down.

And I want to ask you, having found it, and by bitter experience in the electrical area, do you look at it in other areas like air systems, et cetera?

MR. ROBY: Yes. I think when the question arose, of course, we quickly realized that it wasn't just concerned with electrical systems, and reviews of the other systems were performed in order to I guess really learn from the principles that were established on that degraded voltage condition.

MR. EBERSOLE: Well, in the course of doing that do you also find a corollary which is rather than have a total functional failure of some function or some system, in fact you have an excess of that which is the ultimate voltage or pressure or whatever you may be able to get, which is normally controllable by a thing that's called a control, not a safety function?

A case in point might be what is the upper limit that you can get if the regulatory system that controls DC charging voltage sticks at its utmost limit. What will be your terminal voltage you will get on your DC charging system if that occurs when the control system is locked up in the highest mode? Can you tell me what that is?

MR. ROBY: Yes. The analysis that we do to look at what might be those highest voltages takes the generator terminal voltage to its maximum level that the machine can produce. We then do a calculation to ascribe the maximum voltage as it will appear throughout the station for those given terminal voltages.

MR. EBERSOLE: Well, in the DC system I believe you have 125 volts.

MR. ROBY: 125 volts, yes.

MR. EBERSOLE: If I apply the maximum available field current to the DC generators, what is the terminal voltage I get?

MR. ROBY: The voltage that will go at the DC battery?

MR. EBERSOLE: Yes.

MR. ROBY: It could go to 133 or 134 volts.

MR. EBERSOLE: That's nailed at that point then? It cannot go any more?

MR. ROBY: Not unless the generator can exceed its design voltage rating and the capability of the field current to produce that voltage.

MR. EBERSOLE: This is without the regulator in place. Right? This is with full, uninhibited current flow?

MR. ROBY: This is with full field current applied to the machine.

MR. EBERSOLE: Yes. So you have a nail in it?

MR. ROBY: Yes, absolutely.

MR. EBERSOLE: And correspondingly elsewhere you have—

MR. ROBY: And it is very important to establish what those nails are.

MR. EBERSOLE: And that voltage thus then presumably is capable with the sustaining volage of the connecting equipment?

MR. ROBY: Yes. In fact, those today, the very things that you talk about, are step number one in the design. Whereas perhaps in many years past one would order equipment with voltage ratings, today we look at the full range of voltage which the plant can experience, and we procure and design the equipment for those voltages. So that you may see plant-important motors with voltages as low as 60 percent of normal capability instead of a 70, 75 percent standard by which one would procure directly.

There is very close concern given to those very things that you're discussing now.

MR. EBERSOLE: Thank you.

DR. KERR: Any further questions in this area?

DR. MARK: Just a small one on the remote shutdown panel.

Let me assume that for some reason, unexpectedly but definitely, you have to transfer control from the control room. How long does it take to activate and get proper attention at the remote panel?

MR. ROBY: The remote panel. The remote panel is of course located actually within the control building complex.

DR. MARK: It is downstairs?

MR. ROBY: Downstairs, along the passage.

DR. MARK: Yes, I've seen where it is.

MR. ROBY: So certainly the time to get there from the control room is only in the order of perhaps a minute or a minute and a half.

DR. MARK: Now you've got to do some transfer switching.

MR. ROBY: That's right. Once you get to the control -- to the auxiliary shutdown panel location, you have only one function to perform in order to get transfer to the auxiliary shutdown panel, and that is the manual operation of the control switches in the transfer switch panels which will then give you full control, an indication at the auxiliary switch panel.

Certainly within a minute, two minutes, of entering that room, you should be in the transfer position.

DR. MARK: So the total time might be between two and three minutes?

MR. ROBY: I would get that that's a good estimate to use,—

DR. MARK: Well, that was—

MR. ROBY: -- probably less.

DR. MARK: I just wanted a feeling for it.

MR. ROBY: Yes.

DR. MARK: Thank you.

MR. ROBY: Certainly.

DR. KERR: Mr. Michelson, did you have a question?

MR. MICHELSON: Yes. Mine is more of a general question.

I have a number of things I wanted to get cleared up as a result of the tour yesterday, and I believe the utility would be prepared to answer these questions today. But when the scheduled opportunity avails itself--

DR. KERR: The opportunity to ask?

MR. MICHELSON: To ask questions and get them answered--

DR. KERR: Well, let me get to Mr. Ebersole first.

MR. EBERSOLE: In the design of the remote shutdown panel, I would like to get what your general principles and rationale and logic is in building that thing. So far as I now know, the Staff -- and I may be wrong about this -- hasn't really gotten a Standard Review Plan or design concept set for this, but let me ask what you did.

You certainly must, at the shutdown control panel, have the ability to provide these critical shutdown functions that I referred to earlier, and I understand that is to be provided in spite of any chaotic condition in the spreading room or the control room or any localized point of common vulnerability elsewhere in the plant, like a cable tunnel. Am I correct?

MR. ROBY: Yes, you are.

Really to meet the regulatory requirements one is only bound — at least has been bound to provide for remote control in the event the control room is evacuated but the control room is undamaged.

MR. EBERSOLE: I understand the extension-cord logic from the control room. That is a decadent notion—

MR. ROBY: Yes.

MR. EBERSOLE: — that has I hope gone down the drain forever.

MR. ROBY: Yes.

MR. EBERSOLE: But anyway, let me go on.

In the design of the center you must therefore retain the critical functional needs of the plant to shut down.

MR. ROBY: Yes.

MR. EBERSOLE: In the course of doing that, do you have in your rationale the admission that in the control room or spreading room or wherever it might be there will be a number of undesired spurious events, or could be. due to hot shorts is a case in point, and you must intercept their occurrence to preserve the notion that you are going to maintain the critical functions in that area, the preservation of function in the face of undesired malfunctions?

To what extent have you provided disconnects and cutoffs?

MR. ROBY: We have provided for that very scenario that you have described, the loss of either the control room or the cable spreading room or the instrument rack room, as you would have seen at Millstone, are really adjacent to one another.

We have provided alternate instrumentation on what we term in the fire instrument panels in the switchgear rooms associated with the auxiliary shutdown panels which provide alternate instrumentation paths to those paths which were used for the control room, so that in the event of a loss, a complete loss of the control room instrument rack room or cable spreading room, which is quite significant, we would have available instrumentation to us in the auxiliary shutdown panel area to be able to effect a safe shutdown.

MR. EBERSOLE: You are going down the same track where we were a while ago with Dr. Okrent talking to you. You provide for the loss of.

MR. ROBY: The loss of, yes.

MR. EBERSOLE: I asked, though, not for the loss of but for the undesired presence of, or the continuing oscillatory or malperformance of the functions which you must guarantee the loss of in order to execute the safety function in an isolated way at this panel.

Take a case in point. What if you have circuitry that opens all four main steam line oscillation valves or closes them, or whatever?

MR. PITMAN: That review was part of the Fire Protection Review Branch Technical Position 951, similar to Appendix R. Our review looked at both aspects here. Mr. Roby talked to those features which must remain operable.

Regarding those that could now operate spuriously and interfere with shutdown, we looked in much detail at those. I can't give you every detail about how we handled every valve, but what I can say is that there is an Action Plan. There is a procedure on the street right now for comment that deals with what actions, what response to take, based on the symptom that is generated.

In the case of motor-operated valves, in most cases it's a matter of going down, removing power from the motor control center, and randomly repositioning the valve.

In a case, an extreme case where that generates a large leak that needs to be taken care of in a hurry, that valve would be protected electrically.

PORVs is a procedure to close block valves before leaving the control room.

MR. EBERSOLE: Okay.

MR. PITMAN: Those kind of things. So it has been looked at in much detail.

MR. EBERSOLE: Right. That's all I wanted to know, that you had done an in-depth review of the undesired positive functions.

MR. PITMAN: Yes, we have.

MR. EBERSOLE: Thank you.

DR. OKRENT: One other question in the area of AC/DC power.

When I look at the May 30th report from Livermore et al. to the NRC concerning the PRA, they mention the following:

An important dependance of the vital AC main electrical system and emergency generator load sequencer on the vital DC system was not included in the corresponding fault trees. In the event of a loss of offsite power, the vital AC system would initially be dependent upon the batteries and the vital DC system.

This is an apparently critical dependence because the emergency diesels cannot transmit power to the emergency bus unless the load sequencer is operating but the sequencer requires vital AC to function. The real difficulty occurs in the individual fault trees of the vital AC and DC system.

The unavailability of each system is calculated assuming DC power is available on the emergency bus. This makes the results invalid for those cases where no power is available on the emergency bus. Thus the PSS provides no estimate of the unavailability of the vital AC and vital DC systems on demand for those cases in which offsite power is unavailable, yet such a case is precisely when the unavailability of these systems is extremely important.

I don't know. Is that an area in which you've been thinking, or is that something we have to wait to deal with in terms of the PRA?

MR. ROBY: I think you could -- we could respond to it now. Dr. Bickel could respond to it now, or you could have it covered in the PRA.

MR. BICKEL: John Bickel, PRA Section, Northeast Utilities.

DR. KERR: Will you lean into that mike, please?

MR. BICKEL: First of all, that was a heck of a question. Could we break it up into some pieces?

DR. OKRENT: Well, I was just reading from a report which I'm sure you have seen as much as I have.

MR. BICKEL: Not exactly. We saw an earlier draft some time in March. I'm not familiar with the section you have.

DR. OKRENT: I see. Section 3, which I thought was in the earlier draft. I thought they just left out the conclusions sort of. But go ahead.

Are there any important dependencies sometimes, obscure dependencies, between the availability of DC power and emergency buses for starting diesels, et cetera, et cetera?

MR. BICKEL: Yes, there are, and they are described— I believe you will find it in Figure 1.1, Section 1, of the PSS.

DR. OKRENT: Well, I'm not quite sure how to take care of the response, and I guess I was sort of asking the question in terms of, since we're talking about testing more than PSS at the moment, does the testing program go through things in sufficient depth that each vital dependency in fact is known about and tested in such a testing program?

MR. ROBY: To the extent that the people that write the procedures are very knowledgeable, the testing procedures, that is, are very knowledgeable of all the aspects of the plant design and the plant design requirements, I think we cover the very features that you talk about. Now that's—

DR. OKRENT: That's a tricky answer because I have just read where, in a system interaction study at Indian Point, they only turned up — an electrical systems interaction, they said in this report I read, by several different analysts putting their input together and grinding it through this master sets codes which puts together various fault and event trees, and the dependence turned up.

This was after the utility had spent some millions of dollars doing what I thought was and still think is a really good job in trying to uncover interactions. So I'm not fully impressed, let's say.

MR. ROBY: Well, really you answered the question. Even if you do a very thorough, absolutely first-class job, system interaction is such a complex review that you can't, with 100 percent certainty, identify that every interaction affecting the plant would have been recognized.

DR. OKRENT: You're leading—

MR. ROBY: I think you appreciate that.

DR. OKRENT: You're leading me into my $64 question:

What depth of systems interaction studies have you done or do you plan to do?

MR. ROBY: That is covered in the PSS.

MR. PITMAN: Dr. Okrent, I've requested one of the members of my staff to procure a copy of what we call our Systems Interaction Logic Diagram, which was the figure I mentioned earlier.

Now you-all I guess have a copy of the PSS. This diagram was the result of failure modes and effects analysis. It was carried out both as a part of control systems and protective systems failure modes and effects analysis, an additional FM&EA analysis which was carried out by NUSCO.

We combined the results of both of these failure modes and effects analysis into what we call a Systems Interaction Logic Diagram. What this diagram indicates on here is the impacts of the loss of AC, the loss of DC, and loss of vital AC, and how they are interrelated.

I believe your question-- You know, possibly we can possibly defer it to the PRA section, but I would refer that there is a drawing that does illustrate how the various electrical functions are interrelated both in terms of vital AC being supplied by the batteries, how the diesel field is flashed by certain battery circuits, and how the unavailability of various batteries for vital AC circuits impacts the sequencer, the diesel, and all those type of things.

I believe your question is answered in the study.

DR. OKRENT: I see.

Should I understand then your answer to tell me that were Indian Point 3 to have taken your logic and applied it to their plant, they would have turned up this weakness?

MR. PITMAN: I can't guarantee what Indian Point would have done. I know that we think we did a fairly good job of trying to scrutinize the design and find out where such interactions were possible. We did identify two of them which were critical, and are found in what I guess you would call the dominant cut set list for the plant.

And additionally we have ranked them, and we have looked at them and their impacts in the design. And we have considered them in procedures, both in emergency restoration and in on-going efforts to try and assure that we have the issue pretty well covered.

DR. OKRENT: Thank you.

DR. KERR: Let me get some guidance from the Subcommittee.

We are now almost an hour into the morning meeting and we have not yet gotten to the morning's agenda. We have scheduled for the rest of the day an extensive discussion of PRA, and there are a great many people here I think just for that purpose.

It is up to the Subcommittee as to how we spend our time for the rest of the day, but I would point out that the more time we spend on non-PRA -- and I think we ought to be thorough -- the less time we have for presentations by -- I started to say a "horde" of people, but that sounds pejorative -- a rather significant number of people who are here at the meeting.

Are there further questions on these items?

(No response.)

DR. KERR: I see none--

MR. EBERSOLE: Pardon me. Are you talking about Item 3.10?

DR. KERR: I'm talking about the items that we should have covered on yesterday's agenda and that we are covering this morning by questions. I'm not talking about the items on the Wednesday agenda.

MR. EBERSOLE: All right.

DR. KERR: Okay.

We are ready then I guess to go into--

You have not completed your response to the open question?

MR. ROBY: I had not completed my response to the electrical cross-connection question.

DR. KERR: Okay. Will you do that now, please?

MR. PITMAN: Mr. Roby?

MR. ROBY: Yes?

MR. PITMAN: Could I take this opportunity to correct a misunderstanding on Mr. Ebersole's question? I think you are content with Mr. Roby's answer that has to do with the DC system overvoltage, and I think he gave you the right answer to the wrong question, so you might want to ask that question again.

But let me give you the answer that I believe is correct.

The DC regulators--

DR. KERR: Now to which question are you giving an answer?

MR. PITMAN: You asked a question earlier about the impact of a battery charger going into an overvoltage condition.

MR. EBERSOLE: Let me make it more general.

By and large many functions are looked at only in the context of when they fail. They are not looked at in the context of when you get too much of them. And whether you get too much is -- the control over that is frequently vested in a thing called -- whatever -- a controller, a modulator which is not of a safety grade characteristic.

It is designed so you can pick it up if it fails, but in many cases no one looks at it when it goes into its ultimate forcing mode, in this case to produce the highest possible DC voltage.

MR. PITMAN: Right. And I believe the correct response to that for the specific example -- let's just take that -- a DC battery charger can indeed go into an overvoltage condition. If it can provide enough voltage at low AC input, it can provide too much at high AC input, naturally.

We do have individual overvoltage alarms set at a threshold level that would be indicative of a potentially damaging condition. A failure that caused this regulator to go astray would be alarmed; it would be an individual failure. We would have to address the consequence of that overvoltage at the time that it occurred and decide whether anything had been damaged.

I believe that's the correct response to that question.

MR. EBERSOLE: Well, what is the degree of overvoltage that you could get while the alarm is going on? What is happening to the parallel equipment in that interval?

MR. BICKEL: That's what I was trying to relate to, that the overvoltage can be there and accessible that the equipment is designed to normally function under. And recognize that most equipment can take short periods of overvoltage and not sustain. And at such time as a condition like that occurred, as could occur with diesel generators and anything else, you must then analyze what happened, what levels did I go to, what is the impact of that on the equipment and decide from there where do I go from here?

MR. EBERSOLE: But long before that you must establish by design what those terminal conditions are so that you don't have inadequate time to pick up the —

MR. BICKEL: That is indeed correct and we do have a specification, for example, for DC components --

MR. EBERSOLE: To get to the point what is the peak voltage you can get on the 125 DC system?

MR. BICKEL: I can tell you in absolute values, sir. All I can tell you is that it can go over the performance —

MR. EBERSOLE: And it would apply also to the 4160's or whatever.

MR. BICKEL: And we indeed have alarms there.

MR. EBERSOLE: I don't like the having alarm, because alarm suggests that it could be anywhere above what it should be and there may or may not be time enough to intercept damage to that paralleled equipment. Do you follow me?

Just the fact that there is an alarm leaves me cold.

MR. BICKEL: Yes. But it's the follow-up to the alarm and things can happen and will happen.

MR. EBERSOLE: Is there time? Perhaps the damage can occur in five seconds.

MR. BICKEL: Let's say for example this did occur, an isolated incident. It's going to be within a division. You're going to have the other division available and you will have time to --

MR. EBERSOLE: Stop just a moment. Remember earlier on in this session we said the typical design which the minimum required by NRC is that you have redundancy, and this applies to support systems. It's generally thought that you have redundancy in the context of meeting LOCA's on equipment which is in pure standby waiting to respond to something which will probably never occur.

In the service systems it's different, you don't have redundancy. You have -- for instance, this case here you throw an A train or whatever into disarray, perhaps you fail the whole thing. Now that almost invariably introduces a transient circumstance. You are not left with redundant configurations to address that train.

MR. BICKEL: That's correct.

MR. EBERSOLE: And I just want to point out that ı 's not as beautiful as it seems. The redundancy is not there after this kind of accident.

MR. BICKEL: I agree.

MR. EBERSOLE: Well why don't you sooner or later prepare a list of the ultimate parametric levels of the several critical parameters that you can have which are controlled by non-safety grade upper limit controls. Do you follow me?

MR. BICKEL: I believe so. Within the electrical system.

MR. EBERSOLE: Well in the hydraulic system you usually put on relief valves.

MR. BICKEL: Sure.

MR. EBERSOLE: That would be enough.

MR. ROBY: I think the question that you really wanted me to address at this time was our ability and our thoughts on cross-connecting --

MR. EBERSOLE: It was. We haven't got to that yet.

MR. ROBY: Is that still one that you'd like me to talk about?

MR. EBERSOLE: Yes. You know, one of the more critical areas in our considerations now is the reliability of AC power and it would be particularly true for you with these Westinghouse seals.

MR. ROBY: Yes.

MR. EBERSOLE: -- which we'll have to ask about later on, what are you going to do about the seals.

So when you have a multi-unit station like this certainly it enters into your mind that there are both merits and problems in providing system assistance from one of the units. I want to know what's your rationale, what protective logic do you use if you do translate power or services from one to the other.

MR. ROBY: I fully understand that question.

I think you have to remember that although the Millstone complex contains three nuclear units, each plant really has been designed in succession to the others starting in the mid-1960's. Hence basically we did not have the opportunity to designing a shared systems aspect into what essentially is a three-unit concept.

Now adding, of course, to that situation and making our position more difficult is that each of these three units is markedly different, even insofar as its basic type is concerned: we have one boiling water unit, one PWR and one Westinghouse PWR.

When Unit 1 was installed, it, of course, accessed off-site power by one 345 Kv circuit and one 23 Kv circuit which is present at the station.

With the advent of Unit 2, its off-site power was supplied again from one new 345 Kv line and a connection to the 345 Kv circuit used by Unit 1.

Now as the design proceeded for Unit 3 -- and I'd rather like to stay Unit 3-specific from now on -- it was originally intended that it would access off-site power again with an additional 345 Kv line and use, as its second source, the 345 Kv line which had been provided for Unit 2.

However, in 1981 this concept really changed dramatically with the decision to use a generator breaker in the Millstone 3 generator main connections to the switchyard.

In that respect, of course, the generator breaker now enabled two immediate, automatically-operated full capacity circuits to be available to provide off-site power to the unit without recourse to any equipment located in other plant areas.

Although the question, of course -- although that concept has been used, this question of cross-tying the supplies between units is really still applicable. And we included -- in order to get a more rational understanding of its use and the degree to which it would enable us to have a more reliable source to Unit 3 -- we included in the PSS considerations of what such a cross-connection would buy us.

In fact it turned out — we were interested — it turned out that the PSS clearly demonstrated that there were insignificant gains in such a cross-connection. And it also established, which is perhaps as important, that there are real downside risks associated with such a cross-connection because in order to go to the ultimate to get this connection you're really talking about sharing DC — sharing on-site power supplies between units. And in that instance, of course, these essential emergency supplies, which would be connected one unit to another unit, are such that a failure of such a connection raises the real prospect of adversely connecting the ability of both units to handle emergency situations.

MR. EBERSOLE: Pardon me just a moment.

In these cross-ties that you might have used, did you evoke the separative logic and the trip logic — refusal to close on faults — what one would say an enthusiastic attempt to prevent undesired translation of faults from one to the other.

MR. ROBY: Yes.

MR. EBERSOLE: Or did you just do it in the rudimentary way which almost always guarantees it will show bad on the PRA?

MR. ROBY: We included the requirements to provide for such a connection: backup protection to the main protection — the failure, of course, of the backup protection would ultimately result in a loss of the diesel which would now be supplying both units. So those were considerations, full protection schemes.

MR. EBERSOLE: So in other words you use double breakers?

MR. ROBY: Breakers at both ends, yes.

MR. EBERSOLE: And you provided relay logic to not close on faults.

MR. ROBY: We provided relay logic which would not close on faults which would only be, in fact, available at the discretion of the operator. It would not be automatically accessed.

MR. EBERSOLE: And still this cross-tie was detrimental to the overall —

MR. ROBY: The gains were really insignificant. In fact, really equating the benefits of the emergency bus cross-tie with the risks and consequences of such systems, we came to the conclusion that such a scheme -- that a better scheme is a well-designed, self-sufficient reliable power source engineered on a single-unit basis, that that provides a preferred power scheme —

MR. EBERSOLE: Yes, you mean like a gas turbine.

MR. ROBY: Pardon?

MR. EBERSOLE: Like a gas turbine?

MR. ROBY: An additional gas turbine you're talking about?

MR. EBERSOLE: Well what you're telling me, if you don't mean something like that is that two diesels are all that anyone needs.

MR. ROBY: In addition to the off-site sources --

MR. EBERSOLE: Yes.

MR. ROBY: Oh yes. Oh yes.

MR. EBERSOLE: Your conviction is two diesels and off-site power is a package which need not be improved upon.

MR. ROBY: -- which need not be improved on providing one diesel has the capability to provide one train of redundant safety equipment.

MR. EBERSOLE: You are aware of our current blackout study.

MR. ROBY: I am, yes.

MR. EBERSOLE: And the degradation of reliability that we see.

MR. ROBY: Yes, I have a --

MR. EBERSOLE: You must be at the top of the list.

MR. ROBY: I'm not sure about that, but I certainly -- loss of off-site is not the same as station blackout, of course. And I think frankly you're referring

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to that.

MR. EBERSOLE: We'll get into it with the blackouts.

DR. KERR: Are there further questions on this?

(No response.)

DR. KERR: Thank you very much.

MR. ROBY: Thank you.

I would like to introduce Mr. Paul Blanch of the Generation Electrical Engineering Group to talk to you on Regulatory Guide 1.97 and Millstone 3 Unit's compliance with that guide.

CONFORMANCE WITH REGULATORY GUIDE 1.97

MR. BLANCH: Good morning. My name is Paul Blanch and I'm supervisor of the Instrumentation Engineering Group for Northeast Utilities.

(Slide.)

My talk this morning will address Northeast Utilities' position with respect to Reg Guide 1.97. As everyone is aware, I'm sure, the title of Reg Guide 1.97 is Instrumentation for Light Water Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident.

(Slide.)

Millstone Unit 3 is in full compliance with the guidance of Revision 2 of Reg Guide 1.97. The parameters

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selected to meet the guidelines of Reg Guide 1.97 were based on a detailed analysis conducted jointly between Northeast Utilities, Westinghouse and Stone and Webster.

This analysis was based on the FSAR accident analysis and also using the Westinghouse emergency response guidelines. This analysis was completed during the early design stages, which facilitated the incorporation of newly identified instrumentation into the design of the control room and control boards.

In design of the post-accident monitoring instrumentation special consideration was given to ensure that the same instrumentation is used both during normal and accident conditions.

Part of the accident monitoring instrumentation includes a system to monitor the status of inadequate core cooling. This inadequate core cooling system is in full compliance with the guidence given in NUREG-0737, Item 2F2. This is a fully redundant and a Class IE electrical system. It includes a redundant reactor vessel level monitoring system using the Combustion Engineering heated junction thermocouple system. It includes a system that calculates both subcooling and superheat from reactor coolant system pressures and temperatures. The ICC system, Inadequate Core Cooling System, also monitors the status of all core exit thermocouples.

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The primary display for this Inadequate Core Cooling System is by the safety parameter display system and will be displayed as part of the core cooling critical safety function.

In summary, Millstone Unit 3 is in full compliance with the guidance of both Reg Guide 1.97 and NUREG-0737, Item 2F2.

This concludes my formal presentation.

DR. KERR: Thank you, Mr. Blanch.

Are there questions?

DR. OKRENT: Does the Staff concur?

MS. DOOLITTLE: The Staff has not yet completed its review of the Applicant's submittal.

DR. OKRENT: Would you remind me, is there some requirement for a continuous hydrogen monitoring system or not?

MR. BLANCH: Dr. Okrent, I believe I can answer that question.

There is a requirement within NUREG-0737 for hydrogen monitoring. It must be available within 30 minutes. Millstone Unit 3 has a hydrogen monitoring system which is capable of monitoring containment hydrogen concentration within the required 30-minute time.

DR. OKRENT: How does it work?

MR. BLANCH: It is a dual redundant independent system located outside the containment which takes a suction, a sample from the containment and analyzes the percent hydrogen in the containment and returns that sample back into the containment.

DR. OKRENT: Is that what everybody is doing, or do they have something in the containment?

MS. DOOLITTLE: I don't know the answer to that.

DR. KERR: Are there further questions?

(No response.)

DR. KERR: Thank you, Mr. Blanch.

MR. BLANCH: Thank you.

At this time I would like to introduce Dr. Rodgers.

DR. KERR: Excuse me. In light of our schedule and the time I'm going to ask the Subcommittee if we can handle the radiation protection program with questions. Is there any objection to that? I hope Mr. Rodgers won't feel slighted.

Are there questions on the radiation protection program?

(No response.)

DR. KERR: I see none. And I therefore would ask that we go now to -- Mr. Michelson said that he had some questions that he wanted to raise.

Carl, do you particularly want to read these questions, or would it be possible for you to give them to the Applicant and ask for answers at the Full Committee meeting, or what?

MR. MICHELSON: Well, any of those that they can't answer yet, sure, the Full Committee is fine. Most of these are very short brief questions.

DR. KERR: Okay.

MR. MICHELSON: They were asked during the tour, and I suspect they've got the answers all ready to go.

RADIATION PROTECTION PROGRAM

MR. MICHELSON: The first question deals with the penetrations of primary containment, both the personnel and equipment airlocks. Are the seals there inflatable seals or the standard elastimer seals?

MR. COUNSIL: Bill Counsil, Northeast Utilities. They are standard elastimer seals.

MR. MICHELSON: Okay. Thank you.

The next question deals with the venting of the auxiliary feedwater room. It was not clear during the tour just how the pressurization of that room is handled in the case of a steam line break within the room.

MR. COUNSIL: Mr. DeBarba of Northeast Utilities will answer that question.

DR. KERR: Did you get the question, Mr. DeBarba?

MR. DE BARBA: Eric DeBarba, NUSCO. I did get the question.

There are no high energy lines in the emergency safeguard features room. The line that you refer to, the steam line to the Terry turbine is not normally pressurized. The valve that controls that turbine is located outside of the ESF, and that is consistent with regulatory criteria.

MR. MICHELSON: In the unlikely event that you start up the auxiliary feedwater turbine and there is water accumulated in the line or whatever and you break the line, what provisions do you have for isolation and how do you assure that it doesn't overpressurize the room before it isolates?

MR. DE BARBA: We're not analyzing for that condition.

MR. MICHELSON: I guess you're saying that it's not a postulated line-break within the room?

MR. DE BARBA: That's correct.

MR. MICHELSON: I'd have to ask the Staff if they agree that that is not a high energy line-break.

DR. KERR: Do you understand the question, Mr. Youngblood?

MR. YOUNGBLOOD: I understand the question.

MR. MICHELSON: You may want to answer for our full Committee; it's not necessarily now. But that's an open issue, as I would see it.

The next question deals with the diesel generator room itself. The fire protection is a water spray at the ceiling. I'd like a clarification: Is that water spray automatically or manually actuated?

MR. RONCAIOLI: I'd like to answer that question. My name is John Roncaioli and I am the supervisor of fire protection engineering.

That water system for both diesel rooms is a manually actuated sprinkler system.

MR. MICHELSON: You might want to have the -- There are several documents I've read which say it's automatic. Has it been recently changed to manual?

MR. RONCAIOLI: It has been recently changed --

MR. MICHELSON: Okay.

MR. RONCAIOLI: -- based on discussions with the Staff and --

MR. MICHELSON: So my documentation probably just hasn't quite caught up.

MR. RONCAIOLI: Okay.

MR. MICHELSON: Okay. Thank you.

MR. EBERSOLE: May I ask, if you actuate that water system is it mandatory that the diesel engine generator be shut down, or do you continue to roll it?

MR. RONCAIOLI: To my knowledge it is not

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mandatory that we shut the diesel down.

MR. MICHELSON: That was going to be my next question.

MR. RONCAIOLI: Oh, okay.

MR. MICHELSON: On page 9-26 of the SER it says that the engines can run with the water spray activated. Have you provided environmental qualification of all the equipment necessary in that room to run the engines with water spray?

MR. RONCAIOLI: The exciter commutator --

MR. MICHELSON: I looked around the room. There are a lot of things that seem to be no more than drip-proof.

MR. RONCAIOLI: I can defer that question to our electrical engineering staff on environmental qualification of equipment. But let me just say as far --

MR. MICHELSON: I would be happy if you want to answer it at the full committee meeting instead. You may want to go back and look into it. It didn't seem at all obvious.

MR. RONCAIOLI: No, I think we can handle that today.

MR. MICHELSON: Okay.

MR. RONCAIOLI: Let me just say the water sprinkler system for the diesel rooms would be our last line

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of defense to be used.

We have a very sensitive detection system in that room that gives us early warning, and our position would be we would fight the fire manually to the extent possible, and that's using portable extinguishers and, of course, hose stations as a backup. And if we used hose stations it would be very, very selectively.

Even if the water suppression system -- if the decision was made to energize the water suppression system, you have to understand that the system is such designed that it's got fusable link heads designed into the system. And that means the fire would have effected those heads that have been exposed to the fire, and not the entire room would be exposed to that water suppression system.

MR. MICHELSON: I'm surprised they are fusable links since they are 40 feet from the fire locations at least.

MR. RONCAIOLI: Fusable links, yes, some are at ceiling elevations, but some branch lines do drop down where we can postulate the presence of a fuel oil.

MR. MICHELSON: Well, the SER makes the statement -- and I'll ask the Staff:

Why does the SER make the statement that you can run these unless that is the case? I assume you've looked into it and have determined that they can operate with the

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fire protection activated.

DR. KERR: Do you understand the question?

MS. DOOLITTLE: Yes.

DR. KERR: You may want to answer it at a later time.

MS. DOOLITTLE: Yes. May I do that?

MR. MICHELSON: I'd be quite happy to do that. Okay.

Let me go on to the next question: The turbine building vent. Apparently the ventilation for the charging pump, component cooling water pump and some other pumps in the auxiliary building are vented through the turbine building ventilation vent. Is that -- First of all, is that your understanding?

Well, let me tell you my problem. On page 9-32 of the Safety Evaluation Report it does state that they are vented through the turbine building vent. And my question is simply this:

Is that turbine building vent seismically qualified? And again, just giving me a reply at the full committee meeting would be fine. I would prefer it to be right the first time.

DR. KERR: Do you have the question?

MR. COUNSIL: No.

DR. KERR: I don't mean the answer, but do you have the question?

MR. COUNSIL: We have the question.

MR. MICHELSON: Okay.

DR. KERR: Okay.

MR. MICHELSON: And just look at the SER, and maybe the SER isn't correct; I don't know.

The next question: On our tour we asked about the CO-2 system since it appears not to be seismically qualified, but there was some question. So my first question is:

Is the CO-2 system seismically qualified as far as the actuation and control aspects of it? And if it is not seismically qualified, how do you assure yourself that you don't overpressurize certain compartments with CO-2 because you've lost the control system on it?

MR. RONCAIOLI: Okay. The first part of that question is our CO-2 system is not seismically designed to category one type criteria. Our systems are designed to the standards of NFPA and manufacturers' recommendations. That's all our suppression systems.

Your second question is how do we assure ourselves that discharge of the CO-2 system may not overpressurize our areas, and the answer to that question is we have provided pressure relief mechanisms in accordance with NFPA-12 on CO-2 to assure ourselves that no overpressurization will result in any of the areas that CO-2 is being applied to.

MR. MICHELSON: Not being familiar with the details of the referenced code, could you tell me, does this simply mean that if the CO-2 comes on and stays on until the supply is exhausted that you still do not overpressurize the rooms?

MR. RONCAIOLI: That's correct.

MR. MICHELSON: Okay.

In view of your introduction of CO-2 into the spreading room -- I think you do that -- if this condition should occur what is there to prevent the egress of CO-2 into the control room and thus drown all the operators?

MR. RONCAIOLI: Okay. The cable -- Our particular cable spreading room has been designed almost to a vault type condition, meaning it's a well-sealed area. Most penetrations going from the cable spreading room happen to enter into the instrument rack room, which is adjacent to the control room, although some penetrations do come into the control room. And we have a penetration seal program that would assure us that all openings between any areas in the control rooms would be sealed.

MR. MICHELSON: Do they have the pressure capability compatible with the relief panel?

MR. RONCAIOLI: They have the pressure capability that well exceed the capacity of the pressure relief venting, that's correct.

MR. MICHELSON: Okay.

DR. KERR: Further questions, Mr. Michelson?

MR. MICHELSON: Yes, I have a couple more.

The service water, which is a pretty critical function since it supplies essentially all cooling water to critical systems, uses backwash strainers. It's my understanding that the backwash strainer is not provided with a bypass in the unlikely event that it becomes clogged and cannot be backwashed.

I would like just a brief explanation of what thought you gave to the kinds of contamination in the water supply that might clog the backwash strainer. Particularly I have in mind bio-fouling of the strainer from fish runs or from whatever kind of small material that can get in. And I would also like a confirmation that you are using eighth-inch mesh strainers in the backwash strainer.

MR. RONCAIOLI: Okay. We'll try to find someone that can address that question.

MR. NECCI: I'm Ray Necci, manager, Mechanical Systems Engineering for Northeast Utilities.

The Millstone 3 service water strainers have incorporated in them our experience at Millstone 1 and at Millstone 2. And in that we have taken into account the bio-fouling experience that we have had at those units. I am not sure of the size of the mesh right now. We can get back to you on that today.

The type of bio-fouling that we normally see includes the normal mussel shell build-up and particles.

MR. MICHELSON: Is there any form of bio-fouling that will get through the traveling screens, which I understood were something of the order of a quarter- to a half-inch mesh, so they pass right through them where they will hang up on the backwash strainer?

Are there no small minnow runs, that sort of thing that you have ever experienced, or could have -- This is a low probability event we're talking about, but it's a potential core melt event also if you lose all service water.

MR. NECCI: No. Our experience has been in terms of mackerel type fouling that --

MR. MICHELSON: Have you given serious consideration to this unlikely event and taken the precaution -- or have you thought about taking the precaution of bypassing the strainers -- what you would have to do now with piping; you can't do it when it happens.

MR. NECCI: The strainers themselves have a backwash arrangement with a motor oerator which can be manually operated in case there were problems with the

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backwash --

MR. MICHELSON: No, but that only runs the water back to the lake; that doesn't run it into the cooling equipment where it is needed.

MR. NECCI: But that is to ensure that the filter remains clean.

MR. MICHELSON: Yes, but of course the contamination we're talking about hangs up on these mesh -- this type of filter. As you are probably well aware, not everything backwashes off of it.

MR. NECCI: Yes.

MR. MICHELSON: Okay. I believe that's all the questions I have now until we get to the Staff's presentation on fire protection.

MR. EBERSOLE: One final thing brought up by Carl's questioning.

You told us yesterday your diesel engines had tertiary cooling loops. They didn't use saltwater; typical, of course. Let me ask:

In the shutdown or trip logic of the diesel engines which protective features do you retain even in the emergency mode? For instance, you don't operate on low oil pressure. What about injected water?

What do you retain as a protective feature in the diesel logic even though it's being used in an emergency

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function?

And why I ask that is I want to know how hard you try to save the diesels for the long term.

DR. KERR: Do you understand the question?

MR. COUNSIL: Bill Counsil.

Yes, we understand the question. We'll have that answer momentarily.

DR. KERR: Okay.

Are there other questions on this topic?

(No response.)

DR. KERR: Before we get to the next presentation, which is by the NRC Staff, with comments from the Applicant, I want to ask the subcommittee members to take note of some material distributed by Mr. Duraiswamy, which is a suggested agenda for the full committee meeting.

Please look that over and give us any comments by about noon as to the appropriateness of the material that has been included or additions that you would like to see made.

This brings us then to a presentation by NRC Staff.

Ms. Doolittle, I will turn things over to you.

The hand-outs associated with this presentation were distributed yesterday, so you may want to forage into your stack of materials to find it.

MR. COUNSIL: Dr. Kerr, before the staff starts, may I answer a couple of those questions that were just asked?

DR. KERR: Yes, sir. If you don't mind, Ms. Doolittle?

MS. DOOLITTLE: Not at all.

MR. COUNSIL: You asked particle size max that would pass the strainer. It's .0625 inches.

MR. MICHELSON: 1/16th inch?

MR. COUNSIL: Basically, yes. Mr. Ebersole, you asked me about which trips on the diesel remain in in the accident mode. There are only three. One is generator differential, one is a loss of two out of three on our low lube oil pressure, and the last one is overspeed.

MR. EBERSOLE: So you would run it then, without jacket water?

MR. COUNSIL: Yes, sir.

MR. EBERSOLE: How long would it last?

MR. COUNSIL: I believe that number on startup of the diesels is three to five minutes at full load.

MR. EBERSOLE: You regard that as prudent in view of the long-term value of the diesel?

MR. COUNSIL: If we are in an actual emergency condition.

MR. EBERSOLE: Oh, a large LOCA?

MR. COUNSIL: A large LOCA.

MR. EBERSOLE: But now you know that's got a new perspective.

MR. COUNSIL: Yes, sir. I realize it has a new perspective. If in fact we are in a large LOCA which could be determined rapidly, we are going to let that diesel run.

MR. EBERSOLE: But now you know the rationale is on a large LOCA we need not consider it to be — if we would think rationally — coincident with an AC power loss from outside. Now does that change your logic?

MR. COUNSIL: Let me answer that question personally, if I may.

I would rely upon my operators to go outside the bounds of their operating procedures and shut that diesel down. However, at this point in time I would not be permitted to do so, as you are quite well aware, by regulations.

MR. EBERSOLE: Yes.

MR. COUNSIL: Now, in order to get us to the point where such action would be required, or could be effected without going outside the bounds of what we are presently licensed to do, we would have to have numerous discussions with staff, and prove to the staff, for instance, that our emergency based operating procedures and the training of the operators was sufficient that, in fact, we could shut it down without jeopardizing the plant.

MR. EBERSOLE: I think that might be an interesting topic to subject to sort of a mini-PRA. And I'm almost dead certain when you get done with it you'll have a trip on jacket water temperature.

With that I'll close my questions.

MR. MICHELSON: Do think it would be suitable, Jesse, for the staff to tell us what their view is on this subject at the full committee meeting?

MR. EBERSOLE: I would indeed.

MR. MICHELSON: I would like to hear it myself because it's a little unique and operator action is required very quickly to prevent the total loss of all onsite power.

DR. KERR: Do you understand the question, Mr. Youngblood?

MR. YOUNGBLOOD: Yes. We'll be prepared.

DR. KERR: Are there further questions?

(No response.)

DR. KERR: Thank you, Mr. Counsil.

Ms. Doolittle.

NRC STAFF PRESENTATIONMS.

MS. DOOLITTLE: My name is Elizabeth Doolittle. Other members of the NRC staff here today are Mr. Joe Youngblood, Chief Licensing Branch No. 1, Mr. Jeff Kimball from the Geo-Sciences Branch, Mr. David Terao from the

Mechanical Engineering Branch, Mr. John Knox from the Power Systems Branch, Mr. Ashok Thadnani, Chief, Reliability and Risk Assessment Branch, Mr. Art Buslik and Mr. Glenn Kelly, also from Reliability and Risk Assessment Brnch, Mr. Rich Barrett from Reactor Systems Branch, Mr. Neil Choksi from Structural and Geo-Technical Engineering Branch, and Mr. Pat Easley from Accident Evaluation Branch.

DR. KERR: Who's left back to keep the store?

MS. DOOLITTLE: Here again today from Region I are Mr. Ted Rebelowski, Senior Resident Inspector, Mr. Dave Lipinski, also Resident Inspector of Millstone 3. I believe Mr. E. B. McCabe and Mr. Ed Greenman are also here again today.

(Slide.)

During my presentation yesterday I gave a brief overview of the staff's review of the safety portion of the operating license application, and then I highlighted the major items which currently remain unresolved due to differing technical positions between the applicant and the staff. Today I would like to begin by highlighting some important plant features which the staff identified during its review, and then I plan to discuss some of the significant unresolved items in the SER.

(Slide.)

The staff identified and addressed these five key features in its safety evaluation report. The applicant discussed information on four of these during its presentation yesterday. I don't plan to discuss them any further today, although I would like to note that Millstone 3 also will use loop isolation valves.

MR. MICHELSON: Could I ask a question, since you're not going to discuss them? The safety grade cold shutdown discussion, is it your understanding that this can be achieved with single failure?

MS. DOOLITTLE: Yes.

MR. MICHELSON: And it will be performed by safety grade systems?

MS. DOOLITTLE: Yes.

MR. MICHELSON: I guess that means that you define RHR then as a safety grade system?

MS. DOOLITTLE: Yes.

MR. MICHELSON: Okay, thank you.

MS. DOOLITTLE: Regarding the loop isolation valves, there are two double-disk remotely-controlled motor-operated valves in each loop. The function of the loop isolation valves is to isolate the reactor coolant pump and steam generator in each loop for maintenance. The applicant expressed the intent to operate in the N-minus-1 mode in a letter dated April 9, 1984, but must submit the necessary core thermal hydraulic analysis for the staff review.

As I mentioned during my presentation yesterday, there are 19 items which have not yet been resolved as the result of the staff's review. They are: internally generated missiles, diesel generators, protection against postulated pipe breaks outside containment, loading combination, design and construction of component supports, inservice testing of pumps and valves, equipment qualification, flow measurement capability, loose parts detection program, subcompartment analysis, mass and energy release analysis, volumetric inspection of class 2 components, power operated relief valve and block valve fire protection, functional capability of AC and DC emergency lighting, shift technical advisor training program and operating experience for startup, emergency plan, limitation on overtime, and Q list.

(Slide.)

Although your handouts contain information on each item, I only plan to discuss the ones for which there are differing technical positions between the staff and the applicant.

Open item number 2, diesel generators, contains two items related to diesel generators which the applicant and staff do not agree on. The applicant has not shown its diesel generator exhaust piping is protected from tornado-generated missiles. Therefore the staff cannot conclude that the design complies with GDC 4. The applicant's position with regard to this item is that damage to the backup exhaust path from tornado missiles is incredible, therefore, the exhaust will not be degraded as a result of tornado missiles.

(Slide.)

The staff is currently reviewing information submitted by the applicant on August 20, 1984. The expected schedule for resolution is November, 1984.

Also, the applicant has not shown that the diesel generators will maintain the capability to meet the load acceptance test requirements after 24 hours of operation at no load or light load. This does not meet the criteria of Section 6.4.2 of IEEE Standard 387, 1977.

In order to demonstrate this capability the staff required the applicant to either provide the results of a previously run weather watch test report showing closeup photographs of the cylinders, rings, and valves in order to observe accumulation of fuel oil and lube oil on these parts, or perform an onsite test by operating for 24 hours at no load then loading within 60 seconds to full load.

The applicant's weather watch test results did not contain the necessary information. His position now is that he does not plan to run the onsite test because it could either damage or cause excessive wear to the diesel.

The schedule for resolution of this item has not yet been determined.

DR. KERR: What is the staff's view of the applicant's response, that you don't care whether it damages the diesel or not or that you have to follow regulations no matter what? Or none of the above?

MS. DOOLITTLE: I'd like to ask Mr. John Knox from the NRC staff to respond to that.

MR. KNOX: Basically, we have not reviewed the item as yet. However, we will be sympathetic to the possibility that it will cause damage to the diesel generators by overtesting.

MR. EBERSOLE: May I ask before you sit down -- this can get to be a sticky business. To what extent is this unique here? Is this requirement placed on all current diesel packages at our nuclear plants, that they execute a long term no-load run at 24 hours and then crash out full load?

MR. KNOX: Other vendors have done a similar type test. The vendor for PMD diesels has run a test for 7 days at no load and then loaded the diesel generator up to the full load.

MR. EBERSOLE: Is the problem basically accumulation in the exhaust sytems?

MR. KNOX: I believe so, yes.

ME. KNOX: I believe so, yes.

MR. EBERSOLE: Can't you just bore some holes in them and fix it? Is it a matter of drainage of byproducts of combustion?

DR. KERR: Mr. Ebersole, let me suggest that we shouldn't solve that generic problem at this time.

MR. EBERSOLE: All right. I just want to know -- When we talk about it, we'll ultimately be interested in how well the other plants pass this test. It can be a sticky test depending on the design.

MR. MICHELSON: Let me ask a little different question then. What's unique about this engine that seems to indicate it might not do so well on this test and therefore might damage the equipment?

MR. EBERSOLE: I don't believe there's any real indication that that's the case.

MR. MICHELSON: I see. It's just a reluctance on the part of the utility then to take a chance?

MR. KNOX: That's right.

MR. MICHELSON: Thank you.

DR. KERR: Thank you, Mr. Knox. Please continue.

(Slide.)

MS. DOOLITTLE: There are two significant aspects of the component support item which remain open due to differing technical positions. They are load and load

3 WRBpp

combinations and stress limits.

For open item number 4, the applicant has not included LOCA loads in the evaluation of the faulted condition limits for ASME code class 1, 2, and 3 balance of plant piping and supports. The applicant has not addressed how the guidelines of NUREG 0609 "asymmetric blowdown loads on PWR primary systems" have been satisfied. Staff cannot conclude that the design meets the requirements of GDC 4.

MR. OKRENT: Don't run away from that. There are two items I have here: one is protection of postulated pipe breaks outside containment, and then I have another one: loading combinations. And I must confess I'm not sure whether item four is intended to apply to primary system piping or to lots more piping. So first will you answer that question?

MR. TERAO: I'm with the Mechanical Engineering Branch.

DR. KERR: I can't hear you.

MR. TERAO: With respect to the first item which is LOCA loads, basically in our review of the FSAR what we found is in their load combination tables there was an absence of the LOCA loads in the piping and pipe support area. So we had several discussions with the applicant regarding this. And it appears that their response indicates that they will ask for an exemption to GDC 4 by using the leak before break approach.

Now the staff position, of course, has been established in their February 1, 1984 generic letter 8404. And our disagreement with the applicant at this time is really with the extent of the implementation of the leak before break approach. Basically, what the staff believes at this time is the leak before break approach can be used for the elimination of large pipe whip restraints and jet shields and also for the elimination of the asymmetric blowdown loads.

MR. OKRENT: In which piping systems?

MR. TERAO: That's for breaks in the reactor coolant loop.

MR. OKRENT: All right.

MR. TERAO: Now what the applicant is proposing is that -- well, the staff position there is that the margin should not change in any component supports and piping as the result of implementing this leak before break approach. The applicant has analyzed its large restraints on the reactor coolant loop for the original WCAP-8082 pipe breaks. But for the balance of the plant, the applicant is intending to extend the leak before break approach to the design of those piping and pipe supports, not the reactor coolant loop but for the balance of plant.

MR. OKRENT: And what is the staff position, and does it have criteria?

MR. TERAO: The staff position at this time is being developed in NUREG 1061. Right now it's in the second draft. But the position the staff is now taking is that for plants with OL -- operating license and construction permits that component and piping supports should maintain the same margin that currently control their design for structural integrity. The applicant is proposing to, instead of using the WCAP-8082 breaks for those support designs, they are intending to use a smaller worst case branch line break and that is what the staff disagrees with at this time.

MR. OKRENT: How will the ACRS know if it happens to write a letter on operation of this plant what it is that it's approving with regard to the treatment of piping?

MR. TERAO: Well, we're having difficulty at this time because the applicant has not formally submitted its exemption from GDC 4.

MR. OKRENT: But I don't know what the staff's position is, do I?

MR. TERAO: It has been established in generic letter 8404.

MR. OKRENT: It's not going to change on this plant?

MR. TERAO: Not at this time.

DR. KERR: May I just clarify: When you talk about violation or lack of violation of GDC 4, these other documents are interpretations of GDC 4? The only thing I've heard mentioned that was a regulation is GDC 4. These other documents are guidance or Reg Guides or whatever. Apparently there are varying interpretations of GDC 4.

MR. TERAO: That's correct.

MR. KERR: So the disagreement is over the interpretation and not over the general idea that is contained in GDC 4? Is that it?

MR. TERAO: That's correct.

MR. OKRENT: Well, you could say the same thing about fire protection, you know.

DR. KERR: I would indeed say the same thing about fire protection.

MR. OKRENT: That there should be protection against fires.

DR. KERR: But there's also a regulation, Appendix — whatever it is — R, Fire Protection.

MR. OKRENT: But until that, what we had was the GDC.

Are you able to tell me what the position is in the Federal Republic of Germany with regard to — for which plants they allow a departure from a full break, and then when they allow this, what they insist upon with regard to quality of piping, what they insist upon with regard to protection, for example, with regard to environmental effects, what they insist upon with regard to separation; so that were there to be a rupture, you might or might not affect redundant systems, and so forth and so on? Does the staff have that information summarized succinctly?

MR. TERAO: Not at this time. I do not have that answer for you.

MR. OKRENT: Well, I must say at the present time I find I don't know what the staff position is. I hear that there is some position today but my experience is there could be another position tomorrow. I don't know what the basis for the staff position is, whatever it is. I don't know how it relates to various kinds of, what I'll call risk considerations. And if you think about what the Germans are doing, as I understand it, there is in fact a broader picture than just saying we'll have a certain kind of criterion with regard to the size break we'll design for primary system piping.

There are other things that are being protected against,and so forth, and its in a context of a certain plant layout and so forth, as I understand it.

I'd like to see a comprehensive thoughtful presentation by the staff as to just when they think it's suitable to allow a departure from traditional approach of the past and why. And I object to having this done on an ad hoc basis, because one applicant proposes one thing, another applicant proposes another thing without having a reasoned approach.

In fact, at the present time on this position I find myself unable to say I know what the position of the staff is eventually going to be, and therefore at the present time I would have to say I am unable to reach a conclusion on whether or not this plant should be operating or not, because I don't know what's going to happen here.

MR. TERAO: We certainly agree that our position is more conservative than the applicant's.

DR. OKRENT: Today. But I don't know what it will be in 3 months or 6 months.

MR. TERAO: Well, at this time the overall leak before break approach we believe should be implemented conservatively, in keeping with the commission's defense in depth principle. So in that sense all we're saying is that we did not want to see a reduction in the margin in piping supports due to the elimination of LOCA loads or a design double-ended guillotine break LOCA load.

MR. OKRENT: I want you to know I did not say we shouldn't, in various circumstances, no longer design against double ended breaks for certain aspects of the problem. I'd like to see a reasoned -- fully developed approach that gives reasons for each of the various aspects that the staff thinks is okay and when and why. You know, I could envision something being okay for very good new piping and not okay for piping of unknown quality, et cetera, et cetera. And I must confess I can't tell where the staff is drifting.

MR. TERAO: I guess I can only say at this time that we are trying to develop our position in NUREG 1061 which is being developed by the NRC's Piping Review Committee. This is one of the four subtasks, and this one subtask is the evaluation of potential for pipe breaks. So this is being developed at this time. I'm only addressing the current staff position based on this second draft.

MR. BENDER: Could I ask for a little clarification of the present quantitiative position for the primary loop setting aside the branch connections. The staff is willing to back away from a double ended pipe break requirement, to what? How big a break is the staff thinking about as being a basis for design?

MR. HERNAN: We are scheduled to make a presentation to the committee in October on the subject of pipe cracks.

MR. OKRENT: Should we defer review of Millstone until then?

MR. HERNAN: I guess it's my understanding that you were looking for a presentation from the staff which would not be necessarily part of the Millstone licensing.

MR. OKRENT: But on Millstone I can't tell what the eventual design basis is intended with regard to not only primary system piping but other piping, and why.

You know, I might be willing to buy an approach, but I would like to see what it is and understand the logic for it.

I hope I'm not being unreasonable.

MR. HERNAN: I think I can speak for the NRR staff. We will try to present our position as it stands at the full committee meeting next week in connection with Millstone-3.

DR. KERR: Is it possible to respond to Mr. Bender's question other than the response you just made?

Mr. Bender, would you be willing to repeat your question?

MR. BENDER: I've been aware for some time that the staff has accepted probabilistic assessment of the primary loop failure criteria for Westinghouse plants, the understanding being that the double ended pipe break is probably beyond the limits which ought to be considered. But in backing away from it, it was unclear as to where you would back -- to what position you would move to. Some other break size might be controlling? But what is it?

MR. OKRENT: Let me go beyond that. As I

understand the German position, from a very rapid perusal, they, I think, say, 10 percent of the area so far as jet force and this sort of thing — full break so far as containment loading or environmental effects. I think they also have qualifications that whatever the break it doesn't knock out redundant systems that are vital for safe shutdown.

Well, you can start seeing a logic in a position like that. I may have misquoted them. I read it in a hurry but at least there's a package of some sort there. I haven't seen that element of a package in what I've heard from the staff up to now; okay?

MR. YOUNGBLOOD: We're only in the process of issuing our first exemption on this right now.

MR. OKRENT: But you should have some kind of a broad perspective on what it is you're doing and why.

MR. YOUNGBLOOD: I believe they do. I can't give it to you personally.

MR. OKRENT: I would like to know who "they" is.

MR. TERAO: That's the Piping Review Committee.

MR. OKRENT: The Piping Review Committee in fact is a committee of people partly from the NRC and partly consultants and so forth. And what I have read in the past is interesting but I don't think it has given me the kind of perspective I'm talking about. If it is there, lease send the document to Dr. Savio and indicate the pages.

MR. BENDER: Just a point on the question I asked: I am persuaded that if the staff can rationalize reductions in the double break criteria for the large pipes they can have some criterion also for the connected pipe. But there has to be some logic to it. I don't see why it should limit its position only to the large piping. It seems to me that if you are going to make a review for this plant that you ought to look at the whole problem at one time, so you don't have a set of fragmented positions. And I would hope that you would give all of that some thought not just limit it to the primary circuitry.

MR. MICHELSON: I have a follow-up question in the same area. The environmental qualification of equipment outside of containment is based on certain postulated failures of pressure boundaries, high and low energy pressure boundaries. Is that approach in any way being modified now by these new thoughts concerning how you will calculate loadings on supports outside of containment, and is this a part of the overall plan? In postulating new break sizes are you going to change environmental conditions at the same time?

MR. TERAO: No, sir. The staff leak before break approach is not to be used for setting design requirements for four things. One is the ECCS. Second is for containment sizing. Third is other engineered safety features. And the fourth is the environmental qualification of equipment.

MR. MICHELSON: So you're still using the old branch positions concerning that?

MR. TERAO: Yes.

MR. MICHELSON: Then keep that in mind when you answer my question on auxiliary feedwater at the full committee meeting.

MR. TERAO: Yes.

MR. MICHELSON: Thank you.

DR. KERR: Mr. Ebersole?

MR. EBERSOLE: When you clarify this state of flux you're apparently in, I wish you'd put in there for final clarification the degree to which you accept damage to mitigating systems. A case in point: would you accept damage to mitigating systems as a result of these pipe breaks which leaves only a single functional train available to meet and mitigate the consequence? Or would you require post-accident redundancy in the mechanical, electrical, and all other contexts? And when you do that, you better be careful because there's a very muddy situation out in the field in which there's apparently no real consistent standard as to what degree of damage is imposed on the mitigative functions.

MR. TERAO: As the result of implementing leak before break?

MR. EBERSOLE: As a result of -- well, the integrating -- in answer to whatever you do here, whether it's -- you have moderate accidents with leak for before break, or however large they may be. The important thing is to define your acceptable degree of damage to mitigative functions.

DR. KERR: Mr. Mark?

MR. MARK: I find myself just not knowing the situation. Asymmetric blowdown loads are mentioned here. Is there something unique about this steam supply system which has not been discussed in connection with cylinder installations previously insettled there?

MR. TERAO: There is one major area that is different from other Westinghouse plants, and that was the division of responsibility of the reactor coolant loop analysis. Apparently with the Millstone-3 plant the analysis was performed by Stone & Webster and not by Westinghouse. That was what partly originated our question, because the load combinations which eliminated the LOCA loads are found in the balance of plant piping which also included the reactor coolant loop.

DR. KERR: So that the plants aren't different, but the analysis was; is that it?

MR. TERAO: That's correct.

MR. MARK: Well, if an identical plant had been analyzed by Westinghouse, would that not have answered the question, assuming the analysis was satisfactory?

MR. TERAO: I'm not sure what the hypothetical question was again.

MR. MARK: I'm not hearing you.

MR. TERAO: I'm not sure what your question was.

MR. MARK: I'm wondering why, when this question has been looked at with respect to plants quite similar, it is still a question.

DR. OKRENT: If I may interject: The committee talked about this for primary systems for Westinghouse. There are questions now of going beyond the primary system per se: and, if you do that, how, with what criteria, and so forth? This needs to be thought through.

MR. MARK: I would be in favor of that.

DR. KERR: Mr. Bender?

MR. BENDER: I wanted to ask the applicant --

DR. KERR: Will you get close to the microphone, please?

MR. BENDER: I wanted to ask the applicant: I presume that since this subject is a fairly recent one, for a long time you must have been designing on the basis of a double ended pipe break requirement for the primary loop.

What's the impact of this particular difference of view on the status of the plant? What are you planning to do if you get the approval to use these criteria?

MR. DeBARBRA: You're correct. We have included design of double ended breaks for many years. The impact of this exemption would be, essentially, to not complete the installation of the high energy pipe whip restraints on the primary coolant loops which for reasons -- for many reasons -- we think do not add a margin of safety to the plant. In fact, they do things like make inspections difficult. So we think there are very good reasons to not install those pipe whip restraints.

I just would like to take a moment to clarify a few points here. That is, the exemption that we're applying for to GDC 4 is only for the main loop pipe breaks. The basis for those exemptions specifically is WCAP-9558 which is the generic resolution of issue A2 which is the asymmetric blowdown LOCA loads. Additionally we have a Millstone 3 specific report, WCAP 10587, which looks in specific detail at the materials employed on Millstone 3 to justify, in fact, that this double ended pipe break is not likely to occur.

We are still in discussion with NRC staff relative to how we specifically treat branch lines. I think there are still some misunderstandings between ourselves and them as to what precisely has been done on our unit. I don't think that we are actually that far away from them. Our position has been that we do postulate double ended failures in our branch lines, and that we will include those loads on all our supports.

There seem to be some misunderstanding relative to how we, in fact -- should we, in fact include some sort of break in our main coolant loop from a pipe load standpoint.

I would also just like to mention a little bit about the German criteria. We have had discussions with Dr. Karl Kousma from NPA who has been probably the outspoken person in the Federal Republic of Germany on pipe break criteria. And as you know, the Germans use much different material than we use here in the States. And that can be debated and has been for many, many years. They use Type 347, we use something that we believe is much more ductile.

For those reasons we believe that the criteria of eliminating the pipe breaks is appropriate. If we were to use Type 347 we may not believe that to be true.

DR. KERR: Thank you, sir. I take it you do think you understand the staff position even though Dr. Okrent doesn't?

(Laughter.)

DR. KERR: Don't answer.

DR. KERR: Thank you.

Are there other questions?

MR. EBERSOLE: One more.

MR. OKRENT: If the staff could define its position, I'd be quite happy to hear it.

MR. EBERSOLE: A point of clarification on the damage to mitigative apparatus: On a deterministic basis we put in duplicate trains, redundant trains, on the grounds we want to prevent the consequences of random failure to respond.

There is a substantial anomaly here in that having done that we then permit in the various designs in many cases for the consequences of an accident to wipe out 50 percent of our mitigative capability and destroy the thesis that we have in fact got protection against random failure to respond. It's this sort of thing I would like to see addresses in these mechanical piping failures.

What is the staff position? What do they desire? Are they satisfied with responding to one of these serious accidents with one functional train because the other was carried away by the very accident that it was supposed to mitigate?

MR. TERAO: Are you speaking in general or --

MR. EBERSOLE: In general.

MR. TERAO: I don't believe I can answer that in general.

DR. KERR: I don't think he expects an answer now. He's suggesting that this become part of the consideration in the resolution of the question.

MR. EBERSOLE: That's correct.

MR. TERAO: I will relay your concerns.

MR. OKRENT: While we're talking about approaches proposed or taken in other countries, I don't recall ever having seen from the staff a detailed evaluation and point-by-point disposition of the technical comments made concerning measures that should be taken in order to assure pressure vessel integrity. Does such document exist? The British have been very interested in the subject.

MR. TERAO: I think you're getting into an area — I have reviewed the NRC piping document relative to the Millstone 3 criteria, and I believe the question you are getting to — the depth of the questions you are getting into should be more appropriately responded to by either representatives from the Piping Review Committee who are developing the pipe rate criteria at this time.

DR. KERR: Can you relay the question?

MR. TERAO: Yes.

DR. OKRENT: Again, I was in this specific question, talking about pressure vessels; okay?

DR. KERR: This issue is obviously so popular that I'm reluctant to leave it. Are there other questions?

(No response.)

DR. KERR: I guess we must go on then. Ms. Doolittle?

(Slide.)

MS. DOOLITTLE: Again, regarding open item number 5, the applicant has not shown that he has an appropriate or consistent code or standard for ASME code class 1, 2, and 3 components of core construction and has not considered LOCA dynamic loads in the component support design.

The staff cannot conclude that the design meets the requirements of GDC 1, 2, and 4. The staff plans to perform an audit to review the program the applicantis using to design and construct component support.

(Slide.)

Another significant technical open item is fire protection in t. cable spreading room. The primary means of fire protection in the cable spreading room is a total flooding automatic carbon dioxide system. The applicant does not plan to provide a fixed water suppression system as a backup to the carbon dioxide system. Therefore the staff cannot conclude that the guidelines of branch technical position CMEB 9.51, Section C7C will be met.

MR. MICHELSON: We're not going to pass this up yet, are we? Is that the end of your discussion on fire protection?

MS. DOOLITTLE: Yes.

MR. MICHELSON: I've a couple of questions. One is, I will expect to hear an answer from the licensee either now or later. That deals with why CO2 is thought to be sufficiently effective for electrical fires in these areas. But the question for you is, if you put water suppression into these areas, particularly the spreading room area, why haven't you considered the switch gear area which has about as much cable spreading as the spreading room itself? And why is a fire in there okay to be addressed by CO2. Further, what do you think is going to happen to the suppression water in the spreading room after it reaches the floor or wherever?

MS. DOOLITTLE: Regarding those last two items, I'd like to postpone discussion of that to the full committee. At that time, I'll have someone available.

MR. MICHELSON: I think it will require a good explanation on how you think that it can be handled safely. I am neither pro or con. I'm just trying to figure this thing out.

I would also like to hear a good discussion from the licensee as to why he thinks CO2 is all you need. Maybe he would just as soon do that at the full committee also. If he's prepared now, that's fine.

MR. COUNSIL: We are prepared to answer that question now. Mr. John Roncaioli, our fire protection group.

MR. MICHELSON: And I assume his reply will address the situation at Browns Ferry and why it didn't work there.

DR. KERR: Let me suggest there is on the schedule a response from the applicant. Why don't we let Ms. Doolittle continue?

MR. MICHELSON: As I understand it now, the staff will make its reply at the full committee meeting.

MS. DOOLITTLE: Yes.

MR. MICHELSON: Thank you.

MS. DOOLITTLE: The final significant open item that staff has identified is open item number 18, Limitation on Overtime. The applicant has not described a policy governing the limitation on working hours for other than on-shift licensed personnel who perform safety related functions.

The staff cannot conclude the guidelines of NUREG 0737 will be met. The schedule for resolution of this item has not yet been determined.

MR. BENDER: Can I ask one question about that, sir?

Do you have a — Does the Staff have an understanding regarding the other two plants at Millstone? It seems to me that that particular matter is one which should be consistent between all three units.

MR. YOUNGBLOOD: I think that is being worked by the Staff at the present time.

MS. DOOLITTLE: It is also unresolved, I believe, on the other two plants as well. I think the Applicant is treating it the same way for all three of their units.

MR. BENDER: So it's a generic issue and not necessarily a Millstone 3 issue?

MS. DOOLITTLE: Generic to Northeast Utilities, yes.

(Laughter.)

MS. DOOLITTLE: I would also like to point out at this time that the Applicant discussed a little bit about their STA yesterday.

(Slide.)

And I would like to point out that the Staff still maintains the STA is an open item in the SER.

DR. KERR: What is the problem?

MS. DOOLITTLE: The Applicant does not plan to have an STA.

DR. REMICK: I'd like to have the Applicant in response reply to that. I assume that they are under the assumption that the Commission's policy statement will be promulgated eventually, and I would like to have them indicate why at this time they do not plan to have — excuse me, they plan to have STAs; I assume the question is whether they are separate STAs or STAs that are a part of the operating staff, is that correct?

MS. DOOLITTLE: Yes.

DR. REMICK: And I would like to have the Applicant explain their position on that. I think I understand, but I'm not sure.

And suppose the policy statement was not promulgated; I assume that the Applicant then would plan to have separate STAs. So I would like to have that clarified. And that can come at the proper response time, not necessarily at this moment.

DR. KERR: Please continue, Ms. Doolittle.

(Slide.)

MS. DOOLITTLE: As a result of its review the Staff identified 70 items for which the technical resolution is clear, but the Applicant has not submitted certain confirmatory information. If this information does not confirm the Staff's preliminary conclusions the item will be treated as open and the Staff will address its resolution in the supplement to the SER.

The most significant of these items is confirmatory item number one, seismic capability beyond design basis. Since this information was discussed by the Applicant yesterday I will not discuss it further at this time.

DR. OKRENT: I have a question.

I'm not quite sure what the Staff believes is an acceptable set of results, or by what criteria the Staff will judge that things are okay. All I just see is the words "seismic capability beyond design basis." Can you help me?

MS. DOOLITTLE: I'd like to ask Jeff Kimball to respond.

MR. KIMBALL: I am Jeff Kimball, seismologist for the Staff.

This confirmatory issue is set up with the New Brunswick earthquake in mind. So the goal of the issue had accelerations for the high confidence low probability estimates and for looking at also these accelerations in terms of their contribution to core melt frequency or how much they impact consequences. And that acceleration is about .25g.

So we have that criteria in mind when we're looking at what the Applicant provides us.

DR. OKRENT: If we can discuss the matter a little bit, as you are well aware, the ACRS on a variety of recent operating license reviews has asked sometimes is enough known to know that the seismic contribution to risk is not likely to be a dominant or a more significant one. It is not clear to me that answer would come out of what you just said. It would contribute to this but it wouldn't answer it.

Sometimes the ACRS has asked that Applicants look with special care at all equipment needed to accomplish safe shutdown, heat removal, given a fairly severe earthquake.

MR. KIMBALL: I think some of that we'll be getting into in the PSS.

The confirmatory issue specifically had in mind, though, what information is available in the PSS for accelerations that you would associate with an earthquake the size of the New Brunswick earthquake; not necessarily the bottom line number of core melt frequency associated with the seismic initiating events.

DR. OKRENT: Well, I'm not quite sure why you refer so frequently to the PSS since it is sort of an unreviewed document; in part it is a document in which your own reviewers have differences.

MR. KIMBALL: I think some of those issues will be clarified later. I don't think the Staff views it as an unreviewed document.

DR. OKRENT: Well, but you're referring to it in your discussion. So I'm just not sure.

MR. KIMBALL: Specifically the confirmatory issue is to assure the Staff that accelerations down lower than about .25g are not significant contributors to risk using available information in the PSS.

DR. OKRENT: If I can continue just with one more comment, it's my impression that except for oversights and deeds most of the seismic portions of PRAs where they have been done have suggested that the contributions start coming at something above twice the SSE. So you're looking in an area where prior experience, to the extent it's valid, says you shouldn't expect to find very much anyway unless they really have a big boo-boo.

MR. KIMBALL: I think the primary difference here, though, is that the documentation of that specific fact is far more comprehensive. The amount of material that we will receive in terms of conditional probability of failure for fragilities, in terms of actually providing tables of core melt breakdown for different acceleration ranges is far more extensive than has been documented for past PRAs, for example. I don't know of any past PRAs that have gone through the exercise of calculating the high confidence of low probability of failure for all the key structures and equipment, for example. The consultant to the Applicant in this instance is documenting those numbers for us to look at.

DR. OKRENT: I must say, I'm a little bit chagrined at this big emphasis you're putting on the 95 percent/5 percent, or whatever it is, corner on a topic where one of the big problems is to know what the uncertainties are. And you're acting like you're able to define something in the same way other people on the Staff are acting like they know how to calculate cost-benefit and say, yes, no.

Well, I'll leave it at that for today.

DR. KERR: Is that a promise?

(Laughter.)

DR. OKRENT: Oh, excuse me — for this minute.

(Laughter.)

DR. KERR: Please continue.

(Slide.)

MS. DOOLITTLE: Finally, the Staff identified seven license conditions as a result of its review. Item one, instrumentation for monitoring post-accident conditions, two, sediment control during fuel oil storage tank refill, and, seven, blockage of access hatch in diesel generator exhaust system, will be resolved prior to issuance of the operating license.

Items two, heavy load handling, three, post-accident sampling system, and, five, moisture in the air start system, will be included in the license when it is issued.

MR. MICHELSON: Could I ask a brief question on the moisture in the air start system?

As I understand it, you want to ask the Licensee to do a certain amount of purging, I guess, or whatever, until such time as they can get their system in a clean condition and keep it that way, is that correct?

MS. DOOLITTLE: Could you repeat that? I can't hear.

MR. MICHELSON: Well, okay. Let me ask the question differently:

What's the problem with moisture in the air start system?

MS. DOOLITTLE: I'd like to refer to -- I'd like to postpone that discussion.

MR. MICHELSON: Okay.

MS. DOOLITTLE: I'm not able to answer that.

MR. MICHELSON: In particular, when you give the reply at the full committee meeting, I would like to have addressed whether or not damage has already been done to the air start systems and how the precautions that you are perhaps going to ask for will alleviate what has already been damaged, if anything.

Thank you.

DR. KERR: What is the basis for requesting that there be blowdown on each shift? Is that a cost-benefit analysis result?

MS. DOOLITTLE: I don't know. I'll have to find out.

DR. KERR: Okay, thank you.

Please continue.

(Slide.)

MS. DOOLITTLE: This concludes my presentation on SER unresolved items.

DR. KERR: Okay. Let me ask about this number seven.

Is the concern there that one has an ice storm simultaneously with or within a day or two of a severe ice storm?

MS. DOOLITTLE: You mean a tornado?

DR. KERR: Tornado. Did I say...?

So far as I could tell from reading the SER that was the case. And since I didn't believe that that could be the case I'm asking the question.

MR. YOUNGBLOOD: I think there's also some concern about the missile protection as well, even without the ice storm. But --

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DR. KERR: No, but the solution I thought proposed by the Staff -- I mean by the Applicant to -- the alternative to providing missile protection was to, you know, open a hatch. And so far as I could understand -- and correct me -- the NRC said, 'Well, okay, but if you do then you might have a tornado and an ice storm at the same time and freeze the hatch shut.'

So there is considered to be a reasonable probability of a tornado almost simultaneously with an ice storm. Is that the concern?

MR. YOUNGBLOOD: That evidently must be the concern.

MS. DOOLITTLE: I think that is the concern because that specification on the tornado alert would be removed once the diesel generator exhaust item is resolved with the Applicant.

DR. KERR: I would be interested in seeing those calculations of the probability of an ice storm and a tornado occurring within a day or two of each other. I thought sure I had misunderstood the SER. I guess I didn't. Okay.

That concludes your presentation?

MS. DOOLITTLE: Yes.

DR. KERR: Are there further questions?

(No response.)

DR. KERR: Then we have comments by the Applicant on the same topic, I believe, and then maybe some further comments from you on the original.

EFFORTS TAKEN BY THE STAFF AND THE APPLICANT TO RESOLVE THE ACRS COMMENTS

MR. COUNSIL: Bill Counsil, Northeast Utilities.

We would like to comment only on the two direct questions from the ACRS. On the other issues, we are working with the Staff to resolve those issues.

Now first I would like to answer Dr. Remick's question on our philosophy on the STA position. John Roncaioli will answer the fire protection questions of Mr. Michelson after mine.

In late 1979 and early 1980, when we had to come up with an STA position, we formulated at Northeast Utilities an interim STA position to get us through the first three years where we would have degree people available and so forth at our operating units. We also looked at what was going to be our long term position on the STA.

We felt that the best way to operate our units would be to incorporate the STA position into the shift supervisor's position. We set out on that course in early 1980 with a detailed training program that we in fact had developed with a university.

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How did we get to that position? Basically it was — and I can only give you what my experience and the experience of the various people with me that made that decision — how we arrived at that as our long term program.

Most of us graduated in the top of our class, including myself. The very first thing that happened to me when I entered the Navy Nuclear Power Program was I was told that wasn't good enough. In other words, an engineering degree is not good enough. So consequently I was put back into school.

We all underwent a very comprehensive program developed by the Navy. We all felt that program was very, very beneficial.

In looking at our program for our operators there were no college courses that could have taught what we would have taught. So consequently, we took that program and, with Memphis State University, developed a similar program for our high school educated shift supervisors. We put them through that program.

And in every step of the way since 1980 we have informed the Staff of our full intentions and what we were going to do and exactly what the program was. We had the program reviewed by INPO very early on. And in addition, throughout this process have informed the Staff both for the operating units and our intentions on Unit number 3.

Because of the constraints of trying to send all of our shift supervisors and supervising control operators to college while we were attempting to operate units, and also transfer operating experience to Unit number 3, we very early on decided that for the Unit 3 staff we would hire BS-trained operators, although that is not our intent for the full term operation of that unit.

Throughout this process of qualifications of our personnel — and it was described by Mr. Crockett yesterday — we kept the Staff informed of our position. We have not received any comments back from the Staff on that position to date. And this is over a four-year period now.

Most recently I provided that course and our position to the chairman of the CRGR, Mr. Vic Stello. He had not heard about it and what our plans were. To the best of my knowledge Mr. Stello has further provided that position as an alternative directly to the Commissioners as recently as two months ago.

Now we fully intend to continue on this course and we fully intend to keep the Commission apprised of what our position is. And we believe it is a good alternative to just requiring a BS degree on shift.

Further to our course, because of our removal or wanting to remove administrative requirements from the shift supervisors, we do have BS degrees on shift. However they are there only for communications purposes; they are there for a training and upgrading of them directly out of college in order to teach them nuclear technology, communications, remove the administrative burdens. And we fully intend, after a three-year training program, to phase them out and into the engineering department while new engineers come in in this training status. So there are engineers on shift.

In addition to that, though, we do have the full resources of Northeast Utilities in backup at all times to our operating stations.

Dr. Remick, does this basically answer the question you were asking?

DR. REMICK: Yes. I thank you very much.

The one question I would have remaining: As I would see it, if the Commission policy statement that is currently out for public comment were promulgated as proposed you would have no difficulty; there would be no difference between the Staff and the Applicant, am I correct? Is there any...

MS. DOOLITTLE: I'm not sure that is correct. I think the Staff would like to address that at the full committee meeting.

DR. REMICK: All right.

Now suppose that policy statement on engineering expertise and shift was not promulgated. I think the probability is very small. But if it wasn't then should I infer from what you're saying that you would ask -- you had planned to ask for an exemption to the STA requirement. Is that what your plans would be?

MR. COUNSIL: The policy statement and our position has no basis in regulation, and it would be very difficult to ask for an exemption from a non-regulation.

DR. REMICK: No, but --

MR. COUNSIL: However if asked to do so, definitely we would.

DR. REMICK: No, the exemption I was thinking of was the requirement of having STAs. You currently have a quasi-Commission requirement of STAs.

MR. COUNSIL: That's true.

DR. REMICK: And I assume that if the policy statement isn't promulgated which would permit you to have this alternative then it would be your plan to ask for an exemption of the requirement of separate STAs.

MR. COUNSIL: That's correct.

DR. REMICK: Thank you.

MR. EBERSOLE: May I comment on this STA busines?

I guess I've got a hang-up on the desirability of STAs and I would like to have your thoughtful consideration of the fact it's just not engineering expertise or the relative abilities of operators versus some other kind; but it's what they're doing in the control room.

The absence of such a person leaves the plant operation in the active and probably vigorous manual and other controls pursuit of activities to get out of trouble. I think it's worth something, and needs evaluation, to have somebody stand back and say 'Are there system interactions taking place which cannot be viewed by these busy people; is the plant drifting to a state which they don't recognize; are we getting into trouble and just attending to the front but not the depth of the problem.'

And I invite you, in order to do this, to consider an interesting accident which I think is a good model. It's the 14th Street Bridge accident where the 737 crashed into the bridge. It had two people, a pilot and co-pilot. They didn't know that they were attempting to fly an ice-laden airplane with 70 percent power. Had they not had the ice they would have got off. Had they had full power they would have got off.

The combinational aspects of having neither of these, or, rather, having the resources not of the full power was not noticed by them. They were busy handling the direct problems in front of them. Had there been a third party, such as is on a 727, they would never have been leaving without full power.

I just use it as a model for you to reflect. It's not just the expertise, it is what is being done with it.

DR. KERR: Ms. Doolittle, we are now at a point at which you are going to comment on the ancient ACRS letter, I believe.

MR. COUNSIL: Dr. Kerr, we still have the answer to Dr. Michelson on fire protection, if we may address that.

DR. KERR: I'm sorry. I moved too soon.

Please continue.

MR. RONCAIOLI: Good morning. My name is John Roncaioli and I am the supervisor of fire protection engineering.

(Slide.)

We would like at this time for the purpose of clarification to put on a very short presentation on why we prefer carbon dioxide for our primary suppression agent for the cable spreading room.

Assisting me in this presentation is Mr. Jim Naylor, our lead fire protection engineer from Millstone Unit 3.

As noted, to date we have not reached resolution with the Staff with respect to our philosophy of using CO-2 as the primary suppression agent for the cable spreading room. The Staff recommends in their BTP 9.5-1 the primary fire suppression for the cable spreading room should be an automatic water system such as closed head sprinklers, open head deluge systems or open directional water spray systems.

Millstone Unit 3's position is the primary fire suppression for the cable spreading room is an automatic total flooding CO-2 system. The Staff is not challenging the design of our CO-2 systems.

(Slide.)

Please note in Section 9.5-1 under carbon dioxide systems in the SER on the basis of its evaluation the Staff concludes that the carbon dioxide extinguishing systems meet the guidelines of BTP 9.5-1 and are therefore acceptable.

Note there is no disagreement on the actual design of our CO-2 systems. The disagreement is in philosophy, in terms of the type of protection to be provided for the cable spreading room. The Staff prefers water and for our specific situation we prefer total flooding CO-2.

MR. MICHELSON: Excuse me. Did you say a little earlier, or did I misunderstand, that this is automatic or manual? I thought the slide said automatic, but I didn't really --

MR. RONCAIOLI: Yes. Earlier we were talking about the suppression system for the diesel rooms, which is a manually actuated water system. This is the cable spreading room and this is an automatic total flooding system.

MR. MICHELSON: It is a 60 second time delay automatic?

MR. RONCAIOLI: That's correct.

MR. MICHELSON: Thank you.

MR. RONCAIOLI: Okay. Why do we prefer CO-2?

To begin with, as a fire service individual, I fully recognize that if I can apply water directly to a burning cable -- as can be done in control laboratory conditions -- it is the preferred agent. But real conditions, power plant environment cable systems are far from laboratory conditions. Existing cable tray arrangement and geometry significantly reduces the merits of water.

(Slide.)

With respect to the cable system layout of Millstone Unit 3's cable spreading room it should be noted that existing cable tray congestion, coupled with cable tray covers, make it extremely difficult for water to be effectively applied to a cable type fire. Even with the best in sprinkler system designs, water discharge patterns would be severely obstructed, and the best that can be expected is to establish a water curtain effect between cable tray systems. This, of course, would provide a passive fire protection feature, not an active extinguishing feature.

The use of CO-2, on the other hand, extinguishes fires by using a totally different mechanism.

(Slide.)

CO-2 extinguishes fires by inerting the entire volume, thus displacing the air-oxygen mixture necessary to support combustion. The significant advantage of CO-2 for cable spreading room type environments is its capability as a gas to effectively penetrate cable tray systems.

A second and equally significant feature of our CO-2 system is the detection and activation concept associated with the CO-2 suppression system.

(Slide.)

Fires in cable systems, especially IEEE-383 rated cables, generally develop as slow smoldering type fires. A considerable amount of smoke is generated before much heat is created in these type of fires. Automatic wet pipe sprinkler systems, as recommended by the Staff, basically depend on the fusable link element to melt when exposed to heat before becoming activated.

The fusable link concept depends on heat to activate and therefore considerable time can expire before the affected sprinkler head or heads become activated. To

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further compound this slow response, ceiling height, and already noted cable tray geometry could easily divert and dissipate heat away from those sprinkler heads, thus preventing or slowing considerably the activation of automatic water sprinkler systems.

The detection system in the CO-2 activation concept for Millstone Unit 3 has been designed to respond to smoke and products of combustion — not heat -- and therefore application of the extinguishing agent will be much quicker than the fusable links of wet pipe sprinkler systems.

The point that should be obvious is that our CO-2 detection and activation concept is designed for the hazard it serves and therefore will activate quickler, thus minimizing damage. But even more important, it will prevent that larger fire from developing and causing significant damage.

(Slide.)

In summary, our CO-2 system has been designed to respond quicker and more effectively than NRC's recommended water suppression system, and therefore we conclude that we have provided an equivalent level of protection for our cable spreading room.

That basically concludes our short presentation on why we prefer CO-2.

MR. MICHELSON: I'm sure you're well acquainted with the Browns Ferry fire. Why, in that case, didn't CO2 seem to be effective in putting it out?

MR. RONCAIOLI: Okay; the Browns Ferry fire, as I recall, their CO2 system was a manually activated system.

MR. MICHELSON: It's automatic. It was put on manually. But it is an automatic system.

MR. RONCAIOLI: That's right; but at the time it was needed it was deactivated and it was in a manual model.

My recollection of that fire is that there was a lot of confusion, and that system did not get activated until well into the fire scenario. And when it was activated it ultimately extinguished the fire in the cable spreading area.

What had happened was that at that point in time the fire was well advanced into the reactor building because of the pressure differential between the cable spreading room and the reactor building. The fire that was truly damaging was the fire that was in the reactor building, and there were no systems there to extinguish that fire.

As I recall, they tried to fight that manually, and they used a considerable amount of portable extinguishers.

MR. MICHELSON: I guess you're saying, then, that if CO2 had come on at the onset of the incident and had been left alone, that it was have effectively stopped the fire?

MR. RONCAIOLI: That's correct.

There are two points that should be taken from that lesson. First of all, if the fire -- if the CO2 system was activated when the fire was in its incipient stage the fire would have been suppressed very quickly and there would have been almost no damage at all. The fact that the fire was allowed to go on for such a long period of time and the CO2 finally became activated, the CO2 still put out that deep-seated fire in the cable spreading area.

MR. MICHELSON: Could I ask for clarification on an earlier reply on the question of what happens if the control system failed and the CO2 continues to pour into the room? You said you had vent arrangements whereby they would limit the pressure you would reach.

Could you tell me just a little bit about the vent arrangement -- where does it vent to, and so forth?

MR. RONCAIOLI: Okay. Pressure relief venting for our CO2 systems is now in the engineering design phase. For the cable spreading area specifically, the venting would be to outside.

MR. MICHELSON: Does that mean directly to outside?

MR. RONCAIOLI: That's correct.

MR. MICHELSON: How about in the case of the

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switch gear room?

MR. RONCAIOLI: I would like to have Mr. Jim Naylor address that specific question as to the switch gear room.

MR. NAYLOR: Jim Naylor, fire protection engineer.

With regard to the switch gear rooms, we are presently designing a scheme where we will be venting via the cable spreading room directly to the outside.

MR. MICHELSON: In no event are you planning on venting into the ventilation system?

MR. NAYLOR: We will use that as backup, additional venting.

MR. MICHELSON: Well, how are you isolating the ventilation system so that you don't back up CO2 into other areas? Because I think it's common with the control room ventilation system.

MR. NAYLOR: No; the switch gear rooms are separate, they are individual ventilation systems.

MR. MICHELSON: You do not isolate the ventilation system, then, in case of fire? --fire detection, that is.

MR. NAYLOR: Certain dampers will close on actuation of CO2, depending on the area.

MR. MICHELSON: I thought you were trying to

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build up CO_2 in the room.

MR. NAYLOR: Our ventilation systems are high, and our dampers would be located high in the ceiling; therefore, it would be--

MR. MICHELSON: Well, I assume you've got to get enough CO_2 high in the room to stop the cable tray fire in the highest cable tray, which is pretty near the ceiling.

MR. NAYLOR: Yes. CO_2, being heavier than air, would not continue up the ductwork.

MR. MICHELSON: Well, CO_2 is what is going to put out the fire in the highest cable tray. You've got to get enough CO_2 to do that job, to inert the entire room.

MR. NAYLOR: We will be inerting the entire room.

MR. MICHELSON: And you can do that without isolating ventilation?

MR. NAYLOR: The ventilation will automatically shut down.

MR. MICHELSON: All the ventilation ducts are going to close, you're saying?

MR. NAYLOR: No; the fans will shut down in certain area.

MR. MICHELSON: But the ducts remain open?

MR. NAYLOR: Yes.

MR. MICHELSON: And none of those lead to any inhabited areas?

MR. NAYLOR: The vent paths are high in the room, so they would be leading up through the control building.

MR. RONCAIOLI: Let me provide some clarification for that.

Our ventilation paths that will be left open are those paths which we will be using for pressure relief only.

MR. MICHELSON: You said you're going to vent your pressure directly to atmosphere and not through the ventilation system.

MR. NAYLOR: We're going to have a special ventilation system to take care of pressure relief.

MR. MICHELSON: Yes; so you don't have to-- I thought you said you were going to vent directly to the outside.

MR. NAYLOR: No; via the cable spreading room with independent ductwork.

MR. MICHELSON: Right; and then directly outside?

MR. NAYLOR: Yes.

MR. MICHELSON: Now, the ventilation ducts in thecable spreading room, are they all going to be isolated?

MR. NAYLOR: No; those are all closed systems, there's no ventilation in the cable spreading room.

MR. MICHELSON: None at all?

MR. NAYLOR: None.

MR. MICHELSON: How do you take the heat out?

So what we do on the initial discharge of CO2, we discharge over a certain time frame like seventeen tons of CO2. And then in order to maintain that concentration we provide a continuous discharged which is sized and calculated for the expected leakage that we can expect from that environment.

MR. MICHELSON: And you have one backup of another completely full charge available?

MR. RONCAIOLI: That's correct; we have another complete discharge available to us.

MR. MICHELSON: Thank you.

MR. BENDER: How does this system compare with the systems you have in the other two units?

MR. RONCAIOLI: With respect specifically to the cable spreading rooms?

MR. BENDER: Yes.

MR. RONCAIOLI: Our Millstone-2 installation has a water deluge system for the cable spreading room, and it has recently been backfitted based on the VTP reviews that we did back in the late seventies, to install an additional wet pipe sprinkler system in the areas of high cable concentration, which is basically below the main control board.

MR. BENDER: Now, why is it that you were able to do that for that installation and you find it unacceptable in this installation?

MR. RONCAIOLI: Okay; again, you have to look at both cable spreading environments on a case-by-case basis. The Millstone-2 installation does not lend itself to manual fire-fighting. Cable tray systems are relatively close to the ground, and it would severely restrict a manual fire-fighting effort. Therefore we went with two water suppression systems.

Also, the cable arrangement was such that it basically lent itself to being able to get water on those cable tray systems.

The Millstone-3 design, as you've seen yesterday morning, actually lends itself to manual fire-fighting as far as being able to walk around in there and get some fire brigade crews to do whatever activity they have to.

The Millstone-3 design also has an enclosed cable tray system, in which we feel the gas suppression agent would be much, much more effective.

MR. MICHELSON: An enclosed cable tray system?

MR. RONCAIOLI: Let me clarify that. It has cable covers.

MR. MICHELSON: Cable tops. And it will be on top, not on the bottom?

MR. RONCAIOLI: That's correct.

MR. MICHELSON: Another clarification which I asked yesterday and maybe you can give me: In the environmental qualification of the switch gear and other vital equipment in the basement underneath the spreading room, is the CO2 deluge included in considering the environmental qualification of that equipment?

MR. RONCAIOLI: I think I would like to let our electrical engineering manager discuss any questions on environmental qualification of equipment in the switch gear rooms.

MR. MICHELSON: But you are intending to dump a large amount of CO2 into the room if you get a smoke signal?

MR. RONCAIOLI: That's correct.

MR. MICHELSON: Now, is there any chance that the fire is in the spreading room but the smoke is getting into the switch gear room? Is there a good barrier between the spreading and switch gear rooms?

MR. RONCAIOLI: That's correct; it's definitely a three-hour rated barrier, and all penetrations will be sealed with our penetration seal program.

MR. BENDER: All of them will be?

MR. RONCAIOLI: That's correct.

MR. MICHELSON: So if you get a fire — if you get a detection, it's presumably a fire in the switch gear room somewhere?

MR. RONCAIOLI: That's correct.

MR. MICHELSON: And then you turn the deluge on.

Both trains of equipment are in that switch gear room, aren't they?

MR. RONCAIOLI: Two separate switch gear rooms.

MR. MICHELSON: Okay.

Are they fully environmentally isolated from each other?

MR. RONCAIOLI: By environmentally you mean from physical barriers point of view?

MR. MICHELSON: From smoke.

MR. RONCAIOLI: Oh. That's correct, they are fully separated from each other.

MR. MICHELSON: So then the question simply is, Is the CO2 deluge included in the environmental qualification.

DR. KERR: Mr. Ebersole.

MR. EBERSOLE: Is this plant traversed by duct work which then is isolated by dampers that are operated by fusible links or whatever?

MR. RONCAIOLI: That's correct. The ductwork -- the cable spreading room is isolated by, I believe, two dampers, which is on a fusible link concept but electrically activated, not heat activated. Our detection system is such that the first detector will trigger an alarm locally, and remotely to the control room, to give early warning of the incipient type fire. When a second detector com, s in on a totally separate, when that detector comes in, then the fusible link elements on those dampers fuse, and basically those dampers will close.

MR. EBERSOLE: Really, then, this is mechanically operated by a fusible--

MR. RONCAIOLI: Yes; they are spring-loaded with a fusible link holding them open; that's correct.

MR. EBERSOLE: So you could cause them to open at any temperature you wish -- I mean, to close -- and thus protect the overloads relays and systems of circuit breakers in distant room--

MR. RONCAIOLI: That's correct.

MR. EBERSOLE: --from seeing a too high ambient.

Let me ask this: I ran into paragrap. 8.3.3.1.9. on page 823 of the SER. It says that-- There was a little bit of a disturbing sentence. It says:

> "Type SJO cords for lighting drops to fixtures are sized 12-AWG or smaller in supplying 120-volt AC or 120-volt DC low energy."

I got a vision from that that you might have cable trays with small wires on it, and I wanted to ask you: what is the basic rationale, when you use small wires like that in connection with -- if you present them with a hard bolted short, and you consider the short circuit availability to them? Will they fuse? Will they burn?

MR. RONCAIOLI: For a point of clarification: Are we discussing the detection system associated with--

MR. EBERSOLE: No; we're talking about the fire potential of small cables under short circuit conditions, like lighting drops.

MR. RONCAIOLI: With very low voltage, I assume?

MR. EBERSOLE: I don't know. 125 AC, I reckon.

MR. RONCAIOLI: Mr. Pitman of Northeast Utilities will address that question.

MR. PITMAN: The low energy density of those circuits was considered, and we dealt with the staff on that issue because it did represent a deviation with respect to Reg Guide 175. We determined that you would not start a fire in those circuits, and, thus, the drops which come down to the light fixtures would be adequate without further protection.

MR. EBERSOLE: Well, let me ask a more general question: In full consideration of short circuit availability, and with hard shorts on small wires, and with time delays, if they are protected by circuit breakers instead of fuses, what is the damage level you accept in the cables?

MR. PITMAN: What is the damage level we would accept?

MR. EBERSOLE: Yes.

MR. PITMAN: The criteria here was that it not burst into flames and create a hazard to adjacent circuitry.

MR. EBERSOLE: How close is the margin to doing that that you worked toward?

MR. PITMAN: I can't tell you at this moment.

MR. EBERSOLE: Would it depend on them being tightly bunched, maybe, or--

MR. PITMAN: They certainly are not tightly bunched. They are single drops to single fixtures.

MR. EBERSOLE: So your general criteria is if you have a voltage short on a cable, wherever, it will not ignite?

MR. PITMAN: This category of cables, sir, not just any cable. There may be some 41 60-volt cables where that could happen. Okay?

MR. EBERSOLE: That it will ignite?

MR. PITMAN: There's a lot of testing been done, and it is difficult to get a cable to ignite, but I can't say categorically that it would not.

MR. EBERSOLE: Would those be in the safety class cables?

MR. PITMAN: Yes, they could be. And in that respect we met the applicable criteria with respect to separation.

MR. EBERSOLE: So the situation is upon the occurrence of a hypothetical but unlikely voltage short, you might ignite a cable?

MR. PITMAN: In the high density power circuit, that's correct.

MR. EBERSOLE: And then you depend upon the separative aspects of Reg. Guide 175?

MR. PITMAN: That's correct. Reg. Guide 175 covers in situ fires as opposed to exposure fires.

MR. EBERSOLE: How many sets of cables are in that category? Are there many that are borderline to ignition on a voltage short?

MR. PITMAN: I would be guessing if I told you, sir. Rather than to deviate from the rule, which would save a lot of money and a lot of cable tray covers, we complied with the various criteria and incorporated the appropriate separation. You know, if we had decided to go out of conformance with the criteria, then a test would have been appropriate and we could have seen what actually would happen.

Our assumption is that there are some circuits that could cause a fire to start through a fault.

DR. KERR: Are there further questions?

MR. MICHELSON: I think he has an answer yet for me.

MR. EBERSOLE: No, I understand him. He's got some cables that will potentially ignite on a voltage short. That's all I want to know.

DR. KERR: Thank you.

Please continue.

MR. MICHELSON: I think you were going to answer the environmental qualification question.

MR. PITMAN: Yes, I was.

That particular issue, equipment impact caused by CO_2 discharge, came up as a late item. It really wasn't around when we first started considering mild environment qualification, which a switch gear room would be.

We did an assessment as to the impact on switch gear and it is our conclusion that because it does not contain sensitive electronic circuits, -- there are electromechanical relays, high current buses and so on -- that there would be no adverse impact.

Additionally the switch gear is located in enclosures, two divisions worth of them that are bonded by three-hour fire walls that are intended to prevent CO_2 in one room from entering the adjacent room.

MR. MICHELSON: Maybe I misunderstood during the tour. I thought the switch gear has been modified in many cases to include solid-state control circuitry instead of

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relay circuitry. Was I misinformed?

MR. PITMAN: I believe some of the 480-volt gear has some overcurrent relays which are solid state.

MR. MICHELSON: Yes, that's the equipment that is down there. A lot of it is 480.

MR. PITMAN: That is correct.

MR. MICHELSON: And so have you considered that in the environmental qualifications?

MR. PITMAN: I would have to get back to you on that.

MR. MICHELSON: Okay. Maybe for the full Committee meeting you can address it just a little more.

MR. PITMAN: Certainly.

MR. MICHELSON: Thank you.

DR. KERR: Any further questions?

(No response.)

DR. KERR: Thank you, sir.

MR. RONCAIOLI: Thank you.

DR. KERR: In view of the length of time that we are behind schedule, and in light of the long time ago that the construction permit letter was written, I am going to skip the response unless there are Subcommittee members who want to hear further about that.

Can you just provide us a written statement, Ms. Doolittle, about the response, and then you won't have to--

MS. DOOLITTLE: There are slides in your packages that address each item.

DR. KERR: Okay. Thank you.

Any further comments or questions on the part of the Subcommitte before we end this part of the session?

Again I ask the Subcommittee members that they look at the proposed agenda for the full Committee meeting. and let Sam or me have comments by noon if possible.

Does the Applicant have any further comments on this part of the meeting?

MR. COUNSIL: The Applicant has no further comments.

DR. KERR: Does the Staff have any further comments?

MS. DOOLITTLE: No, the Staff has no further comments.

DR. KERR: Thank you.

I declare a ten-minute recess, after which we will begin consideration of the PSS.

(Recess.)

DR. OKRENT (Presiding): This meeting will reconvene, please.

The remainder of the Subcommittee meeting will be related to the Millstone 3 Probabilistic Safety Study and associated things. I guess that means also anything done in the area of systems interactions.

My expectation is that we will break for lunch at 12:15 as the agenda says, for one hour, and that the session will break a little before 3:45 for the day.

We don't expect to go through in great detail the entire or even part of the PRA since that's a job that takes considerably more time. I would say of primary interest for the purposes of today's discussion are what insight appeared to have arisen from the study itself, from reviews of the study and so forth, that may be suggestive of safety aspects that the full Committee should hear about and factor into their thinking, at least in a qualitative way, when they meet -- I guess it is in September, to review Millstone for operation.

It is planned at some time, probably after Election Day -- I'll put it that way -- to have a much more detailed discussion, examination, review of the Millstone PRA and the evaluation of it.

So what I would like most to have discussed today by all of the participants -- that means representatives of Millstone, those of the Staff, the consultants, members -- are topics that seem to have some special significance, and that might be relevant to call to the full Committee's attention, one way or another, to the extent that one is

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able to.

It may be the information is incomplete, but nevertheless it seems like an open issue or whatever.

Are there any comments from the Subcommittee?

(No response.)

DR. OKRENT: I'm assuming that we have received all of the documents that the Staff has in its possession that bear on the Millstone PSS; that if the Union of Concerned Scientists were to send in a Freedom of Information request, they would not come out with a fistful of other documents that the Staff has not provided us.

If the latter is the case, I urge that the situation be changed and that we do get the benefit of what are sometimes called letter reports, draft memoranda, memoranda from one Staff member to another, et cetera. But I don't expect to have them today, but certainly before we need to discuss this in more detail.

And if any of these things bear on what I would call the significant subjects, sooner is much better than later.

Okay.

INTRODUCTION TO THE MILLSTONE UNIT 3 PSS

DR. OKRENT: The first item on the agenda as it was laid out was an NRC Staff presentation, their views on the use of results of this PRA in the licensing process.

Who is the spokesperson?

MS. DOOLITTLE: Mr. Ashok Thadani will be making tha presentation.

NRC STAFF PRESENTATION

MR. THADANI: Good morning. I am Ashok Thadani. NRC Staff.

(Slide.)

In the next few minutes I will briefly describe to you the status of the review, some very preliminary insights that we have, as well as some short discussion of how we intend to utilize this source of information.

If you recall a few years ago the Staff had a perception that for certain plants, if the population density were significantly higher than the normal or average population density, that there was a perception that the risk may indeed be significant from operation of these facilities.

To get a somewhat better understanding, the Staff decided perhaps the most useful way to address this concern was to develop an integrated look at the plant design as well as its operation.

The Staff requested Northeast Utilities to perform a plant-specific probabilistic safety study, requested that it be fairly complete, and indeed about a year ago Northeast did submit a probabilistic safety study which included internal as well as external events.

At the time of the submittal, Northeast indicated to us that certain aspects of their seismic analyses were perhaps incorrect, and that they hed embarked on a course to revise their estimates. Specifically speaking, this related to some of the fragility estimates that were provided to us in the PSS.

Over the next seven or eight months the Applicant did conduct further studies, not only in the area of fragility considerations but they also provided us some revised information in terms of the hazard function.

Basically those are the key documents we received from the Applicant.

I am sure it is clear to you that the process has been interactive, and that we have in fact questioned the Applicant and received other documentation as well in response to our questions.

The Staff contracted the review out to two laboratories. Lawrence Livermore Laboratory-- We asked the Lawrence Livermore folks to critically evaluate the systems analysis, starting from initiating events on up to core damage considerations.

Further, the Staff has a contract with Brookhaven National Laboratory to look at the phenomenological aspects, what happens if one does end up with a molten core, as well as containment performance.

Recently, in the last few months-- Let me backtrack a little bit.

The Staff's reaction to the initial probabilistic safety study, in particular the seismic analysis, was pretty negative. There were a lot of concerns. Some of these were, in my view, shared by the Applicant in the area of fragilities. They had indicated to us that they were indeed doing some more work and would provide us with better estimates.

There were a bunch of questions in terms of systems analysis consideration of seismic issues, and generally the Staff feeling at this stage, although the review is not complete, is that in the area of fragility considerations and systems analysis, the later submittal by the Applicant was fairly good. There are still some issues hanging which I will touch upon in the next couple of slides.

In any case we do have a draft report from Lawrence Livermore. I trust you have copies of that. If you don't we will certainly make sure that you receive them immediately.

We are expecting to provide our thoughts and reactions to the Livermore report to Livermore in the next few weeks, so it does appear to us as though the Staff cannot develop its carefully considered thinking on a number of issues until Livermore has addressed some of the Staff comments.

We do think that we will be ready to support your November meeting and that we should really have completed most our work, most of our technical evaluation at least.

Next slide, please.

(Slide.)

I thought it might be worthwhile making a few comments about some of the important things — at least I think they are important — that still need to be addressed by the Staff.

In the review process, Livermore as well as the Staff seems to have come to at least an initial judgment that several of the scenarios analyzed in the probabilistic safety study are much more important than the sort of importance that was given to these scenarios in the study.

The Staff is also looking at some new sequences and is in the process of evaluating them now to determine if these new sequences might not also deserve further attention.

So far, if I may just briefly describe what did we learn from this process, we did find that the design has some unique features, and I want to be really careful. It has some features; I'm not sure that they are necessarily unique to this design.

It does have some features which do tend to suppress some of the dominant accident sequences, for example, number one, the large refueling water storage tank. If I remember correctly the capacity is about 1.2 million gallons versus traditional refueling water storage tanks, the capacity of which I believe is somewhere in the neighborhood of 300,000 to half a million gallons.

That, in conjunction with the type of recirculation system that this design has-- Basically let me describe what that is.

It's a four-train system. The function is core makeup as well as containment spray, but you can use any of the pumps to perform either of the two functions. And that system is actuated automatically and does not depend on a low refueling water storage tank level. That appears to be a pretty good feature.

DR. OKRENT: Is there a single line running from the refueling water storage tank, like in some of the plants I've seen?

MR. THADANI: I don't know the answer. Perhaps some of the Staff members--

MR. KELLY: I think it is a single line.

MR. THADANI: We'll check that.

MR. CROCKETT: Excuse me. Yes, there is a single line from the refueling water storage tank.

line from the refueling water storage tank.

MR. THADANI: From our past studies we had also come to certain judgments regarding the intersystem LOCA sequences. Obviously the concern there was if such an event were to occur where the integrity of the valves and the ECCS is compromised, that that sequence had the potential for bypassing containment.

And on this design it appears-- It's an area we are in the process of confirming, but it does appear that instead of the typical two valves that one sees in the high-pressure piping that there are three valves which would at least provide some additional protection for such a scenario.

DR. KERR (Presiding): Excuse me.

What are you-- You are looking to see whether there are three valves or not, or to see whether three valves are better than two?

MR. THADANI: Basically for this sequence, three valves should be better than two. The question-- And we have come to recognize this only recently. In our discussions with Northeast, we did discuss this scenario with them, and at the last meeting they indicated to us that they believe the design -- high-pressure piping actually incorporates three valves and not two. And we are in the process of confirming that.

DR. KERR: You are confirming that there are three valves? Is that it?

MR. THADANI: Yes. If there are three valves, the judgment would be that that would be a safer situation.

DR. KERR: It doesn't strike me that that should be very difficult to find out whether there are two or three valves, but I'm pleased it is being done thoroughly.

MR. THADANI: I cannot disagree with you.

(Slide.)

Ms. Doolittle described to you the loop-stop valves. Those I think are a useful feature to protect against or isolate certain types of small LOCAs such as pump seal failures. They appear to be an improvement in design.

There are some other plants which do have loop-stop valves, though.

MR. EBERSOLE: Do you at this time have criteria for when you do and when you don't isolate?

MR. THADANI: I'm sorry?

MR. EBERSOLE: Do you have any criteria for when you do and when you don't isolate those LOCAs?

MR. THADANI: To the best of my knowledge, I don't know of any such criterion.

MR. EBERSOLE: Well, I think there is a potential for an intermediate to large LOCA, having been isolated, to give you trouble in refloods.

MR. THADANI: That's correct. I do not know the details of it, but the Staff does look at such a potential for starting up another loop or an isolated loop, and so on.

MR. MICHELSON: I might suggest at the full Committee meeting you clarify this because I recall that those valves have their power disconnected. Therefore, they would not be in a good position to even address a large LOCA or even an intermediate one, because it is over so quickly.

Is it really true that the power is disconnected, and what is their position on when it would be reconnected?

MR. THADANI: I don't know.

MR. MICHELSON: For the full Committee meeting I think you ought to clarify that, and put that problem to bed I think.

MR. THADANI: Certainly.

But normally, as I understand it, the power is disconnected from these valves, at least in some of the plants where they do have loop-stop valves.

MR. MICHELSON: Well, you certainly wouldn't worry then on a large break, would you? You don't have time to run down and--

MR. THADANI: I would agree with you. But I think the only point here would be that if you have a leak, that you could isolate that leak.

MR. MICHELSON: Yes. And I think with a small leak it makes no difference, on a small leak. You don't worry about isolating small leaks; you worry about isolating large leaks, and having the system repressurize.

MR. THADANI: I guess I'm not so sure that one wouldn't worry about small leaks. It depends on what size small leaks one is talking about.

We have seen leakages of perhaps hundreds of gallons per minute, which is certainly above some of the makeup capabilities. It would seem to me that one would want to worry about small leaks.

MR. MICHELSON: Well, for the full Committee I would like to hear a discussion of the potential for break isolation and why you would or would not worry about it. I don't know that I agree with your statements, but think it through and give us a statement on it.

MR. THADANI: Okay.

DR. OKRENT: You might let out just enough water that you didn't want to isolate and build up pressure.

MR. THADANI: There would be some situations where one would want to, yes, indeed.

Another feature — again it is not necessarily unic e for this design — is the large dry subatmospheric containment which does provide some protection from certain type scenarios such as the likelihood of the containment being unisolated during an accident is reduced. You use a lesser amount of oxygen for hydrogen burns. And this containment appears -- as I understand it, has higher free volume as well, which should be of some help for overpressure events.

Those are some of the features which appear to influence some sequences and make them less important than they might have been otherwise, relatively speaking.

On the other hand there are things we are seeing that we think deserve some attention, some of them more than others, clearly.

One element that is again not terribly uncommon for Westinghouse-designed plants is the issue, every time you have a reactor trip, the main feedwater system is tripped as well. We have asked Northeast to see if there aren't ways to try to minimize tripping the main feedwater system every time the reactor trips.

Northeast has indicated that they are looking at this issue, but we haven't seen anything formal back from them. I think it does deserve some attention.

MR. EBERSOLE: We mentioned that yesterday, an aspect to why do you throw the baby out with the wash water when you want to ramp down. I understand that there is a substantial effort to investigate this as well as any other aspects of shutting down or tripping which require safety-grade equipment which probably don't really need to require it.

I believe that's a characteristic of the APWR as well.

MR. THADANI: A characteristic of what?

MR. EBERSOLE: The APWR. It's a Westinghouse characteristic.

MR. THADANI: Yes, it is a Westinghouse characteristic. We thought it might be worth exploring to see if there aren't things one can do.

I'm sorry, I wasn't here yesterday, but at least my understanding is that the Applicant is looking at this issue to see if something can't be done.

DR. OKRENT: Is the control down to low enough flows satisfactory?

MR. THADANI: Well, there are plants where they are able to do that.

MR. EBERSOLE: But this plant has an unusual configuration, not at all standard. It has one motor-driven and two steam-driven pumps I believe.

MR. THADANI: It has, as far as I know,--

MR. EBERSOLE: Am I correct, one motor-- So the opportunities for doing something like this probably are a good deal-- Well, they may be unique.

MR. THADANI: Okay. That's issue number one. We are still pursuing it with the Applicant.

Our reaction to the probabilistic safety studies, particularly in the area of station blackout, is fairly negative. We thought the analysis was not as complete as it could have been. The consideration of the reactor coolant pump seal response to the blackout situation, in our judgment, was not done correctly.

The study was incomplete perhaps in taking into consideration the duration for which the diesel generators may be required, and that there may in fact be some potential for diesel generators to fail to operate for extended periods of time, that is, including in the analysis failure-to-run considerations, not just failure-to-start considerations.

Those are some examples of the sorts of difficulties that we see, or perhaps even deficiencies that we see in the analyses.

The Staff is doing its assessment taking into account the best understanding that we have of these scenarios.

The next issue that needs further attention is the big seismic issue. As you know, Lawrence Livermore has issued under the Seismic Hazard Characterization Program a set of hazard functions which, in this case, are somewhat different and perhaps significantly different in certain areas than what the Applicant had provided to us.

The Staff is looking at both hazard functions, doing its estimates using both hazards or hazard functions, also looking at the fragilities of structures as well as components, to get an understanding of how fragile certain components may be, which components — using systems analysis, which components seem to come to the forefront in terms of potential for severe consequences.

That process is not yet complete. There are some areas we haven't pursued yet. One in particular, at least it is my personal opinion, that needs further attention is the whole issue of what happens to relays if you do have some severe seismic event. What type of relays are present, sequencers, the whole logic? What sort of actions would be needed from an operator if relays were to chatter?

And that element was not analyzed in the safety study by Northeast. The Staff hasn't been able to analyze it. I think it is certainly our intention to pursue this matter because it might well be quite important.

Whether we pursue it on Millstone Unit 3 or in a more generic fashion, pick certain plants and proceed, it's not clear. The analysis would be fairly complicated, but something that at least I think needs to be done. We just have some scoping thoughts at this point which indicate that this issue may be important.

The Staff's review has also indicated the importance of the role of the humans, whether they are operators or other crew members, in the event of fire scenarios. Because of the large uncertainties in performance of humans, the Staff is looking somewhat closer at the sorts of activities that may be involved if fires were to be initiated in specific locations such as cable spreading rooms, control room, instrument rack room, and so on. That area we are also looking at at this stage.

By this list I don't mean to imply that there aren't other things we are looking into also. We are also doing a fair amount of work in the containment analysis, and some other aspects such as potential common-cause failures in the service water system, and so on. But we have not completed our analyses. We have gone far enough to see that some of these elements we think are important, and we ought to pursue these, our analyses, plus interact with the Applicant.

DR. KERR: Mr. Thadani, let me understand your comments in terms of the licensing process.

Are you discussing areas which you think may not be in conformance with existing regulations on the basis of your look at the PRA, or are you discussing results of the PRA which may or may not be part of the licensing process? It is not clear to me how I should interpret this discussion.

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MR. THADANI: Okay; in fact that element is addressed in the next few graphs. Most of the discussion that I went through is not necessarily part of licensing but there may be certain things that we learn from this process. And if indeed, we find in the dominant accident sequences that the sequence becomes dominant, and having looked at it we find that one or more of the regulatory requirements are not met, then it clearly becomes part of licensing consideration, and some sort of improvement would obviously be indicated then.

MR. OKRENT: There's always going to be some sequence that is dominant.

MR. THADANI: Clearly.

MR. OKRENT: Are you going to treat these in the context of an effort to find out whether the existing design meets existing regulatory requirements. Is that the principal thrust --

MR. THADANI: No, that is not the principal thrust. The principal thrust really is to see if once we look at the study to see what we can learn from it, do we think it poses really disproportionate risk.

MR. OKRENT: How are you going to determine what this proportionate risk is?

MR. THADANI: I might address that we're finding it very difficult to do that for a variety of reasons. We have not looked —

MR. OKRENT: I'm more interested here in procedure than I am in philosophy. Philosophy is important but I think we need a longer time to discuss it. What I'm trying to understand is, how you're going use your conclusions in the licensing process.

MR. THADANI: Well, there are only two ways. Number one, as I say, if as a result of our review we identify that something is significant and it doesn't meet our regulatory requirements, action will be taken. The other way is if we find, as a result of this review, there is something significant to safety that really stands out like a sore thumb vulnerability, the staff would consider action depending on whatever regulatory authority is available — mechanism is available — to the staff.

MR. OKRENT: Okay. I interpret that answer to mean you haven't really decided yet how you're going to use the results?

MR. TNADANI:

MR. THADANI: he two ways.

MR. OKRENT: I have heard what to me are generalities, which are, if we find something significant — and significant apparently doesn't mean that it violates the regulations because you dealt with that earlier. And so I don't know how to interpret significant.

MR. THADANI: Well, I think if I understand regulations, and there is an element in there that talks about compensatory considerations for plants located in high population density sites.

MR. OKRENT: I'm trying to understand what you're going to look at. Are you going to look at numbers? For example, is there a risk number. A core mill probability number. A fragility number. What are you going to use as a basis for your decision as to whether something is significant?

MR. THADANI: It seems to me that it's a combination of those factors. You clearly would have to see if the sequence you think is important, is important, why is it important. Is it because of it's contribution to core melt as well as risk?

MR. OKRENT: No. I recognize -- what I'm saying is you're using generalities now and I don't think there's anything wrong with that. But at some point one has to decide what is the basis for a go or no go decision? Now, perhaps you haven't reached the point at which you know how you're going to make that decision.

MR. THADANI: The staff has discussed with you at several meetings this severe accident policy and the sort of thought process that's going into that policy development. That's generic. As far as the specific plant is concerned, we are basically left with, as I see it, just two elements. And those are the two elements I described to you. Numbers which certainly influence the staff but I don't believe the staff would just rely on a certain estimate. The staff is going to have to bring in some other what-if type questions after we get through this process.

MR. OKRENT: Okay, so at this point you really have not reached a decision as to how you're going to use the results. But you will reach that decision after you've completed your review, is that a fair statement?

MR. THADANI: That's reasonable. A reasonable statement, yes.

MR. OKRENT: Thank you.

MR. THADANI: I can't predict -- if I knew today exactly, at least to the best of our abilities what significant safety issues might really be, what can I learn from the quantification process in spite of its limitations.

When I talk about safety it could be two ways. One could look at it two ways. Core melt or off site risks. Not knowing that, I can only tell you that it seems to me ultimately it'll have to be judgmental. If the judgment is that it's significant then certain actions would be indicated.

MR. OKRENT: Thank you.

MR. MICHELSON: Before you go on, let me pursue something with you just a moment. On page 9-41 of the staff SER it is stated that the staff is concerned whether the mechanisms by which fire and fire protection systems may cause simulataneous failure redundant or diverse trains have been adequately considered in the design.

Now, I would like to know and maybe you can tell me who's pursuing this. Are you looking at this issue or are the fire protection people looking at it?

MR. THADANI: Well, basically that issue, I'm sure, is being pursued by chemical engineering branch in NRR. In terms of probabilistic safety study, we have contractors reviewing those kinds of considerations --

MR. MICHELSON: Is the specific question, though, for Millstone being considered which really is the subject of this SER?

MR. THADANI: I can't give you a definitive answer but we could get one. We do have the same people in the chemical engineering branch also working with us in the review of the probabilistic safety study but I can't tell you for certain that issue is being considered --

MR. MICHELSON: Are you doing the analysis, probabilistic analysis work, to determine whether or not there is a concern with simultaneous failure of redundant due to fire or fire protection methods, or are the fire protection people doing that. I'd really like to know if the fire protection people are doing it. Are they adequately qualified to really go into this issue in terms of its overall effect on plant operation?

MS. DOOLITTLE: The fire protection people are doing that.

MR. MICHELSON: Now for the full committee meeting did we get a short presentation by the fire protection people on exactly what they're doing for Millstone to clear up this issue since it's stated as a concern in the SER?

MS. DOOLITTLE: Yes.

MR. MICHELSON: Thank you.

MR. THADANI: Next slide.

(Slide.)

MR. THADANI: I'll put up the slide and really — I won't really touch upon it in order to save time I'll forego this unless you have specific questions. I'll be glad to address questions.

MR. MICHELSON: I have a question in this general area. Maybe you can iell me how you're treating it. Among the design bases events that the licensee is now to address are the pipe failures outside of primary containment — pipe breaks outside of primary containment. In looking through the study, I could not find any treatment of this other than in the flooding sense. Where is the treatment in the environmental sense, the release of steam. For instance, they discussed a letdown line break in terms of what it does to doses offsite and they point out that it dumps about 4,100 gallons of water, 39 percent of which flashes to steam. But they never discuss the environmental effect of that steam on, potentially, on vital equipment. But only point out there's no dose problem.

Where is this being picked up. Maybe you could tell me. What part of the probabilistic study includes this?

MR. THADANI: I can't specifically respond to that for Millstone Unit 3. Perhaps Glen, you can identify specifically where in this study is this type of issue considered, analyzed --

MR. KELLY: Glen Kelly, with the staff. My recollection is that pipe breaks outside of containment are primarily handled as a flooding issue --

MR. MICHELSON: Well, clearly there's more than flooding involved depending on whether it's a high or low energy break. So my question is why is it apparently ignored high energy breaks, other than from the viewpoint of flooding effects. There must be a justification for this.

DR. OKRENT: Could I ask is the SER dealing with that?

MS. DOOLITTLE: The SER does address pipe breaks outside containment but it's open right now so that review hasn't been complete.

MR. OKRENT: Well, would you give Mr. Michelson an answer other than we're studying it if you possibly can, when next we meet?

MS. DOOLITTLE: Yes.

MR. THADANI: Mr. Michelson, basically, I concur that one ought to consider if one postulates leaks, breaks, whatever, that the consequences of that event do knock out systems, that one needs to protect against that event. If that is not being considered in terms of our review, I think we'll make sure we pick it up.

MR. MICHELSON: Yes, that's what I'd like to clarify. You know, it's a very large amount of documentation and it may be buried somewhere in it. I could not find it in the materials. I looked in the more obvious places, I thought. I could not find it in there. Other than from the flooding viewpoint with no reflection on humidity changes or steam releases or whatever -- I could only find it on the letdown line and then only from the dose viewpoint.

MR. THADANI: I'll certainly look into it.

MR. MUELLER: I'd like to get a point of clarification. On your Item A.1. you say the dominant sequence is attributable to system performance that failed to satisfy NRC REG requirements must be corrected.

Is the implication there then that if system performance does not affect or it is in no way part of a dominant sequence that it might be relaxed?

I just don't know how to read that sentence.

MR. THADANI: No. Actually, it's a very simple point here that we are looking at the probabilistic safety study, not paying too much attention to what our regulations are and requirements are. We're looking at systems in terms of their availability and not necessarily the pedigree. A pedigree may well influence availability of systems but having gone through this analysis we identify a set of sequences which appear to us to be more important than others.

Having gotten to that point we say, well, what is causing certain systems to perhaps have lower availability than one might want to have. And if the cause is that this system or function does not meet our current regulatory requirement, then that situation must be corrected. But the reverse is not necessarily true.

DR. SIESS: So it then does meet regulatory requirements you don't do anything about?

MR. THADANI: I'm sorry. Dr. Siess. I can't hear you very well for some reason.

DR. SIESS: I said if it is a dominant contributor but it does meet regulatory requirements, that you would do nothing?

MR. THADANI: No. I didn't say that. Then we go on to one of two other places. Item number 2 really says is it so significant that one ought to take immediate corrective action. And item number E there says, well if the judgment is that one doesn't need to take immediate action what can one do that would improve safety and would be cost effective. And I don't necessarily mean -- when I talk about cost effective I'm not talking about cost benefit ratio of one and that kind of precision. Because there may be alternative ways to improve the situation to make some of the sequences less significant.

And so you move from A.1. to A.2. and then come to E and that's the process we're in at this state. And that's the type of document I was talking about, that we would hope to develop over the next three months.

MR. BENDER: Excuse me.

MR. OKRENT: Mr. Bender?

MR. BENDER: I get the impression that you're going to have, in about three months, something for Millstone. This process is going on in a number of places and I guess I would have to conclude that to make a judgment about Millstone 3 without taking account of Millstone 1 and

2 somehow doesn't seem to deal with the whole site. I'm more than a little confused about how to view the staff's ultimate application of this probabilistic risk assessment business. It seems to me that if the staff is following its intent to establish licensing stability which means to make some decisions and have them stick for a while, then it has to be a little less mushy about it.

And maybe you're not the right guy to speak to but you're the only one here.

MR. THADANI: But that is indeed -- but that is a consideration that has gone into severe accident policy deliberations. And I'd like to think that over the next two years that the staff, NRC, with commission approval, would have developed that process. And decided how to deal with essentially all the operating reactors not just talk about a specific plant which may be going through a licensing process.

Intellectually, I agree with you that three units on the same site -- there are differences in their power rating and so on -- but a lot of their faults may turn out to be generic and they apply to other units as well.

MR. BENDER: We have been waiting patiently for the staff to issue its report on this state of the art of probabilistic risk assessment and its applications. And in a sense you would expect to have that report before you attempt to make some judgment about whether this particular study is useable and useful.

But I think I'll leave it there and say I wonder whether that's coming about any time soon.

MR. THADANI: That document is to be issued, I believe, in the next month or two months. But I guess I would state my opinion and I think the study's useful. It doesn't matter if any improvements -- design improvements -- are made, but the mere fact of having gone through and done this study, in my judgment, the plant is -- would be safer because of the knowledge gained through very detailed and, I would call these logic analyses. That's all they are. Logic models.

The quantification process discriminates, provides you with some additional information. But the knowledge one gets going through this analyses and then trying to filter that information to other sections of the organization at Northeast, I think, it may well be the biggest value.

And so I have a personal opinion. I think other plants should also proceed and do such analyses. At least safety systems analyses -- carry them on, look at common cost failures and systems interactions and so on. Get a better of understanding of more people's failures, where the operators are needed, the fault hazard analyses on human performance, I think, would be very, very useful. Totally outide of numerical analyses. It's a strong tool for that.

MR. OKRENT: Mr. Ebersole?

MR. EBERSOLE: Mr. Tnadani, it seems almost 100 years ago when I asked the staff if they had any rationale about designing an interval three-unit station versus three independent units as though they were 100 miles apart. And I found that they didn't want to undertake whatever the complications are considering a multiple unit interval station as such a station. They insisted that they be separate stalls. And they did not want to involve themselves in the pros and cons of helping the units help one another or being in danger of each of other, so to speak. Both these effects exist, or can exist.

At this station, if we're going to invoke the matter the severe accident considerations with high level releases much beyond the minute releases that are presently controlled by the thesis that the containments will always close and be tight. Then we have to look at such things as are the control rooms, in fact, impervious to new levels of contamination and radiation beyond the point in which the operators can sit there and run the other two plants, supposedly undamanged, to a safe state. I don't think any of these considerations have been given.

And I think you have to either say you will or you won't consider such potential. You can do things about this. You can extend air intakes. There's lots of things you can do. But what to do is the issue and the staff has been on dead center for at least 20 years.

MR. THADANI: I really have no comment on that one.

Unless you have further questions, that was essentially all I intended to say.

MR. OKRENT: I have a few. If I recall correctly, some of the data that was used in the Millstone PSS, that is failure data I'm speaking about, is marked proprietary, is that correct?

MR. THADANI: I believe some of the data has been indicated to be proprietary, yes.

MR. OKRENT: And it's being handled now as proprietary?

MR. THADANI: At this stage, to the best of my knowledge, it is being handled as proprietary. Whether the staff has made a finding, I am not sure, that, indeed, there's ample justification for the information to be proprietary.

MR. OKRENT: When is the finding to be made?

MR. THADANI: Has it been made or is it —

MR. KELLY: To the best of my knowledge the only proprietary data that the staff has received directly concerning the probabilistic safety study involves reactor coolant pump seals. Westinghouse's data base upon which some of the unavailabilities of equipment and failure rates, the actual data that that was gathered from, that is considered proprietary. The staff does not have that as background data in its hands. It just has the results of that data. That is considered proprietary.

MR. OKRENT: Why?

MR. KELLY: We have not requested it and therefore as far as I am aware we don't have the justification for its being considered proprietary.

MR. OKRENT: I'm sorry. You don't have the justification for it being proprietary?

I wonder, has the staff thought through carefully, would it make sense to allow it to be proprietary -- I'll put it in a commercial sense -- and also what it makes sense to permit to be proprietary in a public policy sense, and whether or not these two are always compatible.

MR. THADANI: Most of those judgments are made by our office of Executive Legal Director's Office with some information from us as to what the issue is about. The rules that govern what can be considered proprietary and not and we provide information but we don't make those findings. In any case the finding is made by the NRC where just the attorney's make that finding.

MR. OKRENT: It seems to me that that input data into these calculations — there's a final aspect of it — other groups are for the most part, if not entirely, publishing the basis for their choice of data. If data that is used for a PRA is permitted to be proprietary only the result but not the background for it is presented. This makes it completely inaccessible to evaluation, peer review, and so forth and so on.

I wonder, myself, whether this is a sound approach. Has it been taken to the commissioners?

MR. THADANI: Has what been taken to the commissioners?

MR. OKRENT: Whether or not data like it's being withheld in this case, should be withheld.

MR. THADANI: I don't believe it has. I think Glen Kelly made the point that the Livermore review did look at the results of what was presented to us in the safety study with other sources of information. That doesn't really address the question you're raising. It would seem to me that that information should be obtained and the decision made. As far as I know, the decision has not been made as to whether it's appropriate to maintain this information in that proprietary form or not.

And this is the second item I will look into to see where we are and if we didnt make a finding there has to to be some judgment by the staff one way or another.

MR. OKRENT: While you're looking, will you look to see why it is that the General Electric GESAR can be proprietary in large part and other similar PRA's or portions thereof. And I'd like to have a written opinion that it is NRC policy and why, if at all possible.

I find it troublesome myself for the whole thing. Let's see, according to my watch, we're at 12:15. I said we would break at 12:15 for lunch for one hour, so we'll do that. I have a few more questions for you Mr. Tnadani, so we'll begin with that at 1:15.

(Whereupon, at 12:15 p.m., the hearing was recessed, to reconvene at 1:15 p.m., this same day.)

AFTERNOON SESSION

(1:20 p.m.)

DR. OKRENT (Presiding): Let's see. When last we were chatting the question of the proprietariness of the Westinghouse data was something it was suggested one look into, and also in the same breath I mentioned it might be worth looking into some of the other things that are said to be proprietary in PRAs, other PRAs.

Somewhere I think in a presentation you mentioned a Brookhaven report. Do I recall that correctly?

MR. TNADANI: No, I don't recall mentioning any Brookhaven report, but, rather, that Brookhaven was also assisting the Staff in the review.

DR. OKRENT: I know, it said they are consulting on accident phenomenology and containment phenomena.

MR. TNADANI: That's correct.

DR. OKRENT: This is all verbal?

MR. TNADANI: We do not, to the best of my knowledge, as yet have a report from Brookhaven. But let me confirm that from Rich Barret.

Rich, is that correct?

MR. BARRET: I'm Richard Barret, I am with the Reactor Assistance Branch, NRC Staff.

We have a preliminary report from Brookhaven which was basically a preliminary review for use in preparation of the draft environmental statement. It is a letter report.

DR. OKRENT: Do we have it?

MR. BARRET: I'm not sure that you have it. I'll be happy to provi le you with it.

DR. OKRENT: I can't imagine that the Brookhaven people work for some period of time and everything is by word of mouth. It would be helpful if we could -- that is, the ACRS could get letter reports, draft reports, Brookhaven memoranda, memoranda within the NRC Staff that bear on a particular PRA. I this case we're talking about the Millstone PRA.

From time to time I've mused about how I learned about things a couple of things later because the Union of Concerned Scientists or some other group used the Freedom of Information Act, and I only half-heartedly asked that we should send in a Freedom of Information Act request every month in order to be kept up to date and not rely on others to do it.

MR. COUNSIL: Dr. Okrent, Bill Counsil of Northeast Utilities.

It would be nice also if the Applicant could have received those reports.

(Laughter.)

DR. OKRENT: I absolutely agree.

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So I think the Staff really needs to tackle this problem.

MR. TNADANI: Yes, I agree.

DR. OKRENT: It's about time. It's been too long.

MR. TNADANI: No, I certainly agree with what you're saying, Dr. Okrent, and I understand your comment.

In terms of the information that we provide to the Applicant, whatever we provide to the Applicant will be put in the PDR. And if there are some areas where the Staff hasn't reached that point and there's some pre-decisional material, I believe we don't make a practice of sending that information to the Applicants. And it's resigned now, we intend to follow those prior policies.

DR. OKRENT: But if the Union of Concerned Scientists sends in a Freedom of Information request then you supply all kinds of things.

MR. TNADANI: Anything we supply to the Union of Concerned Scientists there is no doubt in my mind that we ought to be supplying to the applicant, licensee, ACRS and others. As far as I am concerned I don't see any question in that.

I was only trying to make a distinction of some of the information that may be provided to you versus what might be provided to the applicant. And I don't know myself what the restrictions are. Clearly I know of the restrictions in terms of what we're supposed to give to the applicant and not supposed to give to the applicant.

DR. OKRENT: And we get less or more?

MR. TNADANI: I would think you get more. That's what I would think. It may be that in the past we've not provided you all the information. Certainly I have heard your comment and we will try to do better.

DR. OKRENT: Thank you.

MR. HERNAN: Dr. Okrent, this is Ron Hernan on the Staff.

Do I interpret your comment to be limited to PRA issues, or is this any matters involving licensing action?

DR. OKRENT: This is what you would call a generic matter, an unresolved safety issue. Is there some other term?

(Laughter.)

DR. OKRENT: But I'm just wondering, maybe I had better go the legal route.

MR. HERNAN: I think I understand your question. Let me commit, on behalf of NRR, that I will discuss this with Mr. Denton and we will have a dialogue at some future time. I don't think we can give you a real clear answer now or a commitment that every draft document will be sent both to the applicant or licensee and the ACRS.

DR. OKRENT: I can give you all sorts of examples, not necessarily that apply to Millstone, of things that have turned up because other people put in Freedom of Information requests, information that was certainly of interest which the Staff chose not to send to the ACRS, or late, or perhaps not at all.

MR. TNADANI: I think when you put it that way, information that was of interest to you that we did not provide to you, I understand your comment.

But the Staff -- almost on any study, the documentation is enormous and perhaps some fraction of it is of not much real value to you. Somehow there is a discrimination process that has to be gone through.

But, yes, we have received several requests from the Union of Concerned Scientists and we have made available to them about ten or twelve boxes of material; how much of it may be of value to you at least at this stage it's difficult for me to assess.

But I understand your comment and will certainly give it closer attention. As Ron said, we'll pursue this matter further ourselves.

DR. OKRENT: Well, that's about the fourth time I've had this question end up this way.

All right. Let's go on to another topic.

You mentioned something about looking at fragilities. But I guess I didn't know quite what you meant you were going to do.

MR. TNADANI: Fragilities? Seismic related fragilities for structures and components?

DR. OKRENT: Yes, what do you have in mind?

MR. TNADANI: Well, we basically -- our initial process, that we have to a large extent completed, was to review the Applicant's revised material. The next step is there are, we believe, some holes that need to be pursued. We would certainly look to see what the dominant scenarios are from systems analysis and which components might be most fragile.

That's the process. And we're not there, we're not at the end yet.

DR. OKRENT: In a sense, which components are the most fragile may tell you which are the dominant scenarios rather than vice versa.

MR. TNADANI: It could be that way too. But some fragile components may not result in a core-vulnerable state.

DR. OKRENT: But you don't seem to have any systemmatic way of evaluating the current base of fragility information.

MR. TNADANI: We have -- We're clearly in need of more information. We have requested, as I think you know, the Office of Research to develop a better data base, identify areas where further experiments might be useful.

There is the seismic margins activity that is going on. I understand they are going to be developing their plan, if I remember correctly, by the end of this calendar year. And this element is critical to that process.

So, yes, there are some limitations, clearly. There is a need to do more. Where one should do more is a question that is being addressed as a part of the margins activity.

DR. OKRENT: Let me ask a different question.

Is it your intent to have the review being done for you of the Millstone PSS to be rather similar and equivalent in nature to that done for Zion, let's say, and Indian Point, or to be of a different nature, and, if so, of what different nature and why?

MR. TNADANI: The review is in many aspects similar to Zion and Indian Point. There are some differences. There is less of an emphasis on requantification by contractors and Staff; some greater attention to searching for potential combinations of events that might lead to undesired end conditions.

The resources are essentially limited, fixed, if you will --

DR. OKRENT: Less resources.

MR. TNADANI: I don't think on Millstone the resources that we're spending are less. They are certainly less than the resources we have spent on Limerick. The trend may be in that direction. So the reviews have to be modified in some respects.

But on Millstone, if I compare Millstone to Zion and Indian Point I would say they are reasonably comparable in resource considerations. But there are some variations: Less emphasis on requantification, greater attention to searching for potential common cause failures, looking at room cooling, looking at service water systems and so on. I can't give you an answer which one is better. I'd like to think that as we learn more we do better.

DR. OKRENT: Do you find the draft Livermore report is useful to you in trying to judge whether certain systems or configurations should be at least examined in greater depth or perhaps are clear candidates for consideration for improvement, as was the case with the Zion and Indian Point reviews?

MR. TNADANI: I think there is a little bit of a difference here. We were in a great deal of rush to try to provide whatever information we could for completion of our draft environmental statement. For that reason Livermore didn't really have a lot of time; they had limited time.

And for that reason their report was I believe marked draft, preliminary, incomplete. It had a lot of qualifiers to it, most of them I think appropriate.

DR. OKRENT: Well, there's a draft report out very earlier, like January or --

MR. TNADANI: It was out February-March, yes, that time frame, that's correct. And I thought that's the one you were referring to.

DR. OKRENT: I'm referring to what is now the--

MR. TNADANI: Oh, the June.

DR. OKRENT: -- the June draft or May draft.

MR. TNADANI: Yes. I think there are clear indications in two or three areas that we have to pay more attention to. I think seismic is one. Station blackout is another. In fact, I think the Staff might be a little more concerned than what is reflected in the Livermore report on station blackout. And those two areas, at least in my mind, seem to stand out as deserving special attention.

DR. OKRENT: Well, you know, Mr. Kerr frequently asks you what are you going to do with these PRAs, and so now I'm asking you what are you going to do with the review of the Millstone PRA and are you going to have more detailed follow-ups in some areas or what?

MR. TNADANI: I think clearly in some areas I think we're just -- I don't think there is much of an alternative but to have a follow-up effort. In the area of station blackout -- I think that's probably true in the area of seismic.

In the area of station blackout we do have, as you know, generic safety issue B-23 on reactor coolant pump seal performance, and there is some discussion, as you're well aware, of elevating that issue to an unresolved safety issue. At least we continue to believe that that's a very important issue and that it should indeed be pursued aggressively. Resolution should be obtained for that issue as early as is possible.

One way one might be able to accomplish that is to elevate it in terms of its importance, in terms of their resources that could be put on it. As part of that activity, as you know, there are some tests being run, there is some discussion going on now about running full-scale tests using blackout-like conditions to see what the performance would be.

I don't know, at least speaking from the Staff's side, that that would -- some more information is needed: we just don't have enough confidence as to the performance of the seals.

I think for some reasons offsite power may be more reliable for Millstone 3 than others. I don't know right now. But in terms of onsite AC power this unit has two diesel generators so that there is some redundancy as to what that means.

MR. EBERSOLE: Mr. Tnadani, why did you say it that way, 'it has two,' as though that were exceptionally good?

MR. TNADANI: No, I didn't mean it that way at all.

I meant to say we've looked at, as you know, several plants. There are some plants where they may have two units — two diesel generators per unit. But frequently they have the capability to utilize diesel generators from one unit for the next unit. They have some other kinds of capability in terms of component cooling water, which is essential, cross-ties, service water system cross-ties in some cases.

There are ways that, even if a unit had only two diesel generators there are ways one could improve or reduce the likelihood of losing seal cooling functions.

What I was suggesting was that I don't think I have seen any plant where they had less than two diesel generators except I do know of some two-unit sites where they have three diesels which are shared by two units. So in that regard having two diesel generators per unit might be better.

MR. EBERSOLE: These particular diesels, what is known about their standing reliability record? They are unusual machines, I think; they are of foreign make; maybe they're better than anything else, I don't know.

MR. TNADANI: They might be better. As I understand the preoperational experience to indicate that their raliability in terms of starting reliability might be better. But we have to temper that because in some other cases of diesels we found that preoperational testing to indicate higher reliability than actually seen during normal operation.

DR. KERR: Just a question of clarification. I thought they were Fairbanks-Morse diesels. Is that a foreign manufacturer?

MR. CROCKETT: They are Fairbanks-Morse diesels.

MR. EBERSOLE: They are foreign-manufactured?

MR. CROCKETT: No.

MR. EBERSOLE: They're not? They're domestic machines?

MR. CROCKETT: Yes.

MR. EBERSOLE: How many of those have been built?

MR. CROCKETT: There are over 1000 units in marine use. And if you want the exact numbers of nuclear use we have Mr. Ray Necci who can respond to that.

MR. NECCI: I'm Ray Necci, manager, Mechanical Systems Engineering.

There are currently five Colt-Peelstick engines in service. Colt Industries is the manufacturer in the U.S., Colt-Fairbanks-Morse. Peelstick is the name of the engine, and that is based on a French design by the company name of SENT-Peelstick.

MR. EBERSOLE: And there are how many that are carbon copies of those?

MR. NECCI: There are currently five Colt-Peelstick engines that have been in service since 1978.

MR. EBERSOLE: Five?

MR. NECCI: Five units, yes, sir. A total of 27 units have been sold for nuclear service.

MR. EBERSOLE: How does that compare with the 500 I heard a while ago?

MR. NECCI: The total industry experience of this type of engine — I'm not sure about the 500, but there are approximately 1000 of these types of engines in service in marine applications and approximately 300 of these types of engines in stationary applications. And that is since 1964. The experience beyond that is much, much higher.

MR. EBERSOLE: When you say "this type" to what extent do you mean iden...cal or not?

MR. NECCI: The model engine that we have at Millstone 3 is entitled a PC-2, and that designates a frame size that is based on horsepower per cylinder. The 1000 and 300 number that I quote are of the PC-2 design.

MR. EBERSOLE: So they are a different design?

MR. NECCI: No, sir, they are the same frame design. They may have different numbers of cylinders but they are the same rating.

MR. EBERSOLE: Per cylinder?

MR. NECCI: Per cylinder, yes, sir.

DR. OKRENT: One last question:

Mr. Tnadani, to what extent do you feel systems interactions were taken into account in the Millstone 3 PSS?

MR. TNADANI: I think, not knowing the details of the Millstone probabilistic safety study, I would perhaps be better off asking either a Staff member or a consultant.

Perhaps, Abel, could you address Dr. Okrent's question?

MR. GARCIA: I'm Abel Garcia with Lawrence Livermore National Lab.

I think the answer to the question is that they were considered in the systems analyses that were folded into the evaluation.

A separate evaluation of systems interaction was partially considered in the dependency analysis that was conducted in the PSS. But I really can't answer beyond that at this time.

DR. OKRENT: Any other questions for Mr. Tnadani?

(No response.)

DR. OKRENT: Thank you.

MR. TNADANI: Thank you.

DR. OKRENT: I guess we'll go on to the next agenda item.

It's clear that we will not be able to cover all of the matters which were optimistically put in the tentative schedule. I will ask the Applicant to try to focus on those matters of most significance, as he sees them, resulting from the study.

SUMMARY OF THE MILLSTONE UNIT 3 PSS

MR. BONACA: Good afternoon. My name is Mario Bonaca. I am system manager of Reactor Engineering at Northeast Utilities.

The purpose of my presentation was to provide you with an overview of the Millstone 3 PSS and some of the intended applications.

My presentation was to be followed by a presentation of Dr. Bickel, who was the coordinator of the PSS study. We had left almost two hours go to into detail of the studies, and he was to cover particularly significant issues in the PSS such as systems interaction and results.

His presentation was to be followed by the one of Dr. Dube, who is a senior engineer in the PRA section of NU,

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who was intimately involved with containment and consequence analysis.

Since we have less time available I would propose that I will go through an overview to you that you will temper or cut back as you wish. And I would then like to call upon both Dr. Bickel and Dr. Dube to expand on those areas that you would want to cover today. Significant issues, for example, systems interaction, we may cover that if you wish, and so on.

But let me go on with my presentation to start with and see if it is of significance to an overview. I believe it is.

(Slide.)

DR. OKRENT: Why don't you assume that Millstone will have between now and about 3:10, including questions. And you can divide it up however you see fit. That's about an hour and twenty minutes. I'm sorry, but we'll have a long time some other time to go into details.

MR. BONACA: Okay.

Let me start by saying I want to point out that well before we received the request of the NRC for a plant specific PSS for Millstone 3 Northeast Utilities had been planning to perform probabilistic studies to core melt for all of our plants, and the intent was to use these PRAs as an engineering tool for the decisionmaking process. The reason why we set up, in fact, in 1980 a task force to assess how we could do that was because we had found in the late '70s significant insight into equipment performance and, at times, shortcomings in our operating units due to limited scope PSS performance.

In mid-1980 we recommended, in fact, an in-house performance, maintenance, end-use of PSS for all of our plants, and the Millstone 3 PSS was scheduled to have -- to be performed in the 1986-'87 time frame, essentially after construction.

(Slide.)

The 1981 NRC request for a Millstone 3 PSS modified our planned priorities, of course. And we assigned all of our resources to the Millstone 3 PSS. At that time these resources were five individuals in the PRA section, with some significant support in transient analysis and LOCA analysis, fully assigned to those functions.

The request of the NRC, as you know already, was for a PSS to address both internal and external consequences, and to address -- internal events, I mean -- and to address external consequences.

In particular the PSS was to address what I would call a frozen design here. We had to freeze the plant to the 1982, February design stage in order to be able to perform an ordinate kind of study. And the objective of the study clearly was one of obtaining an assessment of risk of Millstone 3.

We performed the study in this fashion, pursuing this objective, and we submitted the study to the NRC on August 1, 1983.

It's clear that since we intended also to pursue our objective of having what we call a living-PRA, which is a PRA amenable to be updated and utilized in support of plant operation and safety, we were kind of concerned about what or how we would then be able to update this PSS to be usable during operations. So therefore we spent a significant amount of time in early 1982 to write specifications.

In particular Dr. Bickel spent several months reviewing past PSSs looking at shortcomings, areas where we felt we had to strengthen our process. And also we put in our specifications to our vendors the requirement for a technology transfer. We wanted to have a PSS installed on a computer-dedicated system in our office so that we could exercise this system.

(Slide.)

Also we had to think very deeply at that time because we felt unless we had a staff of knowledgeable, capable and experienced people truly trained into the understanding of the fault trees we will never understand the PSS sufficiently to utilize it in support of operation and safety. All this was built in up-front into this process.

We then hired Westinghouse as the main contractor to perform the job, and we had Stone and Webster performing most of the subcontractor functions, although we had also additionally eight subcontractors for this study.

(Slide.)

Here this overhead indicates some of the review functions that were essential to us. We assembled an in-house PRA team to supervise the study and to effect the technology transfer. This also was the most intimate review process we could implement in that -- And I must say that many of our engineers spent many, many weeks going back and forth between here -- between Berlin and Pittsburgh to assure that we were truly intimately involved both in the decisionmaking process in certain actions, and also into the understanding of the sequences.

DR. MUELLER: Are you going to say how much in-house effort was spent on this PRA?

MR. BONACA: Yes. I can summarize it right now by saying that we had a full time effort of approximately seven or eight engineers, fully-dedicated from Reactor Engineering into this effort, plus we had a plant scheduling individual who utilized computerized methodology to maintain this process on track.

We had mechanical, electrical and civil engineering support from our in-house staff as needed. We had significant support from the plant personnel in providing us with insights into the application of ERGs as well as providing us with insights into an ENICO practice, which we feel is significant to the way that the ERGs would be interpreted in support of the operation of Millstone 3.

MR. EBERSOLE: May I ask a question?

With all this intimate attention to detail, is it true that at this time that when you looked at the AC power failure, the total power failure, that you included that facet of it related to reactor coolant pump seal failure in aspect to containment pressure rise?

MR. BONACA: I'm sorry, I didn't understand fully your question.

MR. EBERSOLE: I say when you looked at the total AC power failure and picked up the fact that the seals may leak, you would almost intuitively look for a loss of core coolant in the context of losing the core, but not pick up, perhaps, that what was really happening faster than that was the containment pressure and temperature was becoming uncontrollable.

This was something that came out of a recent meeting; I think Mr. Michelson picked this up. It seems that the schedular aspects of recovering power may have to be vastly diminished because it's the containment pressure that's running away, not the core heating. Is that in your PRA?

MR. BONACA: I'll let Dr. Dube address this question because he performed those analyses on containment.

DR. DUBE: Dr. Donald Dube from NUSCO's PRA section.

If one looks at the generic Westinghouse ERGs, I believe there is some calculation of containment response as a result of reactor coolant pump seal leakage, and there was nowhere near what you seem to be indicating in terms of containment pressurization. And indeed, we have performed calculations for a wide spectrum of small LOCAs which indicate that the containments would not really pressurized that much; they would not even reach design pressure for some time.

MR. EBERSOLE: Right. Even though it has no heat removal?

DR. DUBE: That's correct.

MR. EBERSOLE: Thank you.

MR. BONACA: The other essential review process we viewed was the one of assembling, you know -- The expert review board was chaired by Professor Rasmussen and the other two members were Sol Levine of NUS and Dr. Wood of

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Wood, Leaver and Associates. We were very concerned about the function of this review board. We involved them very heavily in review processes, in particular where there were concerns raised with common cause and with the human factor. We assigned in-depth and extensive reviews to the organizations of Dr. Wood and Sol Levine to perform, and most of all to give us a statement of adequacy and to, if necessary, redirect the study.

I would want to say that this review board acted in this PRA at times as a steering group. We really used them in this particular fashion, allowing them to redirect the efforts of our contractor whenever we felt that there were shortcomings.

We also requested the review board to provide us with a statement of -- well, summarizing their findings at the end of the study, feeling that, well, if they had to put it in writing they probably would do a more in-depth review. And so we got a report on the study also.

I would like to summarize in the next overhead in a nutshell the conduct of the study.

(Slide.)

We looked at the external and internal events. I must say, from a management standpoint, that our major concern was the one of completeness. And, again, we do not pretend to be able to find everything there. But we were very much aware of the fact that significant initiators are not identified in Chapter 15, and that that's not news to anyone. We did whatever we could, and we had in mind systemmatically to utilize too to find initiators.

I think at some point I would like to have later on Dr. Bickel —

(Whereupon a fire alarm was sounded.)

MR. BONACA: Again here I am referring to completeness.

I would like to point out in the top five dominant contributor sequences to core-melt probability for this plant we find three which are known Chapter 15 events, essentially loss of vital AC, loss of vital DC. And we find many other of these sequences which really were part of the systems interaction study, which is part of the PSS. And Dr. Bickel can address that later. But again, completeness was a great concern to us.

We studied event trees and fault trees using techniques which are very consistent with PRA guides. We did do extensive work in containment. We felt that there were some features, such as the sizeable RWST, that provided the amount of, you know, delaying of certain sequences into containment challenge that would provide significant insight into accident management conditions. And I think we felt from the beginning that we could get a lot of insight for

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operators into those conditions by studying the sequences.

And finally, we utilized the standard techniques, such as the CRAC-2 code, to evaluate external consequences.

I would like to summarize in this slide significant findings.

(Slide.)

Among all the sequences which we have identified, no individual accident sequence contributes more than ten percent of the internal core-melt frequency. And we conclude that there is no single plant feature that stands out as a risk outlier.

Thirteen separate accident sequences each contribute between one and nine percent, and in total they contribute approximately 50 percent to internal core-melt frequency.

You realize that in performing this evaluation and in making this statement we are as concerned as anybody can be about uncertainties. It is obvious that uncertainties can skew a risk profile as such, as we present here. And we are aware of that. And we feel that this statement I am making here is a first statement.

MR. EBERSOLE: There's a word up there that bothers me a little bit. It is "internal." I see it in two places. What does that mean?

MR. BONACA: Oh, yes. I am referring here to a core-melt frequency from internal events.

Then there are four dominant sequences in the seismic analysis that -- but again the seismic contributor that we will present to you later on is as far as the results it is not a major contributor to the total melt, core melt frequency for this plant.

(Slide.)

I would like to summarize here in three overheads to you what I view as strenghts of the Millstone 3 PSS -- the strength of the Millstone 3 plant, as shown in the PSS. I'm not implying that these are not typical strengths of other plants too; I'm only saying that we see the effects of strengths into the systems, into the PSS analysis.

First of all, the auxiliary feedwater system. It is the system, as you have seen, which is made up of two electric and one steam driven pump. Each one of them has the capability of removing decay heat all by itself.

There is no dependency on instrument air, component cooling or service water. And loss of instrument air will auto-start -- or DC power will auto-start the steam driven pump. And we feel that -- Well, we see that there is sufficient redundancy, diversity and independence in these pumps to provide a net unavailability on demand for the system which is low, even assuming and considering in it common mode failure components. We still find a number of the order of 6.8 and ten-to-the-minus-five unavailability of demand for this system. And we consider this a strong system.

We have strength into the high pressure injection capability. By that I mean both charging pumps and self-injection pumps. The fact that they are all self-degrade pumps is significant. The fact that they are located in two different buildings I think is significant. The fact that they have dedicated and independent pump cooling is significant, although clearly there are two trains which are cooled by service water too insofar as the independent cooling loops.

Feed and bleed capability is a significant strength of this plant. And the one HPSI and two PORVs are sufficient to perform this function.

MR. EBERSOLE: May I ask, are those PORVs competent to withstand the environment within which they will have to work?

MR. BONACA: Yes, they are. They have been qualified.

MR. EBERSOLE: Thank you.

(Slide.)

MR. BONACA: I will not go over again the RWST capacity. It is true that it is required maybe for a large break LOCA scenario. The fact is that it is a large inventory of water and on many scenarios it provides an extra margin which is not found typically in other PWRs.

I mention here the dry --

DR. MUELLER: Mr. Bonaca, can I back you up a second on RWST?

In the very beginning of your PSS you state the RWST capacity as something that contributed favorably to low risk.

There is, then, a sentence in there that said something about your not taking benefit from that capacity in a quantitative sense.

And then when I read your results you said the reason one of the small LOCA scenarios was not a dominant was because of the RWST capacity.

Did you or did you not take credit in your accident recovery times for the RWST?

MR. BONACA: Yes, we did.

DR. MUELLER: Okay. Thank you.

MR. BONACA: I would like to point out here a combination of features that required extensive analysis on our part.

The original inspection of the plant at the beginning of the PSS showed a cavity which was dry design and yet it could be changed very quickly into a wet design because there was an opening and there was not a close on

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that to the sump.

Therefore we really performed extensive analyses in containment to understand whether or not a dry cavity was a benefit to us.

And we came to the conclusion that the combination of the dry cavity and the basaltic concrete, which managed to produce legal CO-2 caused the following:

In the early containment core melt situation we don't have the large overpressure plateau over which the pressure spike could challenge containment.

This is a generic statement, clearly. It does not apply to every sequence, but it applies to most, and it is a strength in this plant. It convinced us of staying with the dry cavity for most situations.

And, of course, the basaltic concrete is a benefit too in that a low production of CO-2 will give us a low pressure plateau based on CO-2 production and legal CO for CO burns.

Finally, the containment spray system --

DR. OKRENT: Excuse me.

Based on your studies would you suggest that Zion try to take steps to find a dry cavity with basaltic concrete if they could?

MR. BONACA: I'm sorry, could you rephrase the question? I can't hear you very well.

DR. OKRENT: As you well know, the Zion and the Indian Point 2 design say that under most circumstances, they expect to have a wet pressure vessel cavity and they find advantages, for the most part, maybe for all parts, as far as they're concerned.

You have a dry cavity. You found it is better than to try to make it a wet cavity.

MR. BONACA: Yes.

DR. OKRENT: I am asking, do you recommend that Zion change to the dry cavity?

MR. BONACA: Let me say first of all that it is a borderline recommendation. If Don Dube has time to show his results, it will show you that really it wasn't such a tremendous advantage, having a dry cavity. It showed, however, that in many sequences there was some advantage there in that there was no justification for going to a wet cavity.

It wasn't really such a strong-- Clearly looking at strict challenges versus hydrogen burns there, and there are a lot of considerations going behind the decision.

Containment spray systems. We have already described these systems, and Millstone Unit 3 employs a quench spray which has two pumps, as you know, and a recirculation spray with four pumps. The recirculation sprays do not utilize the decay heat removal pumps. They utilize—

What I mean, the low pressure injection is not provided through the decay heat removal system; it is provided through the recirculation pumps which can be utilized both to provide high pressure injection and recirculation or low pressure injection and recirculation. And these two spray systems delay substantially containment failure in many events.

Each one of these systems has a significant, reasonably high unavailability — low, I mean, unavailability on demand, and the combination of the two is a strong feature of this containment safeguard.

I would like to finally summarize these findings saying that we find the ultimate containment strength of 117.7 psi to be pretty much in line with other evaluations for plants of similar design. We never took any credit for the enclosure building and yet there is a collection and release system in that building. And if the a leak before break is to be the effect of a failure of containment, there will be some mitigation provided by the enclosure building, too.

Meteorology is not a design feature but we like to have it always with a prevailing wind towards Long Island Sound. That's favorable.

I have not mentioned here some of the strengths such as the third valve for the increased sequence that Mr. Thadnani mentioned before, and loop-stop valves. I want to just state that the third valve is there. We are only evaluating whether or not the piping of the valve is qualified for high pressure. We believe it is.

And the loop-stop valves, the only use we would make of this valve at this stage would be I would say for long-term control and isolation of a break. It would not be considered a short-term mitigation of events. Clearly we will not operate those valves until the system is stabilized and safeguards are on standby.

MR. BENDER: I wonder if I can ask a question about the time available.

You have indicated that this RWST system gives you more time. It should, I suppose. But what is the target? What is a good time? What would you judge to be a good period of time to make a case for the safety of the Millstone plant, and what would be a bad time?

MR. BONACA: Let me explain, please.

MR. BENDER: Yes.

MR. BONACA: I cannot give you hard and fast numbers. All I want to say here is, for example, if we looked at the -- I don't know, as an example, the in-core instrument tube rupture event, we can show how we can withstand an event. I believe substantially it is about

24 -- 17 hours before seeing a core melt if we have utilization of the RWST.

Now if you compare that with what we are seeing for other plants of similar design, I consider 17 hours a significant amount of time for action. I would consider a few hours questionable.

MR. BENDER: Why?

MR. BONACA: Because--

MR. BENDER: What are you going to do in the 17 hours versus four or three or two, or whatever the number is?

MR. BONACA: What you view I believe is also-- What you see is a company which I believe since 1979 has given up a lot of capabilities also outside the control room of the plant itself. We have an emergency operating facility. We have an emergency operating center where -- for example, typically doing exercises to, myself and my staff, provide inputs.

There is a way by which we can get outside expert insight on how to proceed, first of all in managing events from an engineering standpoint, and second, in providing resources right onsite to add water, and that kind of thing. Things can be done.

MR. BENDER: Well, are you looking at those strategies? I agree with the viewpoint that more time should give you more opportunity. But in trying to understand the PRA and what the significance of the time is, I'm still left with the feeling that if you don't have a strategy that makes use of the time, you have only done an arm-waving exercise.

MR. BONACA: We have strategy. I can mention to you, and I believe it's a fact that in a drill that we had recently on Millstone 1 we already had a bulldozer lined up outside an auxiliary building wall, and the fire pump ready to pump water, and we knew exactly how to connect it and we have also nozzles to do so.

So there are backup actions that we have planned. They are more a part of what I would call the EOC/EOF support.

But I will show to you later and I think that is the significance then of the Millstone PSS. We have a lot of dialogue going on with the operator of these plants, and I really feel that that is where the Millstone 3 PSS is going to pay off.

MR. BENDER: I am only thinking of this in terms of, you know, what I can tell the public if I were sitting where you were about why this plant is safe, and being able to say that I've got some resources outside the containment that I can take advantage of that I haven't even taken credit for up to now would I think make the story a lot better. But it is hard to get that out of the PSS at the moment.

All I can find out now is that you might have 17 hours and that you can do a lot with them.

Thank you.

MR. EBERSOLE: May I ask for just a moment to return to that question a while ago about the reactor coolant pump seal leakage subsequent to AC power failure?

MR. BONACA: Yes?

MR. EBERSOLE: What number did you use for the totality of primary coolant leakage into the containment under this circumstance?

MR. BONACA: We looked at the spectrum of leak rates ranging all the way to 300 gpm.

MR. EBERSOLE: I'm sorry, I wanted the total, the total leakage from all four pumps.

MR. BONACA: 1200 in all. But of course there was one other value assumed.

MR. EBERSOLE: 1200 gpm?

MR. BONACA: Yes.

MR. EBERSOLE: That was the upper end of it?

MR. BONACA: The upper end of it, yes.

MR. EBERSOLE: Thank you.

MR. MICHELSON: I find your reply a little confusing. You're saying you are pouring out reactor coolant at full pressure and temperature at the rate of 1200 gallons a minute. And at what point in time did you reach the design pressure of the containment with no heat removal, including of course the heat loading you are getting from all of the hot materials within the containment after loss of cooling?

MR. BONACA: I will have Dr. Dube respond to the question.

MR. MICHELSON: I think you will find other people have done this calculation as well.

MR. BICKEL: In mind of your question, I will attempt to address that in my presentation.

MR. MICHELSON: I'm going to be leaving in about two minutes.

MR. BICKEL: Then let me try to give you one two-minute answer.

The scenarios we looked at concentrated on what was the most likely station blackout. Okay? The most likely station blackout would be a loss of offsite, a complete failure of the onsite AC power system, but with the auxiliary feedwater system still available, the steam-driven portion of it.

We have analysis that indicates that all the features needed in the control room to maintain both vital AC and vital DC following the station blackout should be available. In other words, we've determined that there are no environmental considerations like in the steam turbine cublicle or in the areas such as the electrical switch gear room.

If one depressurizes the RCS using the single steam-driven feedwater pump, you can drop the coolant system pressure, you're going to drop the leakage rate into the containment over what it was initially, and even in the worst case, -- I'm talking about the 95th percentile leakage rate assumed out of all four pumps simultaneously -- you find that you don't get to core uncovery in that situation until a period of about two hours.

MR. MICHELSON: I think we're asking about containment pressure with the core uncovered.

MR. BICKEL: The containment pressure will of course be-- You are not adding as much mass and energy.

MR. MICHELSON: Two hours I will believe. I thought the inference from your reply was that it was a non-problem, and it becomes a problem-- It's a question of at what point in time it becomes a problem, because you see some people say I can stand a total loss of AC power for 20 hours.

I think you'll find this feature has become a problem long before 20 hours.

MR. DUBE: We did calculations which we

provided to the NRC Staff in response to successful ECC injection but failure of recirculation before a large LOCA, not a small LOCA. And those calculations found containment cooling. The design pressure would be reached in eight hours, and ultimate containment pressure would be reached in something beyond a day.

MR. MICHELSON: Yes, but I'm not sure that's the comparable answer to the loss of all AC power.

MR. DUBE: I think this is more severe than the loss of all AC.

MR. MICHELSON: I would have to see your analysis to be sure. It doesn't correspond with some other replies that we've gotten on the same question.

Could we get a copy or a reference to that and our Staff people will look it up?

MR. BICKEL: We provided this information to the Staff I believe in October of last year.

MR. MICHELSON: Okay.

MR. BICKEL: And if you cannot get it from them, I'll send you a copy.

MR. MICHELSON: I think Savio can probably find it with that, or give you a call.

Thank you.

MR. BONACA: I thought you would like to see some of the results.

(Slide.)

I have summarized here in this overhead the results of the study.

I have provided here the frequency of core melt from different contributors.

The frequency of core melt from internal events, as you can see, is 4.5 in 10 to the minus 5 reactor years.

The frequency of core melt from earthquakes as the final result from the seismic analysis is 0.9 in 10 to the minus 5 reactor years.

The frequency of core melt from fires is approximately .5 in 10 to the minus 5 per year.

And we have a total core melt frequency from all causes of 5.9 in 10 to the minus 5 per year, with the risk curve early and latent fatalities consistently lower than the corresponding WASH-1400 curves.

I want to point out here that this number, the frequency of core melt from internal events, we have looked at the contributors, we have looked at what the Lawrence Livermore study has provided to us. The variations there between our estimate and their estimate we find to be very much connected to operator actions, particularly to small break LOCAs with assumptions of the operator turning off high pressure injection and then failing to restart any high pressure injection and leading to core melt, essentially a

Three Mile Island sequence.

This was-- We find that in the estimate of -- you know, presented in the SER, that sequence per se contributes a very large amount to the Staff estimate, and we disagree with that kind of approach to that operator action, and we feel the contribution is less than that.

But these are the values we calculated in the study.

DR. OKRENT: If I could ask a question for clarification, your total core melt frequency is of the same order as WASH-1400, so if you are consistently lower it could be because the containment fails less frequently or with smaller release categories, given the same release for a articular failure mode, or it could be because given a certain kind of failure mode, you are predicting much lower amounts of radioactivity getting out of the containment when you put your probabilistic treatment in.

Is it both of those, the first or the second? And if it is both, which is the more important?

MR. BONACA: Are you talking about the differences between our estimate and the one--

DR. OKRENT: -- in WASH-1400.

MR. BONACA: I believe the significant-- There are two significant differences. One is in part due to the systems, and one is due to the different source term assumed. Our source term is somewhat lower than the one assumed in the WASH-1400 study.

DR. OKRENT: Would you say that's the predominant reason for the substantially lower than WASH-1400 or not?

MR. BONACA: Yes, sir.

DR. OKRENT: Okay.

DR. MUELLER: Let me ask another point.

You are using the existing source term assumptions then from in-core or wherever? What source term assumptions are you using?

MR. BONACA: We do not use the in-core assumptions. I will let Dr. Dube give you the details of our source term input.

DR. DUBE: The source terms that we're using are consistent with what was used in the Seiswell BPRA. One actually looks at which -- at a particular action sequence and assigns a range of probabilities that the source terms is one, one-half, one-tenth, and what-have-you times the WASH-1400 methodology.

However, if one compares the effective average source term that we used in the study and compares it with a recently released draft report put out by Battelle, BMI-2104, we are extremely close to the source terms that they calculated in that report for the Surry Plant.

And that is for sequences such the interfacing systems LOCA, the V sequence, effectively a source term reduction or a factor let's say of about one-half or one-third, something like that.

For sequences which result in intermediate type failures, a factor of one-fourth.

For a little bit later containment failure, factors of one-tenth; something like that.

So it is sequence-specific.

Does that answer your question?

DR. MUELLER: That's fine, yes.

DR. KERR: May I ask a question?

In this study it does not seem to me any account is taken of the fact that this plant is part of a three-plant grouping with whatever risks that introduces and whatever benefits it introduces. It would seem to me that that could have significant influence, possibly reducing the risk significantly, or possibly increasing the risk significantly.

How do you account for that, or did I miss something?

MR. BONACA: We have not, as far as I can tell, introduced or given consideration to the other units in the study. You realize the short term available to us for performing the study, and concentrating on that particular plant.

I must say that we have been looking at the other plants in place. We are aware of the presence of other emergency power sources there. Our questions to ourselves are what benefits would there be from being able to interconnect. We have performed the study in-house that shows maybe the benefit on paper probabilistically not to be very high.

But these kinds of issues I can assure you are given consideration outside of the PSS right now, and within Reactor Engineering.

DR. KERR: I was thinking not only of the possibility of using mechanical resources but of human resources, because it would seem to me that we may well be in a state of development in the business where the risk contribution from people is likely to predominate that due to malfunctions of equipment.

And if you have extraordinarily good human resources available because of a multiple plant site, this is likely to have some influence on risk, it seems to me.

MR. BONACA: Yes,--

DR. KERR: And there are perhaps other negative contributions. When we talk about dominant sequences, I have a feeling that the existence of that complex may be perhaps as dominant as anything else that is being considered, yet there apparently doesn't seem to be any way of introducing this into one's consideration of the totality of risk.

MR. BONACA: I think this is an opportunity for me to emphasize the objective of the study, and the short time again that we had to perform the study.

It is clear that when we had a program as I described it of utilizing probabilistic studies in support of all plants, this kind of almost I would say infrastructure considerations are essential. Here the essential point was to look at the plant to qualify the design of this plant. Essentially to me it was a design evaluation of Millstone 3 in 1982 and had to be performed in a very short term. Okay?

And so we limited ourselves insofar as the scope we could cover.

DR. KERR: Perhaps I was influenced somewhat by the correspondence that I saw. But the NRC picked this site as one which, by some method of calculation estimation, they considered to be possibly above average in risk.

And hence it seems to me in one's consideration of the question as to whether it is or is not above average in risk, one certainly takes into account equipment, but one also would want to take into account other possible contributors, either to risk or lack thereof.

DR. OKRENT: A different question, if I might:

Earlier on this morning there was a presentation by a small set of representatives for Millstone concerning the seismic aspect of the risk. I am sure you are well aware that there are differences of opinion concerning the hazard curve chosen, the best estimate, or whatever you want to call it in your study, and other best estimate curves.

I am interested in knowing how you decided to go ahead or not with the material being supplied to you with your own chosen set of consultants when I have to assume it was clear to you and to them that there were indeed previous and going to be upcoming hazard curves substantially different and larger.

MR. BONACA: I must say that we commissioned the study of the hazard curve I believe in 1982, early 1982, and it may be a limitation on my side, but I was not aware of the higher connotation of seismic risk at the site by some other organization at that time.

DR. OKRENT: And the people whom you hired didn't advise you of this?

MR. BONACA: We went back and reconsidered the Coleman zone into the study and we reperformed the hazard curve study at that time. But there was no-- At that time I didn't feel there was any inadequacy about the curve, and I don't see there is yet now any inadequacy.

There are two points of view there I believe that have been brought to bear, and there are still what I would call arguments among experts on whether or not in fact one representation of the site is more accurate than the other.

Again in my mind the PSS has to be a best-estimate evaluation of the plant, and I am not looking for a conservative approach to the seismic profile of that site, so I cannot say that the one provided by Livermore is more correct because it is more conservative.

DR. OKRENT: The Coleman theory only applies to part of the picture. If there were no such theory and Livermore were getting a bunch of experts together, trying to get some mean estimate of acceleration that corresponds to a one in 10,000 or 100,000 per year, I'm sure there would be a considerable spread among their experts. Furthermore, I have little doubt that it would come out larger than what you had in your own.

Now you used the term "best estimate," but I'm interested in knowing how you choose to define the term "best estimate." Is it "best estimate" from a restricted set of consultants? Is it "best estimate" from the whole field of knowledgeable people in the area? What does the word "best estimate" mean when you use it?

You used it and you sent it into the NRC. You present it here. You use it to the public. What does it mean to use that term "best estimate"?

MR. BONACA: "Best estimate" means to look at a convergence of opinions on a certain issue, that that is in fact a best-estimate representation of the site.

My contention here is that we do not have a convergency of opinion of what the best estimate is for that site. And I would say in our justification the choice made in 1982 is that the issue of seismicity on the East Coast has been growing through the years since that time, and I think we are much more sensitized today than we were two years ago to that particular issue.

DR. OKRENT: Again I'm trying to ascertain what it is you think you're saying when you use the term "best estimate."

MR. BONACA: I told you I think it is a general assessment by a broad team of experts with also divergent views on an assessment for a certain site.

The point is we don't have any convergence of different opinions.

DR. OKRENT: Well, I will word the question another way:

You pick a group of what you say are experts that diverge a little, and you come up with a best estimate.

Another group picks a larger set of experts and comes up with a mean or mean estimate of the same parameters, and they vary by an order of magnitude. Each one now has a best estimate. If differs, but it differs by an order of magnitude.

What does it mean if either of you puts out a document that says this is a best-estimate calculation? I'm at a loss.

MR. BONACA: Let me answer it this way:

We didn't have the benefit of the time to sit back and wait for numerous experts to spend months of time to tell us what the best estimate was. We hired what we felt were competent individuals to provide us with this estimate. We inputted that into the study.

We do believe that also there are uncertainties in the study that covers very specifically for that kind of weakness you are mentioning. That's a weakness in the PSS methodology which is a weakness in the input. And all we can do at this time is to acknowledge the fact that there are these weaknesses in the PSS, in the PRA, in the methodology in that it is attempting to bring to bear so much information and knowlege about so many different areas.

I think that scientifically it's a way that typically covers for some of this inherent problem.

DR. OKRENT: I'm sorry but I have to disagree that uncertainty as it is used in your PSS covers for a situation where you have really a broad disagreement between two different sets of experts. It is intended in a sense to deal with another kind of situation, unless you were to put uncertainties in of a factor of a hundred each way or, you know, something which says in effect I have a flat curve; I don't know what the answer is.

MR. BONACA: Let me say this, Dr. Okrent.

You will agree with me that the PSS is an interative process. I do not believe that this particular PSS is a finalized document sitting on a shelf because it is not. Clearl it is an iterative process. We are still studying it. We are performing analyses. We are looking forward to seeing the reviews performed.

We are going to answer to those comments, and yes, we will maybe zero in one of these days on what is a proper treatment of the whole seismic issue for that plant.

All I'm saying here is that when we were requested to perform this study we had less than a year and a half to perform it, and we had to make very hard and fast decisions on how to move, and we made them as best we could within that time.

DR. OKRENT: Okay.

But let me concede you are not alone in using the term "best estimate" where in fact, if you go to different sets of experts, you get big differences. I have been a little hard on you. I could have been equally hard on others. Okay? Let me put that up front.

It seems to me everyone involved has to rethink what information he is conveying when he does a calculation, puts out a result, and says "And this is the best estimate," or even "This is my best estimate," or something. Let me leave it at that for the moment. It is a problem that does not have to be answered, obviously.

But people I think are using the term "best estimate" too loosely. That's what concerns me. Okay?

DR. POMEROY: Can I ask you for a point of clarification?

With regard to the question that Dr. Okrent has been posing, you gave us a bottom-line figure on the previous slide that was .9 times 10 to the minus 5 I believe for the frequency of core melt from earthquakes.

Yesterday we were given some indication of the fact that you had considered the Lawrence Livermore results. Could you just refresh my memory as to what that frequency of core melt from earthquakes might be if the hazard input were an order of magnitude different as Lawrence Livermore--

MR. BONACA: Okay.

Let me state that in the review performed, the value, the frequency of core melt from earthquakes assuming the same input that we used is actually lower than what we got. It is 0.6 times 10 to the minus 5 per year.

And I have here Mr. Jain of the PRA Section to provide you with the information assuming the Livermore curve.

MR. POMEROY: Can I just clarify though? I would like to have the information in terms of the way Livermore stated it originally, not as you modified it, as I understood some modifications of Livermore numbers were made, but as the way the original Livermore numbers came out. That is an order of magnitude higher in terms of seismic hazard.

MR. JAIN: This is Jain, PRA Section.

Using the hazard curve which Lawrence Livermore came out with without any modification, a rough estimate for the core melt frequency is 2.8 times 10 to the minus 4 per year.

MR. POMEROY: 10 to the minus 4.

MR. JAIN: It's about a factor of 30.

MR. POMEROY: Thank you very much.

MR. BONACA: Okay.

(Slide.)

What I have done here, we have integrated those curves of early and latent fatalities to obtain a Millstone Unit 3 public risk total. We are providing here for all events, median, and 90 percent confidence.

Clearly there are medians, 1.6 times 10

to the minus 6 and 2.0 times 10 to the minus 3. And if you look at the two numbers, latent fatalities dominate the representation of the expected fatalities at the site.

MR. REMICK: In getting the latent fatalities, how far out did you integrate the consequences? In distance? How far from the site?

MR. BONACA: Three hundred and fifty miles.

DR. OKRENT: Is that number multiplied by thirty, or something? What does "per reactor year" mean?

MR. BONACA: It means that each year or operation that's the number. It's specifically a total per reactor year of operation.

DR. OKRENT: For all future times?

MR. BONACA: Per year for the license years of the plant, which is thirty years.

(Slide.)

I would like to summarize here in this overhead what I view as the important thing about Millstone-3 and what I view as the strengths of this plant. --of this PSS, actually.

I'm not mentioning here what the strengths of the PRA methodology is, or the limitations of it. I think you are familiar with those. I feel, however, that the Millstone PSS is an important tool in our hands, because it is now in a form which is amenable to be updated and exercised. It is, in fact, implemented on our computer system which is dedicated to the PSS, and is being repeatedly exercised in support of the PSS.

It is supported by specialized personnel knowledgeable of the strengths, limitations and the uncertainties. And I believe that, to me as an engineer, is the most significant thing. I don't think there is any hard and fast rule in treating uncertainties except engineering judgment when you come down to evaluating sequences and equipment. And that kind of intimate knowledge with the uncertainties assumed in the sequences is important to make judgments.

I think it is important also to say it is managed by a staff which is equally skilled in deterministic as well as probabilistic analysis. That's critical, too, because, again, we're talking about equipment and the performance of equipment, we're talking about twenty years of nuclear engineering experience we want to bring to bear in the PSS; I don't think we want to look only at the probabilistic aspect of it.

I think the most important statement I must make about the strength of the PSS is that it is supported by a management organization which is committed to using it to support the plant in operation, and that's significant: it is not a document on a shelf right now, but is being exercised and utilized for judgments.

I have two slides here to summarize to you the insights and practical benefits we found in performing the PSS.

(Slide.)

These are just examples.

MR. MUELLER: Excuse me; are you going to continue, and then go into your living PRA program?

MR. BONACA: Yes.

First of all, in performing the study, we are concerned, first of all, to assess the adequacy of the systems as built. And we feel that we did perform this assessment. I don't think we are identifying any specific weakness in the mitigative systems as installed.

However, we also got insights in certain situations. For example, we found that the emergency generator load sequencer input logic was erroneous; in particular, the EGLS was tied in such a way that turbine trip or reactor trip would cause the EGLS to sense the loss of off-site power and, in turn, to lose off-site power. So we corrected that.

We also found that the EGLS was--

DR. KERR: Excuse me; just a matter of my own curiosity: Was this a new control system designed for Millstone, or is this same flaw likely to be in other similar plants?

MR. BONACA: This was a plant-unique design, and the critical thing was that there have been upgrades in the design, actual improvements in the ties that caused this logic error there.

Clearly, these logic errors would have been surfacing in the testing phase.

Yes, there is a lot of time-saving just in the fact of identifying the short-comings this early.

DR. KERR: Thank you.

MR. BONACA: The other issue was that EGLS was being powered by an incorrect power supply that was planned to be set in case of off-site power. In so doing, it would have defeated the EGLS. We corrected those errors.

In reviewing boron dilution events, we found they were really dominated, insofar as probability, by operator actions. Although they were unlikely as events, a specific recommendation in administrative procedures and control would definitely reduce the probability of these events. We have provided those recommendations to Operations.

We performed extensive analyses in the dry reactor cavity effect, and particularly on the impact of deliberate hydrogen igniters in this plant, to assess the effect of deliberate burns, and Dr. Dube has an extensive presentation that he won't be able to provide to you today, to support this.

DR. OKRENT: Can you tell me in fifteen seconds whether it was good or bad to have deliberate burns?

MR. BONACA: Dr. Dube will address the question.

DR. DUBE: Obviously it has an impact the core melt frequency, but in terms of the impacts of risk, and we used two measures, early fatality and latent, it's a negligible impact.

(Slide.)

MR. BONACA: Where we found the best benefit really is in operator actions. Reactor Engineering has the problem of supporting review of procedures for all our plants, and also provides a lot of cross-information about different designs and objectives. --designs, really.

The important thing that we found also is that operator action clearly dominates certain sequences, and it's important that we bring to bear the PSS experience into the operator training.

I here list only a few of the many insights which were received in operation actions which are citical. I list here the cutting back on quench spray to conserve RWST for a smallk LOCA with failure of recirculation. This particular action is identified by the ERGs. We tend to strengthen this into direct operator training information of the way the systems work in mitigating certain conditions beyond the design basis.

We looked at the use of isolation valves. We're trying to provide a recommendation on those. They're critical. We feel that although we did not cover them in the study, they're significant in the long term mitigation of reactor coolant pump seal LOCA or steam generator tube rupture induced core melt.

Again, we are moving cautiously, because we don't view this isolation valve as a mitigative system you can just throw in in the middle of a transients, but as a system which you can intelligently use when you have a system already stabilized and you have safeguards which are on stand-by there ready to provide mitigation.

We looked at alternate means of charging and pump cooling in case you lose service water. It was important. That's a direct finding of the PSS. It's a way of cooling those loops, and the way it is to open up the drain from the component cooling water drainage tank that will result in a backflow and provide cooling to those pumps in case you lose service water. We feel that's a significant insight.

Finally, monitoring containment sump levels for in-core instrument tube rupture, a small LOCA. These are insights of other PSS's, too, but they are significant if we can have a means of directly feeding back this information to the operators.

(Slide.)

I just want to point out in two slides here, that this is not the first time we are feeding back into design procedure evaluations this kind of insight from PRA. This is just a list of recent applications of insights into design evaluations.

I mention to you at the top of the slide the ones related to Millstone-3. I mention on Millstone-1 that we were requested to look at the scram discharge level instrumentation in Millstone-1, which is a BWR. And we had no problems with the intrumentation whatsoever. We found that, in fact, that the issue of instrumentation and detection of the level in the volume was typically tied to the manipulation of all the valving that we have doing testing for that system. We came up with an alternative proposal to the NRC for modifications in the valving system which would reduce probability of unavailability of the system much more than changing instrumentation. And that, for example, was a typical input to design which resulted in a design change, resulted in what we feel is a significant improvement in plant safety.

I'll not go through all these others. Some of these studies were extensive, in particular, the limited scope Connecticut Yankee decay heat removal system in the Millstone-1 study. Again a lot of insights. Some of them led to significant reduction in core melt probability directly because of the studies performed. In particular, for example, changing from an AC to a DC power source, and valves that go to the isolation condenser for Millstone-1.

(Slide.)

These are other examples of things we have done in support of procedures evaluations, safety evaluations, best estimate safety analysis.

(Slide.)

Time is short. I would like to go on just to say a few words about what we are doing with the Living PRA program. By "Living PRA" I mean having a PRA which is an effective engineering tool. By that I mean it is installed on a computer, it is somewhat modified to make it accesssible so that evaluations can be performed, and it is handled by a number of engineers who are experienced in the PSS, understand the limitations and uncertainties, and can provide, therefore, significant answers from evaluations.

We have installed the Millstone-3 PSS on an in-house computer. We have answered NRC questions with our computer with in-house staff.

We have two problems under way: one is to utilize the PSS for plant support, which I'll provide to you in the next slide, and then Northeast Utilities has made a corporate commitment at the corporate level for utilization of a plant-specific PRA through all of NU's plants as a safety management tool.

MR. MUELLER: Yesterday Mr. Counsil said that you have a fairly extensive data management system where you have computerized your maintenance records, and so forth. And root cause attack, if you will, was credited for a lot of your success with respect to the trip issue.

How much did -- if any -- did you take failure data from that in-plant management system and apply it to your probabilistic safety study? That's Question No. 1.

No. 2, Do you see that replacing more and more the generic data that you obviously had to use for your PRA.

No. 3, Do you see yourselves being able to take credit for your attack of root causes, if you will, in order to reduce failure data in your PRA that you can't really support with records, but which should be better than generic data because of your attacking?

MR. BONACA: Let me answer first of all Question No. 2 and Question No. 3, and I will let Dr. Bickel answer Question No. 1.

Question No. 2 has to do with when we utilize a data base plant-specific for our plant. That's absolutely an objective that we have. I have it on one of the next slides. It's essential that this PSS become plant-specific as much as it can.

The second question, No. 3, had to do with...

Could you refresh my recollection? I lost track of it.

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MR. MUELLER: No. 3 refers to--

MR. BONACA: Oh, I recall.

I would like to make a distinction between regulatory use of this PSS for which we will have to have NRC accepting the credit, and internal use that we intend to have for the PSS. If we have a judgment that there is an improvement in using the data base, we will use that. It doesn't matter really what kind of credit we may receive on the regulatory level; unless, of course, there is a licensing requirement that we have to respect, and then, clearly, we will clear that issue with NRC.

But, in general, you know, credit is going to be taken, because we feel that that's important.

Dr. Bickel will address the issue of data base specific to the plant in the PSS.

DR. BICKEL: I'm John Bickel, Supervisor of PRA.

My group currently has a current formal program for the systematic collection and analysis of operating plant data based on a wide variety of sources. I was going to discuss what we intend to do on Unit 3, but I don't think there is really the time.

(Slide.)

I would like to show you some examples of data which we have collected and analyzed from the Millstone Unit 1 plant. We are currently doing the same effort for the

Connecticut Yankee plant. We will be doing the same effort for Millstone-2 shortly.

What I have shown up here in the very solid lines are the mean values and the 95th percentile values obtained from WASH-1400 for specific types of plant components. Beneath them I have shown statistically-derived values for a large number of plant-specific type components for Millstone Unit 1.

One of the ones I think are very interesting, if you take a look at the very bottom, the breakers, the AC breakers, the collection and analysis of the data we found has indicated that 4160-volt breakers have a reliability that is tremendously better than WASH-1400 has ever assumed. We can back this up by a computerized record of all the failure events that have occurred. And we, additionally, know the exact number of cycles of every one of the breakers in our plants.

If you take a look at that you'll notice that there is about, say, a full decade.

(Slide.)

Another example. We have here the failure rates per hour for a large number of the pumps. Again, the solid line up on the top is the failure rates per hour which are tabulated out of WASH-1400. The chart is a little cock-eyed, but the number -- the lower number is, again, the

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(Slide.)

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If you look at that, the failure rates per hour based on actual plant experience, again, fall below what is assumed in WASH-1400.

This data base, I would point out, was collected using fourteen years of plant-specific experience that was collected by my staff. We intend to do the same type of effort as part of our on-going activities with Millstone Unit 3. However, as you can recognize, the statistic will not become significant on Unit 3 until we probably have accumulated at least five years of operation. What I'm trying to point out is that we have a formal program to collect it, to analyze it, and to do analyses.

Thank you.

MR. MUELLER: Does that include root cause tracking and trending?

DR. BICKEL: That's correct.

(Slide.)

One of the interesting trends that we have observed is the differences in performance of specific locations of valves. We have noticed-- We intend to probably publish some of this next February at the ANS meeting.

We've noticed that there are, if you look at the data and have the ability on a computer to split it all out as to location of the valves and systems, and so on, we've identified the fact that certain motor-operated valves seem to work better than others. And this type of information we do intend to accommodate in our living PRA program.

Therefore, the estimates that come up from the quantification of fault trees and reliability analysis point the way to where there are the historical weak links in thw system.

We think this is a very strong corrective action program.

MR. MUELLER: Thank you.

ACRS CONSULTANT COMMENTS

DR. OKRENT: I think because of the ending time, which is somewhat inflexible, I'm going to switch now to see what comments of a more general nature the consultants that we have sitting at the table here may wish to make that may be useful at this stage of the Committees' review of Millstone operations, recognizing a more detailed look at the PRA itself is to come.

Then if we have time before 3:25 or so, we'll look for other information as we can get it.

So why don't I just start at the far right?

Mr. Mueller?

MR. MUELLER: There were two issues as far as this ACRS meeting is concerned. One is the information relating to the operating license, and the second was a review of the probabilistic safety study. With respect to both, of course, this heavily involves the credibility of the licensee -- or the applicant, rather.

I must say I've been tremendously impressed with the presentation today. The level of detail that upper management seems to be capable of addressing off the top of be well wired into industry and technical committees. That impression, if you will, seems to be supported by the NRC and INPO report cards that they've received, the SALPs, their response report card to identify problems. More numeric or quantitative measures seem to be stop work orders and the number of reactor trips that apparently Northeast Utilities is performing excellently on.

With respect to the probabilistic safety study, from all appearances it was well done. I have-- My problems with the probabilistic safety study are the same problems that I've been having with probabilistic safety studies in general. I'll identify a few specific comments and their general applicability.

In the first section, or the summary of the probabilistic safety study it was stated that the key safety systems in Millstone-3 are the main reason why public risk is lower than in WASH-1400. It was stated within the last hour that a stronger reason might be source term assumptions. Obviously, if we take the risk -- if we change the risk assumption....I'm sorry; the seismic risk assumptions around, we have a higher core melt risk than WASH-1400.

Where all this is leading to, as far as I'm concerned, is that I would like to see for all these PRAs an identification of not just the key sequences but the key assumptions that make those sequences key.

Clearly, if I take a probably equally defensible set of source term assumptions I can change your results -- I can change the thrust of your results. I can do the same with seismic, I can do the same with accident recovery. And there's one more that I'm thinking of that escapes me right now. It would be very useful if the NRC in their review provided a list of such key assumptions and the kinds of sensitivities that can be "defensibly supported" in light of today's technical knowledge.

Second comment on the PSS: This refers to the size of the reactor -- the RWST and the associated credit that was taken for recovery actions. That's really embodied within my first. I would like to see that identified as to how much credit was actually taken. I notice that the RWST capacity came across a number of the sequences. Obviously, if I changed the rules there I'm going to get different

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answers.

Along the same lines, the PSS said that independent reviews for reasonableness and consistency of subjective judgment was included. Obviously these reviews were somewhat limited with respect to seismic risk: there just ain't that many experts. It would be interesting to have seen more elaboration on the probabilistic safety study of how you assigned your source term assumptions and your CRAC-2 assumptions in which you reduced your point estimates down to your distributions, if you will. The DPD arithmetic is shown, but really the support for that is not shown.

As partial defense for your DPDs, the Zion probabilistic risk assessment was mentioned, while the Zion PRA got the same rap for not defending their DPDs, as is evident here, or as I'm bringing across here.

A fourth comment refers to a comment within the PSS that estimates of initiating event frequencies -- blah-blah-blah -- are based largely on domestic PWR experience. It wasn't clear to me how much of the uniqueness of Millstone-3 was brought into these initiating frequencies. I did notice there was a considerable amount of difference between initiating event frequencies assumed for Millstone-3 vis-a-vis Zion.

In short, I would like to see -- whether it be a living PRA or a reliability assurance program, or whatever it's called -- be used very much to support plant-specific frequencies very much akin to your intention of using in-plant data to support your failure probabilities.

Finally, the last comment:-- Let me end on a positive note. The last comment is that I thik it is commendable that the PRA, if you will, is intended to be a living document. And I would very much like to see not only your input published in the literature starting with the PRA in February, but I would like very much also to see just what -- well, perhaps a summary of what Dr. Bonaca stated in his last presentation on what management insights are into using a livingt PRA to make safety decisions and how you perceive that to be affecting you in costs and manpower.

That concludes my comments.

DR. OKRENT: Dr. Pomeroy.

DR. POMEROY: I'm going to confine my comments primarily to the seismic hazard analysis, primarily because I haven't had the opportunity to review the entire PSS in detail.

In view of the importance, and perhaps the dominance of the seismic external event initiator, it seems to me that there has been a disproportionately small percentage of resources devoted to trying to define the seismic hazard model. I believe that some significant additional work and documentation of the siesmic hazard would be extremely useful.

I'd like to indicate some of the areas that I think might be important.

We've had an indication that there have been a variety of expert opinion samples in the case of the assignment of source parameters. It's true that this seismic hazard study involves more seismic source zones and/or hypotheses than any previous one I've seen, and I think that is commendable.

However, the weights that were assigned to each of those hypotheses were correctly identified in the PSS as a subjective evaluation of Dames and Moore. And I believe that each of those weights which do enter into this calculation in a significant way should be associated with an uncertainty also.

I believe you can find other seismologists that might assign quite different weights to the various hypotheses. And, in fact, you do see that in the Lawrence Livermore -- the first Lawrence Livermore study and/or the second Lawrence Livermore study.

Yesterday Dr. Kennedy indicated that one of the significant sources of differences between the Lawrence Livermore study and this study had to do with the selection of a lower magnitude cut-off; that is, MB minimum. If that is the case, certainly there is little document to indicate the importance of that in the PSS. And if it is important, we should be able to clearly see its importance, not solely on the basis of a damage criteria.

The third area I'd like to stress is in terms of attenuation relationships. There has been an on-going discussion of this particular problem, and in the Lawrence Livermore study there has been a rather complete evaluation of the attenuation relationships that are used in this type of analysis.

In the present study, the present PSS, four relationships are selected, given equal weights, again; but other people might not choose to give those four relationships equal weight. And, in addition, there are a selection of relationships which would result in further divergence of the hazard curves, in my estimation.

We really need documentation on this. The current EPRI is drawing from the Lawrence Livermore study. I believe that it would be important to incorporate some of that Lawrence Livermore developed work into this present study.

The question of truncation of acceleration is certainly an open question. In the PSS, in the seismic hazard input, truncations of .6, .8, and, in some cases, no truncations were used. I would like to be able to trace through and find the reasons why different truncations were used, and what effect this particular truncation has on the seismic hazards curve.

Finally, at the end of the hazards analysis, the 184, I think, curves were aggregated according to a methodology that was discussed in a document which I didn't, and do not, have access to. I would like to have access to that document, if it were possible. But that aggregation in itself may result in a difference — certainly will result in a difference in the median hazard curve. And I believe that that should be clearly documented within the seismic hazards study itself.

I'd like to repeat that in my estimation the PSS, the seismic hazards analysis that I read, which is Amendment 2 in an appendix, is the best one that I've seen to date in the PRAs that I've read. I do believe it can be significantly improved. I'm pleased to see there is an effective use of the PSS, it seems to me, on the part of Northeast Utilities.

I'm not still clear in my own mind how the staff intends to use the PSS, and, in particular, the seismic hazard analysis that's associated with that. I would appreciate at some point a clear statement on that issue.

That's all I have.

DR. OKRENT: Thank you.

Mr. Bender.

MR. BENDER: I won't comment much more about the PSS. Let me say a couple of things about the general picture as I see if from having heard these presentations.

First, there's evidence here that having run two plants that the management has learned quite a bit about how to run nuclear power plants, and that's likely to reflect favorably on the operation of Millstone-3, and I think it shows in the presentations that were made here today and yesterday.

From the standpoint of public risk, the fact that three plants are here and two already operating leads me to feel fairly relaxed about the third. If the NRC feels comfortable with the first two which were built some time ato to less rigorous standards, I don't see any reason to think this one shouldn't be equally safe.

I did find some value in hearing about how the PSS is being used to evaluate operating procedures, which I think for the purposes of an operating utility may be the most useful thing that can be done with it. It's obviously useful in design, but at this stage of the game it's mostly hindsight. And the only thing that really can be effective is finding out whether there are any glitches in the design that might be fixed. Evidently some of that has been done, from the presentations that were just made.

I do believe that knowing more about the time available to do something in the event of a severe accident has an effect on what the emergency planning actions can be. And I was pleased to hear that might thought had been given to that than I might have expected from reading the PSS. In fact, the public, I think, will be more comfortable if they know that there is something on the outside that can be done as well as relying on what may seem to some people uncertain reliability of the equipment.

With regard to the data used in the plant assessment, I think it was useful to know that you're collecting data from Millstone-1 and -2, and that other data exists that you'll probably take advantage of. I think it would be useful to go and discuss with INPO how to get comparable information on other plants to blend with the information you've got. And I think the NRC would be -- would find that information of use to them as well as to you.

We're looking, I think, to the concept of having the whole industry provide a data base, and not for each element to provide its own data base. But integrating the information is a difficult thing. And I find the work going on there certainly to be constructive to safe nuclear power plants.

A few observations that seem to me to still a a little fuzzy. One, how to deal with station blackout still seems to me to be a little vague, and how long you've got and what the actions are, and how much reliability you can put in to restoring equipment that didn't operate that caused the blackout seems to me to be something that needs more study, and could be done in a probabilistic way. It's good to do it in just a planning sense, but dealing with operator actions and their response could tell us more about how likely we are to be successful if something happens.

The other point I think I'd like to emphasize is that the steam generator issue is not closed because you've got a new design. And I would think that more knowledge exists than we were told about yesterday, and it might be well to get that story in a form that we could all understand. It might be well even to write it down and explain to use why the Model F steam generator is so much better than all the others that we can stop worrying, and that might make a few people comfortable as well.

On the whole, my belief is that the organization here is large enough and has enough diversity to handle whatever problems might arise here, and I'm quite comfortable with what I've heard so far.

Thank you.

DR. OKRENT: Are there any comments from Subcommittee members at this time?

MR. EBERSOLE: I guess I will make a somewhat standard statement about the PRA in aspect to utilization of what is called reliability of test data which doesn't reflect the utilization of equipment in duress or emergency states. Maybe the best example of that is valves.

If you look at the valve data you'll find it's hollow; it shows valves that swing from full open to closed shut, essentially with no load. They are just sort of bi-stable devices, and you get red and green, and you record successful operations. In no way with that show you, nor will you accumulate a record of what it will do when it is actually having to work under duress, such as intercepting full mass flow of fluids through a faulted pipe. So you put a number down and the machine cranks out a degree of safety which is an illusion. I think you have to look at not just the numbers for valves but for whatever other pieces of equipment are operating not in the mode in which you test them and accrue the reliability data base but in a mode perhaps which you haven't even operated them once, and then properly temper the reliability numbers to reflect the lowered relibility that certainly must exist.

That's all I have to say.

DR. OKRENT: Any other comments?

Yes, Mr. Bohn.

MR. BOHN: This is Mike Bohn of Sandia.

I just had a couple of comments in regard to the documentation. There was considerable documentation on the internal event analyses, and it was relatively easy to follow through, and I just had a cursory look at this before we came out here.

The seismic part of it was not nearly as well documented; in fact, I was not really able to separate out the effects of initiating events, the dominant components, and that sort of thing, in a very simple fashion. Now, maybe that's because I didn't spend enough time. But it seemed like there was considerable difference in the level of documentation. It would help if more was provided.

In particular, it was not clear to me where the concepts of damage effective acceleration were used, and to what extent they were used for functional failures rather than structural failures of equipment.

A second area was in the regard to the responses, what responses were assumed for different piecess of generic equipment, because different pieces of equipment might have some response correlation even though they were not located side-by-side in a plant, especially yard-mounted equipment. If that information was available so that one could know how the accident sequences were evaluated, that would be very helpful.

I guess those are my main comments.

One other comment that I was just a little confused about was this idea of having high confidence, low probability numbers that have been expressed. I haven't traced through this, so I don't know: it's more of a question. Presumably one goes through some sort of culling process in getting the final accident sequences and which accident sequences are dominant. Typically the culling process for internal events is probabilistic. And I wondered if there's any possibility that-- There's no reason to believe that the 90 percent values for all the failure rates should be correlated, therefore, if one did a lot more calculations, is it possible that some of the release categories would change if higher confidence levels were use, and it might change the result.

I think the assumption here is that the high probabilities that the 90 percent condfidence failure rates for all the components are in effect correlated. That's a question that I'm confused about?

DR. OKRENT: Thank you.

Well, time is getting short. I will only note in passing that I didn't get to hear about how your testing program would have turned up some of those things that developed in the past on electrical systems. Maybe you can include a couple of minutes when next we meet.

Since I don't know that my plane is late, I'm going to adjourn the meeting.

(Whereupon, at 3:30 p.m. the Subcommittee meeting was concluded.)

CERTIFICATE OF OFFICIAL REPORTER

This is to certify that the attached proceedings before the UNITED STATES NUCLEAR REGULATORY COMMISSION in the matter of:

NAME OF PROCEEDING:

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

COMBINED MILLSTONE NUCLEAR POWER STATION
UNIT 3/RELIABILITY AND PROBABILISTIC
ASSESSMENT SUBCOMMITTEE MEETING

DOCKET NO.:

PLACE: Windsor Locks, Connecticut

DATE: Wednesday, August 29, 1984

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission.

William R. Bloom /sg

William R. Bloom

Official Reporter

ACE-FEDERAL REPORTING, INC.

Reporter's Affiliation

CERTIFICATE OF OFFICIAL REPORTER

This is to certify that the attached proceedings before the UNITED STATES NUCLEAR REGULATORY COMMISSION in the matter of:

NAME OF PROCEEDINGS:

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

COMBINED MILLSTONE NUCLEAR POWER STATION
UNIT 3/RELIABILITY AND PROBABILISTIC
ASSESSMANT SUBCOMMITTEE MEETING

DOCKET NO.:

PLACE: Windsor Locks, Connecticut

DATE: Wednesday, August 29, 1984

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission.

Anne G. Bloom /sg

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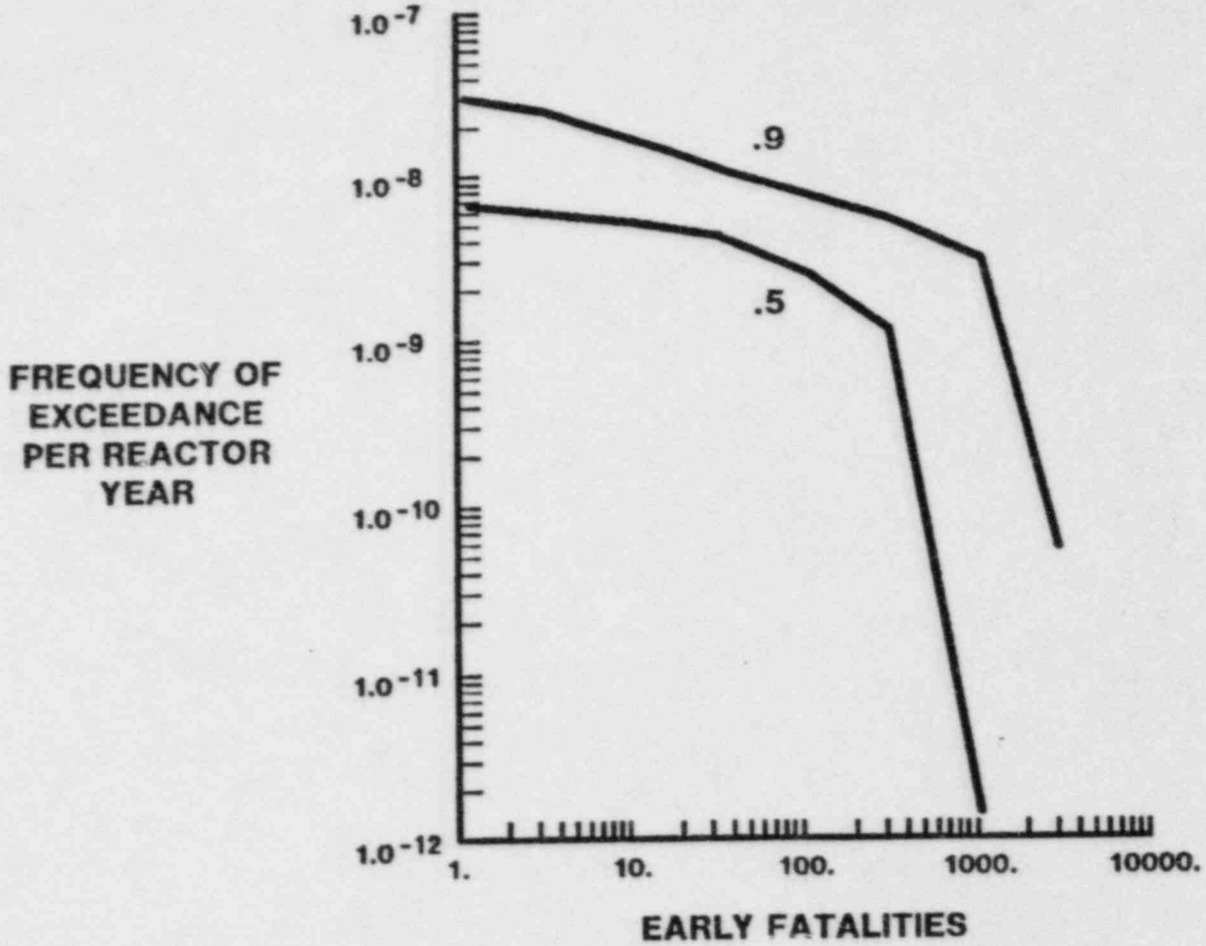
Official Reporter
ACE-FEDERAL REPORTERS, INC.
Reporter's Affiliation

RISK DIAGRAM FOR EARLY FATALITIES DUE TO EXTERNAL EVENTS



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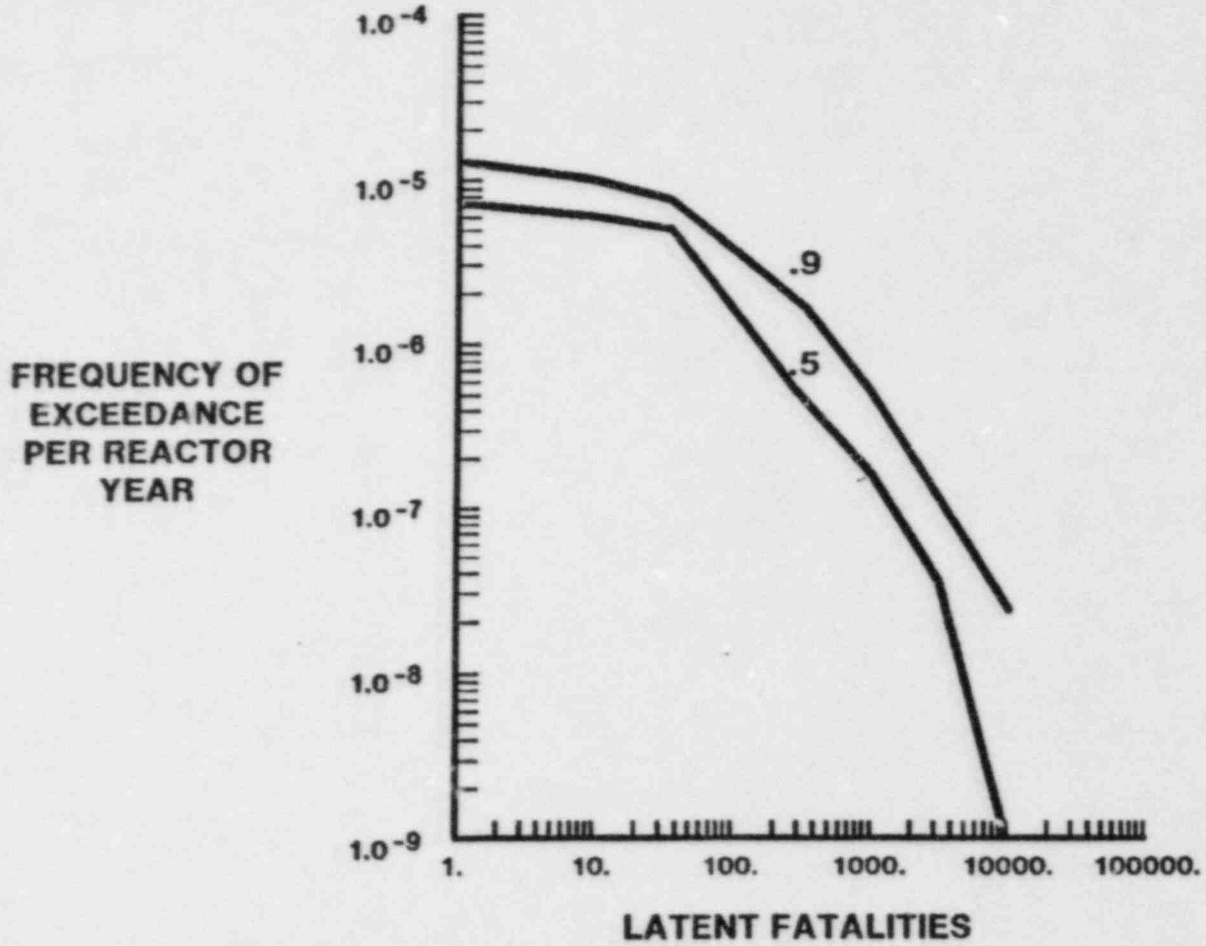
RISK DIAGRAM FOR LATENT CANCER FATALITIES DUE TO EXTERNAL EVENTS



NORTHEAST UTILITIES SERVICE COMPANY

PROBABALISTIC SAFETY STUDY CONTAINMENT AND CONSEQUENCE ANALYSIS

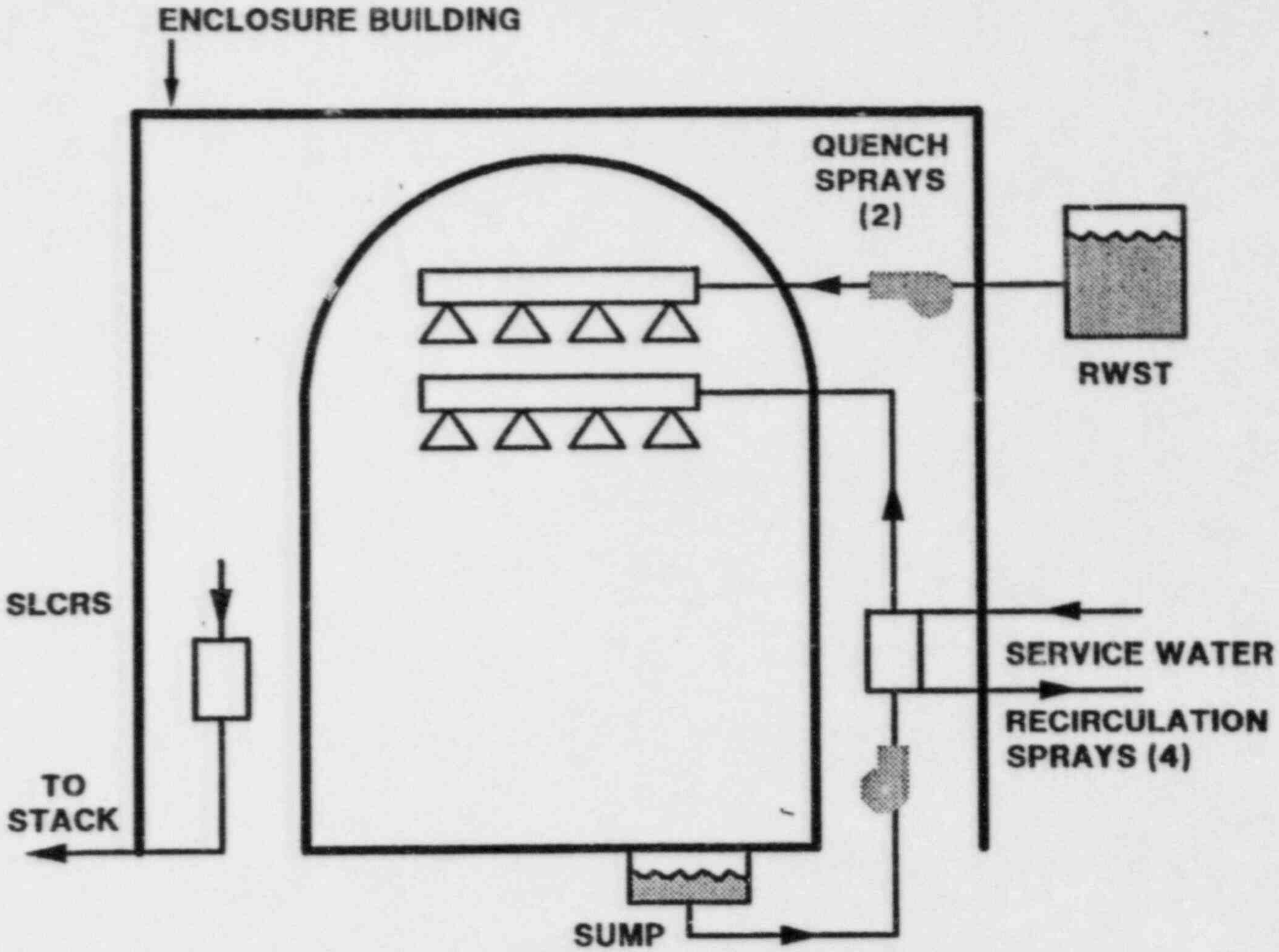
DR. DONALD A. DUBE
PRA SECTION
SAFETY ANALYSIS BRANCH

NU

OUTLINE

- IMPORTANT CONTAINMENT FEATURES
- DEGRADED CORE AND CONTAINMENT ANALYSIS
- SOURCE TERM ANALYSIS
- CONSEQUENCE ANALYSIS
- ADDITIONAL STUDIES

MP-3 CONTAINMENT SAFEGUARDS



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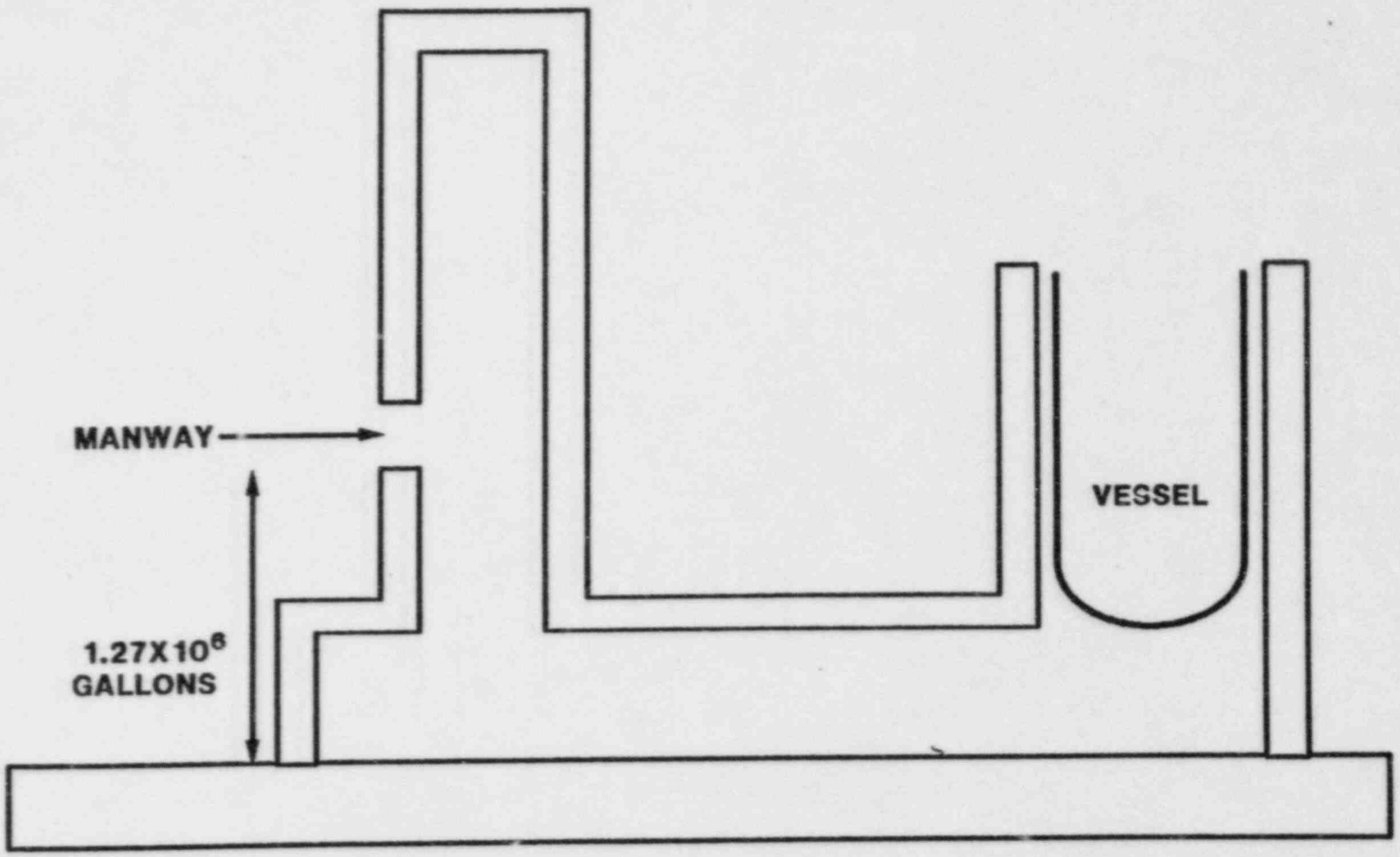
MP-3 REACTOR CAVITY DESIGN



DEGRADED CORE AND CONTAINMENT ANALYSIS

- CONTAINMENT FAILURE MODES ANALYSIS
- HYDROGEN BURN CONSIDERATIONS
- CONSIDERATION OF THE S_2C SEQUENCE
- SUMMARY OF CONTAINMENT RESPONSE RESULTS

NU

CONTAINMENT FAILURE MODES ANALYSIS

STRUCTURAL

- AS-BUILT MATERIAL PROPERTIES AND LOADINGS
- FAILURE CRITERIA
  - ANY SECTION IN A GENERAL STATE OF YIELD
  - ANY SECTION FAILS IN SHEAR OR CONCRETE FAILS IN COMPRESSION
  - LOCAL DEGRADATION OF LINER MATERIALS AT DISCONTINUITIES
- THIN SHELL AXISYMMETRIC FINITE ELEMENT MODEL
- NUMEROUS FAILURE LOCATIONS INCLUDING MAJOR PENETRATIONS CONSIDERED

NU

UNCERTAINTY ANALYSIS

- MEANS AND VARIANCES FOR EACH FAILURE MODE ESTABLISHED
- VARIANCES REPRESENT
  - UNCERTAINTIES IN MATERIAL STRENGTH
  - VARIATIONS IN CONSTRUCTION PRACTICES
  - UNCERTAINTIES INHERENT IN THE STRUCTURAL ANALYSIS
- WEIBULL DISTRIBUTION WITH CUTOFF AT 52 PSIG (TEST PRESSURE) USED
- 4 MOST DOMINANT FAILURE MODES CONSIDERED
  - YIELD AT CYLINDER MIDHEIGHT
  - MAIN STEAM LINE PENETRATION
  - MAIN FEEDWATER PENETRATION
  - GENERAL YIELD AT SPRINGLINE

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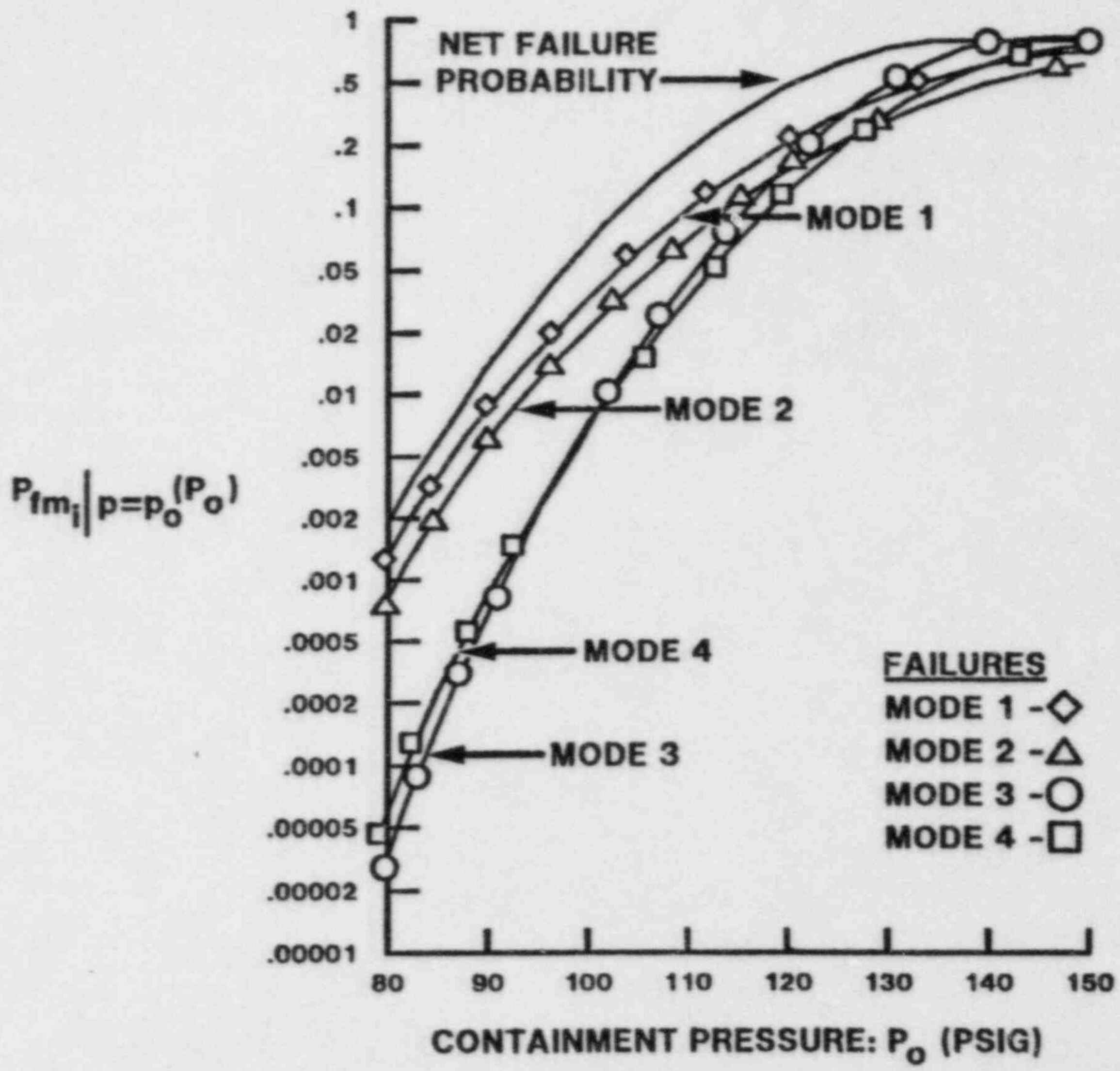
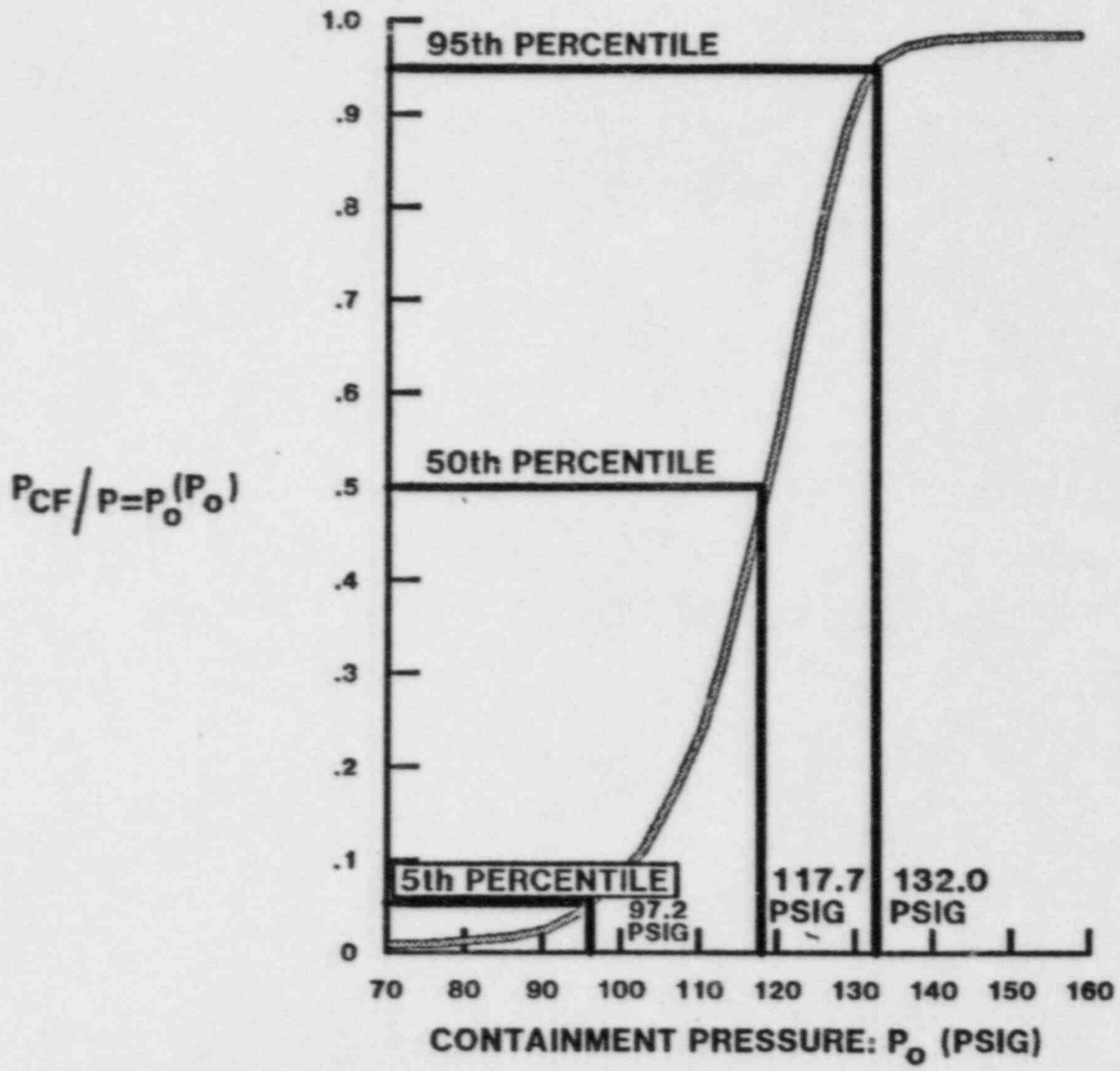


NET FAILURE PROBABILITY
MODE 1
MODE 2
MODE 4
MODE 3
FAILURES
MODE 1 -◇
MODE 2 -△
MODE 3 -○
MODE 4 -□
1
.5
.2
.1
.05
.02
.01
.005
.002
.001
.0005
.0002
.0001
.00005
.00002
.00001
80
90
100
110
120
130
140
150
CONTAINMENT PRESSURE: P0 (PSIG)
Pfmi | p=p0(P0)



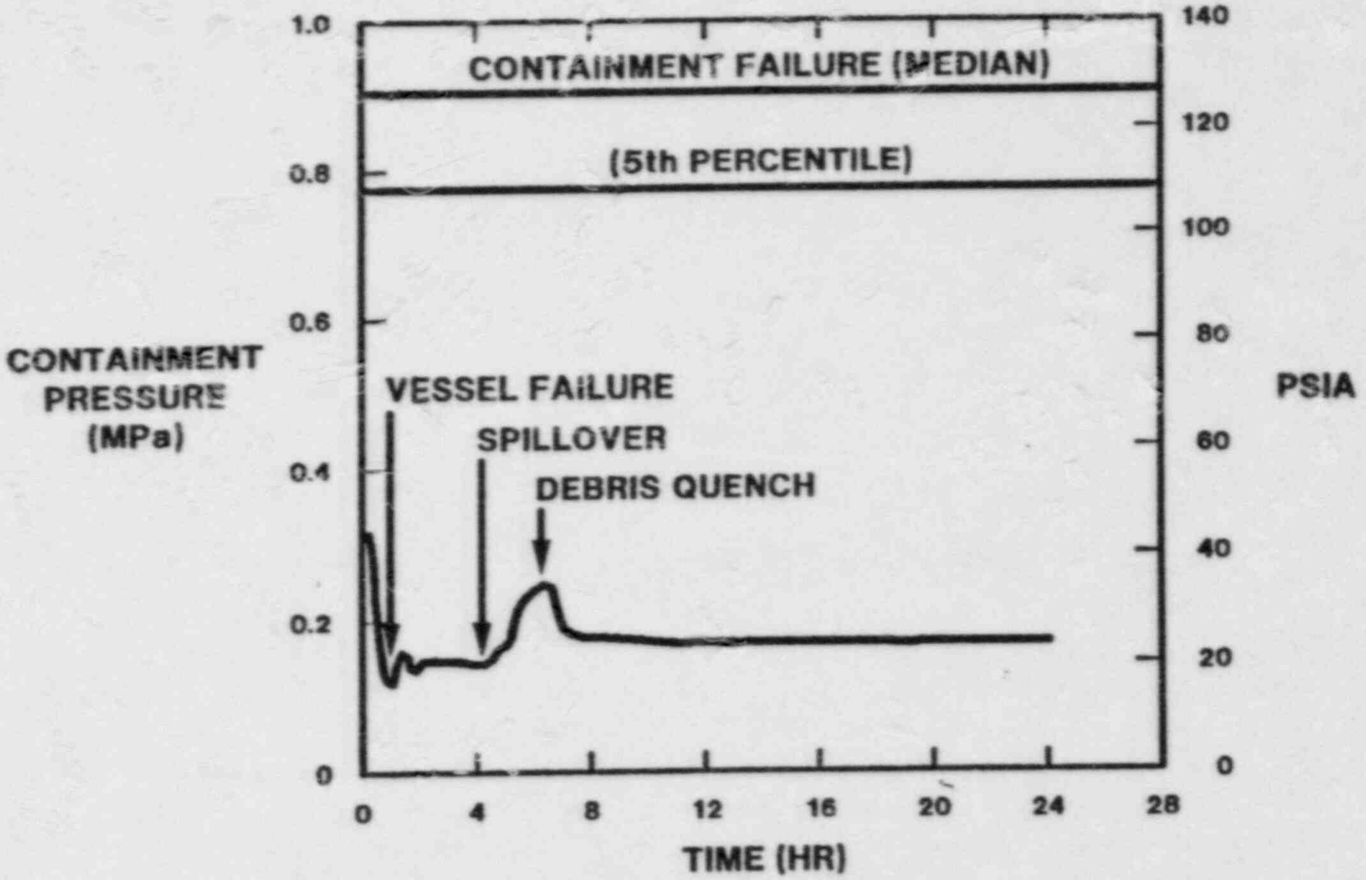
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
95th PERCENTILE
50th PERCENTILE
5th PERCENTILE
97.2 PSIG
117.7 PSIG
132.0 PSIG
70 80 90 100 110 120 130 140 150 160
CONTAINMENT PRESSURE: P_o (PSIG)
$P_{CF} / P=P_o(P_o)$

NU

HYDROGEN BURN CONSIDERATIONS

- SINGLE AND MULTIPLE BURNS "FORCED" AT VARYING TIMES IN ACCIDENT SEQUENCES
- CONTAINMENT GENERALLY INERTED FOR STEAM VOL PERCENT >60
- FLAME PROPAGATION SPEED 2.2 TO 9.0 M/S
- HYDROGEN IN EXCESS OF 100% ZIRC-WATER MAY BE PRODUCED BECAUSE OF SIGNIFICANT CORE/CONCRETE INTERACTION
- RESULTS USED IN THE QUANTIFICATION OF CONTAINMENT EVENT TREE

LARGE LOCA
FAILURE OF ECC INJECTION, FULL CONTAINMENT SAFEGUARDS



INCORE INSTRUMENT TUBE RUPTURE

(S_2C IN WASH-1400)

- SMALL LOCA, QUENCH SPRAY FAILURE
- ONE OF THE TOP 3 CONTRIBUTORS TO RISK IN WASH-1400
- PECULIAR TO SUB-ATMOSPHERIC CONTAINMENTS
  - REACTOR CAVITY CONFIGURATION
  - RECIRCULATION SPRAY ACTUATION LOGIC
- CONTAINMENT FAILS EARLY AND BEFORE CORE MELT

NU

S_2C ACCIDENT SEQUENCE COMPARISON

	RSS	MP-3
RWST CAPACITY (10^6 GAL)	0.34	1.2
DEPLETION OF RWST (HR) (1 TUBE FAILURE)	4	16
CONTAINMENT SPRAY ACTUATION (HR)	0.5	1
CORE MELT TIME (HR)	5	17
CONTAINMENT FAILURE TIME (HR)	4	>30

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CONTAINMENT RESPONSE TO CORE MELTS

INTERNAL EVENTS	
• NO CONTAINMENT FAILURE	76%
• LATE (>24 HR) FAILURE	15
• BASEMAT PENETRATION	5
• CONTAINMENT BYPASS (V)	4
• OTHER EARLY FAILURE	<< 1

SEISMIC EVENTS	
• LATE FAILURE	83%
• INTERMEDIATE (4-7 HR) FAILURE	7
• BASEMAT PENETRATION	7
• NO FAILURE	2
• CONTAINMENT ISOLATION FAILURE	0.4
• OTHERS	<< 1

FIRE	
• NO FAILURE	59%
• LATE FAILURE	35
• BASEMAT PENETRATION	6
• OTHERS	<< 1

SOURCE TERM METHODOLOGY

- THIRTY CORRAL-2 RUNS (ONE FOR EACH CONTAINMENT ANALYSIS)
- CSI PREDOMINANT CHEMICAL FORM OF IODINE
- GROUPING INTO 13 RELEASE CATEGORIES BASED ON SELECTION OF MOST CONSERVATIVE RELEASE FRACTIONS
- ASSIGNMENT OF ACCIDENT SEQUENCES TO RELEASE CATEGORIES CONSERVATIVELY BIASED

NU

SOURCE TERM UNCERTAINTIES

BASED ON

- SRD R256 (SIZEWELL-B PRA)
- NUREG-0772
- NUS-3808

DISCRETE PROBABILITY DISTRIBUTIONS (DPD'S):

- GIVE PROBABILITIES THAT SOURCE TERMS HAVE MAGNITUDES OF 1, 1/2, 1/10, ETC., TIMES THAT OF WASH-1400 (EXCEPT NOBLE GASES).
- EFFECTIVELY, THEY ACCOUNT FOR FISSION PRODUCT PLATEOUT IN THE PRIMARY SYSTEM, AEROSOL AGGLOMERATION, AND OTHER PHYSICAL REMOVAL MECHANISMS NOT TREATED EXPLICITLY.
- RESULTS CONSISTENT WITH BMI-2104 (DRAFT) FOR SURRY

NU

IMPORTANT ASPECTS OF CONSEQUENCE MODELING

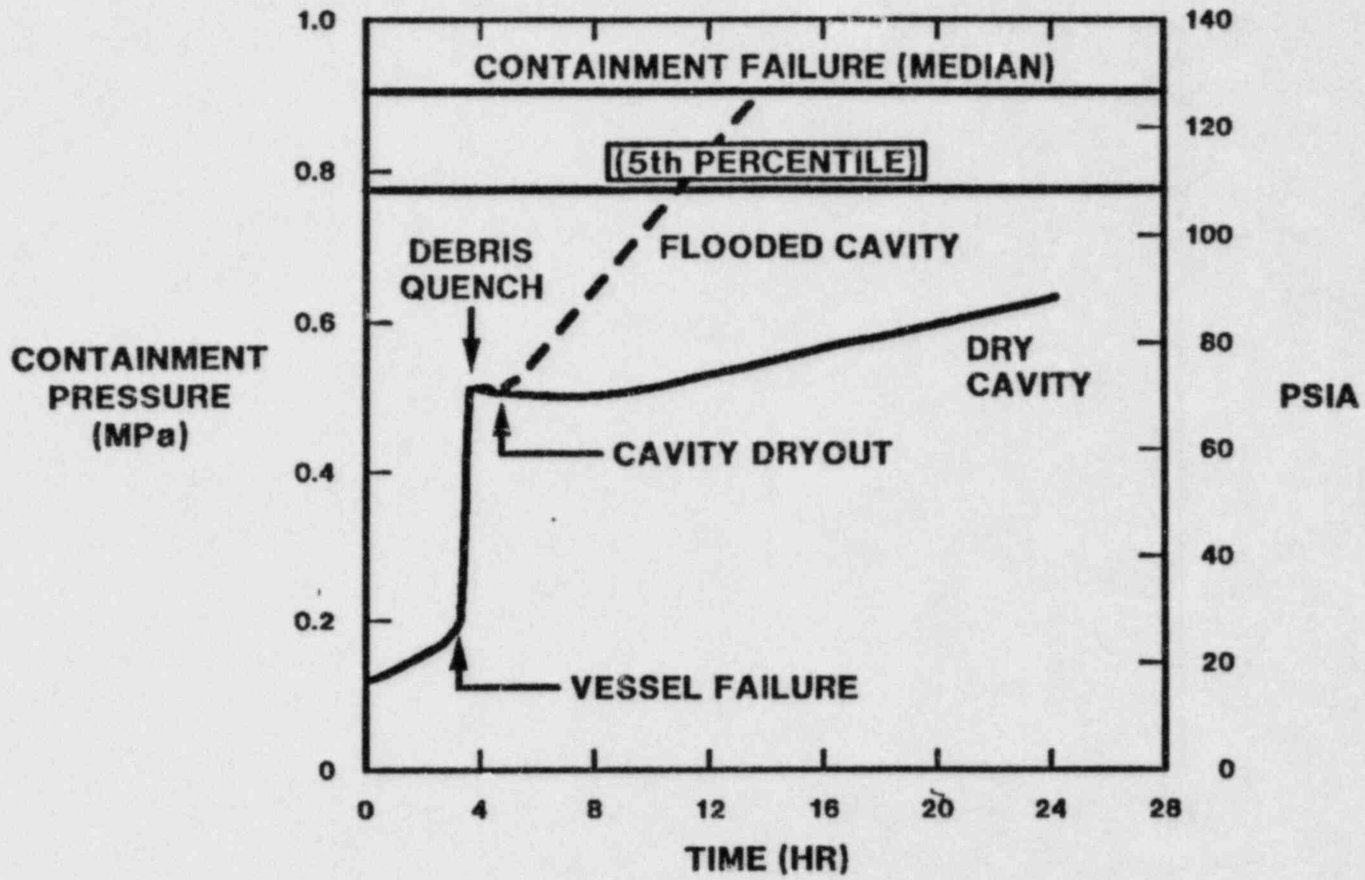
- CRAC-2 USED
- 1980 AND PROJECTED 1990 CENSUS DATA
- SITE-SPECIFIC METEOROLOGY
- SEASONAL POPULATION CONSIDERED
- THOROUGH EVALUATION OF EVACUATION FOR SEISMIC AND NON-SEISMIC EVENTS, AND ADVERSE WEATHER CONDITIONS
- IMPROVED "BIN SAMPLING" OF METEOROLOCICAL DATE FOR MOST SERIOUS RELEASE CATEGORIES
- CALCULATIONS PERFORMED FOR WIDE VARIATION OF SOURCE TERM MAGNITUDES

ADDITIONAL STUDIES

- DRY VERSUS FLOODED LOWER REACTOR CAVITY
- RISK IMPACT OF DELIBERATE HYDROGEN IGNITERS

NU

STATION BLACKOUT WITH FAILURE OF AUXILIARY FEEDWATER



SUMMARY

- COMPREHENSIVE CONTAINMENT ANALYSES PERFORMED
  - DETAILED CONTAINMENT FAILURE MODES ANALYSIS INCLUDING UNCERTAINTIES
  - PLANT SPECIFIC CONTAINMENT RESPONSE ANALYSIS
  - HYDROGEN BURN STUDIES
- SOURCE TERM ANALYSIS ACCOUNTS FOR
  - PLANT SPECIFIC CONTAINMENT RESPONSE
  - WIDE BAND OF UNCERTAINTIES
- CONSEQUENCE ANALYSIS ACCOUNTS FOR
  - UNCERTAINTIES
  - IMPACT OF SEISMIC EVENTS
- MANY ADDITIONAL STUDIES PERFORMED AND INSIGHTS OBTAINED

NU

NU ACRS Presentation on use of CO_2 in the Cable Spreading Room

Fire Protection Slides (Ronciaoli)

SLIDE 1

NRC'S BTP CMEB 9.5-1, SECTION C.7.c

STATES IN PART:

"THE PRIMARY FIRE SUPPRESSION IN THE CABLE SPREADING ROOM SHOULD BE AN AUTOMATIC WATER SYSTEM SUCH AS CLOSED-HEAD SPRINKLERS, OPEN-HEAD DELUGE SYSTEM, OR OPEN DIRECTIONAL WATER SPRAY SYSTEM."

MILLSTONE UNIT NO. 3'S POSITION

"THE PRIMARY FIRE SUPPRESSION FOR THE CABLE SPREADING ROOM IS AN AUTOMATIC, TOTAL FLOODING CO_2 SYSTEM.

SLIDE 2

SER 9.5-1

PAGE 9-48:

CARBON DIOXIDE SUPPRESSION SYSTEM

"...ON THE BASIS OF ITS EVALUATION, THE STAFF CONCLUDES THAT THE CARBON DIOXIDE EXTINGUISHING SYSTEMS MEET THE GUIDELINES OF BTP CMEB 9.5-1, SECTION C.6.D, AND ARE THEREFORE ACCEPTABLE."

DISADVANTAGES OF WATER SYSTEMS FOR CABLE SPREADING ROOM

- CABLE TRAY CONGESTION COUPLED WITH CABLE TRAY COVERS MAKE IT EXTREMELY DIFFICULT FOR WATER TO BE EFFECTIVELY APPLIED.

- SPRINKLER DISCHARGE PATTERNS WOULD BE SEVERELY OBSTRUCTED.

ADVANTAGES OF CO_2 SYSTEM

- INERTS ENTIRE VOLUME OF ROOM AND THEREFORE NOT AFFECTED BY CABLE TRAY CONGESTION.
- CAN PENETRATE COVERED/CONGESTED CABL: TRAY SYSTEMS.

SLIDE 5

DETECTION AND ACTIVATION CONCEPT

POSTULATED FIRE FOR CABLE SPREADING ROOM (CABLE FIRE)

- o SLOW DEVELOPING
- o CONSIDERABLE SMOKE
- o LOW HEAT DEVELOPMENT

WATER SYSTEM CONCEPT OF ACTIVATION

- o HEAT
- o SPRINKLER HEAD-FUSIBLE LINK

CO_2 SYSTEM CONCEPT OF ACTIVATION

- o SMOKE
- o PRODUCT OF COMBUSTION

SUMMARY

- MP-3'S CO_2 SYSTEM HAS BEEN DESIGNED TO RESPOND QUICKER AND MORE EFFECTIVELY.

- MP-3'S CO_2 SYSTEM REPRESENTS AN ACCEPTABLE LEVEL OF FIRE PROTECTION FOR THE CABLE SPREADING AREA.

MILLSTONE-3 PROBABILISTIC SAFETY STUDY

CHRONOLOGY

- THE STUDY

SEPTEMBER 1981	STAFF REQUESTED NORTHEAST UTILITIES (NU) TO PERFORM DESIGN-SPECIFIC PRA. CONCERN OVER HIGH POPULATION ZONE SITE.
AUGUST 1983	MILLSTONE-3 PROBABILISTIC SAFETY STUDY SUBMITTED TO STAFF - INCLUDES EXTERNAL EVENTS. (FULL SCOPE)
APRIL 1984	REVISIONS TO SEISMIC ANALYSIS, INCLUDING SEISMIC HAZARD AND FRAGILITY ANALYSIS, SUBMITTED.

- STAFF REVIEW

LLNL - STAFF CONSULTANT ON PLANT DAMAGE STATE FREQUENCIES.

BNL - STAFF CONSULTANT ON ACCIDENT PHENOMENOLOGY AND CONTAINMENT PHENOMENA

JUNE 1984	LLNL DRAFT REPORT RECEIVED
SEPT./OCT. 1984	FINAL LLNL REPORT TO STAFF
NOV. 1984	STAFF "INSIGHTS" DRAFT REPORT

INITIAL REVIEW RESULTS

- SOME SEQUENCES MAY BE MORE SIGNIFICANT THAN JUDGED IN THE MPSS

- SOME STRENGTHS OF THE DESIGN

  LARGE RWST, 4 TRAIN RECIRCULATION
  THIRD VALVE FOR EVENT V
  LOOP STOP VALVES
  LARGE DRY SUBATMOSPHERIC CONTAINMENT

  :

- FURTHER STAFF FOCUS

  TRIP MFWS FOR ALL REACTOR TRIPS
  SPECIFIC STATION BLACKOUT SCENARIOS
  SEISMIC ISSUES
  SPECIFIC FIRE SCENARIOS

  :

MILLSTONE UNIT 3 PSS USES

A. USE IN SAFETY REVIEW

1. DOMINANT SEQUENCES ATTRIBUTABLE TO SYSTEM PERFORMANCE THAT FAIL TO SATISFY NRC REGULATORY REQUIREMENTS MUST BE CORRECTED.

2. CONSIDER ADDITIONAL MEASURES TO CORRECT A UNIQUE DESIGN ASPECT IN THE EVENT THIS ASPECT IS SIGNIFICANT TO OVERALL PLANT SAFETY.

B. USE IN MILLSTONE-3 DES AND FES

C. USE IN SEVERE ACCIDENT POLICY CONSIDERATIONS

D. USE IN VOLUNTARY IMPROVEMENTS IN DESIGN AND OPERATION

E. INSIGHTS

NORTHEAST NUCLEAR ENERGY COMPANY

MR. J.O. CROCKETT
MP3 UNIT SUPERINTENDENT

ANTICIPATED TRANSIENTS
WITHOUT SCRAM

NU

ANTICIPATED TRANSIENTS WITHOUT SCRAM

POST-SALEM REVIEW

- GENERIC LETTER 83-28
  1. POST-TRIP REVIEW (PROGRAM)
  2. POST-TRIP DATA
  3. EQUIPMENT CLASSIFICATION/VENDOR INTERFACE
  4. POST-MAINTENANCE TESTING
  5. RTS RELIABILITY
  6. SHUNT TRIP

- GENERIC LETTER 83-32
  - EOP TO DEAL WITH FAILURE TO TRIP
  - ENTRY IF TRIP NOT VERIFIED OR MANUAL TRIP NOT EFFECTIVE

NORTHEAST UTILITIES SERVICE COMPANY

MR. ARNOLD R. ROBY
SYSTEM MANAGER,
GENERATION ELECTRICAL ENGINEERING

CONTROL ROOM

NU

MILLSTONE UNIT 3 - CONTROL ROOM DESIGN REVIEW

REVIEW PROCESS

INVESTIGATION

- CRITERIA & STANDARDS ALREADY INCLUDED
- RELEVANT OPERATIONAL EXPERIENCE
- CONTROL ROOM SURVEY
- OPERATOR TASKS DURING EMERGENCY SITUATIONS

ASSESSMENT

- IDENTIFY DISCREPANCIES
- DETERMINE THE DISPOSITION OF DISCREPANCIES

REPORTING

- SUMMARIZE REVIEW FINDINGS
- PROVIDE REFERENCE DATA

CONTROL ROOM HABITABILITY

SYSTEM DESIGN FEATURES

- VENTILATION
- EMERGENCY PRESSURIZATION
- EQUIPMENT LOCATION
- MINIMUM LEAKAGE

NU

AUXILIARY SHUTDOWN PANEL DESIGN FEATURES

- DESIGNED TO WITHSTAND A SEISMIC EVENT
- COMPLIES TO APPLICABLE PORTIONS OF IEEE STANDARDS AND NRC REGULATORY GUIDES
- DESIGNED TO MAINTAIN SAFETY TRAIN SEPARATION THROUGH THE USE OF METAL ENCLOSURES AND PHYSICAL SEPARATION

NU

REMOTE SHUTDOWN CAPABILITY

- AUXILIARY SHUTDOWN EQUIPMENT PROVISIONS
  - EMERGENCY SWITCHGEAR FOR EACH SAFEGUARD TRAIN
  - TWO TRANSFER SWITCH PANELS, LOCATED ONE IN EACH SWITCHGEAR ROOM
  - AUXILIARY SHUTDOWN PANEL, LOCATED IN THE PURPLE SWITCHGEAR ROOM

- FIRE PROTECTION PROVISIONS
  - FIRE TRANSFER SWITCH PANEL, LOCATED IN THE ORANGE SWITCHGEAR ROOM
  - FIRE INSTRUMENT PANEL, LOCATED IN THE ORANGE SWITCHGEAR ROOM

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NORTHEAST UTILITIES SERVICE COMPANY

MR. ARNOLD R. ROBY

SYSTEM MANAGER,

GENERATION ELECTRICAL ENGINEERING

POWER SYSTEMS RELIABILITY

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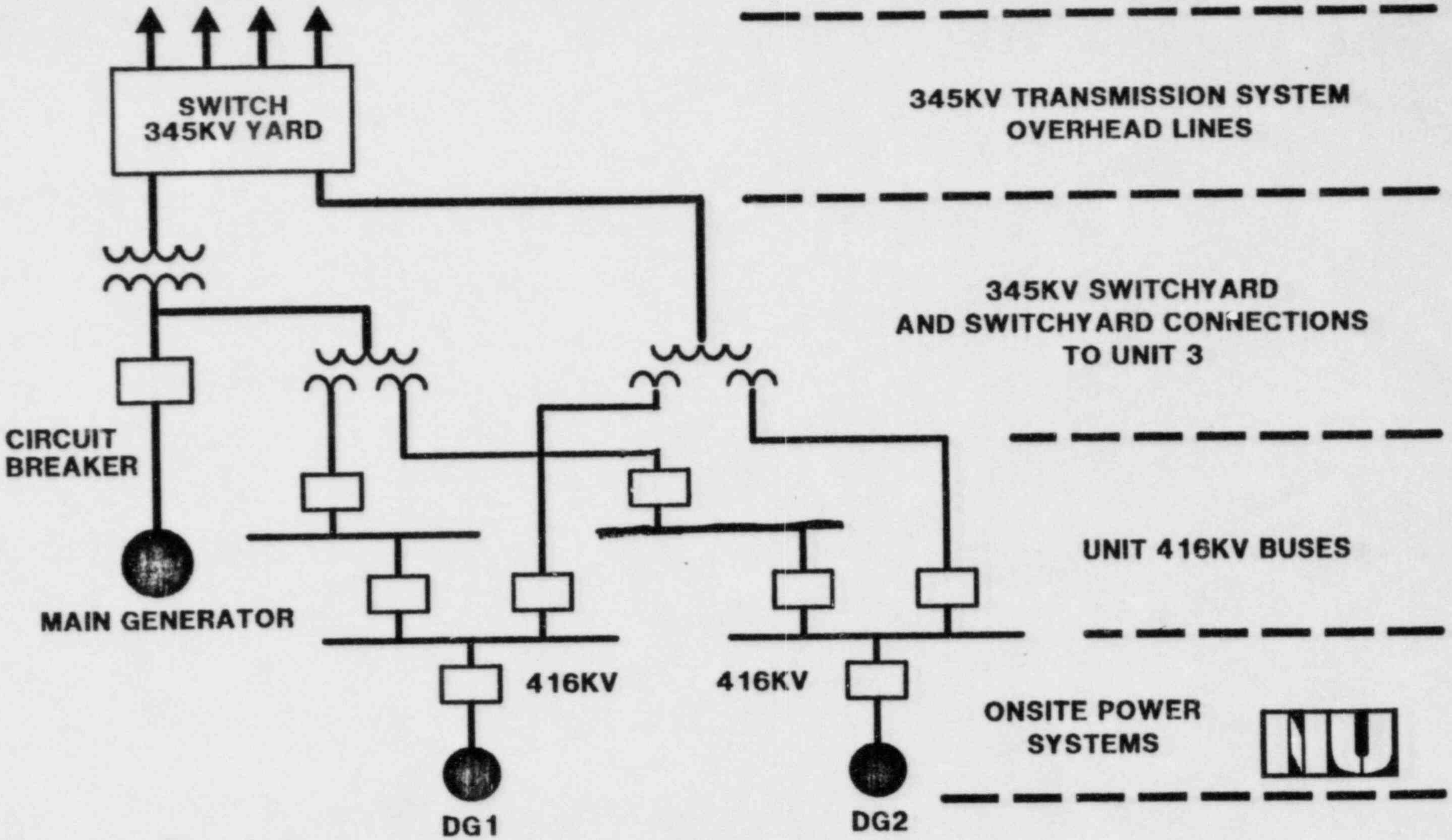
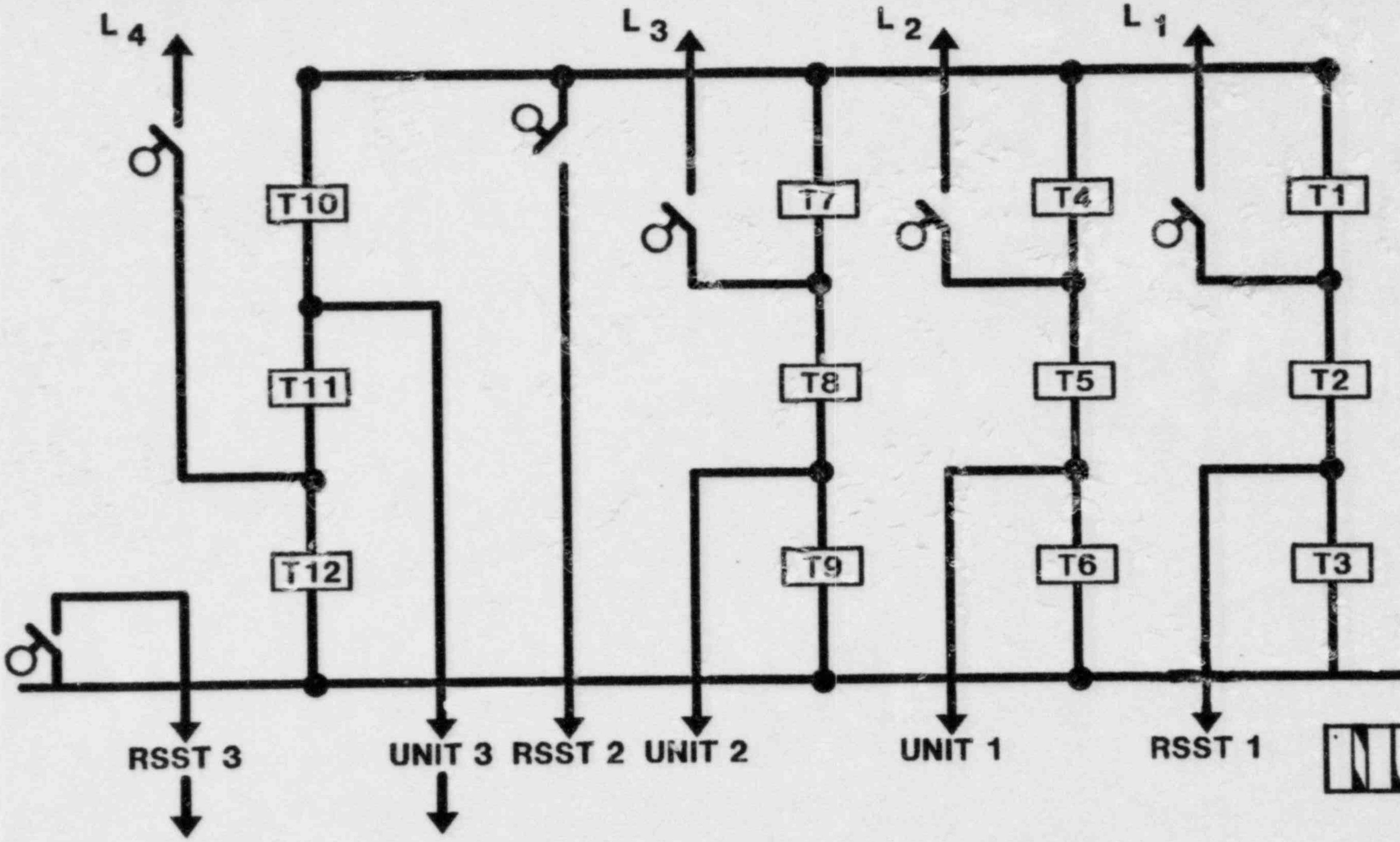
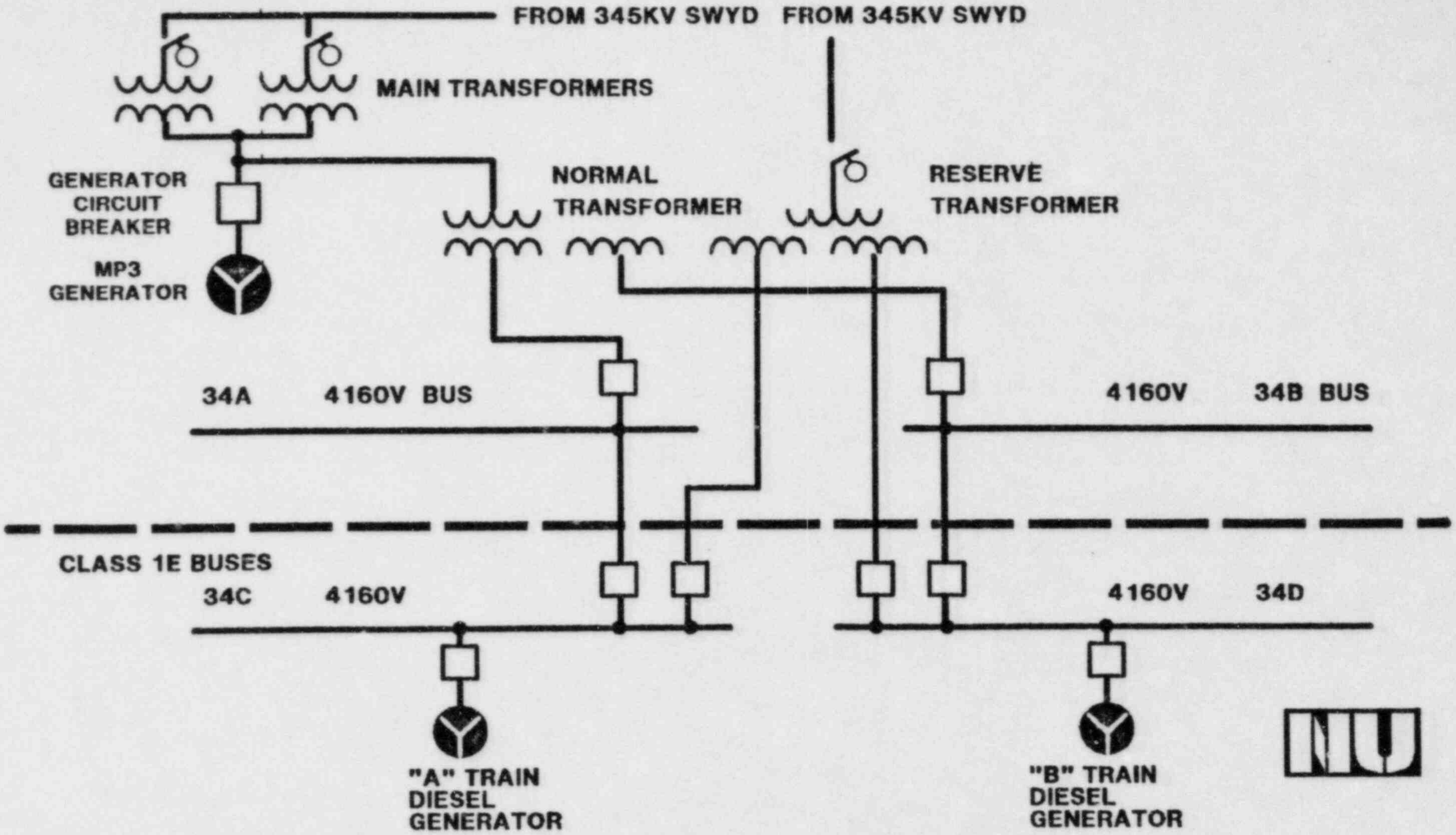
POWER SYSTEMS RELIABILITY



345KV SWITCHYARD CONNECTIONS



345KV & 416KV UNIT CONNECTIONS



NORTHEAST UTILITIES SERVICE COMPANY

MR. RAY P. NECCI

EMERGENCY DIESEL GENERATOR

EMERGENCY DIESEL GENERATOR

- DESIGN
- MANUFACTURE
- PREOPERATIONAL TESTING
- STARTUP TESTING
- INSERVICE TESTING

NU

NORTHEAST UTILITIES SERVICE COMPANY

MR. PAUL M. BLANCH

REGULATORY GUIDE 1.97 IMPLEMENTATION

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REGULATORY GUIDE 1.97 IMPLEMENTATION

- COMPLIES WITH GUIDANCE OF R.G. 1.97
- PARAMETERS SELECTED BY DETAILED ANALYSIS
- FULLY INTEGRATED SYSTEM
- USED FOR NORMAL AND ACCIDENT CONDITIONS
- ICC SYSTEM COMPLIES WITH GUIDANCE OF NUREG-0737, ITEM II.F.2

NORTHEAST UTILITIES SERVICE COMPANY

R.C. RODGERS
MANAGER RADIOLOGICAL ASSESSMENT

RADIATION PROTECTION

NU

OPERATING RADIATION PROTECTION EXPERIENCE

1967 HADDAM NECK NUCLEAR STATION
1970 MILLSTONE UNIT 1
1975 MILLSTONE UNIT 2

= 42 REACTOR YEARS OF OPERATIONAL EXPERIENCE
(25 YEARS AT MILLSTONE SITE)

INPUT INTO

- PROGRAM DEVELOPMENT AND MANAGEMENT
- DESIGN OF MILLSTONE UNIT 3

NU

OPERATING EXPERIENCE INPUT INTO THE DEVELOPMENT AND MANAGEMENT OF THE RADIATION PROTECTION PROGRAM AT MILLSTONE UNIT 3

NU

STANDARDIZED CORPORATE PROGRAMS

OBJECTIVES

- ESTABLISH UNIFORMLY HIGH QUALITY PROGRAMS AND PRACTICES TO MEET NU'S STANDARDS OF EXCELLENCE
- ACHIEVE COLLECTIVE LEARNING CURVE GROWTH BY BOTH SITES THROUGH SHARING OF LESSONS LEARNED
- OPTIMIZE COST BY SHARING RESOURCES AND PROGRAMS BETWEEN SITES

CORPORATE MANAGEMENT COMMITMENT

- CORPORATE POLICY STATEMENT
- IDENTIFICATION OF RESPONSIBLE CORPORATE OFFICERS
- COMMITMENT TO PROVIDE NECESSARY RESOURCES
- SUPPORT IN THE IMPLEMENTATION AND ENFORCEMENT OF POLICY AND PROCEDURES

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NORTHEAST UTILITIES RADIATION PROTECTION

SENIOR VICE PRESIDENT

(OVERALL RESPONSIBILITY)

VICE PRESIDENT
NUCLEAR & ENVIRONMENTAL ENGINEERING

CORPORATE OFFICE STAFF

VICE PRESIDENT
NUCLEAR OPERATIONS

OPERATING STATIONS

MILLSTONE 1 & 2
HADDAM NECK

UNDER CONSTRUCTION

MILLSTONE 3

NU

PROGRAM ELEMENTS

- STANDARDIZED HEALTH PHYSICS PROCEDURES
- STANDARDIZED HEALTH PHYSICS EQUIPMENT LISTS
- STANDARDIZED ALARA PROGRAM
- STANDARDIZED HP TECHNICIAN AND SUPERVISOR'S TRAINING AND CERTIFICATION PROGRAMS

NIU

PROGRAM ELEMENTS

- STANDARDIZED RADIATION WORKER TRAINING PROGRAM
- CENTRALIZED COMPUTER BASED RADIATION EXPOSURE DATA SYSTEM
- PERSONNEL RADIATION DOSIMETRY LABORATORY
- ROVING INTERPLANT HP SUPERVISORY STAFF
- AUDIT AND EVALUATION PROGRAM

NU

OPERATING EXPERIENCE INPUT INTO THE ALARA DESIGN OF MILLSTONE UNIT 3

- INCREASED SPACE/SEPARATION OF SYSTEMS & COMPONENTS
- INCREASED USE OF SHIELDED CUBICLES
- NEUTRON STREAMING SHIELD
- FUEL TRANSFER TUBE SHIELD
- STEAM GENERATOR DESIGN
- MAIN CONDENSER - TITANIUM ALLOY TUBES

NU

NORTHEAST UTILITIES SERVICE COMPANY

DR. M.V. BONACA

SYSTEM MANAGER,
REACTOR ENGINEERING

PROBABALISTIC SAFETY STUDY

NU

CHRONOLOGY OF EVENTS

- 1980 NORTHEAST UTILITIES (NU) TASK FORCE DEVELOPED PRA PLAN WHICH INCLUDED ALL NU NUCLEAR UNITS
- PLAN RECOMMENDED IN-HOUSE PERFORMANCE, MAINTENANCE, AND USE OF PROBABILISTIC SAFETY STUDIES (PSS) FOR ALL OF NU'S REACTORS
- MILLSTONE UNIT 3 MP-3 PSS TO BE PERFORMED IN 1986-1987 TIME PERIOD

NU

CHRONOLOGY OF EVENTS (CON'T)

- SEPTEMBER 1981 NRC REQUEST FOR MP-3 PSS MODIFIED PLANNED PRIORITIES
- ALL AVAILABLE NU PRA RESOURCES AND A SUPPORTING TEAM WERE ASSIGNED TO MP-3 PSS
- PSS TO INCLUDE INTERNAL AND EXTERNAL EVENTS
- PSS TO ADDRESS EXTERNAL CONSEQUENCES
- MP-3 PSS SUBMITTED TO NRC ON SCHEDULE ON AUGUST 1, 1983

NU

CHRONOLOGY OF EVENTS (CON'T)

- NU DEVELOPED PSS SPECIFICATIONS SATISFYING SHORT TERM NRC REQUEST AND LONG TERM NU OBJECTIVE
- SPECIFICATIONS INCLUDED TECHNOLOGY TRANSFER AND PSS INSTALLATION ON DEDICATED COMPUTER SYSTEM AT NU
- WESTINGHOUSE CORPORATION SELECTED AS MAIN CONTRACTOR
- STONE & WEBSTER CORPORATION SELECTED AS MAIN SUBCONTRACTOR

NU

CHRONOLOGY OF EVENTS (CON'T)

- NU ASSEMBLED IN-HOUSE PRA TEAM TO SUPERVISE STUDY AND TO EFFECT TECHNOLOGY TRANSFER
- EXPERT REVIEW BOARD WAS FORMED, WHICH INCLUDED DR. P. WOOD, MR. S. LEVINE, AND WHICH WAS CHAIRED BY PROF. RASMUSSEN
- BOARD MEMBERS WERE ASSIGNED IN-DEPTH REVIEWS OF SELECTED CRITICAL PSS AREAS
- REVIEW BOARD REQUESTED TO SUMMARIZE FINDINGS IN LETTER TO NU FOLLOWING PSS SUBMITTAL

NU

CHRONOLOGY OF EVENTS (CON'T)

- EXTERNAL AND INTERNAL EVENTS INITIATORS WERE ANALYZED. INTERNAL INITIATORS WERE SCREENED USING A MASTER LOGIC DIAGRAM

- ACCIDENT SEQUENCES WERE STUDIED USING STANDARD EVENT TREE AND FAULT TREE ANALYSIS TECHNIQUES

- DETAILED BEST ESTIMATE MODELS WERE EXTENSIVELY UTILIZED TO ASSESS CONTAINMENT RESPONSE TO SEVERE CORE DAMAGE

- EXTERNAL CONSEQUENCES WERE EVALUATED THROUGH THE USE OF THE "CRAC-2" CODE

NU

SIGNIFICANT FINDINGS

- NO INDIVIDUAL ACCIDENT SEQUENCE CONTRIBUTES MORE THAN 10% OF THE INTERNAL CORE MELT FREQUENCY

- THUS, NO SINGLE PLANT FEATURE STANDS OUT AS A RISK OUTLIER

- 13 SEPARATE ACCIDENT SEQUENCES EACH CONTRIBUTED BETWEEN 1% AND 9%. THEY CONTRIBUTED IN TOTAL ABOUT 50% TO THE TOTAL INTERNAL CORE MELT FREQUENCY

NU

MILLSTONE UNIT 3 DESIGN FEATURES

- AUXILIARY FEEDWATER SYSTEM
  - 2 ELECTRIC/1 STEAM DRIVEN, 100% CAPACITY PUMPS
  - NO DEPENDENCY ON INSTRUMENT AIR, COMPONENT COOLING OR SERVICE WATER
  - LOSS OF INSTRUMENT AIR OR DC WILL AUTO-START THE STEAM DRIVEN PUMP
- HPSI CAPABILITY
  - 3 CHARGING PUMPS (2600 PSIG SHUTOFF HEAD)
  - 2 SI PUMPS
  - DEDICATED, INDEPENDENT PUMP COOLING
  - 2 HPSI MITIGATE LOCA IF LPSI FAIL
- FEED AND BLEED CAPABILITY
  - ONE HPSI AND TWO PORV'S ARE SUFFICIENT

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DESIGN FEATURES (CON'T)

- RWST CAPACITY
  - 1.2 MILLION GALLONS VS. 0.3-0.4 MILLION GALLONS TYPICAL OF U.S. PWR'S

- DRY CAVITY DESIGN AND BASALTIC CONCRETE
  - DRY CAVITY PRECLUDES EX-VESSEL STEAM SPIKING AND EARLY CONTAINMENT OVERPRESSURE
  - CAVITY CONFIGURATION ACTS AS TRAP FOR CORE DEBRIS
  - UNDER MCCI CONDITIONS, BASALTIC CONCRETE RESULTS IN NO APPRECIABLE CO2 PRODUCTION AND REDUCES RISK OF CO BURNS

NU

DESIGN FEATURES (CON'T)

- CONTAINMENT SPRAY SYSTEMS
  - MILLSTONE UNIT 3 EMPLOYS 2 DIVERSE SPRAY SYSTEMS:

    QUENCH SPRAY (SHORT TERM COOLING)
    RECIRC. SPRAY (LONG TERM COOLING)
  - EITHER SPRAY DELAYS SUBSTANTIALLY CONTAINMENT FAILURE
- ULTIMATE CONTAINMENT STRENGTH
  - DESIGN PRESSURE IS 45 PSIG
  - BEST ESTIMATE MEDIAN ULTIMATE PRESSURE CAPABILITY IS 117.7 PSIG
- METEREOLOGY
  - PREVAILING WINDS TOWARDS LONG ISLAND SOUND

NU

RESULTS OF THE STUDY SHOW:

• FREQUENCY OF CORE MELT FROM INTERNAL EVENTS	4.5×10^{-5}/YR
• FREQUENCY OF CORE MELT FROM EARTHQUAKES	0.9×10^{-5}/YR
• FREQUENCY OF CORE MELT FROM FIRES	$.48 \times 10^{-5}$/YR
• FREQUENCY OF CORE MELT FROM ALL OTHER EXTERNAL EVENTS	EXCEEDINGLY SMALL
• TOTAL CORE MELT FREQUENCY, ALL CAUSES	5.9×10^{-5}/YR

• RISK CURVES, EARLY AND LATENT FATALITIES, CONSISTENTLY LOWER THAN THE CORRESPONDING WASH-1400 CURVES

MILLSTONE UNIT NO. 3 PUBLIC RISK

	EARLY FATALITIES PER REACTOR YEAR	LATENT FATALITIES PER REACTOR YEAR
ALL EVENTS		
MEDIAN................	1.6×10^{-6}	2.0×10^{-3}
90% CONFIDENCE	2.6×10^{-5}............	1.2×10^{-2}

NU

STRENGTHS OF MILLSTONE UNIT 3 PSS

- AN EFFECTIVE MODEL IN A FORM AMENABLE TO BE UPDATED AND EXERCISED
- SPECIALIZED PERSONNEL KNOWLEDGEABLE OF STRENGTHS, LIMITATIONS, AND UNCERTAINTIES
- MANAGED BY A STAFF EQUALLY SKILLED IN DETERMINISTIC AS WELL AS PROBABILISTIC ANALYSIS
- SUPPORTED BY A MANAGEMENT ORGANIZATIONS COMMITTED TO USING IT IN SUPPORT OF PLANT SAFETY AND OPERATION

NU

DESIGN CHANGES AND INSIGHTS DUE TO PSS

- IDENTIFICATION OF EMERGENCY GENERATOR LOAD SEQUENCER (EGLS) INPUT LOGIC ERROR

- IDENTIFICATION OF INCORRECT EGLS AC POWER SUPPLY

- RECOMMENDATION OF ADMINISTRATIVE CONTROLS TO REDUCE THE PROBABILITY OF A BORON DILUTION EVENT

- INSIGHTS INTO DRY REACTOR CAVITY EFFECTS

- INSIGHTS INTO IMPACT OF DELIBERATE HYDROGEN IGNITERS

EXAMPLES OF CRITICAL OPERATOR ACTIONS

IDENTIFIED BY PSS

- CUT BACK QUENCH SPRAY TO CONSERVE RWST WATER FOR SMALL LOCA WITH FAILURE OF RECIRCULATION

- USE OF LOOP ISOLATION VALVES (NOT CREDITED INTO STUDY) IN THE LONG TERM FOR RCP SEAL LOCA AND SGTR-INDUCED CORE MELT

- ALTERNATE MEANS OF CHARGING AND SI PUMP COOLING IN THE EVENT OF TOTAL LOSS OF SERVICE WATER

- MONITOR CONTAINMENT SUMP LEVEL FOR INCORE INSTRUMENT TUBE RUPTURE/SMALL LOCA

"LIVING PRA" PROGRAM

- THE MP-3 PSS WAS INSTALLED ON THE IN-HOUSE PRA-DEDICATED COMPUTER
- IN-HOUSE STAFF HAS ANSWERED NRC QUESTIONS ON PSS
- PROGRAM UTILIZING PSS FOR PLANT SUPPORT IS UNDERWAY
- 1984 NU CORPORATE GOAL ESTABLISHED FOR APPLICATION OF PLANT SPECIFIC PRA OF ALL NU'S PLANTS TO MAINTENANCE, OPERATION, AND AS A SAFETY MANAGEMENT TOOL

NU

RECENT PRA APPLICATIONS AT NORTHEAST UTILITIES:

DESIGN EVALUATIONS

- MILLSTONE-3 HYDROGEN IGNITER
- MILLSTONE-1 SCRAM DISCHARGE LEVEL INSTRUMENTATION
- MILLSTONE-3 REACTOR CAVITY FLOODING
- MILLSTONE-3 C.V.C.S. (BORON DILUTION)
- MILLSTONE-1,2, CONNECTICUT YANKEE, FIRE PROTECTION
- MILLSTONE-1 DECAY HEAT REMOVAL SYSTEMS
- CONNECTICUT YANKEE DECAY HEAT REMOVAL SYSTEMS
- CONNECTICUT YANKEE OFFSITE POWER TRANSMISSION TOWER PLACEMENT
- CONNECTICUT YANKEE R.W.S.T. AIR VENT
- MILLSTONE-3 SERVICE WATER SYSTEM (FLOODING PROTECTION)
- MILLSTONE-1 L.N.P. LOGIC MODIFICATIONS
- MILLSTONE-1,2 R.P.S. LOGIC

NU

RECENT PRA APPLICATIONS AT NORTHEAST UTILITIES: (CON'T)

PROCEDURE EVALUATIONS:

- MILLSTONE-1 L.P.C.I./CORE SPRAY INJECTION VALUES TESTING INTERVALS (INTERFACING SYSTEM LOCA)
- CONNECTICUT YANKEE HEAVY LOAD CONTROL

SAFETY EVALUATIONS FOR P.O.R.C./N.R.B.:

- MILLSTONE-2 STEAM DRIVEN AFW PUMP UNAVAILABILITY
- CONNECTICUT YANKEE D.C. BATTERY CELL UNAVAILABILITY
- CONNECTICUT YANKEE VITAL A.C. BUS UNAVAILABILITY
- MILLSTONE-1 IMPACT OF I.G.S.C.C.

BEST ESTIMATE SAFETY ANALYSIS:

- MILLSTONE-1 ISOLATION CONDENSER RESPONSE AT OFF-NORMAL PRESSURE/TEMPERATURE
- MILLSTONE-3 CONTAINMENT RESPONSE DURING H_2 BURNS

NU

SHORT TERM PROGRAM FOR PLANT SUPPORT

- "PSS LESSONS LEARNED" TRAINING FOR PLANT OPERATORS REFLECTED IN BOTH CLASSROOM AND SIMULATOR TRAINING
- EMERGENCY AND OFF-NORMAL OPERATING PROCEDURES TO BE REVIEWED IN LIGHT OF PSS EXPERIENCE
- STARTUP TEST PROCEDURES TO BE REVIEWED FOR VALIDATION OF MODES OF OPERATION AND SUCCESS CRITERIA ASSUMED IN PSS
- STARTUP TEST RESULTS NOT MEETING ACCEPTANCE CRITERIA TO BE EVALUATED FOR SIGNIFICANCE AND CORRECTIVE ACTION
- PRA EXPERTISE INCORPORATED INTO MP-3 NUCLEAR REVIEW BOARD

NU

PLANT SUPPORT (CON'T)

- IMPLEMENTATION OF THE CORPORATE GOAL ON PRA INCLUDES THE DEVELOPMENT OF:
  - A SHORT TERM PLAN TO COMPLETE THE PRA'S IN SUPPORT OF THE MP-1 AND CONNECTICUT YANKEE ISAP (APRIL 1984)
  - A LONG TERM PLAN IDENTIFYING PROCEDURES TO ALLOW PERIODIC UPDATE OF THE LIVING PRA'S TO REFLECT PLANT CHANGES (OCTOBER 1984)
  - A LONG TERM PLAN OUTLINING MODALITIES OF APPLICATION OF LIVING PRA'S FOR OPERATIONAL AND SAFETY SUPPORT (OCTOBER 1984)

NU

MAINTENANCE OF LIVING PRA

- TIE IN PSS TO PLANT DESIGN CHANGE PROCESS
- TIE IN PSS TO PROCEDURES WHICH COULD IMPACT PSS MODEL
- TIE INTO THE OPERATIONAL ASSESSMENT PROCESS
- TIE INTO EQUIPMENT DATA ASSESSMENT

NU

CURRENT APPLICATIONS OF PRA AT NU

- MP-3 PSS IN INITIAL STAGE OF APPLICATION
- MP-1 PSS SCHEDULED TO BE COMPLETED BY DECEMBER 1984 IN SUPPORT OF THE INTEGRATED SAFETY ASSESSMENT PROGRAM (ISAP)
- CONNECTICUT YANKEE (CY) PSS SCHEDULED TO BE COMPLETED BY DECEMBER 1985 IN SUPPORT OF ISAP

NU

RESOURCE COMMITMENTS

- PERMANENT STAFFING MORE THAN DOUBLED
- ADDITIONAL SPECIALIZED PERSONNEL HIRED FOR TEMPORARY SUPPORT
- PRA COMPUTER SYSTEM EXPANDED

NU

NORTHEAST UTILITIES SERVICE COMPANY

PROBABILISTIC SAFETY STUDY SYSTEMS ANALYSIS

DR. JOHN H. BICKEL, SUPERVISOR,
PRA SECTION,
SAFETY ANALYSIS BRANCH

NU

MILLSTONE-3 PSS ADDRESSES:

- BEST ESTIMATE CORE MELT FREQUENCY AND RISK
- INTERNAL AND EXTERNAL INITIATING EVENTS
- FULL POWER AND SHUTDOWN MODES OF OPERATION
- AIRBORNE AND LIQUID PATHWAY CONSEQUENCES

NU

MILLSTONE-3 PSS USED:

- STATE OF THE ART RISK ASSESSMENT TECHNOLOGY
- METHODS ADDRESSING MAJORITY OF ITEMS FROM CRITIQUE OF WASH-1400
- INSIGHTS FROM PAST AND RECENT PRA STUDIES

NU

MILLSTONE-3 PSS CONSIDERED:

- FROZEN PLANT DESIGN AS OF FEBRUARY, 1982
- COMPONENT FAILURE RATES BASED ON OPERATING PWR EXPERIENCE
- BEST ESTIMATE LOCA AND TRANSIENT RESPONSE
- WESTINGHOUSE EMERGENCY RESPONSE GUIDELINES
- BEST ESTIMATE CONTAINMENT, SOURCE TERM, CONSEQUENCE ANALYSIS
- MILLSTONE SITE RELATED CHARACTERISTICS:
  - HISTORICAL WEATHER CONDITIONS
  - OFFSITE POPULATION DENSITY
  - OFFSITE EMERGENCY PLANNING

STRENGTHS/LIMITATIONS OF PRA

STRENGTHS INCLUDE:

- CONSIDERATION OF OUTCOME OF MULTIPLE FAILURES
- INCORPORATION OF OPERATOR INTO OVER ALL UNDERSTANDING OF SAFETY/RISK
- CONSIDERATION OF ACTUAL EQUIPMENT PERFORMANCE VS. DESIGN BASIS
- UNDERSTANDING OF DOMINANT CAUSES OF ACCIDENT SEQUENCES IN CERTAIN AREAS
- ABILITY TO EVALUATE IMPORTANCE OF ISSUES BASED ON ACTUAL STATISTICS FROM PAST EXPERIENCE

LIMITATIONS:

- STATISTICS FROM CERTAIN AREAS ARE NON-EXISTENT
- RELIABILITY ANALYSES IN SOME CASES YIELD NUMBERS TOO SMALL TO COMPREHEND
- CERTAIN FAILURE MODES MAY BE BEYOND ABILITY OF ANALYSTS TO CONSIDER
- SEVERE ACCIDENT SEQUENCE PROGRESSION INVOLVES PROCESSES FOR WHICH THERE IS A LACK OF KNOWLEDGE OF INTEGRATED EFFECTS

TREATMENT OF SPECIAL ISSUES:

- INITIATING EVENTS
- SUCCESS CRITERIA
- SYSTEMS ANALYSIS
- COMMON CAUSE FAILURE
- SUPPORT SYSTEMS
- SYSTEMS INTERACTIONS
- HUMAN ERROR
- UNCERTAINTY ANALYSIS

INITIATING EVENT SELECTION CONSIDERED:

- FULL SPECTRUM OF LOCA EVENTS
- US PWR EXPERIENCE
- MILLSTONE SITE EXPERIENCE
- BOP FMEA (STONE AND WEBSTER)
- SUPPORT SYSTEM FAILURES
- SUPPORT SYSTEMS INTERACTIONS
- CONTROL-PROTECTIVE INTERACTIONS
- POSTULATED EXTERNAL INITIATING EVENTS

NU

LIVING PRA IMPLEMENTATION:

- EPRI DATA INDICATES GREATER THAN 10 PLANT TRANSIENTS PER YEAR
- N.U. DATA SHOWS A DECREASE TO <3 EVENTS/YR. FOR MATURE PLANTS
- FORMAL PROGRAM EXISTS TO COLLECT FAILURE DATA
- FORMAL PROGRAM EXISTS TO ANALYZE INITIATING EVENTS AND IDENTIFY CAUSES AND SAFETY IMPLICATIONS
- THESE MEASURES ASSURE THAT:
  - NATURE OF EVENTS CONSISTENT WITH P.S.S.
  - FREQUENCY OF EVENTS CONSISTENT WITH P.S.S.
- SIGNIFICANT DIFFERENCES WITH LIVING PRA MODELS WILL BE UPDATED
- DATA BASES:
  - P.I.R.S.
  - B.E.A.R.D.S.
  - P.M.M.S.
  - PLANT MAINTENANCE RECORDS
  - SHIFT SUPERVISOR'S LOG BOOKS
  - NUSOERS
  - L.E.R.S.

NU

SUCCESS CRITERIA

- FSAR SUCCESS CRITERIA USED FOR MOST PART
- CERTAIN SUCCESS CRITERIA REFLECT NEW WESTINGHOUSE EMERGENCY RESPONSE GUIDELINES
- EXAMPLES:
  - MITIGATING LARGE LOCA WITH ACCUMULATORS AND H.P.S.I. IF L.P.S.I. FAILS
  - MITIGATING SMALL LOCA WITH L.P.S.I. FOLLOWING MANUAL DEPRESSURIZATION USING A.F.W. IF H.P.S.I. FAILS
  - MITIGATING TRANSIENTS VIA FEED AND BLEED CORE COOLING USING H.P.S.I. AND P.O.R.V.s IF A.F.W. FAILS

NU

SYSTEMS ANALYSIS:

- LARGE EVENT TREE/SMALL FAULT TREE APPROACH
- EVENT TREES EXPLICITLY MODEL SECONDARY FAULTS AND TRANSFERS TO OTHER EVENT TREES

EXAMPLES: ATWS
PORV LOCA

- EVENT TREES EXPLICITLY MODEL OPERATOR ACTIONS PER WESTINGHOUSE ERGs
- EVENT TREES QUANTIFIED FOR EACH OF THE EIGHT SUPPORT SYSTEM CONFIGURATIONS

NU

FAULT TREES AND RELIABILITY ANALYSIS:

- FAULT TREES DEVELOPED FOR ALL CRITICAL SYSTEMS
- FAULT TREES QUANTIFIED FOR EACH OF EIGHT INITIAL CONDITIONS DEFINED BY SUPPORT STATES
- STANDARD RELIABILITY ANALYSIS TECHNIQUES UTILIZED
- WESTINGHOUSE PWR RELIABILITY DATA BASE UTILIZED
  - STATISTICAL POPULATION IS GREATER THAN THAT IN WASH-1400
  - INCORPORATES ACTUAL FAILURES VS. L.E.R. DATA
  - INCORPORATES ACTUAL DEMANDS/RUN-HOURS

NU

COMMON CAUSE FAILURE

HISTORY:

- REDUNDANCY AND SOUND DESIGN PRACTICES MINIMIZES UNAVAILABILITY DUE TO RANDOM FAILURES
- SYSTEM DIVERSITY AND GOOD MAINTENANCE/TESTING PRACTICES REDUCES UNAVAILABILITY DUE TO COMMON CAUSE FAILURES
- COMMON CAUSE IS KNOWN TO BE THE DOMINANT FAILURE MECHANISM FOR REDUNDANT SYSTEMS

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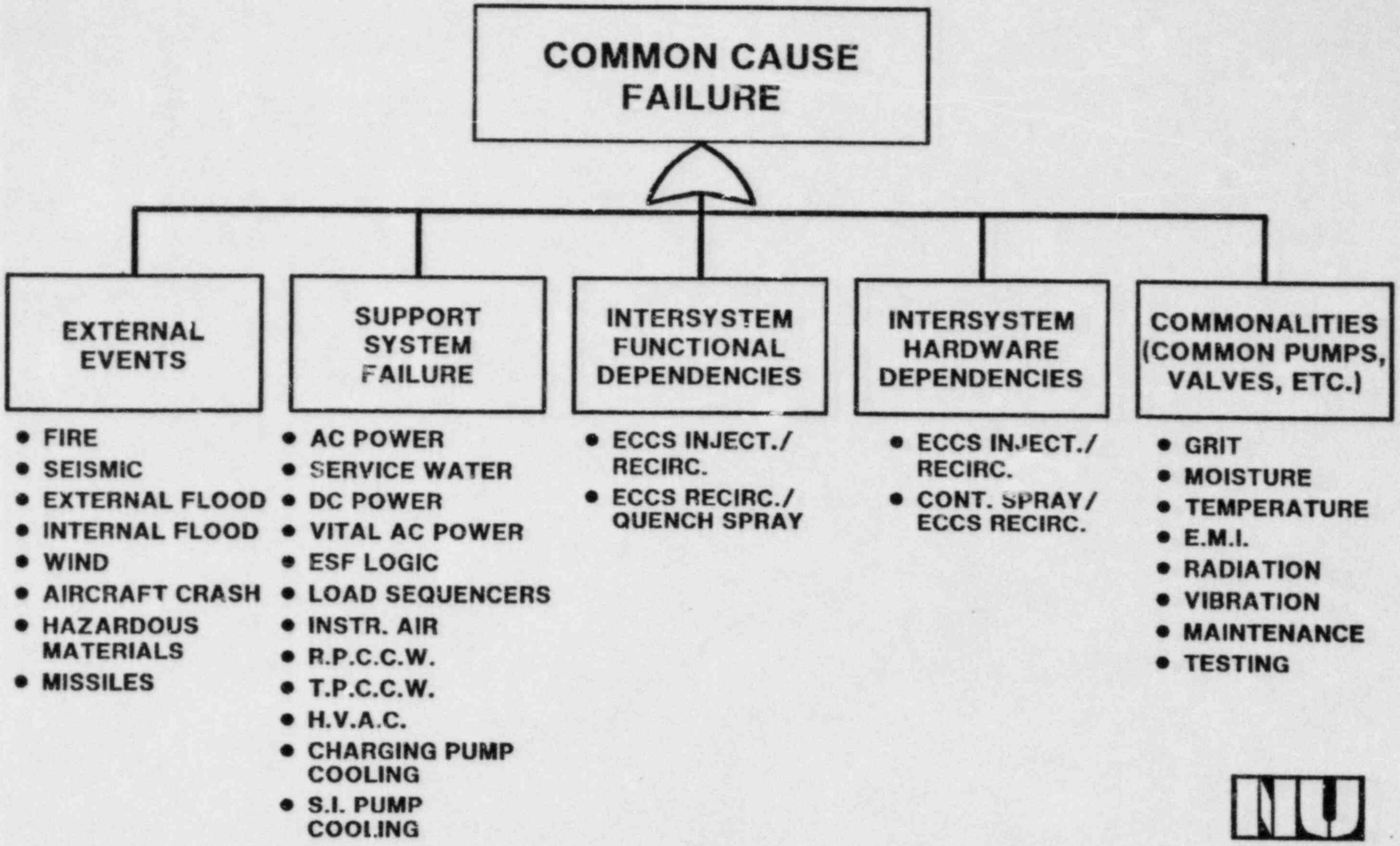
COMMON CAUSE FAILURE
EXTERNAL EVENTS
SUPPORT SYSTEM FAILURE
INTERSYSTEM FUNCTIONAL DEPENDENCIES
INTERSYSTEM HARDWARE DEPENDENCIES
COMMONALITIES (COMMON PUMPS, VALVES, ETC.)
• FIRE
• SEISMIC
• EXTERNAL FLOOD
• INTERNAL FLOOD
• WIND
• AIRCRAFT CRASH
• HAZARDOUS MATERIALS
• MISSILES
• AC POWER
• SERVICE WATER
• DC POWER
• VITAL AC POWER
• ESF LOGIC
• LOAD SEQUENCERS
• INSTR. AIR
• R.P.C.C.W.
• T.P.C.C.W.
• H.V.A.C.
• CHARGING PUMP COOLING
• S.I. PUMP COOLING
• ECCS INJECT./ RECIRC.
• ECCS RECIRC./ QUENCH SPRAY
• ECCS INJECT./ RECIRC.
• CONT. SPRAY/ ECCS RECIRC.
• GRIT
• MOISTURE
• TEMPERATURE
• E.M.I.
• RADIATION
• VIBRATION
• MAINTENANCE
• TESTING

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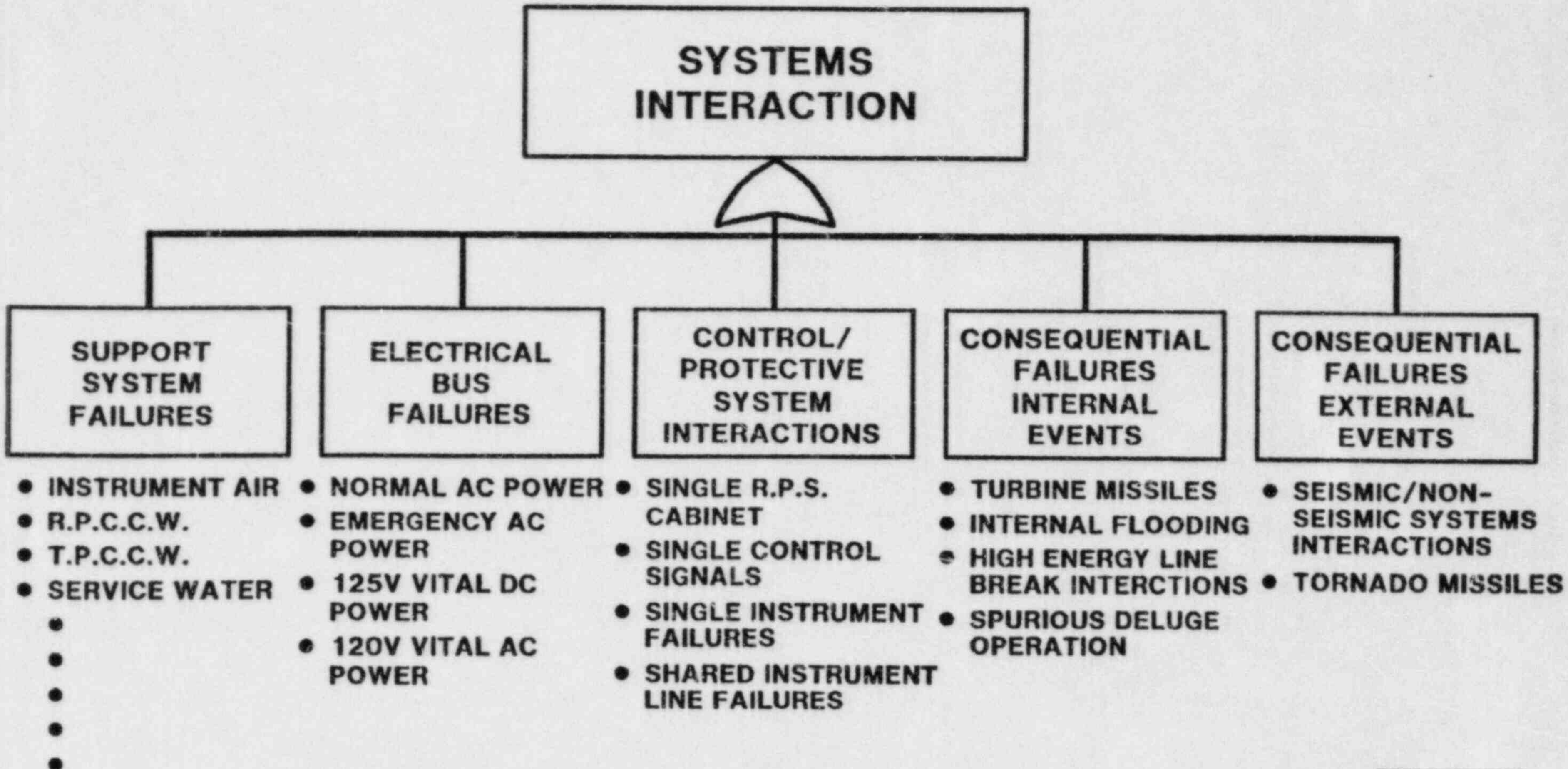
SYSTEMS INTERACTION

HISTORY:

- OPERATING PLANT EVENTS:
  - ELECTRICAL BUS FAULTS
  - SPURIOUS DELUGE SYSTEM OPERATION
  - CONTROL/PROTECTIVE INTERACTIONS
- INDUSTRY DESIGN STANDARDS IMPROVED
- UNRESOLVED SAFETY ISSUE A-17
- NUMEROUS INDEPENDENT SYSTEMS INTERACTION STUDIES UNDERTAKEN FOR MILLSTONE 3
- P.S.S. HAS INTEGRATED RESULTS OF THESE STUDIES IN AN INTERDISCIPLINARY FASHION
- P.S.S. HAS SYSTEMATICALLY IDENTIFIED, RANKED, AND PROVIDED SIGNIFICANT INSIGHTS


SYSTEMS INTERACTION
SUPPORT SYSTEM FAILURES
• INSTRUMENT AIR
• R.P.C.C.W.
• T.P.C.C.W.
• SERVICE WATER
•
•
•
•
•
ELECTRICAL BUS FAILURES
• NORMAL AC POWER
• EMERGENCY AC POWER
• 125V VITAL DC POWER
• 120V VITAL AC POWER
CONTROL/ PROTECTIVE SYSTEM INTERACTIONS
• SINGLE R.P.S. CABINET
• SINGLE CONTROL SIGNALS
• SINGLE INSTRUMENT FAILURES
• SHARED INSTRUMENT LINE FAILURES
CONSEQUENTIAL FAILURES INTERNAL EVENTS
• TURBINE MISSILES
• INTERNAL FLOODING
• HIGH ENERGY LINE BREAK INTERCTIONS
• SPURIOUS DELUGE OPERATION
CONSEQUENTIAL FAILURES EXTERNAL EVENTS
• SEISMIC/NON-SEISMIC SYSTEMS INTERACTIONS
• TORNADO MISSILES
NU

EXAMPLES OF PLANT UNIQUE INITIATORS DERIVED FROM F.M.E.A.:

1. LOSS OF A VITAL DC BUS
   - LOSS OF MAIN FEEDWATER
   - STEAM DRIVEN AFW PUMP INLET VALVES FAIL OPEN
   - REACTOR/TURBINE TRIP
   - INABILITY TO OPERATE 1/2 OF AC BREAKERS
   - LOSS OF 1/2 ESF CABINETS/SYSTEMS
   - LOSS OF 1/2 PORVs
2. LOSS OF A VITAL AC BUS
   - LOSS OF MAIN FEEDWATER TO 1/4 STEAM GENERATORS
   - AUTO CONTROL ROD INSERTION (WRONG INDICATED T AVG)
   - REACTOR/TURBINE TRIP
   - LOSS OF 1/2 ESF CABINETS/SYSTEMS
   - LOSS OF 1/2 EMERG. GEN. LOAD SEQUENCERS
   - LOSS OF AUTO STEAM DUMP/BYPASS CAPABILITY
   - MALFUNCTION OF AUTO PRESSURIZER LEVEL CONTROL SYSTEM
   - LOSS OF AUTO PRESSURIZER SPRAYS
   - LOSS OF AUTO PORV CAPABILITY

TREATMENT OF OPERATOR ACTIONS/HUMAN ERROR:

- CONSERVATIVE SCREENING VALUES USED
- RELIANCE ON WESTINGHOUSE ERGs
- OPERATOR ACTIONS APPEAR EXPLICITLY IN EVENT TREES
- RECOVERY OF FAILED ACTUATING SYSTEMS CONSIDERED
- HUMAN ERRORS APPEAR EXPLICITLY ON FAULT TREES

TREATMENT OF UNCERTAINTIES:

- TECHNIQUES FOR MATHEMATICAL PROPAGATION WELL UNDERSTOOD
  - MEANS AND VARIANCES
  - METHOD OF MOMENTS
  - D.P.D. ARITHMETIC
- IDENTIFICATION OF UNCERTAINTIES IS MORE DIFFICULT
  - RANDOMNESS
  - MODELING UNCERTAINTY
- SOURCES OF UNCERTAINTY:
  - INITIATING EVENTS
  - SUCCESS CRITERIA
  - EVENT TREES
  - FAULT TREES
  - RELIABILITY ANALYSIS
  - HUMAN ERROR ANALYSIS
  - INTERNAL EVENT COMMON CAUSE ANALYSIS
  - EXTERNAL EVENT COMMON CAUSE ANALYSIS
  - QUANTIFICATION PROCESS
- UNCERTAINTY ANALYSIS MUST BE TAILORED TO END USES

ENGINEERING INSIGHTS

- DOMINANT ACCIDENT SEQUENCES
  - INTERNAL
  - EXTERNAL
- CRITICAL SYSTEMS
- CRITICAL ISSUES

NU

DOMINANT INTERNAL EVENT ACCIDENT SEQUENCES CONTRIBUTING TO CORE MELT

SEQUENCE DESCRIPTION	MEAN ANNUAL FREQUENCY	PERCENT CONTRIBUTION TO CORE MELT FREQUENCY
MEDIUM LOCA: FAILURE OF HIGH PRESSURE RECIRCULATION	3.87E-6	6.6
LOSS OF VITAL DC BUS 1 OR 2: FAILURE OF AUXILIARY FEEDWATER, FAILURE OF BLEED AND FEED COOLING (SYSTEMS INTERACTION)	2.20E-6	3.7
LOSS OF VITAL AC BUS 1 OR 2: FAILURE OF AUXILIARY FEEDWATER, FAILURE OF HIGH PRESSURE RECIRCULATION (SYSTEMS INTERACTION)	1.98E-6	3.4
LOSS OF VITAL AC BUS 3 OR 4: FAILURE OF AUXILIARY FEEDWATER, FAILURE OF HIGH PRESSURE RECIRCULATION (SYSTEMS INTERACTION)	1.98E-6	3.4
INTERFACING SYSTEMS LOCA: FAILURE OF RHR INLET VALVES	1.90E-6	3.2

NU

DOMINANT INTERNAL EVENT ACCIDENT SEQUENCES CONTRIBUTING TO CORE MELT

SEQUENCE DESCRIPTION	MEAN ANNUAL FREQUENCY	PERCENT CONTRIBUTION TO CORE MELT FREQUENCY
LOSS OF OFF-SITE POWER: FAILURE OF BOTH DIESEL GENERATORS, FAILURE TO RECOVER POWER IN 6 HOURS, FAILURE OF QUENCH SPRAY RECOVERY (STATION BLACKOUT)	1.65E-6	2.8
LOSS OF OFF-SITE POWER: FAILURE OF ONE ESF BUS, STEAM LINE BREAK INSIDE CONTAINMENT, FAILURE OF AUXILIARY FEEDWATER, FAILURE OF PRIMARY BLEED THROUGH PORV'S	1.63E-6	2.7
STEAM LINE BREAK OUTSIDE CONTAINMENT: FAILURE TO ISOLATE MAIN STEAM LINE, FAILURE OF PRIMARY BLEED THROUGH PORV'S	1.55E-6	2.6
SMALL LOCA: FAILURE TO CONTROL PRIMARY DEPRESSURIZATION, FAILURE TO HIGH PRESSURE RECIRCULATION	1.39E-6	2.4

DOMINANT INTERNAL EVENT ACCIDENT SEQUENCES CONTRIBUTING TO CORE MELT

SEQUENCE DESCRIPTION	MEAN ANNUAL FREQUENCY	PERCENT CONTRIBUTION TO CORE MELT FREQUENCY
LARGE LOCA: FAILURE OF LOW PRESSURE RECIRCULATION	1.37E-6	2.3
LOSS OF VITAL AC BUS 1 OR 2: FAILURE OF OPPOSITE TRAIN ESF CABINET, FAILURE OF AUXILIARY FEEDWATER, FAILURE OF BLEED AND FEED COOLING, FAILURE OF QUENCH SPRAY (SYSTEMS INTERACTION)	7.23E-7	1.2
PRIMARY TO SECONDARY POWER MISMATCH: FAILURE OF BOTH ESF CABINETS, FAILURE OF AUXILIARY FEEDWATER FAILURE OF BLEED AND FEED COOLING, FAILURE OF QUENCH SPRAY	6.15E-7	1.0
REACTOR TRIPS: FAILURE OF BOTH ESF CABINETS, FAILURE OF AUXILIARY FEEDWATER, FAILURE OF BLEED AND FEED COOLING, FAILURE OF QUENCH SPRAY	4.87E-7	0.8
TURBINE TRIPS: FAILURE OF BOTH ESF CABINETS, FAILURE OF AUXILIARY FEEDWATER, FAILURE OF BLEED AND FEED COOLING, FAILURE OF QUENCH SPRAY	3.74E-7	0.6

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DOMINANT INTERNAL EVENT ACCIDENT SEQUENCES CONTRIBUTING TO CORE MELT

SEQUENCE DESCRIPTION	MEAN ANNUAL FREQUENCY	PERCENT CONTRIBUTION TO CORE MELT FREQUENCY
PRIMARY TO SECONDARY POWER MISMATCH: COINCIDENT STATION BLACKOUT, SMALL LOCA, FAILURE OF HIGH PRESSURE INJECTION, FAILURE OF SECONDARY DEPRESURIZATION AND LOW PRESSURE INJECTION, FAILURE OF QUENCH SPRAY RECOVERY	2.43E-7	0.4
REACTOR TRIP: COINCIDENT STATION BLACKOUT, SMALL LOCA, FAILURE OF HIGH PRESSURE INJECTION, FAILURE OF SECONDARY DE-PRESSURAIZATION AND LOW PRESSURE INJECTION, FAILURE OF QUENCH SPRAY RECOVERY	1.92E-7	0.3
TURBINE TRIP: COINCIDENT STATION BLACKOUT, SMALL LOCA, FAILURE OF HIGH PRESSURE INJECTION, FAILURE OF SECONDARY DE-PRESSURAIZATION AND LOW PRESSURE INJECTION, FAILURE OF QUENCH SPRAY RECOVERY	1.48E-7	0.2
LOSS OF VITAL AC BUS 1 OR 2: FAILURE OF AUXILIARY FEEDWATER, FAILURE OF HIGH PRESSURE RECIRCULATION, FAILURE OF CONTAINMENT RECIRCULATION SPRAY (SYSTEMS INTERACTION)	9.36E-8	0.1

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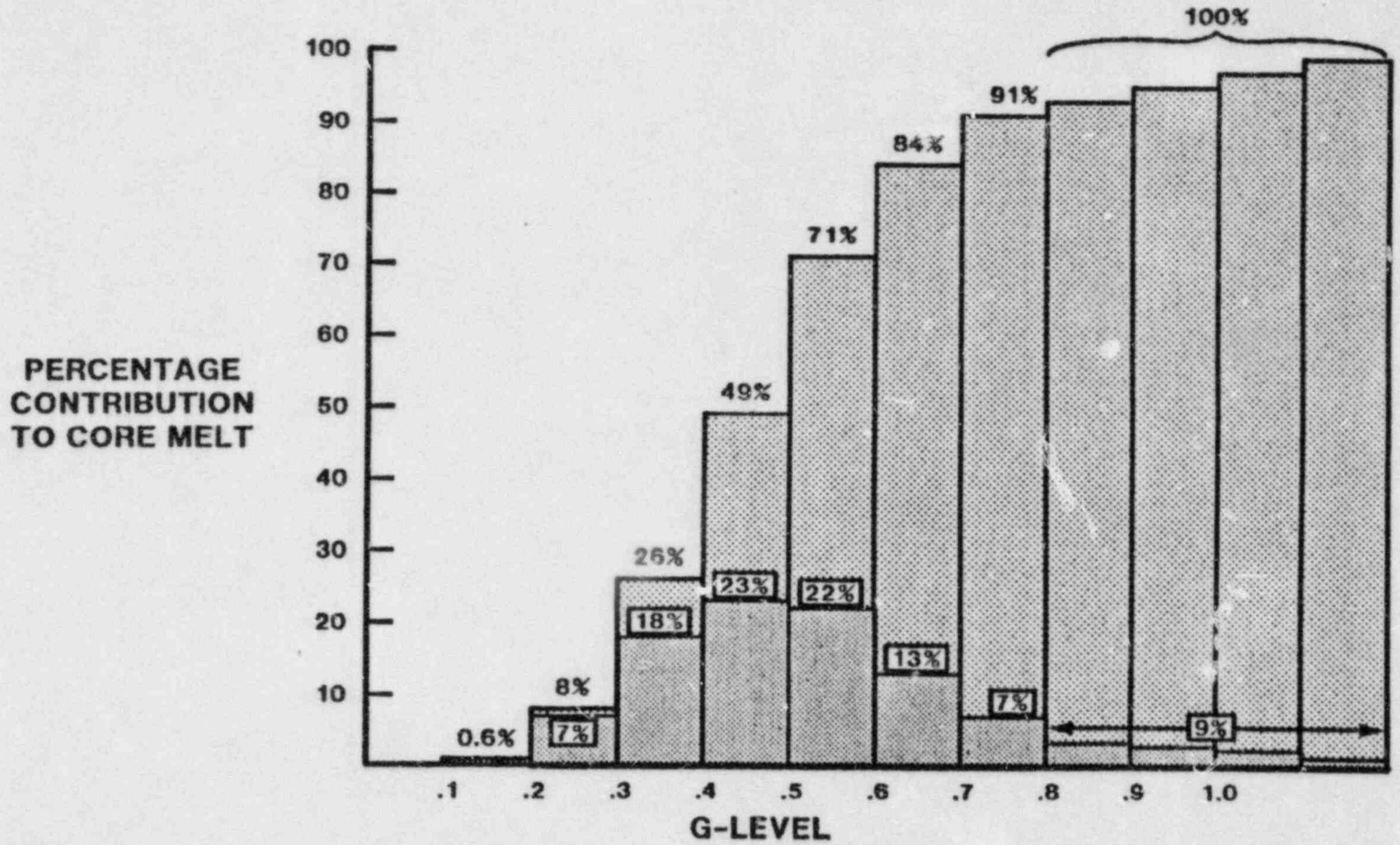

100%
100
90
80
70
60
50
40
30
20
10
PERCENTAGE
CONTRIBUTION
TO CORE MELT
91%
84%
71%
49%
26%
23%
22%
18%
13%
8%
7%
7%
9%
0.6%
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
G-LEVEL

P.S.S. INSIGHTS INTO CRITICAL SYSTEMS:

- ACCIDENT SEQUENCES INVOLVING AUXILIARY FEEDWATER FAILURE COMPRISE 40% CORE MELT FREQUENCY
- ACCIDENT SEQUENCES INVOLVING HIGH PRESSURE RECIRC. FAILURE COMPRISE ~27.5% CORE MELT FREQUENCY
- ACCIDENT SEQUENCES INVOLVING FAILURE OF FEED AND BLEED COOLING COMPRISE ~24.5% CORE MELT FREQUENCY

NU

P.S.S. INSIGHTS INTO CRITICAL SAFETY ISSUES:

- 352 SEQUENCES INVOLVING SYSTEMS INTERACTIONS
  - COMPRISES 18% CORE MELT FREQUENCY
  - BREAKDOWN:

VITAL AC BUS 1, 2	7%
VITAL AC BUS 3, 4	5.8%
VITAL DC BUS 1, 2	3.9%
VITAL DC BUS 3, 4	0%
SERVICE WATER	1.2%

- SEISMIC EVENTS COMPRISE 15.4% CORE MELT FREQUENCY
- 440 SEQUENCES INITIATED BY LOSS OF OFFSITE POWER
  - COMPRISES 11.2 % CORE MELT FREQUENCY
  - STATION AC BLACKOUT WITHOUT RECOVERY: 2.7%
- FIRES COMPRISE 8.1% CORE MELT FREQUENCY
- 264 SEQUENCES INVOLVING STEAM GENERATOR TUBE RUPTURE
  - COMPRISES 2.7% CORE MELT FREQUENCY
- TOTAL LOSS OF DC POWER WITHOUT RECOVERY
  - INSIGNIFICANT CONTRIBUTOR
- PRESSURIZED THERMAL SHOCK
  - INSIGNIFICANT CONTRIBUTOR

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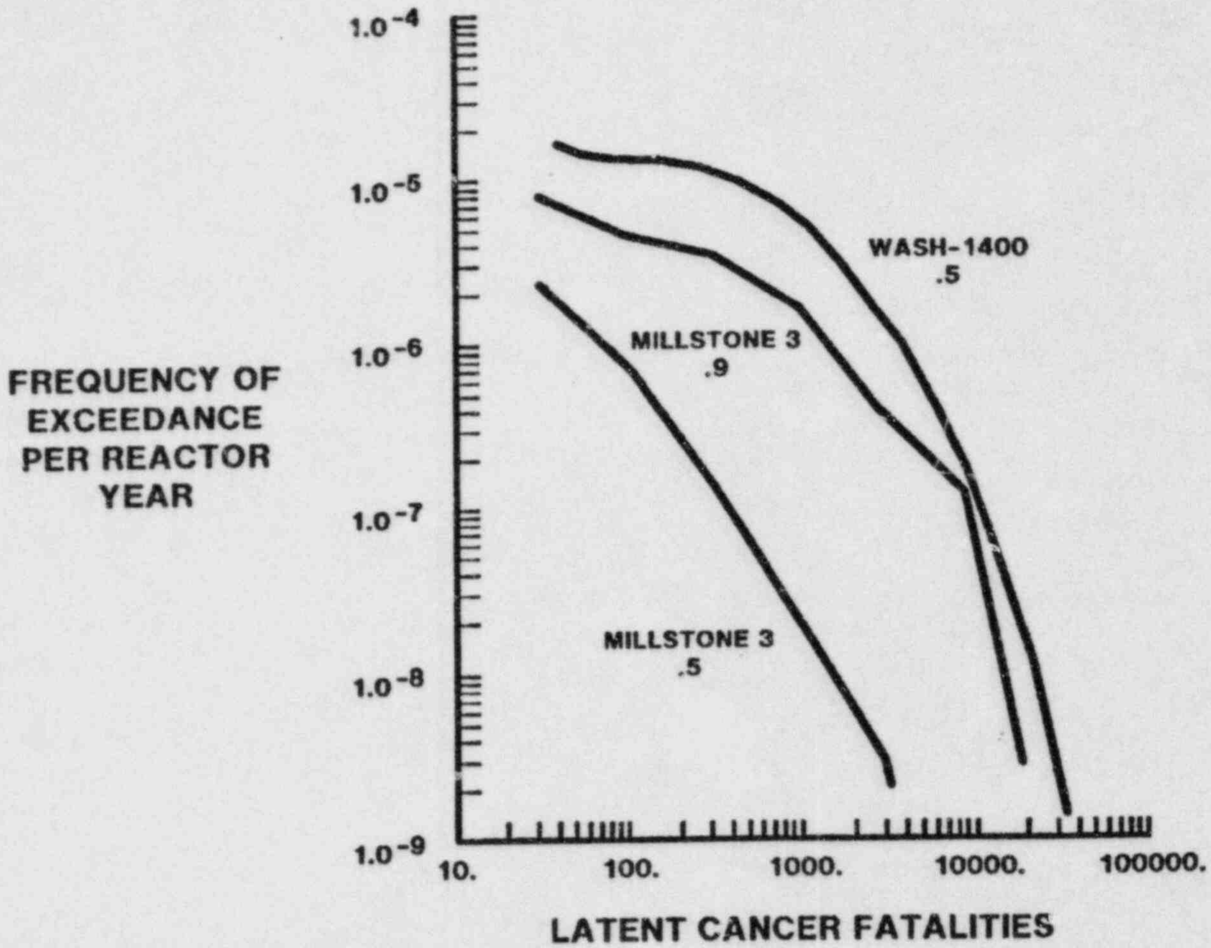
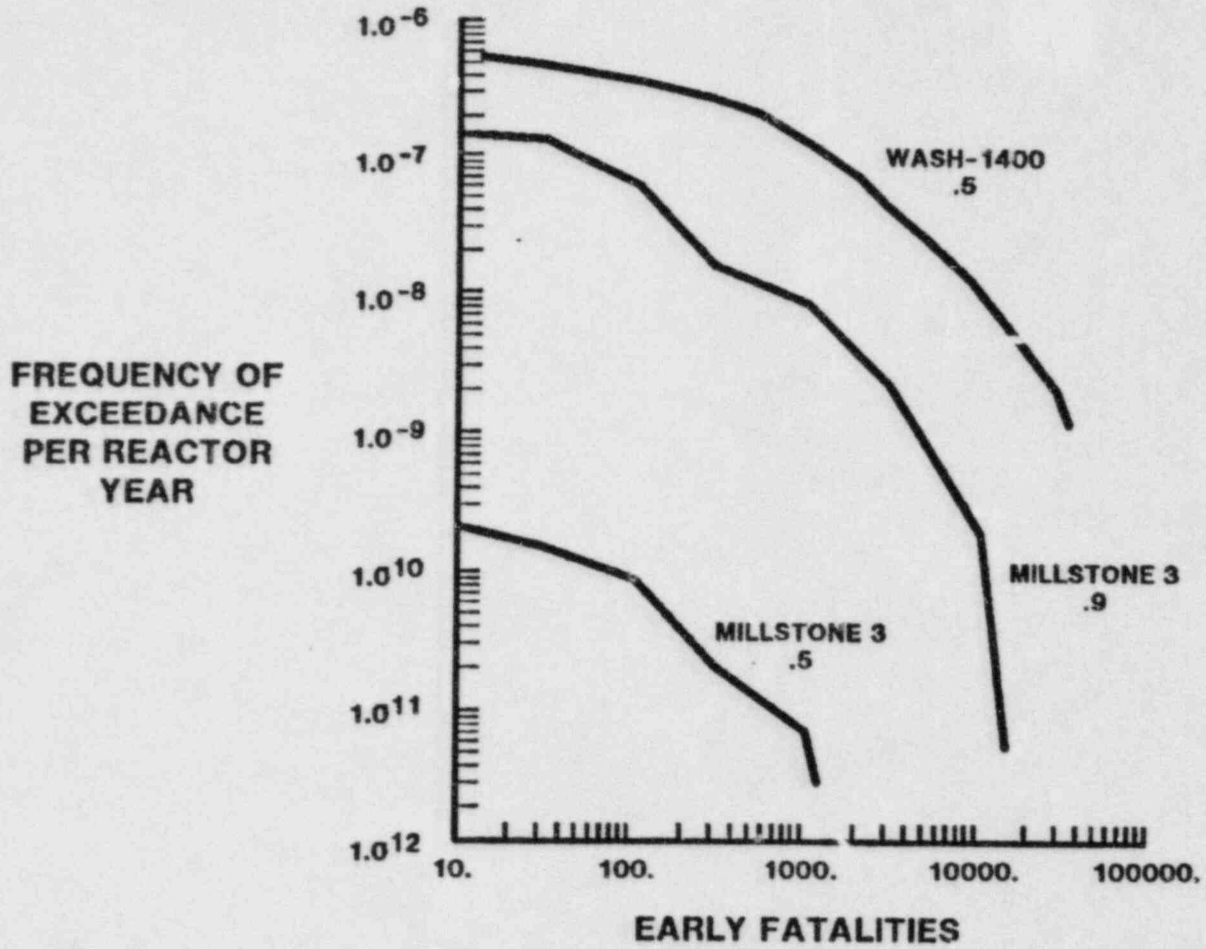
COMPARISON OF RISK CURVES FOR LATENT FATALITIES WASH-1400 VS. MILLSTONE 3



COMPARISON OF RISK CURVES FOR EARLY FATALITIES WASH-1400 VS. MILLSTONE 3



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