UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF:

294TH MEETING OF THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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Nuclear Regulatory Commission
Room 1046
1717 "H" Street, N. W.
Washington, D. C.

Friday, October 12, 1984

The full committee met in open session, pursuant to notice, at 8:30 o'clock a. m.

BEFORE:

JESSE C. EBERSOLE, Chairman

DAVID A. WARD, Vice-Chairman

ROBERT C. AXTMANN, Member

MAX W. CARBON, Member

WILLIAM KERR, Member

HAROLD W. LEWIS, Member

CARSON MARK, Member

CARLYLE MICHELSON, Member

DADE W. MOELLER, Member

DAVID OKRENT, Member

GLENN A. REED, Member

FORREST J. REMICK, Member

PAUL G. SHEWMON, Member

(continued)

CHESTER P. SIESS, Member

CHARLES J. WYLIE, Member

STAFF PRESENT:

R. FRALEY, ACRS
E. IGNE, ACRS
P. BOEHNERT, ACRS
J. McKINLEY, ACRS
H. DENTON, NRR

A G E N D A

P R O C E E D I N G S

MR. EBERSOLE: This meeting will now come to order. This is the second day of the 294th meeting of the Advisory Committee on Reactor Safeguards. During today's meeting the committee will hold a discussion with the NRC's director of nuclear reactor regulation, Mr. Harold Denton. We will hear about and discuss pressurized thermal shock of reactor pressure vessels. We will hear about and discuss proposed regulations concerning backfitting of new requirements into existing nuclear power plants.

We will hear reports on recent experience at operating power plants and reports of recent subcommittee activities.

The schedule for Saturday is posted on the bulletin board outside this meeting room. This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act and the Government in the Sunshine Act. John McKinley is the designated federal official for the first portion of the meeting.

A transcript of portions of the meeting is being kept and is it is requested that each speaker use one of the microphones, identify himself or herself and speak with sufficient clarity and volume so that he or she may be readily heard. We have received no written statements or requests to make oral statements from members of the public regarding today's session.

Let me ask the members again to give me your written comments about the new arrangement here. I have already had a suggestion that we need suspended microphones to improve on the communication and we should also advise the committee members to improve their microphone techniques especially me. Am I doing it?

MR. LEWIS: You are doing much better. If we could improve on the committee members, we would be home free.

MR. EBERSOLE: It is always a pleasure to have Mr. Harold Denton here. So we are going to start the day out with him and I will turn the meeting over to Mr. Denton.

MR. DENTON: I have four subjects that I thought might be of interest to the committee to talk about and I will be happy to talk about anything else that you would like to cover but I will cover the status of the near term applicants for operating licenses. I don't think I have gone over that with you recently.

I wanted to say a word or two about the INPO accreditation process which I observed a few weeks ago. I want to mention an initiate we have within the staff on fire protection and finally talk a little bit about technical specifications and are they doing the job we think they should be.

You might interrupt anywhere along the way and why don't we start with near term OL's and I will do it sort of geographically and we will start with Region I. Limerick is a near term OL. It is essentially finished. There was a Board decision that authorized the conditions for the license and there was an Appeal Board decision recently that remanded two environmental issues so the lower board is considering whether or not these remanded environmental issues affect the issuance of a low-power license or not. We expect a decision from that Board very soon.

The plant will be physically ready about the middle of October.

Shoreham in the same Region, there is a Board decision which authorizes fuel loading and zero power criticality at Shoreham. That decision is not effective and is before the Commission. There are a number of other hearings still going on at Shoreham, that is with respect to the adequacy of the TDI diesels in general.

The staff has complete[illegible] [illegible]s review of those diesels and is requiring some testi[illegible] [illegible] [illegible]e testing is going on right now. Outside emergency preparedness is still an issue before the Board.

TMI-1 Restart is another plant in that same Region. The three issues have been remanded there to the lower board including the Herman Diekamp mailgram, operating cheating, leak rate and that hearing is proceeding and the Commission is considering whether to take review of that case or not.

MR. MARK: Harold, I didn't hear what you may have said in connection with Shoreham about the negotiations with Suffolk or whatever it is county.

MR. DENTON: There are some negotiations going on possibly settling on some issues, but I don't know the details and I don't know that any party has taken a position but there is a Board decision that would authorize fuel loading and zero power criticality testing that is pending before the Commission. The other hearings are proceeding and on some issues the parties are trying to negotiate a settlement outside the Board proceeding.

MR. MARK: So it isn't known when this might converge?

MR. DENTON: No, it is not.

Moving down to Region II, Catawba has loaded fuel. They don't have permission from the Board for any further activity. There is one issue still before the Board and that is an allegation from a welder. That hearing, the testimony before the Board, was recently completed I believe and we are awaiting a Board decision on those allegations.

Another item of interest in Region II is Watts Bar. Watts Bar had been scheduled to be complete sometime this year. Apparently they discovered that they could not meet Appendix R because of the intermixing of cables needed for some of the reporting systems and have announced a delay until I believe March of next year before they say the plant would be in conformance with Appendix R.

Region III, probably the nearest term action is the Callaway OL. The Commission voted five to nothing the other day to issue a full power license on Callaway contingent upon a couple of items, that is satisfactorily completing the low power testing and looking at the 50 or so allegations that were recently received on that plant but would be prepared to move on that in the near term.

Byron is a case that you are familiar with that the Board found had not been constructed in accordance with the Commission's regulations. That hearing has been reopened, testimony given and we are awaiting a Board decision. I would expect one perhaps this month.

MR. SIESS: Which one?

MR. DENTON: Byron. I think the Board there is the pacing item on Byron. I think Byron is essentially complete. We have done a readiness review and we don't have any outstanding problems with Bryon.

MR. OKRENT: Could you elaborate on the phrase "the Board found their not doing something in accordance with..."?

MR. DENTON: I was just trying to use shorthand for the Board decision of last spring. Remember in the issue of quality assurance, the Board issued a decision that a license couldn't issue and I don't remember all the details but that is the Board decision I am talking about.

MR. OKRENT: There is nothing since then?

MR. DENTON: No. It has been reopened since that time and all sides have presented testimony.

MR. OKRENT: All right. Thank you.

MR. DENTON: One I forgot in Region I is Indian Point. You may recall that back in 1979 the UCS petitioned the staff to suspend operations of Indian Point Two and Three. A hearing was held and a Board decision issued. We have recently briefed the Commission several times on the staff's testimony in that case and that is actively under review by the Commission at the present time.

Also, I guess Byron and Callaway are the two major plants in Region III that we are working on in the near term.

Region IV has Waterford and Commanche Peak. In both plants we ended up forming large technical review teams of staff members and outside consultants to review a variety of allegations.

In Waterford our technical review team has completed its on-site activities, issued its report and we are awaiting a response from the applicant. He has responded on some of the issues. We provided testimony to the Appeal Board on the adequacy of the base mat and the Appeal Board has asked for more testimony from all of the parties regarding the adequacy of the Waterford base mat. So we will be proceeding down that line. Wateford obviously, I don't think would be in any posture to meet their projected date of Ocotber of this year.

Commanche Peak, we have mounted a big effort also to do follow-up on a variety of issues. We have met with that Applicant on two of the five issues and have given them the staff's view. We still have not given them our views on quality assurance and some other areas. The Board at Commance Peak is still open. It is still in session and just issued a recent order with a number of questions raised because of an anonymous start-up engineer's testimony before the Board.

Commance Peak is still requiring a lot of attention from the staff. I don't see those issues being resolved in the near term, in the very near term, that is.

Another plant that might be of interest is Fort St. Vrain in Region IV. You may recall back during the summe there was an event in which six of the 24 control rods failed to insert properly. We and the regions have made a big effort to review that incident, to review the adequacy of instrumentation at the plant, conduct of operations, tech specs and those sort of areas and a report should be available within the next few days from the staff covering that event and a wide variety of conduct of operations issues at Fort St. Vrain.

In Region V the near term plant is probably Palo Verde. Palo Verde, I don't think there are any legal impediments to issuance of a license and the main activity is awaiting completion of the plant which we would expect toward the end of the year.

The other case out there is Diablo Canyon which, of course, is before the court. Oral testimony, I think, is expected around the end of this month on the issues which have been raised there.

One other noteworthy event in Region V is the finding that Rancho Seco may have exceeded the Appendix "I" releases, liquid releases. You recall that Rancho Seco was intended to be a dry site and not have any liquid releases but there was a settling pond and if you go through the calculations of release of liquid effluents and reconcentration in fish and the fishermen who fished in the nearby stream, there is a possibility that someone may have received doses in excess of Appendix I. So we are doing such things as whole body counting of that individual and the utility has already done whole body counts and are pursuing that issue further.

MR. SIESS: What are the limits in Appendix I?

MR. DENTON: Five millirem.

MR. SEISS: That supercedes part 20? I thought this dumped into a canal. Is there fishing out in that area?

MR. DENTON: I don't think that it was anticipated that there would be fishing in that area and I think the fishing has occurred in a stream that flows from the settling pond through private property. There are a lot of arguments over what calculational method would result. The source of the problem has not been collected.

You may recall they shut down some time ago thinking that they possibly had defective fuel because they were getting a build-up of activity in the primary coolant. It subsequently turned out that the operation was bypassing the clean-up system and that was not discovered immediately so they have now adopted a procedure where they will not be backflushing their demineralizer. Therefore, we don't expect any addition of radiation to that settling pond and this effectively will stop whatever problem has occurred in the past.

MR. SIESS: Harold, when Diablo Canyon is taken up by the federal courts, does the staff have to testify in that or just the lawyers and the Commissioners?

MR. DENTON: It is the Commission's legal staff and the lawyers from the Department of Justice.

MR. SIESS: So the technical staff won't be tied up with that?

MR. DENTON: We are involved in assisting the legal staff in preparing their testimony but it is not anticipated we would be witnesses.

MR. LEWIS: Who are the opponents on Diablo Canyon? It is my state and I am wondering if I am a complainant against you. Has the Governor's Office joined in the suit?

MR. DENTON: I think the Governor is a party to the proceeding and I think supports the issuance of the license.

MR. LEWIS: So the Governor is a party?

MR. DENTON: Yes.

MR. LEWIS: Are you reasonably sure of that?

MR. DENTON: I can see if there is anybody here who would know.

MR. LEWIS: It is of special interest because the Governor represents me.

MR. DENTON: I don't know the legal status for sure but I did see a telegram from the Governor indicating his support of the NRC decision early in the process. Now whether he is actually a party or not, I am not certain.

MR. LEWIS: Oh, he is on your side?

MR. DENTON: Yes.

MR. LEWIS: I am sorry. In a previous thing, he was on the other side.

MR. DENTON: Right. So the parties are the same parties which have opposed issuance of a license all along.

MR. LEWIS: I see. All right. Thank you.

MR. EBERSOLE: Harold, let me ask you a little bit about Watts Bar. If there ever should be a couple of plants that would be in compliance with Appendix R, it should be Watts Bar and then ahead of it would be Sequoia because after all Browns Ferry set the standard for fires, I think, and the TVA should have responded.

I would hate to think that you were looking at the superficial aspects of non-compliance with Appendix R but rather go back into the QA process that led into this state of disarray that they are in, whatever it is, and route out how it got the way it is because it is indicative of making a finding at Watts Bar, you may find the same thing at Sequoia.

MR. DENTON: We have found the same thing at Sequoia and they have taken adequate compensatory measures involving fire watches and stationing people in the areas. So we did look at that aspect and there should be a report available soon on that.

MR. REMICK: Harold, going back to the Rancho Seco thing, I get confused by that. I thought that Part 50, Appendix I, was basically defined ALARA in the design of plants and therefore that Appendix I were kind of design objectives. I thought Part 20 is what you had to actually meet. Apparently I am wrong in this. Apparently they are being asked to comply with Appendix I actual release limits rather than Part 20. Am I wrong?

MR. KERR: Appendix I also says that a licensee is responsible for monitoring system that insures compliance with those design objectives.

MR. REMICK: I see.

MR. DENTON: I didn't want to get into enforcement aspects but EPA standards are as you recall set at 25 millirem and Appendix I was set below that. From a calculational standpoint depending on your assumptions about reconcentration in fish and the amount of fish consumed by this family, you can calculate that they exceeded the EPA standard. That is why we are trying to get samples of the fish to be analyzed and get whole body count on members of that family who may have eaten fish from the canal rather than relying on calculation.

It is getting a lot of looking into. I think the release of radioactive material to that settlement pond has been effectively stopped and we have let the plant resume operation. The question now is looking back and trying to sample the pond and estimate what might have been injested by someone who occasionally fished there.

The reason I brought it up is because it is the first case I know of since Appendix I became really effective where we thought it might have been exceeded so that is its real interest to us.

MR. REMICK: So from an enforcement standpoint, the

Commission does hold them to Appendix I rather than Part 20.

MR. DENTON: I don't want to get into enforcement because I am just not sure what enforcement action the region will take on it.

MR. MARK: Harold, you mentioned Fort St. Vrain. Is it operating or is it suspended until the result of these reports?

MR. DENTON: It is not operating. They plan to be down for a number of months responding to some of the problems that had occurred but this report will contain some requirements they must meet prior to restarting.

MR. MARK: All right. The other question I had was you didn't mention as far as what occurred at Braidwood.

MR. DENTON: Braidwood is further out in time.

MR. MARK: I thought it was following Byron fairly closely but apparently not then.

MR. DENTON: Let me see what my notes are on Braidwood but it is not receiving a lot of attention at the moment from the staff. I think it is not scheduled until late next year sometime. What all these plants do by clustering at the moment put a severe strain on our resources to have so many plants nearing completion in the next few months.

MR. SEISS: Harold, I can remember when we had four or five a month nearing completion and there weren't 30,000 people working for the NRC. There must be something else putting a strain on your resources, not the licensing.

MR. DENTON: I think we don't do things the same way we used to.

MR. SEISS: Differently or not as well?

MR. DENTON: It depends on your perspective. Many of them, if you take Commanche Peak are as a result of issues that are before the hearing board and allegers coming up with information that has to be pursued so it is a much more formal process. We refer allegations of wrong doing, for doing, to OI. We have to wait for the OI investigators to come back with the facts before we can move. I think certainly we get into a lot more detail today than we did a decade ago.

MR. SIESS: I don't think there is any question about that. I have a xeroxed copy of a staff safety evaluation and it is copied only on one side of the page and even so it is about half as thick as the one for Waterford which just covers the allegations. That was enough to license a plant in 1971. We are getting into a lot more detail. Are you making them any safer?

MR. DENTON: I think we are.

MR. SIESS: You think so.

MR. DENTON: It doesn't say whether it is cost effective but I think in terms of safety, we are doing better and I think partly it is as we hire up specialists in various fields, suddenly you find from that specialist that there is a whole world out there that we weren't covering before. So over the past 20 years we have added. We are up to maybe 40 different discrete technical disciplines in the staff now. I think if you go back a decade or more, you will find the staff mainly general.

So now we have people who graduated in fire protection engineering and their views on fire protection are quite a bit different than non-fire protection specialists of a decade ago.

MR. EBERSOLE: This always results in a superior product. It sometimes results in a monster.

MR. HERNAN: On the subject of Braidwood, we are tentatively planning to bring Braidwood before the ACRS in January.

MR. DENTON: That is sort of a thumbnail sketch of plants. If you have any questions on any of those or other plants, I will answer them or go to another topic. I mention it just to show that there is a lot of activity going on in almost every region now with regard to licensing of several new plants and it is hard to predict a date by which any of these will be completed because of the interaction of the boards and plant completion dates. But we are trying not to be on the critical path for any of these.

MR. OKRENT: Harold, you mentioned Indian Point. I have been trying to understand in my own mind why the staff didn't look for ACRS comment on this position, in fact, why the Commission has not asked for ACRS comment at some stage of this particular issue. Do you have any opinion on either the first or the second or both of these?

MR. DENTON: Not really, Dave. I know you brought the subject up. You will recall I received a 2.206 petition on that requesting that I suspend the license. I acted and the Commission took review of my action so they really became the controlling body from a legal standpoint and they heard from all the parties involved and have since directed the actions.

They set down the hearing and we have been carrying out the Commission's instructions ever since.

MR. OKRENT: What I am trying to understand is since this is an advisory committee on reactor safeguards and since there certainly were major safety issues involved and maybe some other kinds of issues as well, I would have thought that the views of the ACRS would have been sought at least on whatever was thought to be significant safety matters being considered.

It wasn't a typical case like an operating license where the matter had already been reviewed and then it went to a hearing board. So I remember after Three Mile Island, there was talk that the role of the ACRS if anything should be augmented and I am trying to understand those comments in the light of the seeming lack of interest in an ACRS view on what I think is one of the more important safety-related decisions of the last few years between 1980 and 1984.

MR. DENTON: I think you would have to ask the Commissioners themsevles, Dave. I don't know. It became an issue before the Commission and they set down the groundrules for proceeding. It was one of the largest hearings we held. I think there were over 200 witnesses involved in that proceeding from all sides of the issues.

Going next to accreditation, and by accreditation I mean INPO's of utility training programs. One of your colleagues incidentally serves on the oversight board, is that the proper term.

MR. REMICK: Accrediting board.

MR. DENTON: I attended a meeting of the accrediting board just to get a feel for how this process was working. You may know that INPO has undertaken to in effect accredit utility training programs for the key jobs in reactor operation. What I found was a very high quality probing process going on at INPO. It reminded me a lot of ACRS type meetings.

The INPO staff did a detailed review of the utility's program against INPO standards and presented their views.

The Board then had the benefit of questioning the utility management about their training program. It struck me as equal to in quality of anything that the staff could put together. The people seem very well qualified with people like Faust and Gordon Robinson from Penn State on the board.

The one point I wanted to make is that it is not subject to public scrutiny in that they don't hold these meetings in public and they don't allow material to be taken out and they vote in executive session and so forth.

There is a meeting today between the industry group that is involved in this program and the Commission. I think it starts at 9:30 or 10:00 that I have to attend and the whole issue is to what extent should the Commission become involved in issues like accreditation, fitness for duty through formal rulemaking. I expect a very interesting meeting upstairs in that the industry view is that we should stay away from this process and let it work.

I am pleased about the quality of the review and I think the other side of that coin is there really is no at the moment NRC input into it or accountability to the NRC. EPRI is accountable to the owners.

MR. KERR: When you talk about fitness for duty with reference, for example, to operators there is an NRC licensing process that presumably provides some input into operator qualifications, isn't there?

MR. DENTON: By fitness for duty, it was shorthand and I meant with regard to drug and alcohol abuse. What kind of program should a utility have to assure that their operators who are qualified are not abusing drugs or alcohol.

MR. KERR: All right.

MR. DENTON: In that case industry is also initiating a program in that area.

Let me mention fire protection. We have made a number of inspections of plants to see if they meet Appendix R such as the one at Watts Bar. We are having some internal difficulties in getting everyone to agree as to what Appendix R requires and how to implement it.

We have received a number of differing professional opinions by individuals both in headquarters and in the regions about how we are implementing Appendix R. We have formed two groups. We have appointed a steering committee composed of representatives of headquarters and in regions to decide what are the issues that are causing the difficulties. We have now held an internal meeting at which everyone involved in fire protection in the whole agency was involved to share their views on how we should proceed.

Then we have a working group headed up by Faust Rosa and several other very experienced people to in effect do the technical work for the steering group. The steering group is headed up by Dick Vollmer. I expect to get their recommendations around the end of the month and provide them to Bill Dircks either indicating that we are going to proceed as we had originally issued our guidelines or either recommending changes to the guidelines and how to proceed.

This is an area that we haven't managed to move as fast as we had hoped because of strongly held different opinions about what Appendix R meant.

MR. MICHELSON: Could you tell us just a little bit more about what these differing opinions are or where the problem is?

MR. DENTON: I think there are two sides. There are technical differences of opinion among the fire protection specialists and I can't go into the details of that any further and then there are policy differences of opinion with regard to exemptions.

You recall the way Appendix R is structured they only have to ask for exemptions from those areas where they don't otherwise meet Appendix R. I have granted several hundered exemptions to Appendix R which was the instruction we received from our legal staff. Remember, we were taken to court over Appendix R and we were found by the court not to have completely adequate bases for all the things in Appendix R and we were urged to grant exemptions on individual basis where it was justified.

I granted a lot of exemptions but depending on how--

it has caused a great deal of friction between the staff and the industry on how you interpret Appendix R. I think at the moment there is only one utility in which the Commission and staff see eye-to-eye that that plant needs Appendix R. I believe that is Calvert Cliffs.

I believe as a result of the eight or ten other plants that we have inspected, there have arisen a number of detailed issues about this field that have effectively stalled us out. We do hope to get on with it though and complete a review of all plants once we straighten out these policy and technical issues sometime next year.

MR. MICHELSON: Once you straighten it out, are you going to issue then some kind of a guideline so that there is uniform treatment thereafter on what you finally decide your policy decisions are?

MR. DENTON: Yes. We had issued guidelines earlier and had meetings in every region with the utilities and the public to go over how we would carry out the Appendix R review.

MR. MICHELSON: The guidelines you issued earlier, were they --

MR. DENTON: That is the source of what is now to become reopened.

MR. MICHELSON: What guidelines are you referring to?

MR. DENTON: These were guidelines on how we would carry out the detailed review of Appendix R.

MR. MICHELSON: They weren't regulatory guides though?

MR. DENTON: No, they were not.

MR. MICHELSON: All right. Thank you.

MR. DENTON: Meetings were held in every region and were well attended and we thought we had a common understanding among all parties and that is the issue we are regrouping on.

MR. EBERSOLE: Harold, I would like to comment on this because I got involved in it so many years ago. I hate to think about it. I think perhaps you ought to subpoena the files on fire protection in TVA and start from that point because it has been a grinding matter for all these years.

But in any case, why isn't it reasonable simple to look on it like you used to do a large LOCA? You may in fact face a gross fire because your protectives measures were not 100 percent guaranteed or if you want to go further, you can assure that the plant will not be damaged by fire with appropriate compartmentalization which most plants don't do.

But in the final analysis if you admit to any vulnerability at all, there should be an independent and effective means of shutdown which is completely isolatable and by no stretch of the imagination is touched by fire influence at that time. I don't see why it can't be packaged up into a cohesive package and handled that way.

On the other hand, I think you find a big mess out in the field.

MR. DENTON: You may want to receive a briefing from the steering group--

MR. EBERSOLE: I think we should.

MR. DENTON: -- or the working group at an appropriate time. Maybe the next meeting would be timely.

MR. EBERSOLE: That would be a good idea.

MR. KERR: Mr. Denton, are we in a position where plants have installed or backfitted or whatever and how the staff may work out a position different than the one under which the fire protection backfit to satisfy Appendix R was done? My impression from what you said earlier was that the staff really has not reached a final position on how to do this.

MR. DENTON: We had reached what we thought was a final position. We held these regional meetings and announced how we were going to do it. We went out and did eight or ten inspections -- inspected eight or ten reactors. As a result of those eight or ten detailed inspections, a number of issues arose which sort of unravelled some of the earlier guidelines and that is what we are trying to decide as to we will either stick with the original positions or recommend a change.

We are not recommending changing Appendix R and as you guess, we have had to get legal advice on what does Appendix R really mean and then what technical --

MR. KERR: But if somewhere were trying to do the backfit right now, he would not be certain what the NRC position is.

MR. DENTON: Other than "meet Appendix R."

MR. KERR: And even the NRC staff hasn't quite decided what that means.

MR. DENTON: That is right.

MR. MICHELSON: One of the problems with Appendix R is I think it is clearer than you really indended.

MR. DENTON: I am getting a little bit beyond my exact knowledge of this lies more in the operating plants than it does in the new plants. In other words, I think for the new OL's that I mentioned, for example, I don't think this dispute occurs there. What we are talking about are the older plants and what kind of measures they take to satisfy Appendix R where they were never designed in the first place for cable separation and the issues get very, very complex.

MR. KERR: I thought I remembered that in this particular case the Commission itself became rather hard-nosed and established rather hard deadlines at the time at which compliance had to occur.

MR. DENTON: I think the history of that rule was that we had reviewed all operating plants against the branch technical position and then there were some new elements added in the rule that the Commission said that just satisfying the old branch technical position wasn't sufficient, you had to satisfy the entire rule.

So that has been what this process is trying to accomplish.

Finally, I wanted to talk just a little bit about technical specifications. The original approach for technical specifications dates back to the days of Marvin Mann and Roger Coe and a few other individuals who said that you really shouldn't make the utility meet the entire application and inspect against the entire application, that we should cull out of the application what are the most important process perameters that have to be controlled to assure that the plant is operating within the envelope for which it was reviewed.

That resulted in issuance of a regulation that required that every license contain a set of technical specifications and these technical specifications were to cover safety limits. These were limits on pressure and temperature, for example, power level. They were to cover limiting conditions for operation and specify what equipment must be in operation. They were to cover surveillance requirements for that equipment. They were to cover various administrative features of the plant such as off-site safety review group and those kinds of things patterned to a large extent, Dave, after the Savannah River approach to technical specifications since Marvin Mann had worked there.

I was on the task force that wrote the first set of technical specifications. I think we wrote them for the MIT reactor through Tommy Thompson's cooperation and since that time they have grown like "topsy" with once again as we became more and more specialized in the various technical areas, the detail of what operability meant and how much instrumentation had to be operable and how you do a surveillance became more and more detailed.

If you look at technical specifications today, they are a very thick package of often 500 pages or so. This then is the license that the plant is held to for its operating lifetime. I think a lot of us on the staff have come to the conclusion that it is time to revisit that issue. Have we defocused away from the principal safety perameters requiring by detailed surveillance of secondary, tertiary and lower important systems are we detracting from the attention given to the primary safety perameters.

Also, in Grand Gulf you recall questions were raised about errors in the tech specs and did the tech specs reflect the application of the plan that is reviewed.

We are putting more resources in this area now on every plant and I intend in the next few months to start an initiative in this area to revisit tech specs to see if it is now time for some revisions to the way we do tech specs.

I am especially concerned about the surveillance part of the tech specs. The real intent of the surveillance part of the tech specs was to assure that the equipment that you needed to rely on in the event of an accident would be reliable and would operate properly.

MR. EBERSOLE: May I break in at that point, Harold? You said something there that just trips me off. You said, "in the event of an accident" and by saying that, you excluded the fact that the plant is almost in a constant state of accident with respect to support equipment.

When you say "in the event of an accident," you imply that the safety equipment and the qualified equipment is standing idle waiting for something to happen. The plant is loaded with a number of systems which are on-line and you don't need an accident. You just have to have failure of support equipment. Everytime I hear the phrase, "in the event of an accident," I come apart.

MR. DENTON: Good point. I think the answer may lie and I think I see it the same way you do in improved preventive maintenance programs, for example. If you had a program such as a really good preventive maintenance program which would assure that equipment was reliable all the time, that would be the ideal thing.

MR. EBERSOLE: Sure.

MR. DENTON: Then you would not have to be testing it and I am bothered when I go into control rooms and find their clock running so-to-speak because of various equipment outages and there may be at any one time in a plant today half a dozen clocks ticking that if the equipment isn't tested or brought back into operation within various time intervals, the plant has to shut down.

There have also been questions of operability. If a brace on a pump is found not seismically qualified, then the pump is declared "inoperable." That is quite a bit different than having the pump disassembled on the floor being repaired in case it really is inoperable.

I have talked to some industry representatives about this and will continue to talk to them. I think I am inclined toward trying to pick perhaps a test case, perhaps a plant that has a PRA bringing up another sensitive topic to look at. I think it would be useful to have a plant that has a fairly comprehensive PRA if we can get the cooperation of that utility and take a hard look both philosophically, what kind of controls do we need on these plants, what is the optimum set, are we really covering the right perameters any more, are there areas where we should have an increased focus or a decreased focus.

Certainly if you look at the enforcement actions being taken today, a lot of enforcement actions are valid nonconformances to the tech specs but they don't tend to be in what I call the heart, for example, of reactor safety. They tend to be often times in the surveillance requirements of the tech specs.

I would welcome any thoughts you have and it is just at the starting stage and we will be forming up a group and trying to move out on this topic. I think it is a long term effort. I don't think it is anything that we can do overnight, but we are going to start working on it.

MR. EBERSOLE: I just think it is the greatest thing in the world to have you revisit tech specs and I thought it had been overdue for a number of years in a couple of aspects, for instance. I remember when we once looked at tech specs and found out they weren't indexed to plant conditions.

This leads to things like happened at Turkey Point where the disabled, both of the channels which protected against low pressure, overpressurization, at a time when they were precisely in the mode when it could occur. In many cases you don't need that particular protection because you are not in the mode that can challenge the plant.

At present the tech specs are not indexed to the plant conditions. You need a matrix system. Yesterday, we were calling out one of the anomalies of tech specs which is pretty much characteristic and which I guess I have used many times the analogy that when the pilot finds his landing gears are not working, he proceeds to land immediately. This is the case of the AC power case and many others. As the plant goes into a state of degradation, sure enough, the operator is called upon to put the residual equipment which is still working in a state of challenge when otherwise it would be simply sitting static.

The tech specs are loaded with all sorts of anomalies and I think it is long overdue that we get into them and index them or put them in matrix form and get on with it.

MR. DENTON: One reason that they have gotten so laborious, I think, is the desire of all parties for enforceability. The utilities want them written in detail so they would understand how to enforce them and so do our own people. But obviously requiring the control room supervisor to be preoccupied with 500 pages of material all the time is not perhaps the best focus.

MR. KERR: Harold, one of the problems it seems to me also is the number of backfits with which plants are still preoccupied. They don't really have time to do the preventive maintenance that they might otherwise have time to do that would help the situation some. Perhaps if we are getting somewhere out of the backfit jungle, part of the problem will be alleviated although certainly it seems to me a look at the tech spec situation is deserved.

MR. REED: As I understand the Japanese system which is pointed to for higher reliability and lesser challenges, the Japanese concentrate more on maintenance, preventive maintenance, and all kinds of maintenance and less on surveillance testing and other testing, surveillance frequencies.

Maybe they are too far on one side and we are too far on the other side. It seems to me there is a lot of survillance that shouldn't be on the frequency that it is and it does offer challenges so a revisiting of the tech specs is a good idea. Jesse just pointed out a very good one. I have actually been in a situation where the tech specs require going to a cooldown and it was very advisable. Now in those days, we broke the rule and were not put in jail for doing it, but there are alot of those things in the tech specs that should be looked at.

MR. DENTON: There are a couple other features that drive me toward revisiting tech specs. Prior to the Sholley rule, we had the ability to amend or change tech specs rather promptly. We could do a midnight change of tech specs if we found a situation where they weren't being effective. I can no longer do that.

With the requirements now on Sholley I have to notice the change. I have to prepare safety assessments and environmental assessments, offer hearings in many cases. I have issued, I think, over 1,400 Sholley notices in the last year, each one is a considerable package and I think about one percent of those do result in hearings of one kind or another.

So the fact that the system is becoming more rigid legally with regard to the changing of tech specs and the findings that have to be made have made it increasingly important.

Another fact that I wanted to mention is that we have tended to go towards standard tech specs and make everyone do the same surveillance but what you find is a utility with a really good preventive maintenance program doesn't need this very prescriptive tech spec. Perhaps another utility with a very poor preventive maintenance might need even more, so we have tended to devise surveillance times and out of service times based on a perception of a norm or perhaps a worst case and we haven't found a way to change it.

Maybe for the utilities who have very reliable equipment and have a record demonstrating that equipment is being maintained, you would need a less prescriptive program. We recently revisited just a very narrow issue. Westinghouse proposed changing the test interval for a part in their reactor protection system and I think it would be a relaxation of a factor of two to four in the surveillance times, making it going from monthly to quarterly, that kind of thing. I think we looked at that and we are on the verge of approving based on the demonstrated performance of that system. Their surveillance times were taking the equipment out of service more than necessary and the equipment is really more reliable than we were giving it credit for.

So I think the whole area both philosophically about what do we want to put limits on and once we define the tech specs, that by definition defines the inspection program because the two ought to be tightly coupled. So I will be coming back with you once we get this program formulated but I thought if you had an input, now is a good time as we begin to staff it and scope out what we are going to cover or if you are happy with the present tech specs, we could stay still.

MR. EBERSOLE: I am virtually certain we are going to set up some sort of an operation here to follow what you do and become quite closely involved with it, at least I know I am.

MR. DENTON: These were the four matters that I thought might be of interest today.

MR. MICHELSON: If you have just a moment and you touched on this in one of your matters, could you tell us a little more about your thoughts on the reliability assurance program and what is your scheduling plan?

MR. DENTON: That issue is wrapped up in the Indian Point proceeding. We had advocated the reliability assurance program to be put in place. I think simplistically we said it is a way to make the PRA come true, to look at your maintenance practices and priority of maintenance to be sure you are getting maintenance attention to the most important contributors to risk and that your operator training reflects this kind of thing.

It is fair to say that in our briefing to the Commission, they don't yet see that they have the value that staff does and they have asked us for more information so we will be sending them a more detailed description.

I did get a presentation of Limerick on how they intend to use their PRA in formulating operational things and I was very impressed by their plans there. But I think at the moment we are waiting for Commission action on Indian Point and on that particular item before going further. I get the feeling that the Commission thinks that more thought should be given to specifying exactly how it might be used in operations.

MR. EBERSOLE: Harold, may I go back to appendix R a little bit? In working this out, is the whole problem of Appendix R and fire protection taken as an integral matter where you look at the whole spectrum of capabilities to go to say shutdown?

I was recently out at that great old plant, Humbolt Bay, which has a super simple way of getting shutdown with a condensor and a few other simple things. It doesn't take a lot of equipment. So in a plant like that or maybe in a plant like Limerick which contemplates direct venting, you can afford to burn out a large portion of the plant and still have a perfectly safe shutdown at some price to pay of the abnormal mode of cooling. You don't need a degree of perfection that you have in other plants that don't have a capacity to shutdown with simplistic methods and very few pieces of equipment.

So when you do Appendix R, do you grade the needs of Appendix R according to the capability of the plant to get shutdown in the ultimate context?

MR. DENTON: That is our intent.

MR. EBERSOLE: It is a system problem.

MR. DENTON: Yes, and it has gotten wrapped into the remote shutdown panel--

MR. EBERSOLE: It is.

MR. DENTON: -- and being sure that the wiring from the panel going back to one single train is separate and it gets into questions about combustibles in a room. I think often a utility will claim we will never have a combustible in this room and therefore we don't need perhaps the full array of detection and suppression equipment and some of our staff will disagree to say that we can't assure that you won't have flamables in that room for all 40 years and therefore, you should put it in.

So the look we are taking is assuming Appendix R is the law of the land, what does it require and what does it mean for both licensing review and inspection and enforcement. It is an area in which there is a great deal of turmoil say between the industry and the staff over this area.

MR. EBERSOLE: Right. Until it is looked at as a system problem, it will always be confused. In the old ones there is not much more than a bunch of control wires. It contains no power equipment and so that leaves the fire equipment susceptible to whatever arrangement it is in. On the other hand a remote shutdown is competent which doesn't use that power equipment is another catch.

MR. DENTON: I just recently acted on a differing professional opinion on Connecticut Yankee, whether or not they had adequate equipment and if not, I should grant an exemption and if so to what part of Appendix R. We did involve in that review representatives from the Auxillary Systems Branch, representatives from the Chemical Engineering Branch. I had Faust Rosa give me his opinion on whether as a system there was one single protective train that could be used to separate and safely shutdown, go to hot shutdown.

I had legal advice on Appendix R.

I must say that when you get into the nitty-gritty of Appendix R, the mill grinds very fine.

MR. REMICK: Almost as bad as emergency planning.

MR. EBERSOLE: It is another case where if you turn it over to the specialist as you mentioned a while ago you have 40 kinds of, it can become a stack of monstrous problems, but if you turn it into a system analysis, it can come out much better.

I can see dedicated people who will never let anything ignite anywhere against a party who is also a fire specialist who says, "I don't care if it burns up or not" because I have another way to go.

MR. LEWIS: If we can come back to tech specs for one minute. You said something earlier that the tech specs represent the boundary within which the plant has been approved. It is not a safety boundary. It is a boundary of approval and it has taken on a very legalistic structure as you alluded to, a very rigid and legalistic structure. You can get fined for violating a tech spec.

It is like crossing a border. Some borders are softer than others and some you get fined more for crossing them. Has anyone made an effort since it has begun to lose shall we say some of the safety significance that it may once have had, has anyone looked at say a plant that has a PRA or is it beyond conjecture that in the management in deference to the fact that Jesse believes a plant is always in a state of accident, a downside fluctuation in the accident status of a plant, that it may be beneficial to violate a tech spec on one less vital portion of a plant in order to relieve stress in another portion of the plant during the management of an accident, but in which an operator might be inhibited for doing so because of the punitive potential of violating the former which would be a negative contribution to safety? Is that beyond conjecture?

MR. DENTON: No. I think that has the potential and when we granted midnight exemptions in the past before Sholley it was for some of those kinds of things where people would present facts on their plant that would be just that and we say, "Well, in fact it is better," so we would amend the tech specs simply by issuing a piece of paper several years ago that we can't do today.

MR. LEWIS: Just to follow-up for just one moment, if you take probabilistic risk assessment seriously, then you have to believe that on a plant for which a PRA has been done the most likely accident sequences are sort of the top "dirty dozen" in the list. Would it be sensible to scrub that list, pretend each one is happening and then ask this kind of question in some detail about each of these because if PRA is right, the downside fluctuations in the accident status will be in that general category.

MR. DENTON: I think it would be and that is why I am inclined to do a test case such as Limerick rather than a global because it is very hard to get agreement in general but find some applicant such as Limerick or Zion or someone with a reasonably complete PRA and do just that and see if we have all the proper requirements.

MR. LEWIS: I guess I am groping for the fact that nobody likes the overly legalistic structure, certainly nobody on the outside likes the overly legalistic structure but if there is indeed even a negative contribution to safety that is far more serious.

MR. EBERSOLE: Let me suggest you use Limerick.

MR. REMICK: Harold, I personally would like to applaud the revisiting the tech specs because I think they have become a tremendous burden in their current format for the operating staff and I don't think anybody knows all that is in them, any one person. I think it takes a combination of persons and it is very confusing.

Also, I think that the current format is impeding improvements to safety because of the Sholley Amendment requirements, the findings of no significant hazard, the noticing, the possibility of a hearing are impeding people making changes that they otherwise would because the risk that that creates by opening up things so I think many times they tend not to make changes that would improve.

In infer from your comment that you are speaking about the Appendix A tech specs and not the Appendix B environmental tech specs. I don't know if they are as burdensome. I have not been that involved. But in your review, are you including environmental tech specs?

MR. DENTON: I had not really focussed on that. I think the initiative is more in the Appendix A where I perceive most of the problems to lie. I had not heard references to Appendix B.

MR. REMICK: I don't know either.

MR. DENTON: I have taken up my hour and I have covered the topics and I have to get to a meeting upstairs as I mentioned earlier.

MR. EBERSOLE: We certainly thank you for coming by and I hope we can have these visits here more often than we have. It is very valuable to us to hear about these activities you are carrying out and I am sure all the members appreciate this. Any questions or comments?

(No response.)

MR. EBERSOLE: If not, we will go right into the next phase of today's work. Our next session is pressurized thermal shock. Is Paul here?

(No response.)

MR. EBERSOLE: Let's take a five-minute break

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because our chairman is not here.

(Whereupon, a short recess was held.)

B_L

MR. EBERSOLE: A couple of years ago the TMI-2 -- well, let's back up. After TMI-2 was decided that if operators had kept pumps on, life would have been different. So, the instruction went out to keep those pumps on. And, gee whiz, we have cursory relief valves, so we will let that take care of it. And that tended to make some of the metallurgists get red in the face and useasy in the stomach, because as you keep cooling the vessel and keep the pressure hot, you can ultimately get down to where, if there are any flaws in the vessel wall, you can rupture the vessel.

And so how to cope with that would come to be known as pressurized thermal-shock, combined cooling being the thermal shock where there is a temperature gradient in the vessel wall which sets up stresses tending to drive walls in from the surface, and the additional pressure inside would also have the potential of driving them through.

If the operators could be relied upon to keep the pressures dropping as the temperature came down, so that there was about 50 degrees F. sub-cooling, then there would be no PTS, but after TMI-2 nobody was sanguine about relying on the operators to thread that needle. And so we have ended up with an exercise that requires different -- well, to set up a rule.

And it is that rule that we will hear about today. There were probabilistic studies done, lead by Westinghouse and improved by others -- I have not followed that in the last year, or at least the last nine months. The staff took the position, and we wrote a letter back, October 14 -- well, it has been at least a year. The letter was written October 14, '82 -- two years, where they relied upon what is called the reference nil doctility, RT-NDT. This you may have bumped into with regard to temperatures that a vessel has to be, or the water has to be, before they can pressurize a system and start going up with nuclear power.

The number is one which is calculated from initial data, it does not depend on, or is not influenced by the surveillance capsules that are there, and is thus calculated to be an upper bound on what is expected for that vessel.

The staff decided that with the aid of probabilistic studies, and trying to set a definite number, that there would be particular limits, 270 degrees F on welds that were longitudinal, 300 degrees F for circumferential. And they would use that as a trip wire, or whatever you want to call it. The utility got to that point, they should come in and show cause for continued operation.

There is one fundamental question, if the water is such and such a temperature, and we know what that is in the calculations, what does that say about the temperature of the steel that is being cooled by that cold water coming in. And it turns out that the steel is not steel wall where this

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potential crack might be, is cooled as rapidly as they thought it was. And we will hear about those thermal hydraulic calculations.

They have also had concerns about whether a crack would run, how long, and how deep. We will also hear about that.

I think the upshot of the research, or at least the simplified bottom line is that each of these has shown that the original temperature limits taken are indeed conservative, the cooling is not as fast as had been expected, there is more mixing in the water and the cold water doesn't run down as closely to the steel walls, for example.

But the staff, after having drawn a line in the sand, I think still feels it is a good line and there has also been flux reduction programs with different reactors which we are likely to get soon. And the one set of numbers says that no utilities' reactor will pass that until the end of the century. And, presumably, they would then have time to do other things that might vary the flux, so that that would be pushed on further.

Althought the rule numbers might be shaved some, we do not wish to shave them now, I think is the staff position. There is no driving force to look at them harder, they seem like good conservative trip wires.

The rule has gone out for public comment. It has

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now come back for public comment. There is work on it in the eyes of the staff, it is approaching completion, as I understand it. And, so they are coming in with what is a finished document, or nearly so, and I think they would like a letter. I would assume we will hear more about that.

Are there any questions?

MR. CARSON: Two questions. These temperatures, 270 and 320 or 300, are temperatures in steel, not in water?

MR. SHEWMON: No, they aren't temperatures at all in the plant. They are related to it, but how is part of the question. They are temperatures at which the steel pressure vessel would undergo ductial revertal transition because of the transition temperature it started with and the amount of radiation it has had over a given amount of life.

MR. CARSON: That I almost understand. But they are temperatures attributed them to the medium, the metal?

MR. SHEWMON: Yes.

MR. CARSON: And is there anyway of knowing whether that temperature exists or has existed?

MR. SHEWMON: Well, that is a good question. I suggest you save it for one of the speakers, Brother Ray will devote some time to that, he's the thermal hydraulic expert.

MR. EBERSOLE: Paul, it is sort of a coincidence, but later in the day we are going to hear about this strange set of events that has resulted from laminar flow in big pipes

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wherein a hot streak at the top of the pipe has caused 20, 24 inch pipes to bend like a tube and to pull their anchors out at the extreme ends. And, thus, there has been a phenomenon going on which has been ill-understood, directly related to whether or not you do get mixing.

So, we will look at this mixing business somewhat carefully. I believe these are mostly vertical surfaces we are looking at here, aren't they?

MR. SHEWMON: For once the research programs are ahead of us, they have been looking at mixing for a couple of years.

MR. REED: I would like to get a little bit of clarification on this. You said if the operators could be depended upon to thread the needle, and I want to find out how small the needle hole is and how fine the thread. Could you clarify whether or not if a primary blow valve system existed on the PWR, or as some people talk about, bleed and feed system for cooling down a hull or two, a sure cooling, would that be enough of a threading of the needle, would pressure be lowered fast enough, so that the temperature that you might see in the metal would always be acceptable on NDT?

MR. SHEWMON: I have been told that what I said was true. That is not my field well enough that I care to defend it, or can actually competently answer your question.

I would urge you to bring it up with the staff later,

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they know more about it than I do.

DR. MICHELSON: Paul, is it possible that this situation can be gotten into, say, during a warm-up in which the water is warmer than the vessel walls, and then you pressurize the system? In other words, all the temperatures that you are concerned about, is it --

MR. SHEWMON: No, because the innner wall has a lower transition temperature because it has seen more fast neutrons than the outer wall. And the main concern is when you put that -- when that is cold and that is intention, and it is the cold wall that is intentioned.

DR. MICHELSON: Thank you.

MR. OKRENT: The things you mentioned from the research tended, if I understood correctly, to make it appear that the staff's current proposed criterion is on the conservative side.

MR. SHEWMON: It is my impression that the research results have increased the margins, instead of decreasing them.

MR. OKRENT: Did they report any research results that go the other way at all?

MR. SHEWMON: I don't know of any, but that is why they are here, so we can ask them.

MR. REED: I notice in some public document at Robinson 2, which was one of the most critical pressurized thermal shock vessels, has now been taken off the list of near-term problems. They did a number of things. Does that mean that research has been more favorable, or the specimen examinations have been more favorable?

MR. SHEWMON: You are talking to somebody who hasn't attended a subcommittee meeting on this subject in a year, or a year and a half. So, I really think we ought to turn it over to the staff at this point, and see what is going on.

Frank.

MR. SCHROEDER: My name is Frank Schroeder, NRR.

I am going to start this off, my part will be fairly brief, and then we will get to the meat of the discussion that Dr. Shewmon mentioned.

But I want to say just a few words about the status of the rulemaking itself, and emphasize that we are interested in an ACRS letter on that. I will then say a few words of introduction as to the objectives and basic elements of the continuing program which goes beyond the rule, aiming toward the ultimate resolution of the safety issue. And then we will have three status reports, and I would like to emphasize that because these programs are not finished yet, on three of the elements of the long-range program. Carl Johnson from research will talk about the plant-specific analyses which are being done; Jose Reyes will talk about thermal mixing studies, and Milt Vagins on the pressure vessel fraction mechanics research.

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Just to refresh your memory a little bit, Mr. Shewmon, again, has already given you a little bit of the background. It was back, as he indicated, about two years ago that we made presentations to the committee and got your letter; in November of '82, we went to the Commission with a fairly large Commission paper which laid out the bases for the screening criteria approach the staff was recommending, which ultimately led to the Commission's agreement that we should prepare a rule.

The rule went back to the Commission in July of '83, and was published in the Federal Register February 7th of this year. The comment period ended in May, and since then we have been digesting and sorting out the public comments. They are described in some detail in the Federal Register notice which you have a copy of, the draft of the Register notice.

I will go over the more significant of them in just a moment.

The final rule package then has been prepared, and you received copies, or you were sent copies of it September 14th, at the same time we moved that package forward to the CRGR for their review. Our future schedule, we are meeting with you today, we are meeting next week with the CRGR, and we hope to be down before the Commission requesting approval to publish the final rule in effective form about the first of December. So, we would like a letter in that kind of time-frame from the committee.

MR. OKRENT: Is there some pressure at this time to put out a final rule, and if so, what is the source of the pressure?

MR. SCHROEDER: Well, there are several sources of pressure, I guess. One is simply that of the usual pressures on scheduling and resolutions on unresolved safety issues, of which the issuance of this final rule is one of the intermediate milestones.

There is in my mind pressure in the sense that I think having taken the initiative to propose this rule which has as one of its central features, a requirement that where necessary, licensees carefully evaluate reasonable flux reduction programs, so as to prevent reaching the vessel properties that we are unhappy with.

I think it would be a mistake to back off and not follow through with the issuance of the rule. I think it would send the wrong signals to everybody. The industry has been very active since we first got into this subject in taking a serious look at flux reduction, and in fact, as someone indicated, plants like Robinson, who were at the top of the list originally, are no longer of great concern, partly because they have gotten a better fix on the materials in their plant, but also, partly because of the flux reduction

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measures that are being taken in a number of these plants.

MR. OKRENT: Well, are there any plants that are within a few years of having to begin to do an analysis, because they might be approaching the threshold?

MR. SCHROEDER: No.

MR. OKRENT: So there is no pressure from that --

MR. SCHROEDER: There is no pressure from that direction. If you assume that the good things that people have done since we started into this exercise will continue to be done.

MR. OKRENT: So, a month or two --

MR. SCHROEDER: As Dr. Shewmon indicated, it is going to be towards the end of the century before any plant hits the screening criteria. And, in fact, it is entirely possible that no plant will, if they take proper flux reduction action.

MR. OKRENT: I am asking you a question, are you able to tell me what likelihood of pressure vessel failure you believe the proposed rule is accepting at the median, and then at a high confidence value?

MR. SCHROEDER: I am searching the files -- I didn't come prepared to discuss this.

Carl, do you remember where the numbers come out?

MR. SHEWMON: Is Carl Johnson ready to discuss that?

MR. SCHROEDER: Carl's numbers will show that.

MR. SHEWMON: Why don't we hold that --

MR. SCHROEDER: My recollection is that on the generic curves that we used to develop the screening criteria, we were talking in the range of 10 to the -5 per year, frequency of a thru-wall crack.

MR. OKRENT: Well, I would like to know what the staff's best estimate today, as distinct from two years ago, because you have learned more. Do you still have the same proposed screening criteria, since you have learned more -- what your best subjective estimate is of what pressure vessel frequency would be, compatible with the rule, and if you have more than one mode of failure, then distinguish the two.

In other words --

MR. SHEWMON: The presentation will get to that, please, let's put it off until then.

MR. OKRENT: I would be happy to do that.

MR. SCHROEDER: Again, just to refresh your memories, and we have already talked about some of this, these are the principal elements of the rule.

First, we have established the screening criteria, in terms of the reference temperature that Dr. Shewmon described. We have, secondly, prescribed a specific method of calculation of that number for use in comparison with the screening criterion, that's prescribed in the rule. The rule requires then that all licensees perform those calculations for their vessels, project them to the expiration date of their operating license, or any longer date they care to, and compare with the screening criterion.

The rule further says that if those projections say that they will exceed the criterion before the expiration of the license, then they must take a look at reasonably practical flux reduction programs that would prevent exceeding it by the end of the operating license and lay out a schedule that would achieve -- a schedule for implementation of those measures that will achieve that objective.

Then, finally, if, inspite of those efforts, they still project that they will exceed the criterion, then the rule requires that three years before they exceed the criterion, they come in with a plant-specific safety analysis of the risk and of the measures that are proposed to reduce that risk. And NRC approval would then be required by the rule for any operation beyond the screening criterion, that approval apparently based on our review of the evaluation that are required.

So, those are the essential elements of the rule.

MR. OKRENT: Could I ask again, just a general question. In the development of the rule, and in the analysis that led to the answers I am going to hear in a little while, there were certain assumptions, or you can call them evaluations of available data and so forth, as to, for example, 13 the likelihood of a flaw of a certain size appearing, or the likelihood of a transient of a rate and extent occurring, and so forth.

Suppose either for all of the PWRs, or for a class of PWRs, there developed information that looked into question one of the sort of correlations or assumptions, whichever they are, after the rule were adopted. What would the staff do in that case?

I am just trying to understand.

MR. SCHROEDER: I think clearly if we uncover new insights or new information that convinces us that the criterion are no longer appropriately conservative to accomplish what we are after here, to use as a screen, I see no choice but to amend the rule.

MR. OKRENT: Would that be hard to do?

MR. SCHROEDER: No, it takes a little time. But, again, while it is a moving target in the sense that vessels get worse with time, it is not so fast that we don't have time to take such action. There is also the possibility that we may uncover something that is more plant-specific. You may say for this plant, or these two plants, I am convinced that the generic solution no longer applies.

And in that case, instead of amending the rule, just initiate plant-specific action to fix the problem.

MR. OKRENT: You are able to do that, even if the rule says 300, you might decide there are these three plants here that you really ought to use 220 for?

MR. SCHROEDER: Yes, if we have a safety concern of sufficient likelihood, and we are concerned about it.

It occurs to me that in such instances you may very well have a situation where PTS is perhaps only one of the concerns. In other words, if you have developed a scenario for an event, in a particular plant that may be of concern for PTS, may challenge whether the generic curve applies to that plant, it may also be a problem you don't want to live with for other reasons and you want to fix it.

MR. OKRENT: But you have the legal flexibility to do something anyway, even though --

MR. SCHROEDER: We can always issue orders or letters.

MR. EBERSOLE: Go ahead.

MR. REED: Will you tell me when it is time to ask this question that I raised at the outset. I don't know, but it seems like we are close to it.

MR. SHEWMON: We have two and a half hours, and we have some speakers on that coming up. This guy is the generalist.

MR. SCHROEDER: I am the one who doesn't know the answers.

MR. EBERSOLE: Isn't, as a matter of fact, the probability that the real problem is in the unique cases, or rather the individual cases, rather than in the general application? That is the crux of the real problem.

MR. SCHROEDER: The rule is structured this way, because, well, we are reasonably satisfied if you stay below the criterion, but if you are going to talk about going above it, it may be all right, but if we are going to go above it, we want plant-specific --

MR. EBERSOLE: And part two, where it says prescribed RT NDT correlation, isn't it true that embedded in that is where the problem is, and how you are going to sharply define how one is going to do that correlation?

I am thinking about copper content and all the recipe business.

MR. SCHROEDER: Well, it is a bit of a moving target, but --

MR. EBERSOLE: I am saying that that part looks hard.

MR. SHEWMON: If you have technical questions, ask Vagins later. Let's get on with the public comment, please.

MR. SCHROEDER: Okay, I am going to very quickly run down the more significant comments. We got letters, by the way, from 14 utilities, three vendors, one AE and AIF and two public citizens, which broke out, when you sort of threw them into 180 individual comments -- there were a lot of duplications, so we were able to group them together, which is what we did in the discussion.

The one that was made, I suppose, most frequently by the industry was a concern that while they supported the idea of a screening criterion to trigger performance of analysis, they were unhappy with the fact that the ruling went further and said NRC has to approve operations beyond the screening criterion.

And there were suggestions that we eliminate that provision from the rule, simply say that it requires an analysis and if the Commission then, on the basis of that analysis, isn't happy, the Commission can take action to shutdown the plant, or to require something more, rather than making it overtly on the operating limit, in effect.

And our conclusion on that was, no, we didn't think that was a good idea. The Federal Register notice tries to explain our basis for that a little bit, namely that we derived the screening criterion on the basis of a generic evaluation which has a lot of difficulty with it in that regard, but we think it is good enough to serve as a screen.

And if anybody is going to talk about operating above the screen, in the staff's view the burden of proof is then on the licensee to come in and justify why that is all right on the plant-specific basis.

So we have retained the approval requirement.

There was also a criticism in the original wording of the rule we talked about if the original plant-specific analysis wasn't good enough to provide a basis for operation beyond the criterion, that the licensee had to come in and specifically request such approval on the basis of a new filing which had additional changes, modifications, or so on, beyond those in the first filing.

The commenters pointed out, you know, you all also ought to allow them to do some re-analysis and use some new information. And we had to agree with that. So, we changed the wording to make that clear.

Some of the commenters were concerned that because this reference temperature RT NDT is used in a number of places, in ASME codes and Appendix G of our regulations, and for a variety of purposes, that there was confusion that we, in this rule, were specifying how to calculate it, and that might cause confusion because in other documents it might be allowed to be calculated differently.

We agreed that was a source of confusion, so in the revised final rule, we have defined the term RT sub PTS as the quantity that we are going to calculate for the prescribed method and compare with the screening criterion.

There was a comment that in the plant-specific analyses that the rule would require some licensees to submit justifying the safety of their plant, that they should be allowed to use other RT NDT correlations, other than the one prescribed in the rule -- make use of best available knowledge and so on. We agree with that. We have added some clarifying words to make that clear, as long as they can justify those they use, they are free to use any correlation they want in that plant-specific analysis.

However, we also made it clear that that doesn't mean they can use any other form for the purpose of measuring against the screening criterion. We want those all done the same way, we want all plants to calculate it the same way, as nearly as possible; plus the fact that in picking the screening criterion, we had very definitely in mind that that is the way you were going to calculate this quantity, recognizing that the calculation has some conservatisms in it that we wanted. So, we did not permit any backing off on that score.

We changed the definition of some of the terms in the correlation to make clear that we would accept best estimate values on copper, nickel and fluence in those calculations. That was our intent in that regard.

A number of licensees thought that the rule was bias excessively in the direction of requiring flux reduction measures. I guess I would have to agree, except for the word "excessively", I think the rule is biased toward a strong encouragement of flux reduction measures. We think that is the best way to fix this problem. But the comment was to the effect that alternatives to flux reduction should be allowed.

Well, in careful examination of the rule, there is nothing in the rule that precludes such alternatives. It simply says that they must evaluate flux reduction measures, show what can be done with them, on what kind of a schedule. But there is nothing to prevent them, assuming there is time and there is in the real world, to come in with a justification for operation above the screening criterion on other grounds that don't require flux reduction.

So, again, we added some words that hopefully made that a little clearer, but also cautioned that any such tactic should not preclude the efficacy of flux reduction measures by delay in their implementation.

MR. AXTMANN: Could you give an example of alternatives that they might propose?

MR. SCHROEDER: Well, I guess the one that you hear most often -- I think I can get better data on my materials, I can do a better regression analysis to come up with a different formula for RT NDT, I can fine-tune the thermal hydraulic analyses that went into this, and I can show you that there is no real problem if I go to higher temperatures with my plant.

MR. EBERSOLE: Are they doing any actual chemical analyses of the copper content?

MR. SCHROEDER: Chemical analyses for copper --

MR. EBERSOLE: Do they take samples and see, in fact, what the welding process --

MR. SCHROEDER: Yes, particularly some of the plants that were on the top of the list. One of the reasons they were on the top of the list was uncertainty in those values, and some have gone in and taken samples. And they have searched archival records and gone to some length to nail down the initial property values in the materials.

Some commenters objected to the provision in there that they periodically report, if they have changed anything -- significantly changed the projections. We think we need that to know what is going on.

Another significant comment which gets back a little bit to Dr. Okrent's question about urgency, is there were several who felt that we ought to delay issuance of the rule in final form, until the staff had published the guidance and acceptance criteria that they were working on, which is an end product of the longer range PTS program.

Our view on that is, for the reasons I mentioned before, is that we think we ought to keep the momentum -- or get the rule in place. The guidance will be out in about a year and nobody is going to need it until long after that. So, we put some words in to indicate that and to indicate that in no event, if there are some plants that we hadn't thought of, that for some reason or another should have to file a plant-specific evaluation sooner, before the guidance, we said -- we put in a provision that instead of three years before reaching the criterion, it is three years, or one year after the guidance is out, whichever is later. I don't expect that situation to arise.

Finally, and very quickly, moving right along -- the Commission specifically asked in the notice for opinions as to whether three years or five years would be more appropriate for lead time on the analysis. I believe it was 10 out of 11 responders said three years is just fine; one of them said, yes, five years might be a little bit better. We left it at three years.

The Commission also asked whether -- asked for comments on whether the thernal annealing paragraph in Appendix G of our regulation ought to be deleted, in view of the fact that it didn't seem to be producing anything anyway. The response there was overwhelmingly yes, they felt it should. The rule package you have before you does not do that, it simply states the Commission's intent to initiate rulemaking to do that.

MR. SHEWMON: Appendix G says you cannot ever, ever anneal a vessel, or what?

MR. SCHROEDER: No, the paragraph that would be deleted from Appendix G, as I understand it, is the one that says if at anytime before end of life your upper shelf energy gets greater than 50 pounds, or the RT NDT is greater than 200, that the vessel must designed to permit annealing. And the argument here is that's really an economic decision, you know, why dictate that they must be capable of annealing; an option is to shutdown when it reaches that point, or an option is to do something else.

MR. SHEWMON: Well, that would be something that would apply to new plants, because the ones we have are constructed to meet Appendix G.

MR. SCHROEDER: (Shaking head) It is my understanding that Appendix G was a design requirement, rather than an operating requirement.

MR. VAGINS: The timing of an issuance of Appendix G and the timing of construction of most plants precluded their -- in fact, most plants in existence were designed to that level, so presently the question is kind of yes or no.

MR. SCHROEDER: Now, just a few words of introduction to the other speakers.

We have the continuing USI A-49 program, which goes on beyond the issuance of the rule. That continuing program really has three major objectives: first, we want to do some plant-specific analyses, we picked three plants that we are looking at in fair detail, to test the generic basis that we used in the rule. If we find something in those plants that brings into question the applicability of the generic test, then we will decide what we have to do.

We also want to develop guidance for the licensees in performing the required plant-specific analyses on their plants.

So, on the basis of staff and contractors having done such analyses, we are going to provide guidance to the licensees on what the essential elements of those analyses ought to be.

And, thirdly, we want to develop some thoughts about what are the staff's criterion going to be, if a plant comes in with such an analysis and wants to justify operation beyond the screening criterion, on what basis will we decide whether or not that is all right.

So, again, building on the plant-specific analysis we will do, plus the research that is going on, we are going to try to come up with -- by the end of this fiscal year, we expect to go to public comment with the first cut, and what will probably be a regulatory guide to provide guidance for the submittal of these analyses and criteria for judging their acceptability.

DR. MARK: Would that be then the close out of A-49?

MR. SCHROEDER: Well, by that do you mean the date? That is the final milestone of A-49, is the issuance of that guidance. The end of this fiscal year date was going out to public comment, so there is still another cycle after that.

Okay, the major elements of the program that lead into those objectives than are, as I have already mentioned, the three plant design prototype analyses, the thermal mixing studies that you will hear about in a moment and the pressure vessel research work.

We also have programs looking at the potential failure mode of the vessel, given the thru-wall crack. This is all building towards the acceptance criteria kind of argument. What are the consequences? Everything so far has been taken to the point of the probability of a thru-wall crack, and we have pretty much stopped at that point.

So we are looking at potential pressure vessel failure modes, we are looking then at the consequences of pressure vessel failures coming out of those modes, in terms of doses, et cetera. We are looking at potential corrective actions, things that can be done in the plant to make the situation better in terms of their costs and their risk-benefits. And then finally, the development of the guide itself.

MR. OKRENT: Is it possible at this point to rule out vessel failure modes that have a probability of at least a half of an early loss of containment associated with the vessel failure?

MR. SHEWMON: Do you understand the question?

MR. SCHROEDER: Generally, but I am not sure how to answer it.

MR. SHEWMON: If you do, will you explain it to me?

MR. ORKENT: I will repeat the question in different words. There is some chance, ranging from zero to one, that if the vessel fails, there will be early failure of containment because of the violent nature of the vessel failure. And I am asking do we know enough now to place that probability in some quartile of the range, or are we unable to say now that it could be -- to say, no, it can't be as large as a half?

MR. SCHROEDER: Staff hasn't reached a judgment on that yet. This work is pointing in that direction. Some of the stuff I have seen from the vessel failure mode work suggests it is pretty unlikely that you are going to get immediate containment failure by missiles and this sort of thing. That is not a staff judgment.

MR. SHEWMON: It is primarily at the core, primarily inner wall, how far the cracks will run was one of the earlier concerns. And Vagins will talk about the best speculation on this. But I don't think -- as you said, the staff has not reached a judgment.

MR. SCHROEDER: Most of the work that goes into the question, it is not one of these three that we are giving you the status on today, it is some work being done at PNL, which we are not ready to report to you yet.

MR. OKRENT: That work will also be done before the USI is closed out?

MR. SCHROEDER: Yes, these are all feeding into the development of this guidance.

I would just like to make one last point, before I turn it over. As an example, Davis raised the question about what would you do if you found out this, as an example, right now in this program, we are taking a hard look at a sequence which has been postulated, as a matter of fact, out of the A-47 program. It is an overfill sequence involving multiple failures, and we are taking a very hard look at that, to make sure that that doesn't fall into question in the generic curves that we have, and we will continue to do that sort of thing in the program.

MR. OKRENT: If it did, you would just do something special with those plants, is that it?

MR. SCHROEDER: Well, as I said before, it really depends, if it is rather plant-specific, or specific to a few groups of plants, then it might be better to focus in on fixing that problem, rather than to change the generic screening criterion for all plants. So, I am not at the point of having an opinion on that, or whether, in fact, it requires any change, that is probably more likely. It depends on who you talk to.

MR. SHEWMON: Is that all?

MR. SCHROEDER: Yes, the next speaker is Carl Johnson, who will talk about --

MR. LEWIS: While he is walking to the podium, can I ask an elementary fracture mechanics question? In the belt area of a pressure vessel, is a longitudinal crack or a circumferential crack more likely?

MR. SHEWMON: They usually run around the weld, most of the welds run longitudinal. I think very few have circumferential in the middle of the core --

MR. LEWIS: I understand that. If the vessel were homogeneous, would there be a preferential direction?

MR. SHEWMON: We will ask Vagins when it comes up.

MR. LEWIS: It is so elementary, I just don't know it.

MR. SHEWMON: Longitudinal from the gallery, okay. Thank you.

MR. JOHNSON: My name is Carl Johnson, I am an NRC staff assigned to the research office.

I would like to discuss what we have learned to-date from the research project to analyze the probabilistic analysis three plants, based on the design of Oconee, Calvert Cliffs and Robinson, to see if when we look at a detailed plant-specific analysis we find something different than from the generic analysis.

The specific objectives are to estimate the likelihood of a thru-wall crack, to identify what is important in terms of accident sequences, operator control actions, and uncertainties, to compare the risk reduction effectiveness of postulated corrective measures and to identify differences from a PTS standpoint between the three plants analyzed.

DR. MICHELSON: You say you are looking at the likelihood of vessel failure, are you also looking at the likely configuration of the failure?

MR. LEWIS: No, sir, that is the next project -- this feeds into the project that Frank talked about, that looks at will this lead to a LOCA, will it lead to a containment failure, what kind of release, what kind of consequences.

The study plan is to use probabilistic analysis to integrate data on plant design and operating procedures with its thermal hydraulic behavior, with the metallurgy of the vessel. The way it works is three utilities, Duke Power, Baltimore Gas and Electric, Carolina Power and Light have contributed design data and operating procedures, and have helped the study team to understand how the plant works, and have helped us to try to assess the accuracy of the models in representing in plan.

The Oak Ridge National Laboratory used an event-tree analysis to systematically delineate sequences that could lead to over-cooling, quantified the frequency of occurrence of these transients in a fairly simplified manner. Idaho and Los Alamos calculated for each plant a sample of a dozen or so of these transients in detail, to calculate the pressure and temperature during the first two hours of such a transient.

In addition, about 100 or so other transients of interest were estimated in a more simple manner, and each of these then was run into the fracture mechanics analysis at Oak Ridge, where these transients in the water temperature were converted into a heat transfer coefficient, worked up in a manner that Jose Reyes will be talking about -- what those temperatures were in the vessel wall and the supposed thermal stresses, and then a probabilistic linear fracture mechanics analysis to calculate the conditional probability of a thru-wall crack versus effective full power years.

Then this conditional probability failure, given the transient times the frequency of occurrence for that transient, summed over all transients, gives the frequency of a thru-wall crack versus effective full power years; examination of those results identifies what is important, and a sensitivity analysis helps to identify and compare the effectiveness of postulated corrective measures.

DR. MICHELSON: Do any of these plants have direct injection?

MR. JOHNSON: Into the cold? Well, in this particular analysis, the temperature never came down low enough to the point where any direct injection into -- let me say it again.

The pressure never got down low enough to turn on anything that would squirt water directly into the pipe --

DR. MICHELSON: Pressure safety injection --

MR. JOHNSON: High pressure injection in these plants all came into the pipes.

DR. MICHELSON: That was my question, none of these pipes had direct high pressure injection?

MR. JOHNSON: No.

DR. MICHELSON: Don't some of the older plants have that? I mean, don't you have to account for that analysis?

MR. JOHNSON: Well, these are three specific plants.

DR. MICHELSON: I realize that.

MR. JOHNSON: I don't know what the other ones do.

DR. MICHELSON: I just wondered if you made a special case out of any of them, if any of them have special injection.

MR. JOHNSON: No, we didn't.

MR. REED: There are some that have direct injection, but they are into the inner barrel, inside not adjacent to the wall, although they penetrate through the wall, the in going pipes penetrate the reactor vessel wall, then go into the barrel, the upper barrel. I am not sure what that all means.

MR. JOHNSON: One of the things that can be done after you have completed this is compare the differences between plants and these plants, and existing plants, and try to generalize on this, but that is not part of this analysis.

MR. EBERSOLE: May I ask, one time it was told to me that the limiting or controlling aspect of whether or not you were going to over-chill the metal was really set by what I think somebody called the conduction coefficient, or whatever -- it was conduction limited in the metal.

And I don't know whether I ever believed that, or not. The transfer coefficient has got a lot to do with it, doesn't it?

MR. JOHNSON: Sir, we did a sensitivity analysis on this analysis, and the heat transfer coefficient turns out to be an unimportant parameter. Jose Reyes will show you a graph that shows why.

MR. EBERSOLE: Is it the conduction in the middle?

MR. SHEWMON: Why don't we wait until we see that view-graph?

MR. JOHNSON: The conduction in the middle, the heat transfer, the time constant for the metal is on the order of an hour. So --

MR. SHEWMON: Why don't we wait for that?

MR. JOHNSON: This picture here for, Oconee is right here (indicating), this is the frequency of a thru-wall crack versus effective full power years, this is also a proportional defluence and this is the mean surface RT NDT. And if you add two sigma to the mean, then you get our screening value cf 270 degrees F. So this shows a frequency of a thru-wall crack of about five times 10 to the minus six per year for this particular plant.

The major class of sequences leading to this is steam line -- large steam line break, which includes things like stuck open valves, or breaks in pipes.

Other classes of transients, like feed water transients, LOCA, are much less important.

MR. SHEWMON: What are those lines?

MR. JOHNSON: What are the numbers you mean? This is a point estimate. I am going to give you some estimates of uncertainties in a minute.

MR. EBERSOLE: The main steam line failure, to compound the effect of that, and it is not unlikely, one ought to say that it occurred and it was coincidental with failure of the main feed water control system?

MR. JOHNSON: Yes.

MR. EBERSOLE: So that you flooded the secondary side with cold water, is that what that does?

MR. JOHNSON: Yes, sir. These are groups for simplified presentation of many different transients. The project divided this thing up of possible transients into an enormous number, more than a million, identified a number that were worth looking at, and then the ones that were less frequent than 10 to the minus six per year, what turned out to be this residual, which in the improved analysis meant that on the next plants got rid of, but yet those are included, multiple failure things are included in here.

MR. OKRENT: Before you leave that, getting back to the overfill of the steam generator, is it estimated that that transient can lead to steam line rupture, in what you have done here, or that --

MR. JOHNSON: No, that is in the A-47 analysis, one of the things that turned up is a class of transients -- these are assumed to start from a reactor terminal trip. The A-47 control system generic issues turned up some transients that start from full power with an overfeed from full power, and then reactor trip, and continuing overfeed.

We are having Oak Ridge, who is also doing the A-47 analysis on that, look at that to see what difference that makes to these answers in fiscal 1985, to look at how does it change the frequency of occurrence, or severity of occurrence.

In a preliminary look-see, it indicates to me that it won't make much difference in either frequency or severity, but we are having Oak Ridge take a look to see.

The reason I don't think it will make much difference is this assumes a steam line break frequency, a main steam line break frequency of 10 to the minus three per year; and that is pretty high anyhow, compared to how you could get to that kind of a situation from this other sort of an overfill transient.

And in the frequency of occurrence -- in the severity, Idaho did some analysis of how cold the things get if you start with a steam line break, with water out in the steam line versus one with water back in just the steam generator. And it makes no difference in the steam generator, basically you are blowing down to saturated pressure in the steam generator anyhow, so you end up with about the same temperature in the steam generator -- you do get a little cooler in the reactor vessel, but not much.

MR. EBERSOLE: Is the 10 to the minus three per year based on the control failure that leads to a steam generator overfill on subsequent refilling of the main steam lines with water, and then subsequent failure?

MR. JOHNSON: No, that is just a break.

MR. EBERSOLE: Just a break, just a sponteneous break?

MR. JOHNSON: Yes, sir.

MR. EBERSOLE: Well, isn't that probability a great deal less than the likelihood of overfilling, if you have a metal design main steam line, and then having your main steam line failure as a result of overfill?

MR. JOHNSON: I don't remember the numbers, but the way these numbers are quantified was to take the plant experience, the Oconee plant experience, the B and W plant experience in general, and use them much as was done in the precursor analysis to get the numbers.

MR. EBERSOLE: It is metallic failure, or static failure, it is not control failure that you are using?

MR. JOHNSON: That's right.

DR. MICHELSON: If I understood your previous reply, I thought you said that even if you overfill and then ruptured the main steam line, that the consequential blowdown was not much more severe than in a steam generator blow down through a steam line break without overfill, is that correct?

MR. JOHNSON: That's right.

DR. MICHELSON: I think you said it really didn't make much difference --

MR. EBERSOLE: Of course, but the question is not that, it is the relative probability.

DR. MICHELSON: I am just trying -- that is a separate question.

MR. JOHNSON: Well, we are asking Oak Ridge to take a look and see what is the difference. I can't tell you the answer.

MR. EBERSOLE: The difference in consequences -- I hear you say it is not much.

MR. JOHNSON: It appears like it is not much.

MR. EBERSOLE: The problem is the relative frequency. I should suspect the relative frequency of steam generated overfill is a great deal higher than a static failure of a steam line.

MR. OKRENT: Is there any calculation that has been done where you overfill the steam generator and rupture the steam line, and this causes trouble, so that you also compound it with --

MR. JOHNSON: Well, this is the A-47 analysis that -- the class of transients that we are taking a look at, and I don't have the answers yet. When we say that it looks, from a thermal shock standpoint ,that the consequences aren't much worse. And remember, the LOCA here doesn't mean much, doesn't make much difference. So, you wouldn't expect that that added to this -- or the severity of this is going to make much difference. And the frequency of this is 10 to the minus three of the event happening.

So, we will see -- we will see what the answer is.

Let's take a look at what we have learned from this, one of the things is to try to find out what is important. Well, if said the dominant sequences involved steam line breaks; important plant features of this particular plant are the vent valves and the mixing that prevents stratification, that is why the LOCA is unimportant for this event. And an interesting thing is that quarter-inch flaws are important to PTS, of the flaws that are calculated -- of the cracks that make it through the vessel wall, more than half of them start from initial flaws an eighth or a quarter of an inch deep.

MR. OKRENT: Suppose they did an inspection and turned up a flaw then that was three-eighths of an inch deep, what would this mean in a regulatory sense, if you had this rule?

MR. JOHNSON: I can't answer that.

Can anybody help me? You mean how much of a risk would it make?

MR. OKRENT: Would the staff be in a position where it would have the flaw fixed, or -- I am trying to understand how to interpret that statement.

MR. JOHNSON: Let me tell you how I interpret it, it means that in-service inspection to be effective needs to be able to identify small flaws, three-eighths, quarter, whatever.

MR. SHEWMON: That three-eights inch flaw happens to be in a vessel which has no cladding, but all of the vessels out there have cladding. So, that is a hypothetical question, when you discuss what it would mean in a real vessel. I think what has been said is that small flaws can be important.

MR. OKRENT: Let me ask a different question. In the analysis you do on probability, you include some estimate of the likelihood of missing flaws of this size?

MR. JOHNSON: One of the sensitivity analysis was to say suppose you could change the effectiveness or the reliability with which you could see flaws, and it did make a difference -- this is just a para-metric analysis -- and it did make a difference. It is questionable how much -- whether to believe it, so I didn't put it down here, because it requires that you be able to distinguish quarter-inch flaws, or eighth-inch flaws.

So, I thought the main conclusion to draw here is that quarter-inch flaws are important. If you are interested in in-service inspection for this purpose, you need to find someway to measure those and identify those.

MR. REED: Do you mean by flaws, cracks on the inner walls, or do you mean inclusions or such as that that might be in the plate?

MR. JOHNSON: The analysis assumes that these flaws are, indeed, cracks that are accidentally lined up in an axial weld, or are lined up with the weld and go from there. Now, that is a conservativism, perhaps, in the analysis.

MR. SHEWMON: A string of inclusions would help, for simplicity they always assume the flaw is a lot longer than it is deep, so the flaw would have to be on the surface.

MR. OKRENT: Excuse me, I am trying to understand the significance of this. Is it important that when people do the in-service inspection, they find flaws a quarter-inch, or larger, with a very high degree of liability, is that what that says?

MR. JOHNSON: No, it says if you are going to take credit for having removed flaws from it, you need to be able to identify this many -- you need to identify flaws this small.

MR. OKRENT: Well, does the calculation assume that there are flaws larger than a quarter-inch?

MR. JOHNSON: Yes, it assumes the distribution of flaws, based on the Marshall Report. We have more small flaws and the deeper you go into the metal, the less number of flaws you have.

MR. SHEWMON: In fracture mechanics they would be worse, but the gradient is not as high.

DR. MICHELSON: As a practical matter can you detect quarter-inch flaws?

MR. JOHNSON: Yes, but the staff would be reluctant to give anybody credit for it down amongst the cladding, I think.

DR. MICHELSON: Yes, that is another complication.

MR. SHEWMON: I think basically, if you could prove there are no flaws, then there is no PTS problem. And this is only relevant in saying is it likely they can come in and prove that there are no flaws. And the answer is no.

MR. OKRENT: But a half-inch wouldn't bother you anymore than if it were a quarter-inch, it is still pretty small?

MR. JOHNSON: That is pretty small. If you are used to designing vessels where you say you can have a crack a quarter of the way through it, and it is no big deal, then if somebody comes up and says, "Gee, we are interested in quarter-inch ones", that is a change in point of view.

MR. SHEWMON: That is a big deal.

MR. REED: What do you mean by vent valves, you mean these little quarter-inch orifice things that have been --

MR. JOHNSON: No, sir.

MR. REED: Or do you mean flapper valves on a B and W plant?

MR. JOHNSON: Yes, on a B and W plant.

MR. REED: Well, let's not confuse what they are really there for, and there is a lot of literature that doesn't identify what they are for.

MR. JOHNSON: The two most important operator actions are after a main steamline break, the operator isolates the feed water to the steam generators, and they are supposed to throttle the HPI to maintain 50 to 100 degrees of sub-cooling, to prevent over-pressurizing the reactor again.

The uncertainty in the results Oak Ridge estimates to be plus or minus a factor of 100, primarily due to uncertainty in temperature during the transient, and due to uncertainty in how many flaws exist initially in the vessel.

MR. OKRENT: Now, is that 10 each way, or 100 each way?

MR. JOHNSON: One hundred each way.

MR. REED: Another shot on that vent valve thing, the B and W type-specific vent valves, this is for all plants?

MR. JOHNSON: No, this is just for Oconee. This is a plant-specific analysis, because you have to use the particular design -- I shouldn't say you have to, but this is the whole purpose was to say did we come up with something different looking at plant-specific.

MR. OKRENT: Excuse me, I want to pursue that uncertainty question. Do you have a number for the steamline break at Oconee if they were at the limit?

MR. JOHNSON: About 10 to the minus sixth.

MR. OKRENT: So, this says it could be 10 to the minus fourth, or 10 to the minus eighth, is that what you are saying?

MR. JOHNSON: Yes, sir. Random variation due to input variables.

In addition, there are biases, due to conservative or non-conservative assumptions in the analysis. This is a list of these, and I believe, in balance, the analysis is conservative. The major non-conservative assumptions are they ignored external flooding, ala Indian Point, from the outside; ignored azmuthal temperature distributions on the vessel, and assumed that the transients didn't last any longer than two hours, and have not yet analyzed the A-47 control system transient which are being done.

So, in the coming year we are going to analyze A-47 ones, and external flooding.

The conservative assumptions, temperature is assumed one sigma variation of temperature of plus or minus 50 degrees F, realistically there are physical limits on how much it can go down. So that really should be plus 50, minus something less than 50.

It is assumed that if successful operator action to actuate the steam generator takes 20 minutes, no other operator action is assumed for two hours; specifically, it is assumed in this particular analysis, to simplify this first one, that the operator does not follow the procedure to maintain the sub-cooling between 50 and 100 degrees of sub-cooling. The large steamline break temperature used in this analysis is colder than the best estimate; for sequences less frequent than 10 to the minus sixth a year, no operator action at all was assumed. The worst conditional probability of failure was assumed to them. Those when added all up formed that residual I talked about.

The flaws are assumed to be on the surface and located in the highest flux locations and we ignored warm pre-stressing, which might be a factor.

MR. OKRENT: Is it important for the steamline break the warm pre-stressing?

MR. JOHNSON: Yes. You could postulate that that should work there. It was not included in the analysis because we are not sure whether there might be some wiggles out there in time.

But it certainly should work, theoretically.

Now, because of this, the preponderance of I believe conservative assumptions, I believe that bias is the answer I showed you before, down. And, therefore, in my opinion, the analysis on the Oconee supports the screening limit of 270 degrees.

In addition, --

DR. MICHELSON: I am not sure on the steamline isolation, that is non-safety grade equipment, isn't it?

MR. JOHNSON: Yes, that is a feed water system.

DR. MICHELSON: That is non-safety grade isolation?

MR. JOHNSON: That's right. We make a probable assessment of what fraction of the time the operator actually turns it off in 20 minutes, or what fraction of time doesn't he. I don't remember the number.

DR. MICHELSON: I am dealing now with the probability that he may not, even after turning it off, it may not function. Is that included in your evaluation?

MR. JOHNSON: No.

DR. MICHELSON: The steam generator rupture main, have you proven that does not interrupt certain equipment that is needed?

MR. JOHNSON: No, sir.

DR. MICHELSON: So, you just ignored that aspect -- that particular aspect? That is a non-conservative assumption, I would think.

MR. JOHNSON: Okay.

MR. OKRENT: Are you going to write detailed reports on your analyses for each of these plants?

MR. JOHNSON: Yes, sir. I just gave to Al Egnes a thousand page report on the Calvert Cliff analysis that just came in the day before yesterday. Al already has this one which is about maybe 700, that came in last spring, draft reports.

In terms of evaluating the postulated corrective measures, none of the three plants analyzed exceed the screening limit during their two-year effective full power year operation. However, for an exercise to see what is the effectiveness and various corrective measures, we went through this para-metric exercise. The one corrective measure that stands out as being effective is reducing flux early.

Flux reduction by a factor of two, four or eight, reduces the chance of a thru-wall crack by three, six, or eight. In this particular plant, heating, high pressure injection, water doesn't make much difference. The reason is the vent valves make LOCA unimportant in this, and so this particular fix is not important in this plant. It is a significant thing in the Calvert Cliffs plant.

MR. SHEWMON: More useful might be the flux reduction truly expressed and how many years it pushes the trip point out.

MR. JOHNSON: That would be another way to look at it.

MR. SHEWMON: Would you tell me how to look at it that way?

MR. JOHNSON: Good point.

MR. SHEWMON: Will you answer my question? If it is a factor of eight, how many years does that --

MR. JOHNSON: I don't know the number.

MR. SHEWMON: Does it vary from plant to plant?

MR. JOHNSON: Probably. But I agree with you, it is a good way to present it. I don't know the number.

MR. SHEWMON: Before you get done, can you tell me -- there was a question about what Robinson had done to push their period for getting the criterion out, off scale, apparently.

MR. JOHNSON: They have taken a look at the material in the vessel welds, and have shown that the copper is nowhere near the amount that we thought it was originally when we designated them as one of the eight lead plants. In addition, they have taken corrective measures of reducing the flux by something like a factor of eight, and they have heated the high pressure injection water, or at least have made plans to do so. And I think they have actually done it.

A para-metric analysis was done to see if by some magic means, unspecified, make a system such that if the plant dropped below 1,000 psi in the primary system, it would never re-pressurize above 1,000 psi. That would reduce the likelihood of a thru-wall crack by a factor of 10, roughly. And how you do it, or adverse effects of that were not evaluated.

As we said before, in-service inspection to be effective must detect all small flaws, annealing the vessel is effective in principle, but the practical aspects are not understood.

MR. EBERSOLE: I wonder if you could elaborate on detecting small flaws? It seems to me I recently heard of a potential flaw found in a vessel, and what I want to know is if I want to hypothesize we get substantial flaws, is it really true these will propagate?

MR. JOHNSON: We have assumed that there are flaws in the vessels.

MR. SHEWMON: Why don't we put that off until the next one -- Vagins going to talk about that.

MR. JOHNSON: A quick look at the results in the

Calvert Cliffs report that just came in two days ago. This is the frequency of a thru-wall crack, versus effective full power years for mean surface RPM DP, equivalent to a screening level of 270 RPM DP here. Here the dominant sequence, or group of squences, small break LOCA, starting from zero power, steamline break from zero power another decade down; LOCA from full power is further down.

Note that the magnitudes that we are talking about is more than an order of magnitude down from what we were talking about for Oconee. And the third analysis coming on Robinson is even further down than this.

One reason is that -- remember we had that long list of conservativisms, many of which are done to simplify the analysis, ways have been found to take care of those, handle those analyses. And so each successive plant has a better analysis on it.

During this year Oak Ridge will give us an estimate on how much of the difference between these three analyses is due to methods of analysis and how much is due to plant differences and design operations.

MR. EBERSOLE: Is it the practice of this process here to use euphemisms a little bit? What do you mean by thru-wall crack?

MR. JOHNSON: I mean that the analyst calculates that a crack that is running through the wall and he calculates it is not arrested.

The next question is, what happened, how big a hole does it blow, and so on? And that is the next step in the analysis that Frank Schroeder talked about, the PNL and NRC staff analysis.

MR. SHEWMON: If just the inside is cold and just the inside is embrittled, then if you put a stress on it it might run partway through and stop. That makes you uneasy, but it is no big deal. And that gets into what Dave was talking about.

MR. JOHNSON: So, the conclusion I come to is that the research results on this project todate with the screening criterion and support effectiveness of early flux reduction measures as a way of reducing the likelihood of thru-wall cracks.

Another main thing that has happened in the past years is the mixing -- the question of how much mixing do you really get and Jose Reyes will tell you the results on that.

MR. EBERSOLE: Would it be appropriate at this time to call a break?

MR. SHEWMON: As you wish. We are probably okay on time.

MR. EBERSOLE: Let's have a 10-minute break.

(Whereupon, a short recess was taken.)

MR. REYES: Good morning, my name is Jose Reyes.

I am going to present to you the thermal mixing study results. I started on this project about a year and a few months ago. Let me outline for you the overall thermal hydraulic analysis study.

The thermal mixing portion is only a sub-compartment of the thermal hydraulic study. And as you saw from Carl Johnson's slides, the thermal hydraulic study is only a small portion of the overall study.

The objectives of the PTS thermal hydraulic analysis are, first, obtain best-estimate downcomer fluid temperatures, pressures and heat transfer coefficients for the overcooling scenarios specified by Oak Ridge. And then use those co-efficients and provide those to Oak Ridge to put them into their fracture mechanics analyses.

The second objective was to determine which operator actions, equipment malfunctions, system designs and fluid mixing phenomena are important to the enhancement or mitigation of PTS.

I will very briefly outline the status here, we have performed 45 calculations using track and relaps codes. For the Oconee, the Calvert Cliffs and the R. H. Robinson design. And as Carl mentioned earlier, have performed about 300 additional calculations using these 45 calculations as guidelines and simplified methods, simplified relaps code or just mass and energy balance.

So, that's essentially where we are at right now. Let me give you the picture here of how we perform these calculations and where the thermal mixing studies come into play.

Carl mentioned earlier that Oak Ridge provided sequences, different sequences overflowing cnange and sequences to the national labs, Los Alamos and Idaho. Los Alamos used track computer codes for Oconee and for Calvert Cliffs. Idaho National Labs used relaps five for Oconee and for H. B. Robinson.

These calculations were performed with the large systems codes were reviewed by Brookhaven National Lab, they reviewed the input and they also did some comparisons of the transient results.

Now, about a year ago we didn't have this step -- a little bit over a year we didn't have this step, we weren't sure how to handle the problem of mixing. And I am going to explain in a little more detail what I mean by that.

I added this additional program here -- we have Creare half-scale and we have a transparent half-scale. The transparent facility is located at Purdue University, which fed into Purdue and Los Alamos for their mixing codes. And the objective of these facilities was to provide some experimental data for benchmarking these codes and see how accurate these things were.

Purdue developed what is called a re-mix code to perform detailed mixing calculations in the downcomer region. Los Alamos has Sola PTS code and we use that primarily for the Calvert Cliffs studies where we were looking at 180 degree section of the downcomer.

All these results were produced and sent to Oak Ridge for their fracture mechanics calculations. Let me explain what I mean by thermal mixing, the trac and relap codes are system codes and as a result, they don't include certain stratification effects under certain conditions, particularly when the loops are stagnent, except for HPI, and you have HPI flowing, you can have a condition like this, where you have cold fluid coming into a cold leg, you have some back-flow of this cold fluid going to the loop, or pump field, and towards the downcomer. In the downcomer you will have a plume where you have some cold fluid coming down and you have warmer fluid going back up into the downcomer, into the cold leg, and actually back to the HPI.

About a year ago we really didn't know how to handle that in these calculations, and now we do have a good handle on it. And I will show how we went about doing that. We had two very important developments in the area of thermal mixing. Professor Theofanous of Purdue Univeristy was given the task of developing a stratification criterion in the cold leg. And the purpose of this criterion was to couple the large system codes with these more detailed mixing codes. We didn't know for what conditions the relaps code and the trac codes were sufficient in the downcomers, and for what cases there was actually a stratification plume there. But he developed a theory of stratification criterion, he documents this in NUREG/CR-3701, and it is published and available. And it is a very simple criterion, and I will show you a detail of that in a minute.

He also developed something called the "Remix Code" and that was designed to predict temperatures and heat transfer coefficients for various HPI flows under stagnant loop conditions. And that is documented in NUREG/CR 3701.

Let's start off with the stratification criterion, this is what Professor Theofanous developed, this straight line here is the stratification criterion, and this is a froude number of the HPI, and this is the loop flow ratio. This is the volumetric flow of the cold leg and the volumetric flow from the HPI. The froude number, as I am sure you are familiar with it, this is essentially based on the superficial velocity of the HPI.

Now, if your plant is operating under certain conditions, for example, let's say your cold leg flow is about 10 times your HPI, somewhere around that ratio -- this region here. And your froude number and your HPI is somewhere in this region here, this is the range of interest, most plants operate around .05 or less -- there is an exception, that is the B and W. That would be in this region, well mixed according to the stratification criterion. For cases below that, they would be in the stratified regime, there would be some kind of a stratified plume.

So, what we did was looked at all 45 of the relap and trac calculations and we decided to apply this stratification criterion to see which cases and for what periods of time in most cases you would be in a stratified regime and the well mixed regime. If you are in the well mixed regime we just use the relaps and trac, if you are in this stratified regime you need the --

MR. EBERSOLE: When you are talking about cold legs, isn't it true that whether the cold leg is in a horizontal or vertical configuration or mixed configuration, does it make a great deal of difference?

MR. REYES: If the cold leg is in the horizontal?

MR. EBERSOLE: Yes.

MR. REYES: Which is the case that we studied.

MR. EBERSOLE: So all of this is predicted on being in the horizontal leg?

MR. REYES: Oh, I see your point. The HPI -- and I will show you that in a minute --

MR. EBERSOLE: If it is coming, don't bother.

MR. REYES: Okay.

I will continue with this train of thought -- I wanted you all to note that natural circulation flows are generally 10 times greater than HPI flows, even when you are on stand-by condition. The range of HPI is around here, so if you can maintain natural circulation flow in your plant, you won't have these stratified plumes developing. That's one of the real important findings that we found in this study.

By the way, this data here is from the one-fifth scale, this was stratified and this is well mixed, and we document this in the NUREG I mentioned earlier.

The results of applying the stratification criterion to our 45 transients, the relap and trac transients, we found that 29 of them exhibited well mixed behavior throughout the whole transient; 16 of the transients exhibited a limited stratification, either one loop was stagnant as the result of the plume or just for a certain period of time you had stagnation as a result of these plumes.

We also used the Remix calculation, the more detailed mixing code.

MR. REED: In your work did you do studies assuming loss of natural circulation flow?

MR. REYES: Yes. Several of the actual calculations were when you would lose natural circulation -- whenever you avoid the steam vents, for example. In all cases we definitely applied the remix codes, and more detailed temperature profiles.

I mentioned earlier that Professor Theofanous at Purdue University worked with a team to develop the Remix Code. This has been benchmarked against Creare 1/5 scale data, one-half scale data, Purdue one-half scale data. They had three specific geometries, they matched the geometries of Calvert Cliffs plant, the Oconee-1 and the H. B. Robinson. Now the Calvert Cliffs and the H. B. Robinson plants both inject their HPI into accumulatorlines, which is different than what the B and W does. They have a smaller line which injects directly into the cold leg. And as a result, you see -- and they also inject at a much higher froude number.

Most plants have a maximum HPI froude number of somewhere around .04 or .05. Well, for Oconee, since they use such a small HPI line and it has such a tremendous jet force it is way over one, it is something like a froude number of five or six and it creates a very turbulent mixing effect, even without vent valve. So, the vent valves, from a mixing standpoint, are like icing on the cake, they cross this region when they are first starting up, but they are only there for a very short time.

So these effects were observed at Purdue in their one-half scale facilities, and since it is transparent and operated a lower pressures, they used (inaudible) to obtain the density gradients that they liked, and they could observe the different phenomenon,for the Calvert Cliffs and H. B. Robinson the accumulator line effect was also very important. And I will describe that in a minute.

Also I have another study here, data from Imatran Voima Oy of Finland, that was used to benchmark the Remix Code also. And they use a Russian design in their plants, they have six loops and they inject from underneath, which is different, but it is also horizontal.

And that cooperation there has resulted from their interest in PTS studies in their own country, and their familiarity with what we have done so far.

Just to give you a little bit more of a feel for what each of these experimental facilities have done. I mentioned that we have the Purdue University transparent half scale, they looked at mixing in accumulator lines, and performed specific mixing tests in Oconee, Calvert Cliffs and H. B. Robinson designs, and they developed and benchmarked Remix.

We also have a Creare half scale, that operates at a higher pressure, around 200 psi as an upper bound, to see what effects this pressure would have, and also it is a metal vessel, with higher pressure, so we can get heat transfer coefficients from that facility.

I mentioned also Imatran Voima Oy, because of the international interest generated from these mixing studies, the Finns have agreed to perform 20 mixing tests for us in any design that we choose they will be glad to do it, just for our cooperation with them and helping them with their PTS studies. And also, they have a multi-loop facility -- both Purdue and Creare are just single cold leg -- so we will be able to look at the effect of asymmetric loop flow on HPI plume behavior. This is important for cases where there is a main steamline break, or something like that, or even a LOCA where you stagnate one of the loops. And we want to see what kind of effects this asymmetric behavior will have on the plume mixing.

MR. REED: I am a little surprised to hear that Robinson and Calvert Cliffs inject their high pressure safety injection into the stub of the accumulator line. That, I don't think, is too common. I think most Westinghouse plants inject individually by three-inch l nes or such, into the 30-inch hot line.

MR. REYES: Yes, that's a good point. All Westinghouse do -- that's a newer design. Free loops,however, usually inject directly into the cold leg regime.

MR. REED: Which is better?

MR. REYES: We are finding that while the accumulator line mixing is better, as far as mixing -- you don't see as much stratification, but we have performed Creare half scale, the other design for Westinghouse, and we are seeing that we are still getting a significant amount of mix in that. So, we haven't look at both designs.

Another agreement with Ivo (phonetic), they have also -- the agreement was signed back in June, the HDR facility, I am sure some of you are familiar with that in Karlsruhe, Germany, they have also signed an agreement to perform some full pressure and temperature mixing tests for us, and several other tests in the materials area, in exchange for some PTS information.

I want to just point out two significant experimental results that were observed at some of these facilities; one the plume heat transfer coefficients have been obtained at the Creare half scale facility. And, also, this enhanced fluid mixing accumulator line was new to us, it was kind of a surprise and we found that in both the CE and the Westinghouse design that had accumulator lines.

To start off with the Creare half scale, this is just some of the results that we have gained, these are still preliminary, they are being reviewed by EPRI and also by Westinghouse, these are conditions of about .05, which would be typical of your maximum HPI flow condition. The loops were stagnant -- this by the way is a mistake here, it should be delta roll over roll, the density of the cold fluid minus the density of the hot -- cold leg fluid divided by the density of the hot fluid and it was about .121, which is typical of plants, full scale plants operating pressure about 200 psi, and looking at 284 seconds into transient where you have the maximum heat transfer occurring.

For this test we only had one block control and that was diameter down from the cold leg entrance. We were measuring about a half meter per second velocities inside the plume. The heat transfer coefficients were measured and we had the heat flux probes also in the location with the velocity probe. We figured 548 BTUs per hour, around 3,000 blocks per meter. And we measured temperatures around 254 degrees F.

And you see, two diameters down, your heat transfer coefficient is dropping more, the temperature is increasing, you have intrainment on the sides of this plume also, and it is just mixing more and more, eventually you get further down and you start meeting some kind of limiting value, somewhere around 376 for this test. You will see higher results if you have higher froude numbers, and your temperatures warm up, about 280 degrees for this particular test.

So, we see within one diameter or two diameters your heat transfer coefficient starts dropping and you are getting a significant mixing.

DR. MICHELSON: What was the temperature of the water, the injection water?

MR. REYES: The injection water for this test about

70 degrees F. And in the cold leg we had not too far from --

DR. MICHELSON: If your injection water had been around 40 degrees, what effect would it have had?

MR. REYES: In the past we have not seen a great effect. You would probably see a greater effect in this particular design than you would in the C.E. or Westinghouse design, but in all cases I don't think the effect is very large.

DR. MICHELSON: By large you mean a few degrees or 10 degrees?

MR. REYES: On this test, for example, you are probably seeing about a 10 degree difference between a plume in the ambient, at the most you would see maybe another five or six degrees difference.

We asked Professor Theofanous to take a look at how sensitive the heat transfer coefficients -- or actually the wall temperature, he did a series of sensitivities studies, he will be publishing this in NUREG CR-3702, in which just varied the heat transfer coefficient between 250 to 700 F. and he wanted to see how this vessel temperature varied. He imposed a fluid transient for this situation, he is assuming a transient where he has about 200 degree drop in about an hour, and he found that at the top -- you see this group of curves here -- at the top you had heat transfer coefficient of about 260, on the bottom you had one about 700.

He found that the vessel temperature, first of all, the profile through the vessel was fairly flat, and secondly, that they were grouped fairly closely. And so his conclusion from that sensitivity study for different types of fluid transients was that anything above 400 BTUs per hour for a square foot per height really didn't effect the temperature that much. If you look directly across, you will see it is only a few degrees for this.

So, that was an important finding.

The second effect that we observed in the experiment was that the Purdue half scale facility -- as I mentioned earlier, they had these accumulator lines, HPI injected into an accumulator line, and this might be nine feet, or more of length before you enter the cold leg. And as a result you have some stagnant water in here, it is warm, and when your HPI ticks on and you have this cold fluid falling within the HPI line itself -- this is about a 10-inch line and this is about an inch and a half or two-inches.

And what was interesting in these films that were shown at the last subcommittee meeting, you could see intrainment of hot water being actually pulled into the accumulator lines. It would actually go all the way to the top of the accumulator line where there was a bend -- it might have gone up further, if there wasn't a bend there -- but each plant has different accumulator line designs. And as a result, you get significant mixing within the accumulator -- actually, even before you get into the cold leg. And couple this with the Creare results, from this point to this point the difference in temperature is only about 10 degrees Kelvin, you see that you get a tremendous amount of mixing, even before you get to the downcomer -- a very strong mixing.

So this entrainment flow is actually coming from the downcomer, up over into the cold leg, all the way over here.

Basically, this is an important phenomenon just for the C.E. and Westinghouse design.

MR. REED: Is the location significant with respect to this, for instance, normally they try to put the accumulator line penetration on the top of the pipe, as you show it there, and therefore, the high pressure safety injection comes out on the top, too.

If it was turned over the other side up, does it make a big difference?

MR. REYES: You are saying on an angle, or --

MR. REED: Angle or rotated 180 degrees.

MR. REYES: We find that there is no difference.

MR. REED: No difference?

MR. REYES: No difference. And we did that also with -- in these cases we had -- these froude numbers, as I said earlier, were about .05 and so even if it was on an angle, the plume would just come down, come on an angle, down to the entrance and drop straight down, because these are very week plumes.

DR. MICHELSON: I thought the question was if it is coming up from the bottom, does it make any difference?

MR. REYES: If somehow you had injection from underneath, yes, you would see a difference. For one thing, your stratified layer would be forming on the bottom, and so you would be feeding this thing from underneath. So you wouldn't have the benefit of all this entrainment from the hot fluid on top.

One of the interesting things we observed -- I think your point is actually on an angle -- but the Finnish test, they did inject underneath. They had a number similar to what you saw in the B and W plant, but we observed the same mixing, and the reason was the HPI, to the small line was injecting with such force it was like an umbrella, so you were still getting that entrainment mixing on top.

But if you had a very low HPI injection from underneath, then you would see a difference. And I think we would have to use a different type of technique for calculating the mixing in that region, because you wouldn't have this entrainment on top.

So, to summarize -- I have only six on this slide here and I presented some of these in more detail at a prior

ACRS subcommittee hearing.

First of all, the trac and relaps overcooling transient calculations have been completed, they have been sent to Oak Ridge as boundary conditions to their fracture-mechanics analyses The sequences that they asked us to perform, we did those.

We have two new important thermal fluid mixing tools: cold leg stratification criteria and the Remix code. We have applied the stratification criteria to all of these transients and we found that 16 of the Remix calculations get better information.

Also, I mentioned earlier the stratification criteria shows that if you can maintain natural circulation in your system, it should be sufficient to maintain good mixing from HPI fluids. We found that the Creare half scale data shows experimental heat transfer coefficients at about 600 btu for the maximum for the typical case, and also we saw this effect of accumulator line mixing in the Westinghouse and C and E designs.

MR. REED: Okay, for the multi-million dollar application question -- imagine that instead of having emergency core cooling, as we now know it in LOCAs, that we decide that there should be a backup system, or something like that, that we could call primarily blow down, or bleed and feed blow down. Does it worsen the situation on pressurized thermal shock or not, if you imagine that instead of trying to keep the pressure.up and enhance natural circulation, that instead of keeping the pressure up, that you have a finite size blow down to remove the heat, and you inject, and you keep injecting into the same cold leg and you continue to blow down to remove the heat and you dump into the containment, or the new Westinghouse advanced reactor, into a cooling torris, does it make the pressurized thermal shock issue worse, or better, if you go right into that essentially saturated pressure temperature condition and continue to blow down with less set quantities of feed required by a magnitude of eight, or does it make it worse?

MR. REYES: We are saying that the HPI is injected in the system, is now in a saturated condition?

MR. REED: Saturated, boiling or near boiling.

MR. REYES: And you are injecting HPI into this saturated boiling type of cold leg condition. Interestingly enough, Creare has performed some tasks -- I am going way back, I guess about seven years ago -- the HPI injections into steam and saturated conditions, what they observed was a very strong oscillation effect, which again provides you with very strong mixing.

Now, you don't have a stagnant type of a situation there. But, again, I don't know what type of stresses that would put on the cold leg. I don't have a feel for that.

MR. REED: Well, you have to realize that the flcw might be one-fifth required, because you are going to be having a combination of boiling and liquid being transferred, and the transfer removal on the open holes and the sides blow down the hole -- you are going to have less quantity injected.

You are saying mixing might be enhanced?

MR. SHEWMON: Use the microphone.

MR. REED: You are saying mixing might be enhanced, you would have less input, cold fluid, because you could get the heat out by a combination of steam and water exiting the side blow down.

MR. REYES: I think if you have some cold fluid in the cold leg, you can use the stratification criteria, if your fluid is saturated, or maybe even steam, --

MR. REED: In order to have cold blow down you are going to have some --

MR. SHEWMON: We have another half-hour presentation, if you have questions, ask them, but discussion you can do in the hall.

MR. REED: I guess what I am saying is you can see right away whether the pressure would be improved?

MR. REYES: Yes.

MR. SHEWMON: Any other questions?

MR. REYES: I have also included in the back a list of qualifications for PTS.

MR. SHEWMON: Thank you very much.

MR. VAGINS: My name is Milton Vagins, I am with the materials engineering branch of the office of research.

Before I go into my presentation, I would like to answer a few of the questions that were raised. Paul kept saying "Vagins will answer it", so I assume somebody is interested.

The first question that was raised is about Robinson 2, and it seems to indicate that maybe they were doing something like sharpening pencils to make the PTS issue disappear. Well, you must understand one thing, a lot of the plants are identified as being in trouble at the beginning of this issue. For those plants whose data base is very sparse, materials data base -- in other words, they did not have their material well identified by chemical constituencies and Robinson 2 is one of those plants.

In fact, what had to be done in that case, was to ascribe to the plant the upper bound on the residual chemicals like copper, the alloys like nickel and -- the residuals like phosphorus. In other words, just for safety sake, because if you don't have data, therefore you have the upper bound on the data base.

And when you put that into our calculations, that puts them in trouble. So Robinson 2 went and took samples, out of a head weld and then identified that that was, indeed, the same weld material that was used in the belt line. And, indeed showed that copper and phosphorus and nickel were much lower.

So that got them partially out of trouble.

Second, they took correction action by going to what was called PLSA, now they went through normal flux reduction, they also developed on their rods, outer fuel rods, toward the wall, port length shoe assemblies, where they had dummy stainless steel in the vicinity of the high flux region of the wall. So, therefore, they reduced their flux.

MR. REED: Does Robinson 2 have a thermal shield?

MR. VAGINS: I don't know, I would assume so.

MR. SHEWMON: There is an answer of yes over here.

MR. VAGINS: Is my statement substantially correct about the corrective action?

VOICE: Yes.

MR. VAGINS: That is the type of action that the plants will take and should take, when they get into difficulties. It is not sharpening pencils, it is going back and getting the data, one way or the other.

Another question you asked is the question of RT NDT and what we mean by RT NDT. RT NDT is that the temperature is never identified as a metal temperature. What it is is a transfer function, which transfers plant phenomenon or characteristics, such as chemical constituency, the fluids and to some extent sharp data which is in the surveillance capsules, allows us to transfer that data to fracture toughness data, which we need to do the analysis. For instance, typically for every point in the material, every point in the steel in the vessel will have a given RT NDT at any time, and this again, will depend on the chemical constituencies and the fluid.

And this RT NDT is end compared to the temperature of the metal wall of that and that gives us a common base temperature base to set our fracture toughness on. Every point in the vessel has an RT NDT at all times.

MR. KERR: Excuse me, when you say the temperature of wall, do you mean the temperature of the metal throughout the wall, or just the inner surface?

MR. VAGINS: At that point, the temperature at that point, whet ıer at the surface or at the back of the wall, or the point. The limiting RT PTS is designated at the wall.

There was another question that was raised, what would that RT do if we found a quarter-inch crack?

I am not with NRR, but I work with them closely enough that I can postulate what they might do. First of all, let me make a point, when we talk about quarter-inch cracks, we are talking about a crack in the base material. We have assumed, and will continue to assume, that the crack is all the way through the cladding, the cladding is there, the bimetallic effects of the cladding, the effects of the claddinç are put into our calculations, but the crack is always through the cladding for our calculations.

So, let's say the quarter-inch into the base material, what do we do? Well, the only thing I can say is we have had occasions where we have found cracks in nozzles, I think Pilgrim was a good case, and they are shallow. And what I would suggest doing for this is to go in and grind it out. Grind out the cladding and grind out the crack, smoothly and efficiently, so it is a nice groove and don't worry about the fact that there isn't any cladding there, keep an eye on the growth with time, because right now there is no NRC approved method of repairing that cracked pressure vessel, we have not accepted the half bead weld method as specified in the code. A weld repair would call for a post weld heat treat and you can imagine the difficulty in doing that with a radiated older reactor.

So those are the three questions. Was there one I missed?

MR. OKRENT: No, but I would like to continue this one. Let's assume that we find for the moment a quarter-inch crack in a region where you are getting an appreciable fluence. The presence of this now with the probability of one change your probability of pressure vessel rupture due to pressurized thermal shock by a factor of two, 10, 100 -- in other words, what is your assumed probability of a quarter-inch crack in the surface at a bad point, that's what I don't --

MR. VAGINS: Right now the finding of a quarter-inch crack would hardly change the probabilities at all.

MR. OKRENT: That means the input probability is about how much?

MR. VAGINS: I can't give you an exact number, but it is -- for a very small crack, the probability distribution of small cracks is close to one.

MR. OKRENT: At the quarter-inch size, are --

MR. VAGINS: The small cracks are assumed to be very, very probable, large cracks are assumed to be very improbable.

MR. OKRENT: Now, pick large --

MR. VAGINS: Over an inch.

MR. OKRENT: And by very improbable, you mean one in a thousand, or --

MR. VAGINS: I can't pull out the distribution out of my head, but yes, let's say one in a thousand.

MR. OKRENT: So, you are saying that if you found a quarter of an inch, it is like what you are assuming with a rather high probability anyway?

MR. VAGINS: Right.

MR. OKRENT: So the probabilities haven't changed in your opinion?

MR. VAGINS: I would say they would change less than an order of magnitude. That's all I can say.

MR. OKRENT: Now, suppose they found one at one inch, would you now have sufficient large change in the probability that you have to fix it, grind it out or something?

MR. VAGINS: Yes, you have two balancing factors here, the larger flaws, the larger cracks are less harmful from the viewpoint of pressurized thermal shock. In other words, if you had a one-inch crack, the probability of a pressurized thermal shock scenario leading to a vessel failure is much, much less than if it is a quarter inch.

MR. OKRENT: Explain that to me.

MR. VAGINS: Okay, this is a very key issue in thermal shock. What you are dealing with is a very steep thermal gradient through the wall, very, very steep. Your cooling on the inside surface is very high and because of the inertia -- the thermal inertia of the steel, you get about an inch, or an inch and a half into the wall --

MR. OKRENT: So, you are saying that the driving force is much reduced.

MR. VAGINS: It is much reduced.

MR. OKRENT: And much less likely to run.

MR. VAGINS: Exactly right. The thermal stresses are what really cause the initiation of a crack in PTS.

MR. OKRENT: Well, let me put words in your mouth, and you are very close to a crack, you are assuming probability -- it may not be a probability of one, but it is no smaller than .1, is that correct?

MR. VAGINS: Yes.

MR. OKRENT: That would then tend to make less important whether or not people knew exactly what their distribution was, is that what you are saying?

MR. VAGINS: Yes. This is critical understanding, the fact that we did make such an assumption. If they could prove though -- now, here is the point, if they could prove there are no cracks, none, that makes a very big factor, the probability of vessel failure becomes almost zero.

MR. SHEWMON: Professor Okrent might be even more skeptical than you people.

MR. VAGINS: I doubt it. Any other questions?

MR. EBERSOLE: There was another question, what was the real meaning, having suffered through the HBDH type euphorism -- what is the meaning of a thru-wall crack?

MR. VAGINS: Okay, the thru-wall crack is exactly that, a crack that penetrates and just hits the outside of the wall.

MR. EBERSOLE: But there is no progressive vessel disruption?

MR. VAGINS: Not by the definition of a thru-wall crack, no, sir. Pressure failure mode is the area where we say what happens when the crack reaches the outside of the wall, moving at a certain velocity, what is its shape, what is the result in opening, does it generate missile, does it penetrate the containment?

MR. EBERSOLE: Well, is that the terminal condition?

MR. VAGINS: The terminal condition for the PTS study, generic study, to establish the ARPTS, was just reaching the outside wall.

MR. OKRENT: Somebody else is following that.

MR. VAGINS: I am following that, too. But the question becomes it is way beyond the state-of-the-art, we are doing something which I have confidence in, but it is really a very difficult analysis.

MR. SHEWMON: The problem, also, let's assume the crack is long already, and all of a sudden when you get to the other side, whether it is infinitely longer, or an inch long, makes a very big difference.

MR. VAGINS: Well, there is more to that than just an assumption. But the fact is that if you have a six-foot long crack, if it opens up an inch, you have a pretty big hole, and we were talking about LOCA -- the necessity of cooling the core, and if this is right at the core, at the belt line, so therefore if your water drips out, your core won't be cooled.

So, that we felt is a reasonable place to set our criteria, at that point. It was in the state-of-the-art of analysis, and experimental data, and also a reasonable approach.

MR. SHEWMON: Milt, the answers have been excellent, I am a little bit concerned about what we are going to do with the schedule, if you try to explain to this capable group all of the wonderful things that have been going on down at Oak Ridge.

If you talk about issues and talk about conclusions, and questions that come up.

MR. VAGINS: Absolutely. Why don't I do this -- Paul is right, I run about $8 million worth of research a year, and if nothing else, I have to fill up that weight of money with the weight of verbage, just to justify my existence.

So, why don't we look at the uncertainties that we face, and I will give you a brief summary of what we have done with them. This is the same slide that I presented to the ACRS in 1982, and you will see where the progress is.

The first point is the applicability of linear elastic fracture mechanics for initiation, propagation and arrest for reactor pressure vessels subjected to a pressurized thermal shock scenario. A big phrase meaning how bloody good is our analysis. We have had some critics who say, look, but can that crack penetrate one-third of the way through the wall, you are going to be at high temperatures, and you are going to be out of the realm of LEFM, and therefore, your total analysis is conservative.

Well, the experiments I done have shown that the use of LEFM to the point where the crack will either arrest, or non-arrest is absolutely, perfectly valid. There is no elastic intercession unless that crack is stopped.

And if you cannot show arrest, it doesn't stop and therefore, it is valid. And when it is stopped, then we have all the tools at hand in newly developed elastic fracture mechanics to analyze that situation. The situation where the crack initiates, stops, the pressure is still on the vessel, then it could slowly tear open.

So we have the total analytic package, so we have the answer to that.

The effectiveness of Warm Prestress, we played with the words pre-stress for years. It is bloody effective, it is so effective that it almost prevented our experimentation. It is extremely effective, and I will talk more about that later, what that impact has upon our probabilities of failure.

Vessel failure under non-pressurized thermal shock conditions. Through the series of our thermal shock experiments, TSE-1 -- well, actually, one, two, three and four, five five-a and six and seven, we have almost conclusively shown that you cannot have the crack penetrate the wall of the vessel under thermal loading alone. You must have the pressure and finish driving it through.

Behavior of small finite flaw when subject to PTS conditions. One of the criticisms we had was that people said

"Well, look, we don't have a long flaw, we have a fingernail flaw, we have a small, itty-bitty flaw about that big and it is on the surface, therefore when it initiates, it is propagates, it is going to propagate in a self-similar manner".

Well, this is partially incorporated in the code in the Section 11, non-mandatory section that says you can do this, propagate the flaw in a self-similar manner. Actually, that is wrong, it has always been wrong, and it is still wrong. And all of our experiments show that if you have a small flaw in the brittle area, the surface is brittle all the way and the flaw will grow long, before it grows deep.

So, the use of an initial long flaw is perfectly valid and acceptable.

We show this at all of our -- cladding flaw interaction, bimetallic effects, this and the next one, irradiated cladding material and fracture properties, are probably the hardest things we have to do. We have -- as I say, we have taken a conservative position, we said that any flaw that is in our analysis, exists through the cladding. The cladding, therefore, only makes the flaw worse, because of the bimetallic effects, the stainless steel has a much higher coefficient linear expansion,the cladding tends to open up the crack more, than if it were not there.

Therefore, we have taken a conservative view, we have neglected the effect of the clad for inhibiting the crack, but in our studies, particularly we have done some radiation studies on cladding -- in this zone of fussion, between the cladding and the base metal, where you have a very strange mixture of material, indeed. You have a migration of the copper versus the silver weld, you have a migration of the copper into the stainless steel, you have a migration of the nickel and chromium in the stainless steel into the base metal.

You have one hell of a terrible material, and it brittles very badly. So, there is a very, very small fussion area, now common to the steel and the cladding, which is actually more brittle than the steel itself and it radiates very badly. It comes down very badly.

But the rest of the cladding toward the material -- now, we are only talking about something like three-eighths of an inch thick -- as you move away from the fussion area, you increase toughness. But that zone of very hard brittleness tends to make us feel that cladding would do nothing, irradiated cladding will do nothing to inhibiting the crack.

But, again, that has not been proven. It is very difficult experimentally to do.

Arrest on the upper shelf, that is what I mentioned before, part of our criteria said that if we got -- now, this is important, because part of our criteria said if the driving force, the K driving force went above this point, which is 220 mega-(inaudible), then arrest would not occur, and the pressure vessel would fail. We knew that was conservative, but we did not have sufficient data to show how conservative it is.

And the work we have just done show that you can get arrest considerably below that, but again, it is very material-dependent.

So, again, the concept of arrest at these high toughness levels is another element in conservativism in the vessel, in our analysis.

However, if you do get arrest very deep in the vessel wall, the question is academic, because if you have a large internal pressure in the vessel, up to 2200 psi, or above 2,000, it doesn't make any difference whether it arrests, or not, because at that point the vessel will just tear wide open. And we have the analysis for both of those conditions, and we have shown it experimentally.

MR. EBERSOLE: Would you say that again, that sounded a little shocking to me?

MR. VAGINS: A little spooky. We said if the vessel -- if the -- okay, in our criterion we said that if the driving force of the crack, the K_1 we call it, gets above 220 and never comes down, then the vessel will fail. Now, we are showing that, indeed, it can arrest at much higher values, so now it becomes a question of how deep in the vessel it will arrest at these high values.

If it arrests at more than two-thirds of the way through the vessel, for instance, the nominal membrane stress on the remaining ligament, one-third of the vessel, at full design pressure or operating pressure is sufficient to fail under just plain ultimate stress, forget about fracture mechanics. It will just ooze open. So, it is academic really. Because we just want to know whether it will go through, or not.

MR. SHEWMON: That's what the operator action, or some relief pressure is critical in this sooner or later?

MR. VAGINS: That is also the reason we are not worried about BWRs.

MR. EBERSOLE: Oh, sure, I know that.

MR. VAGINS: Well, the same reason, if you drop the pressure -- if the vessel cracks, it won't go through.

MR. REED: And why we should have primary blow down on PWRs.

MR. EBERSOLE: It is just coming clear to me that a critical aspect of this problem is a depressurization system.

MR. VAGINS: Yes, if it works, but we had one in PORV.

MR. EBERSOLE: Well, every depressurization system carries it own burden with it.

MR. VAGINS: Yes, sir. The problem is if you have an automatic depressurization that is 100 percent foolproof, you don't have a PTS issue either, you have a BWR. A BWR is an automatic depressurization system.

MR. EBERSOLE: Oh, I know about the merits of BWRs.

MR. VAGINS: Well, I am not pushing BWRs, the pressure goes down, the temperature goes down.

MR. EBERSOLE: So it is just coming out or starting to be clear to me that that is PTS problem, in fact, in laws a rather critical and reliable method of depressurization.

MR. VAGINS: Yes. If that's what you want, but again, a PWR is not a BWR, and you have other factors to contend with.

MR. EBERSOLE: So, there must be then, if we have the conditions that lead to a PTS, a mitigating system?

MR. VAGINS: Yes, that is one of the answers that -- years ago we said that, if you had a mitigating system, you could probably work at a higher level.

MR. EBERSOLE: And that has to come from the primary side, because trying to depressurize from the secondary side just makes it worse?

MR. VAGINS: No, it has got to be on the primary side.

MR. WARD: Why do you say that?

MR. EBERSOLE: Because if you try to do it -- it is going to be worse.

MR. VAGINS: Most of the PTS scenarios were developed from the secondary side, not the primary. You cool it you cool the bulk, you cool it sufficient so that the bulk -- volume reduces, the pressurizer drops, you depressurize your system, it gives a low pressurize signal, the cooling is still going on, HPI fires, you repressurize your system, your system goes solid and at low temperatures. Bang.

MR. EBERSOLE: Well, in a systemic way then what you are saying to me is, if I have the conditions which I can interpret accurately lead to PTS, I must have in place a systemic method to reduce pressure?

MR. VAGINS: Yes, if you have nothing else.

MR. EBERSOLE: What else is there?

MR. VAGINS: Well, don't let it get that far.

MR. EBERSOLE: Well, but I am saying having gotten into that box, having failed in my prevention, I must now go to a mitigation mode.

MR. VAGINS: You are putting me in kind of a box here, but yes, you can -- the reliability has to be high --

MR. EBERSOLE: Oh, I know that.

MR. VAGINS: You could dump pressure, if you could keep the pressure down --

MR. EBERSOLE: Like a boiler.

MR. VAGINS: We have three conditions to PTS, all of which must be present. You must have the graded materials, MR. EBERSOLE: I had understood previously that if you got these thru-wall cracks, even though you retain pressure, you would have an intact system. But now I understand that is not true.

MR. VAGINS: Not necessarily, you still might have thru-wall cracks which is just a weeper.

MR. EBERSOLE: Can you discriminate that which is just a weeper, and what isn't?

MR. VAGINS: It depends upon the scenario of the age of the vessel and even then the reliability of that solution would be very, very low.

DR. MICHELSON: Maybe I misunderstood, but I thought you said it didn't have to be a thru-wall crack.

MR. EBERSOLE: I believe he did.

MR. VAGINS: No, the PTS screening scenario was developed upon the formulation of a thru-wall crack.

MR. SHEWMON: Half, two-thirds, three-fourths, then you maintain pressure?

DR. MICHELSON: Then you are off and running, and then as you reduce pressure there is a further --

MR. VAGINS: Right, it would stop -- if it arrested and there was no pressure, it would stop.

MR. EBERSOLE: Actually, at the apex of consequence here is if you get two-thirds through, even though it doesn't go through, but you retain pressure, it probably will go through.

MR. VAGINS: So, when you are talking about milli- seconds -- we are still talking in milliseconds.

MR. EBERSOLE: These things are maintained in pressure by pressurizers way off in the boondocks, off on the side. So, chilling the primary at the vessel level, doesn't mean reduction of pressure at all.

MR. VAGINS: Not at all.

MR. EBERSOLE: So, now we get into a time response problem, how fast do things have to move here? That sounds to me like a critical problem.

MR. SHEWMON: That will submerge back in the probabilistic analysis.

MR. VAGINS: It is in the PRA.

MR. EBERSOLE: Is it even practical to say you can do it fast enough?

MR. VAGINS: I don't think so, not for the operator.

MR. JOHNSON: Could I just mention that the analysis we showed you before assumed there was no operator action to maintain the coolant pressure at below 100 degrees sub- cooling. And even with that conservative assumption, the likelihood of a thru-wall crack was five times 10 to the minus six, some ambient and some less than others.

MR. VAGINS: -- the less time you have to react. We had 14 PTS scenarios before 1980, not one single vessel failed, some of them were pretty severe, in 1978; in Germany in 1977. None of the vessels failed, not even if it initiated a crack -- of course, from my viewpoint, you keep the vessel tough, you don't have a problem. And then you don't have to worry about operator action, and you don't have to worry about the reliability of the automatic systems.

That is the whole basis of the RT NDT -- if you keep the vessel tough.

MR. SHEWMON: Why don't we stop here now, and see if there are any other questions on this.

I think we have the problem here, we can stop on that. If there are other questions on this, or somebody wants to go back to the thermal hydraulics, or operator action -- we can discuss that.

MR. VAGINS: Okay, do you want me to proceed, or just stop?

MR. SHEWMON: Stop.

MR. OKRENT: Let me ask a time question, we have heard that the staff seems to be generally happy with the proposed rule. Are there any members of the staff that are not fully happy, that have reservations in specific areas that we have not heard about today?

MR. VAGINS: Not on the material side -- and remember, this rule is for screening criterion.

MR. OKRENT: I am talking about for the screening criterion, as the proposed rule is written.

MR. SHEWMON: One of the people over here.

MR. SCHROEDER: I would think one member of the staff would at least -- I don't want to put words in his mouth --

MR. BASDEKAS: My name is Demitrios Basdekas, and from time to time I have expressed reservations about the type of system failures that may induce the type of challenge to the pressure vessel, as well as assumptions. Without going into a lot of discussion, which I am not sure would be appropriate to do at this time, in this forum anyway. The essence of the questions you have raised, some of you certainly in this commission -- all I have heard from you before, and the questions we have on the issuance at this time relate to the fact that the critical analysis is too hard, and b., -- at this time would have a very limited use if any, because of the 300 or so screening criteria.

Basically, it will mean that no plant will have to do anything for the rest of its useful life. So, then why issue it?

MR. SHEWMON: That's anything more than it has done already.

MR. BASDEKAS: The flux reduction program, even for some blocks that have already been made. What I am saying does not imply or be interpreted that it would not meet at all, I believe there were a number of assumptions that went into the analysis with specific plants, in terms of the system failures as well as in terms of the materials and fracture mechanical analysis.

MR. EBERSOLE: One of the things that has never been quantified on this exercise, and it is critical, is what the operators do. I guess one reason I would be in favor of sort of not sweeping it under the rug, or remaining silent on it is that it seems to me that the utilities must be aware of it, must, indeed, include it as part of their operator training, and take care of certain aspects to make sure that, indeed, nothing does happen.

So, to say they don't have to do anything has to be qualified.

MR. BASDEKAS: Yes, this is certainly the case, but remember, we have different requirements. PTS was put in place and the last thing you need is to see this situation. So, the operator under similar conditions, at least in past experience has intervened, thinking he was doing the right thing, but it turns out in many instances he was doing the wrong thing.

And when we started looking at it -- results of a study made three years ago, shows that operator discretion does not necessarily mean it is done in the right direction. As Carl Johnson pointed out, we are in the process of completing some work under A-47, some protection control systems. There are several things under there that I think merit attention, some of them are -- we are saving, others are --

But let me sum it up basically, that I believe although we need the rule, I don't believe we need this one. If you want more details, we will be glad to give them to you, or repeat them, because we gave them to you before.

MR. EBERSOLE: May I ask, you say if he keeps it ductile, you are in high cotton. How precipitious are you on either side, or on the bad side of keeping this in the context -- are you really going to tell the operator to thread the needle?

MR. VAGINS: Keeping it ductile is very --

MR. EBERSOLE: Do you say even though you think it is ductile, I want you to run through this relatively risky business of depressurization?

MR. VAGINS: No, if it is ductile, I would tell the operator nothing.

MR. EBERSOLE: You wouldn't hedge?

MR. VAGINS: No, I wouldn't even mention the PTS issue to the operator. Remember, we went through 14 scenarios and the operators did their thing and nothing happened. If the vessel remains ductile, we do not further burden the operator. And I think anything that throws the burden at the operator is moving in the wrong direction. He has a book like that now, and I am not sure he is going to do the right thing -- so the more instructions you give the operator, the worse it is going to be.

The more reliance you place on the automatic system, the more you can get in trouble.

MR. EBERSOLE: Oh, I hear you.

MR. VAGINS: Ideally, I would like to take these -- do what the early designers wanted you to do, keep it ductile, keep it tough.

MR. EBERSOLE: Yes.

MR. VAGINS: A final closing word, in the 14 or so scenarios, or 12 well defined scenarios of PTS that we actually had before 1980, warm pre-stressing would have intervened even if the vessels were brittle; in 10 of those cases, 10 or 12, analytic analysis would have prevented that vessel from failing.

We have complete -- not used pre-stressing in our approach, because we didn't know what the operators would do, but if you treated warm pre-stressing as a di'tributed variable in probabilities, you would have to lower your probability to failure at least one full order of magnitude. Warm pre-stressing works, it is very, very effective and it is a very significant area of conservativism that should be brought into mind and kept in mind.

I sleep very good at night, gentlemen, with this rule, regardless of my colleagues' approach, I sleep very well.

MR. SHEWMON: Thank you.

Any other questions?

(No response)

MR. SHEWMON: Mr. Chairman, that concludes the presentation.

MR. EBERSOLE: We are doing very well here. Let's recess for lunch and come back at 1:15.

(Whereupon, the luncheon recess was taken at 12:15 p.m.)

AFTERNOON SESSION

(1:15 p.m.)

MR. WARD: The next item on the agenda is entitled Backfitting Requirements, and we will hear a report from the subcommittee on regulatory policies and practices. Dr. Lewis.

DR. LEWIS: I hate to use the term that has become apparent in recent years, but here we go again. You may recall that at our last full meeting, your subcommittee reported on a subcommittee meeting we had had with the principals involved in the on going backfitting drama. And I tried valiantly to reflect what was going on well enough so that we could let the principals forego the pleasure of meeting with the full committee, but I was not successful. And, in fact, the subject aroused such excitement and interest that we were invited to do the play over again, to stage an encore.

And that is more or less what we have. Just to remind you, you have in your books a tab called Tab 10, which has 41 or thereabouts pages, of information on the subject. And, in particular, the questions that came up at the subcommittee meeting which we talked about a little bit last time, and had to do with the situation in which there is a rule on the books, 50.109, which the Commission has apparently just simply decided not to enforce. Perhaps, we will hear later, but I don't think it has been formally withdrawn -- I maybe wrong on that, but it certainly isn't in business.

And instead a draft manual chapter has been promulgated as per policy, while there is in parallel with that, -- has been issued for public comment. And there is in parallel with that a proposed new rule on rulemaking, these two activities seem to be going on in parallel.

And I remember from the subcommittee meeting that we were slightly dismayed by the lack of communication between the two groups -- maybe all of that will be clarified today.

But, in any case, there were many issues having to do with the draft manual chapter, which had to do with -- for the most part, questions of who was responsible for doing what, at which stage of the game. To remind you the way it is written, or at least was last month, was that the staff could propose a backfit negotiate with the licensee, if the licensee chose to appeal, then the appeal process triggered a responsibility on the part of the staff to do some kind of cost-benefit analysis, to see whether the backfit was justified, the criterion for determining how to interpret the end of cost-benefit analysis was never clear.

In addition, at the commission meeting, I guess the day after, or two days after we had our subcommittee meeting, Commissioner Azelstein raised serious questions about the rule, including the old collection of questions of when it is even legal for the NRC to consider cost in determining whether a backfit or retrofit is necessary.

I have always regarded that issue as not as important as others do, but -- anyway, what we are supposed to do today is have a replay and updating of what was done last month, so you all can hear it. And at the same time, get some additional information, both on the legalities of the situation in which a manual chapter has in effect, replaced a rule, and what that implies, and also, have some input from Vic Stello, on the relationship between this new backfit effort, which has to do with plant specific backfits and the generic issues which come to the CRGR.

So that is the program for today. We will adhere to a tight schedule. I have let four minutes extra of my time, which you are welcomed to use, and I think Jim -- according to my schedule, you are the next one on. Did you know that?

Now you know that. It says on my schedule 15 minutes, can you do it?

MR. TOURTELLOTTE: Okay --

MR. OKRENT: Will we get an answer to Commissioner Azelstein's question?

MR. TOURTELLOTTE: I hope we will, when ELD shows up.

Well, where the Commission is right now is we have a rule 50.109, that has been changed considerably, and along with some other acquainted regulations like 50.54F and 2.204, and Appendix O. But the real change in the rule is in 50.109, and what that rule does, is it is a little bit different from the current 50.109, is that it is more specific in defining what backfitting is, in establishing a standard, in establishing the procedures that the staff will use to arrive at a determination as to whether a backfit should be made.

It also imposes a responsibility for -- at least as currently drafted, it imposes a responsibility upon the staff to come up with that justification, prior to the imposition of the backfit.

Other than that, of course, there have been a number of things which have been done for backfitting; one was the creation of CRGR for generic backfits. But really the changes to 50.109 are more directed toward plant-specific backfit. And something else that has been done, there was a staff requirements memo that was put out to the staff, relative to requiring that they come up with some procedures for dealing with backfitting in both the OL situation, and the NTOL situation.

They came up with a process for the OL situation and by reason of a letter that was written by the director of licensing, said until the Commission came out with a position on NTOL, that they would apply that same procedure, that is the procedure for OLs to NTOLs. And there began some sort of problem, I think.

I drafted a letter which I presented to the subcommittee, it was a note actually to the Commission, pointing out that the generic letter which was sent out by licensing, and was actually, I felt, not being followed in a specific case. And I wanted it brought to the Commission's attention, so they could try to reconcile the problem.

Subsequent to that time, Ed Case appeared at a Commission meeting to discuss the rule -- some of you may have read about it in Inside NRC -- indicating that, indeed, the situation as I portrayed it, was not accurate, and for those of you who didn't read it, perhaps it would be good to review that. Beaver Valley had filed eight different complaints of backfitting from May 30th, through June 25th of this year.

The staff puts out a status report on a monthly basis that tells what the status of backfitting might be. I looked at the status reports, there was no reporting in a formal way, in either June-July, or August, and in August it was mentioned as a footnote that Beaver Valley had filed these complaints, but it was not included in the formal statistics, nor was it being treated as through it were a complaint.

My discussions with Beaver Valley indicated the staff, in fact, was denying that there were any backfits. And they also told me that there had been no meetings between them and the staff. Ed Case, at the September 6th meeting, said that there were four or five meetings, between the staff and Beaver Valley. And fairly well confirmed that those meetings did not take place, at least no meetings on back-fitting.

It presented a problem that I thought should be addressed, and that is, if, indeed, we are going to have a backfit procedure that is triggered by a complaint from a licensee, then, indeed, when the licensee writes in, we ought to respond to those letters. And we ought to, if we believe that they are not backfits, then we ought to write back and tell them that they are not backfits. If they are backfits, then under the procedures, as I understand them, we should provide some kind of a justification.

Following through on what happened with Beaver Valley, and I don't want to make particularly a case in point, but this is simply an example -- a meeting was held, not too long ago, in the latter part of September. That meeting was held and the licensee was directed -- it was held pursuant to the procedures established by DOL in generic letter 84-08.

And when we got to the meeting, actually when Beaver Valley got to the meeting -- I attended the meeting, so that I could see how this process actually works, and it turned out that the staff, after they had written the letter, saying that it was going to be held pursuant to 84-08, said that they weren't sure whether it was being held pursuant to 84-08, or not.

And that presented a lot of problems, because what

Beaver Valley was being told at that time was that this is just an appeal meeting, the kind of appeal meeting we have always had.

And you should be ready for this meeting, just like you would have been ready for the appeal meeting before we ever had an SRN.

And after that time, I have to say also, about a week ago, we had another meeting which was a higher level meeting, with Darrell Eisenhut and Ed Case was there for a while, the folks from Beaver Valley were there. And I attended and a couple of the Commissioners' assistants attended. And at that point in time, Darrell Eisenhut did determine that, indeed, whether it was a backfit, or simply a new requirement didn't make any difference, that they would follow the procedures in 84-08.

He requested Beaver Valley to send in another letter summarizing their complaint, and indicated that the staff would respond by providing justification. And I consider that a considerable step forward in the overall backfitting situation. That is simply to bring you up to date.

Now, my own views, and I want to make it clear, that these are my views, they are not the views of the regulatory reform task force, not necessarily -- I'm sure that some of those members share some of these views with me. But these are my views, and the views that I have formulated, really, by having spent about three years pursuing this problem.

One is that I want to make it clear that I believe that CRGR has done a very good job on the generic side, and the kind of job that I would like to see done for the plant-specific side.

I would point out in this regard though that early on with CRGR the word got back to me, in a sort -- well, it is the way that words get around in agencies, I guess -- that there was a possibility that somebody in the staff was trying to by-pass CRGR by simply requiring a plant-specific backfit in five, six or seven different cases, rather than requiring one backfit for seven plants. And in that way, they could get a plant-specific backfit on seven plants and never go through CRGR.

That was all simply a sort of an agency rumor, up until the Beaver Valley experience, and of course, I have to make it clear, too, that this is my interpretation of what goes on there. But at least in the Beaver Valley situation, for probable maximum precipitation, for instance, it was indicated by some of the reviewers, that this was a plant-specific backfit that had been required in seven other plants, five to seven other plants.

Well, the question which comes to my mind, is if it is for seven plants, why isn't it generic backfit? And why is it that we can have a plant-specific backfit for seven plants, without going through CRGR?

I haven't been able to discuss that point with Vic Stello. I wanted to discuss it yesterday with Darrell Eisenhut, but after a period of time, I was unable to meet with him. So, I simply throw that out to you as a matter that I believe deserves some attention and some consideration.

Some other problems, as I see them -- and I am going to skim through them, and then come back to each issue. One is regulations versus reg guide, branch technical positions in standard review plans and so forth. The second point is I want to talk about the fact that many of the backfits that have been imposed and appealed are really imposed by a small group of backfitters, within the review staff. And is actually condoned by a very small percentage of the managers within the staff.

Third, that decided backfit issues seems to reoccur, that is, once management has decided that a backfit should not be allowed, for some reason, or another, the reviewers seem to still be able to impose it upon other plants.

I have mentioned the by-passing CRGR, I want to talk a little bit about what I think is the proper place of backfit appeals in the ACRS review, that is how complete is an SER, when there are backfit appeals still outstanding. And how would the ACRS treat that.

Next, I would like to talk about the lack of clear signals to licensees about resolving plant-specific backfit issues.

Seven, I want to talk about the responsiveness of the staff, and finally, I want to talk about the problem of DPOs, differing professional opinions.

First, with regard to regulations versus reg guides, for technical positions and standard review plans. I would point out as a case example, when we went to the Beaver Valley meeting, the meeting started off by the appeal judge actually saying "You show us, Beaver Valley, how you actually meet the regulation, and then we will have the staff respond to that".

Well, Beaver Valley went through the business about meeting the regulations, and the staff, in response, was waving around reg guides, not the regulations, but reg guides.

Now, my understanding of reg guides, and I have represented the agency in hearings, that say that reg guides are not requirements. Reg guides are something out there like the SRP that says "If you do it this way, we are going to -- you can pretty well rely on the fact that we will give you approval". It does not mean that you have to do it this way.

And yet, one of the reviewers during the term of that meeting, when the appeals judge got around to asking him about it, he says, "If you are going to go their way, you are going to have to change the reg guide, as though it was something that was clad in iron".

And I think that is an erroneous decision on the part of that reviewer, and I think it is something that the ACRS should be aware of, that goes on on a very regular basis.

I don't want to -- item number two is a small group of backfitters, I don't particularly want to get into that, but my informal inquiry into this area, indicates that there are very, very few number of reviewers who repeatedly impose requirements upon the licensees, and they repeatedly impose the same requirements on licensees, which takes me to the next issue --

MR. WARD: Does this -- is this across several branches?

MR. TOURTELLOTTE: Different branches, but even in that area, it is in a relatively few branches, and relatively few reviewers.

MR. WARD: Certain technical areas are more subject to this than others?

MR. TOURTELLOTTE: Yes. And, again, it is an example that came up during this meeting. But it is on fire protection, and fire protection in the cable spreading rooms, and my understanding -- and I confess that I have not had the time to check this out extensively -- but on the basis of what

I consider to be very reliable sources, they tell me, for instance, that the fire protection problem at Beaver Valley -- two complaints of, is very much similiar to the problem that has been complained of before, and has been taken up on appeal. And the licensee has won.

And the question that comes into my mind is why is it that the management of the NRC, once they have decided, for instance, that a CO_2 system in the cable spreading room or redundant CO_2 system in the cable spreading room, with stand-by water is sufficient, why do they continue to insist upon an internal sprinkler system, when they have lost that battle before?

As a matter of fact, what really happens in this situation is that a given reviewer can impose that requirement on Plants A, B and C, A can appeal it; win his appeal; and the reviewer continues to press B and C, and may even now try to impose it on D. And maybe D will complain, but maybe B and C cave in, as they say.

And I just don't think it is a very sound way to approach this problem.

The place of backfit appeal in ACRS review and the SER, I think, is an important thing, because it has to do with ratcheting,the real pressure of ratcheting licensees. That is, in a couple of instances, it has occurred where the reviewers, or people who are in charge of the review would say, "Hey, we can't finish the SER because you are giving us all of this trouble on backfit".

And my view is that if someone initiates a backfit, that is a legitimate procedure within the agency and somehow that should not be treated the same as another open item, over which there is perhaps legitimate concern, and legitimate discussions going on about how to resolve it.

There is a bean count, apparently, that goes on in licensing as to which SERs are going to be coming up to the ACRS for review, how many open items they will have, because they don't want to present so many open items that it is a relatively meaningless SER. And I understand that. But somehow there ought to be an allowance made for backfit, so that there isn't an undue pressure created in either direction, by reason of the fact that someone is making a legitimate appeal.

If they are making a legitimate appeal, it is one of two things: at least one is whatever is being required is absolutely not required at all, or two, whatever is being required, there is something that is equal to, or better than what is in the reg guide, or what is in the SRP. And those kinds of matters should be resolved separately from other open items.

There is also a lack of clear signals to licensees about resolving plant-specific backfit issues, and I think that is demonstrated by the Beaver Valley situation. Beaver Valley actually made its initial complaint about backfitting in February, of last year; there were informal objections that were raised with the project manager. The project manager responded in no particular way to those complaints -- they actually said they wanted to discuss 21 items.

There was no discussion of those items, and after a while, the same matter was brought to the attention of the branch chief, in about March. In April the generic letter, 84-08 came out, and the Beaver Valley folks said, well, in that case, it looks like we proceed in this way. And they proceeded in that way, only to be told several months later, about four months later, that that wasn't the way they were going to be proceeding, and then a week later being told, yes, indeed, that was the way they were going to be proceeding.

So, it may be that because of the meeting last Friday, that the staff has a clear way of proceeding, and that they, indeed, will be following this letter 84-08. I don't know. But I think we are really too close to that to know whether that is the way things are going to turn out, or not. It could be that there is a promise that will come from the management in NRR that will indicate how that will turn out, and that's fine.

But I nevertheless want to point it out.

The responsiveness of the staff is somewhat tied to what I said before, it seems to me that in the first place, in the case I mentioned, there should have been some response in February, when a licensee says there are issues that they want to talk about.

We should be talking about them with them. To allow the period of time to elapse that has elapsed, really creates an undue amount of pressure upon the licensee. And in the final analysis what we want to do, I think what the licensees that I have talked to want to do, is they want to resolve the issues early, so that they can change whatever change orders have to be made. They want to resolve these matters in a way that will assure the safety of the plant and the economic integrity of the plant.

And this isn't a managerial problem.

Finally, I want to talk about this DPO problem, and again, this is one of those things that sort of comes through the grapevine in an agency, and that is that I have heard on numerous occasions that there are managers who are so concerned about a differing professional opinion being formed and being more or less prosecuted through the system. And that regarded in such an adverse way by the overall management of the agency that a reviewer who wants to accomplish some backfit, is not really given the managerial direction and supervision that perhaps he might be given, were the importance that is placed on DPOs not placed there in that fashion.

I don't know what to do about that problem. I have been here ever since the DPO situation came up, I know it is very, very important for us to have an atmosphere where people who have differing professional opinions can express those opinions. And can actually have an impact on the system, if possible.

On the other hand, you realize that everything that we do in life has its advantages and disadvantages. And the advantages of the DPO, or the disadvantages that to some extent some people may regard them in such a way that it actually impairs our managerial ability. And this is perhaps an area that simply should be looked into, but I think it is an important area, and I, in all candor, could not simply refrain from saying something about it, because it is a difficult area.

MR. WARD: Jim, it is not clear, what you seem to be saying is that decisions are being made at a low level, without a lot of management input, but then you also seem to say that -- you are just saying that the DPO or the use of differing professional opinion is - - I don't know quite what you were saying about that.

MR. TOURTELLOTTE: Well, --

MR. WARD: But if decisions are being made at a low level without management input, this would seem to say that it is not likely there are going to be any DPOs coming up.

MR. TOURTELLOTTE: Well, what I am saying is that management is afraid to sit on people, for fear they will turn into a DPO.

In other words --

MR. WARD: Oh, I understand that.

MR. TOURTELLOTTE: In other words, the decision is made at a relatively low level, and the kind of managerial superivison that would turn a bad decision around is not exercised as fully as it would be, because of the DPO situation.

MR. WARD: Thank you.

MR. LEWIS: What is the current status of 50.109 revision, it is in draft form, and it now has the requirement for justification before imposition? And that is, of course, inconsistent with the draft manual chapter, which doesn't have it until later. So, will 50.109 as revised be adopted, in your view, sometime within our lifetime?

MR. TOURTELLOTTE: I certainly hope so. I expect the commission to -- well, yes, I expect the commission to sometime, within the next two to four weeks agree on what should go in the Federal Register; assuming that that happens, then at the very outside, perhaps November the 15th it would go in the Federal Register; January the 15th the comment period would be over, within 30 days after that period, February the 15th, we should have some kind of an analysis and a recommendation to the commission. And then I would guess that it would be somewhere around April to May, then we should have a rule in place.

And if we don't have a rule in place by then, it could be that it would just be at an impasse, but it is going to be one of those things that stays on the books for a long time.

MR. LEWIS: If they finally do agree on their wording to put it in the Federal Register, I do think ACRS ought to have a chance to look at it, before it goes through the process, and I assume that will happen.

MR. TOURTELLOTTE: Yes, I am sure it will.

MR. REED: I like what you are saying, I would like to go back a number of years, to a time when I think Vic Stello visited a certain nuclear power plant, and we had conversations, and I believe that there were words very similar to yours -- I was very concerned about the grand rush into backfitting at that time. And I believe I told Mr. Stello that I felt, perhaps the most serious accidents would come from imposed rushed into backfitting in live -- operating live wire, hot work in nuclear power plants, because you can never truly set a nuclear power plant apart, unless you decommission it and say that it can be worked on without the need for live wire hot work. So, you are involved in that.

And I was concerned at that time that there would be some bad accidents from backfitting. I don't know that we have had any challenges to a short core cooling on backfitting, but we have certainly had a couple of deaths -- the recent Surrey deaths, that I think you can say are the result of backfitting.

Now, it bothers me to think that backfitting isn't seriously considered, not by low level management, or people perhaps pursuing some zeal, it bothers me to think that backfitting is not, first of all, significantly recognized, significant. And that is is recognized that it should be, that it really totally contributes to safety in the life of that plant, and it is a necessary contribution. It bothers me that it is not that, and it bothers me that the decision for imposing might come from low level management without management review, or CRGR review.

I am reminded of a case that really bothered me, and it involved two or three trips, and that is a challenge to safety, where all of the two hour fire stops in a plant, to floors and walls, were removed and replaced by three-hour fire stops.

Now, what you are talking about is taking hundreds of screwdrivers, lots of people, picking away at fire-stop board material and taking it out and -- live wire, under the insulation, and replacing it with something else. And there was the issue of whether the two-hour stop material was fully as qualified as the three-hour material was.

Backfitting is not something to be taken lightly. I like what you are saying.

MR. TOURTELLOTTE: Well, thank you very much.

I want you to know that for the past three years I have made this the number one issue for reg reform, because I thought it was the most important in terms of overall plant safety. And one of the points that I have made before, I made with Dr. Lewis' subcommittee, and I try to make it with everybody, and that is all I have ever asked for is a staff analysis before they impose a backfit, a staff analysis before they impose a backfit.

Dr. Lewis said to me, "Well, that sound very reasonable, I can't imagine why anybody would be opposed to that". And my response to that is, "I can't imagine why anybody would be opposed to it either, but they certainly have been for the past three years".

The real problem that I have with it, and it is a logic problem, it doesn't have to do with any specific technical requirement that has been made, or may be made. But whenever you change the configuration of a plant, one of three things can happen; it can be safer, or it can be neutral in terms of safety, or it can be detrimental to safety.

And as long as an analysis is not made, you never know, because perhaps some reviewer who knows more about his little microcosm of the plant than anybody else in the world, may make a requirement which seems totally reasonable to him, in terms of his microcosm, but in terms of the plant's sytem interaction, in terms of overall plant safety, it might present a very substantial obstacle to safety, it may present a safety problem, if you will.

And my view has been all along, look, what we have to do is come up with the analysis first; make sure that this is a necessary -- necessary, not just nice, but necessary for overall plant safety, and in that process of analysis, it will shake out as to whether you have any risk inherent, that would make it detrimental to safety.

But we are still working on that. I am not Pollyanna, you can't be Pollyanna in this job, but I do believe that we have made some progress.

MR. REED: On the other side of the coin, also, I very much favor the most prompt, unreviewed action, if it is established that a real threat for short core cooling -- that is where things should snap real smartly.

MR. TOURTELLOTTE: Yes, we have that provision in the rule, if there is an emergency, obviously you can't come down with a full computerized analysis of some situation that is going to come to its critical point within the next 30 minutes, that is not possible. And it is going to require all of the ingenuity and understanding that can possibly be had by people in the proper positions.

However, what we are really after is to create a safety plan -- I don't think this is just for backfitting, but generally -- we want to create a safety plan that anticipates most of the likely events, and we are able to handle those likely events within a reasonable period of time.

Once we establish that, then when you start changing the system structure of components of the plant, it seems to me you have to re-think your plan, and determine whether that change to the system, structure, or component is going to possibly adversely effect the way that plan could be carried out in the future, should the system be challenged.

MR. REED: I know I am monopolizing the conversation, but I am thinking about backfits, where there are some back-fits that are pushed into place and a year later they are torn out, because they just weren't appropriate. Another backfit went in --

MR. MOELLER: Well, I guess the question I have is do you stand alone -- you have raised a number of criticisms or problem areas as you see them. Have you been unable to convince a group of your associates that you are correct?

You mentioned in the very beginning of your remarks that you had tried to talk to Eisenhut, but apparently you were unable to see him, or something. I guess what I am asking is what is your position within the NRC staff, and why if you have the job of looking at this situation and offering criticism, why does no one apparently listen?

MR. TOURTELLOTTE: Well, I don't think it is true, in the first place that no one listens, and in fact, the rule itself has been worked out over a very long period of time, in association with the staff, and I am going to be very candid with you. There are members of the staff who very strongly support the direction in which I am trying to move this matter. And they are very responsible, very capable technical people.

There are other people who are in key management positions, who for some reason, or another, want the latitude to run the agency anyway they see fit, and that means with the least amount of discipline, over their managerial positions as possible.

And it is sort of a battle between those elements, and you have to also understand that if you want to know what my position in the agency is, the answer is very difficult. I have been here for 10 years, and some of the people that have been my closest associates because of the position that I have taken on issues, are alienated; and some of the other people who were close associates, are afraid to be seen with me, or to talk with me.

And I am being quite honest about it. And I go right ahead because I think what I am doing is right. And I know that in spite of the fact that I don't get a great deal of response sometimes, and I don't have the communications I would like to have, with some of the technical staff, I also know that, for the most part, I get a lot of their support. I know it is the right thing, and I know that if someone just takes the effort to bring it out into the open, that other people can look at it, it is not going to be me, it is going to be the general public who looks at the rule. It is going to be the five commissioners who look at it, it is going to be the agency RS who looks at it, and presents their views. The staff, anybody on the staff who wants to can comment on it.

And in the final analysis, I guess I believe in the wisdom of our society, and I think it will come out all right. I think there is a real problem, as I indicated before, and I think we are headed in the right direction, because we are headed toward good, common sense, scientific approach. And I want to put the two terms, common sense and scientific together, because sometimes they don't always go together.

MR. STELLO: Can I make a comment? I tried to resist this, but I feel uncomfortable with letting Mr. Reed's comment stay on the record, without a rebuttal. I think we had this same discussion last month, while I don't disagree at all with the concern about excessive backfits, and I think they should be very carefully considered, the pluses and the minuses. I must take strong exception to the implication that two industrial deaths at a plant were somehow directly related to the requirement for a backfit.

I may not understand the whole situation there, but certainly from my experience, industrial deaths are related to the care with which the management of an organization conducts an operation, and that's all.

MR. LEWIS: I am going to let you guys fight about that, but not on my time. The statement and the rebuttal are on the record. I am going to end Jim's time. Thank you very much.

You know the psychological pleasure of being alone, but right.

MR. TOURTELLOTTE: Well, there is someone named Walter Biesheau (phonetic) that says one of the great pleasures in life is doing what people say cannot be done. And so maybe I get some of that pleasure out of doing this, because when I started, no one -- as a matter of fact, people that I respect on the staff, said that we simply couldn't change the backfit rule, and everybody in the industry said it would be impossible.

So, to dream the impossible dream, I guess, is part of the job.

MR. LEWIS: But it hasn't been changed yet.

MR. REED: One last comment, I would like to agree with your words, but I am not so sure I want to associate with you --

(Laughter)

MR. TOURTELLOTTE: You are in a good crowd.

MR. LEWIS: I think we do have to move right along.

I think, Tom, you are on next, and you are going to tell us about the draft manual chapter and where it stands now. And I hope deal with the problem of whether there is or isn't a conflict with the draft rule as now underway. You have view-graphs, --

MR. STELLO: He is going up there -- I don't know exactly what the whole purpose of this meeting is. I thought I understood it at the beginning, but now I am a little concerned that I am losing it.

There are clearly two backfitters, plant-specific backfit issues, the 50.109 issue, that's a generic issue. The generic issue is a very open, long path that is followed in deciding that issue, which includes this committee for the generic question.

I don't sense that there is very much in the way of questions about how that is being done today. The reason it is being done today goes back to the story that Glenn was talking about, when he suggested he was talking to me, and I suggest he was shouting to me, rather than talking. Part of that exercise and a lot of other plant managers shouted at me -- caused us to make the changes that were made in +he whole area of backfit in October of '81.

I want to say that I think that the agency has made enormous progress in that regard, and not only for the generic, but I also think for the plant-specific.

Jim has spent an awful lot of time in suggesting that he wants to talk to me, I wish he had, on the hydronet report that he was referring to.

In April, when the instructions went out to the licensees, talking about how to plan a plant-specific backfit, we picked up and sent a memo to Denton, May 8th, suggesting that this was a concern, and it had an exchange memorandum through May 8th, and it culminated in an agreement that the hydronet issue is, indeed, a generic issue, that oughtto have been handled as a generic issue, and go through the generic issue process.

So, we are watching, we are mindful. Causing things to change from the way you h ave done things in the past, or the way to do things differently in the future is not a process that occurs overnight. You are changing the culture of management to accomplish these objectives and it takes time, and it takes patience.

I believe, contrary to some of the things Jim said, and a lot of what he saiu I agree with, I fully support the

50.109 backfit rule that exists. We have had an awful lot of discussion related to 50.109, but I don't want in anyway to suggest that there is any kind of a negative atmosphere about the progress that we have been making -- it has been very, very positive and very, very good. And the reports that I hear back now from the industry is that they are very encouraged by what is happening, the kind of predictability and stability to the process of licensing, while this is certainly not the whole answer, it is a very important part of it.

We are getting there. We aren't going to get there tomorrow, we are probably not going to get there next month, but I think tomorrow and next month there will be even more progress made.

When the commission decides to issue the rule, that is obviously a commission decision -- whether it is two weeks, or four weeks. I am persuaded that they will make a decision and they will issue this rule in the fairly near future.

The manual chapter that Tom is going to talk about next -- I want to make sure that he is going to hit it, but I want to underscore one point. The whole issue behind this manual chapter was to bring the concept that is in the rule and it is in the manual chapter, and it was a very important point to make -- and that is to have anyone who wishes to backfit an issue, to sit down and say to a licensee, in writing, which will be reviewed by management, I wish to backfit this issue because, and to write out what that because is, to avoid the issue of issuing arbitrary backfits which can, in fact, produce an untoward result, by not having other disciplines know the backfit issue. So, that it is circulated to those who might be effected by that backfit issue and also render a judgment.

I think it is a very important point in the process, and it is there. It is already a part of the process. Now, whether it is being used as much as it ought to be, that I don't think is a relevant issue. I think the issue is that there is a commitment that this is the way that we are going to do things, and as I said, before, the culture of the management process is to assure that this is done, and it is going to take time to change.

And I think we are making progress.

DR. MICHELSON: I want to ask -- while we are there, I want to ask this question.

MR. LEWIS: Are you going to take this out of Vic's time or Tom's time?

DR. MICHELSON: Out of Vic's time later. I was a little puzzled by when a backfit is really a backfit. It was my understanding that if an issue comes up with a licensee in the process of going through the final licensing work, and the licensee agrees to fix it -- which might be changes, what I would call a backfit -- it is done without a cost-benefit study, it's done without any further management consideration beyond branch chief level because it is not considered a backfit unless a licensee resists and writes a letter to the agency and says, "I believe this is a backfit", and then you start going through the delaying process, which he is afraid of and, therefore, he might knuckle under without even starting the argument. He just fixes it. Would you comment on that?

MR. STELLO: Sure. As you are well aware, licensees have their own business decisions to make. When they perceive an issue, whether it's an open issue, whether it is something that a reviewer thinks he'd like to have or whatever, and he makes the judgment that, look, I can accommodate doing what I've been asked to do, for $3,000, and that will save me $100,000 or a million dollars in delay", he will do it. And they make those judgments all the time.

I have licensees tell me that they do it hundreds of times, and it's their own judgment to make. Now, part of the problem is on the fence side of it. Clearly, should that issue have been raised with the licensee because it was a backfit? That's part of the culture I'm talking, whether there needs to be training, there needs to be a reinforcement to separate clearly and identify those issues which are going to be backfit issues, why, it's just a legitimate open issue where there is a need to try to develop the position.

It's going to take time, Carlyle. It's going on now, and it will be slow.

DR. MICHELSON: Is the agency doing something about it then?

MR. STELLO: I thi hat the discussior you've heard in Beaver Valley is an example of the kind of thing --

DR. MICHELSON: Well, that was a backfit case or the licensee appealed.

MR. STELLO: But that's one where the licensee called --

DR. MICHELSON: There are other licensees who have just gone ahead and taken the CO2 and put the water in, or put them both in.

MR. STELLO: Precisely, yes.

DR. MICHELSON: And this seems unwise because the

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decisions are indeed made at the bottom, without much check further out. They are not generic decisions because they are doing it at each plant, and they don't go through CRGR because it is not a backfit issue. They do it without raising it as a backfit issue, although it is, indeed, a backfit.

MR. STELLO: In some cases, it clearly is backfit. In some cases, licensees have so indicated that in their judgment, as in the case of Beaver Valley, they believe it to be backfit, and they made their business judgment that I would wish to bring this issue to management's attention, I don't want to just agree to do it. I think it ought to go through the process, and they sent a letter in indicating that was their position.

There are a lot of others, I'm sure, very similar where they have also made the business judgment, I don't think it's worth even raising. I will do it. The process of controlling it inhouse is one that will take time. It is not going to happen overnight.

You've had reviewers doing the job the way they've been doing them for a long time, for 25 years. Now you are trying to build in more discipline in clearly identifying, first and up front, where there is a backfit, and I think that is going to take a lot more time. It just isn't going to happen quickly, and it's the whole system that has to come around.

Now, Denton puts out a monthly -- Darrell does, Darrell Eisenhut -- a monthly status report on these pending backfit issues. He's starting to identify them, and I think you can start to see that there are more and more of them coming up. A lot of them are coming up as a result of issues that are raised by licensees, but I don't think you want to discourage too much, taking away that judgment on behalf of the licensee either, that even if you call it a backfit, he may still make the business judgment, I'll do it, because it's just faster, especially in the review process where you recognize the delay of a few days or a week means an awful lot of money to him, and they are making those kinds of judgments because it makes good business sense. That judgment will continue.

MR. LEWIS: But that troubles me, Vic -- I'm going to turn to Tom in a moment -- because mutual acceptance by the licensee and lower level staff of a backfit just because it is easy or cheap -- you said $3,000 or because it would make trouble later -- doesn't resolve the question that Jim raised earlier, which is that without analysis, you don't know whether, on a plantwide level, it is good, bad or indifferent, and you tinker away at a plant on easy things to do in such a way that you degrade a plant, and it is a lurking concern.

The criterion should really not be whether it's easy to do at the beginning, but I don't want to argue with you now. I know you haven't answered, but I'm going to make him talk, okay? Fair enough?

MR. STELLO: Okay. I'll get it later.

MR. COX: I think I feel on the spot here.

One of the points we've been discussing we will get to revisit, I'm sure, as we go through this. My part of the agenda today was to try to lay out for you in some detail, not too much I hope, the draft manual chapter, and I have to believe that this was intended because, in fact, the draft manual chapter is that from which the procedures flow, and maybe understanding that will help understand a little better where we are.

I will also, in the process, though, want to go over with you the key elements in the staff requirements memo that came from the Commission that led to the draft manual chapter because, in there, I think, you will see precisely some of the things that wound up in the draft chapter.

MR. LEWIS: Just out of curiosity, how long were you told you had?

MR. COX: 15 minutes.

MR. LEWIS: Good, go show. I'm sorry, I am a drum major at heart.

MR. COX: This is essentially what I hope to do, and I expect going into the first one and the second one will

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take most of the time -- trace through a little bit how we came to the manual chapter and what is its status now, and then I would like to discuss the chapter itself, and then briefly talk about what we anticipate might happen in the future.

The title of this one is Evolution of Plant-Specific Backfit Controls, why does it start out with the CRGR being organized in November, '81?

Well, in fact, I have to back up just a little bit with what isn't on this slide, and that is the fact that Victor mentioned a few moments ago, that in the mid '81, Summer of '81, there was this survey conducted of all plants by the senior management of the NRC and, in fact, was published in August of that year as NUREG-0839, I believe, and it essentially had a principal recommendation that the NRC should take prompt action to get the issuance of new requirements under control, that there was a question of whether or not the proliferation of new requirements following TMI perhaps wasn't affecting -- actually the potential existed for the number and nature of those things to create safety problems of their own. So it was recognized by the Commission that something needed to be done, and in November of '81, the CRGR and the Deputy Director's position was created, to attack this issue at least -- and at that time it was for generic requirements -- those requirements that were likely to affect many, if not all, plants.

That organization has been running since that time, but during the next year, in November of '82 -- and I'm nto clear on when the RRTF started, maybe Jim Tourtellotte might speak to that -- but by November of '82, or thereabouts, the Regulatory Reform Task Force submitted its first proposal for the revision of 50.109, the backfitting rule, and it was under pretty constant discussion by the Commission -- well, I should say periodic discussion by the Commission several times in early '83.

Many of the topics which we have discussed here at the ACRS with you in a subcommittee meeting in September and in a full committee meeting last February, the same topics had been discussed at length by the Commission.

As an example, of course, a particularly thorny one is, what is backfitting, the definition of it? Well, at any rate, the Commission recognized, as they pursued developing the proposed rule change, the 50.109, along about mid '83, that something was needed to take care of the plant specific backfitting, a topic which came up by that name in the discussions of backfitting in general.

It was recognized that the CRGR was effectively dealing with generic backfitting, but if 50.109 didn't work -- and that was one of the assertions throughout this development period -- then what should we now be doing about plant specific backfitting, which was recognized as something that did go on.

As a result of those discussions and the realization, number 3 on this, that the NRC staff does not forward plant specific backfits to the CRGR for review, as a result of that, the Commission recognized the need for some interim controls on plant specific backfitting, and they wrote the staff a directive, a Staff Requirements Memo issued on 22nd June of that year, and that memo directed the staff to take some action to manage backfits, plant specific backfits on operating reactors, during the time that this proposed rule-making was underway. As you know, that proposed rulemaking is still underway, but I'm now talking about June, '83 the Staff Requirements Memo came out to the staff.

What did it say to do? I'd like to review with you some of the specific directions that were in that staff requirements memo, and I would recommend it for your reading as kind of a document that may be the genesis of a lot of what we discuss here today. It is SECY 83-3 and it's date is the 22nd of June, and I'm sure you have copies of it.

There were some key elements in that directive to the staff. The very first item, and there were about eight or nine numbered items in that directive, the very first one said continue reviewing generic requirements through the CRGR process.

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It then said for reactors licensed to operate, the staff should provide, on a plant specific basis, a description of any staff proposed requirement that involved a new staff position or a change in an existing position with respect to the licensee. Now, that was perhaps our first clue to how the Commission was at that time defining backfitting.

So they, in the very opening of that Staff Requirements Memo, initiated a definition of backfitting for plant specific bases and where licensees were concerned.

They said that when the staff proposed to make such a new staff position, or change in a position, that they should describe this proposed requirement to include a statement of how safety would be improved -- not why, not to what degree, but just how safety would be improved.

And the requirements memo then went on to say that there would be an appeal process allowed of the licensee once he was informed of the potential new requirement, and that if after that appeal the licensee wanted to notify the staff in writing that it still objected to the proposed requirement, staff must then assess the cost and benefits.

And it went on to say that that cost-benefit analysis should consider the same elements that were then considered by the CRGR in its review of generic issues, and those elements are outlined in the CRGR charter.

Another key element in that Staff Requirements Memo was that the staff requirement, as proposed and now under discussion in some process, will not be imposed during this appeal process and until there is a final determination by the staff as to whether or not it will be imposed.

There was a little further definition of what the regulatory positions -- you remember I just remarked about change in position or a new staff position -- the memo from the Commission also stated what those positions might involve by way of further amplifying their definition.

They said they could involve new interpretations or a change in the interpretations of rules and regulations, or a new or changed position as set forth in various licensing documents, and they give examples of those licensing documents and there was quite a list of them, to include things like the Standard Review Plan, SERs, tech specs, temporary instructions in the IE or in the regions, plant procedures, almost any document in which the staff spoke to a licensee in a formal way explaining a change in a position or a new position.

Also required of the staff in developing its plan was that the prompt imposition of requirements may be effected, if necessary. If the appropriate staff manage -- in this case, office director -- felt that something was necessary for public health and safety or security, that office director was, of course, authorized to impose this requirement promptly.

Another element was that the licensee should notify the Director of the Division of Licensing of any disagreement with a staff proposed requirement. This is the way that, in effect, the process would be started. It required the licensee to notify the Director, Division of Licensing.

Now, the Staff Requirements Memo was speaking, up to this point, essentially in terms of NRR because that's the way most of the discussions of backfitting had proceeded through the Commission meetings to that point.

However, they also said in that memo that an appropriate appeals process similar to that for NRR should be developed for other offices that can initiate new requirements for OL holders, and that's what the Office of EDO did with this manual chapter. That's why it covers the four office directors who are most likely to initiate new requirements or change requirements, and lays out some of the procedures and requirements and authority and responsibilities for offices other than NRR.

Another element of that requirements memo was that a summary report of the appeal process -- that is, each meeting that occurs -- will be prepared, distributed, and a copy placed in the Public Document Room. This was to be a process that was going to lend some system and some discipline to perhaps what had heretofore been a somewhat informal review, discussions with the licensee.

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Following Commission review of the plan which was directed to be developed, the plan and the appeal process was to be sent to all OL holders. Now, that, in fact, was done after Commission review. I bring that up to indicate to you that when the Commission told us to go out and develop this plan, they meant for us to bring it back to them. It was to be approved, and then it would be sent out to the regulated industry, the operating license holders. That, in fact, was done.

Now, those are just the main elements of that Staff Requirements Memo that came to us, and I wanted to go through them with you, and that's all still in line item 4 here, and now I'm going to move off that to the manual chapter issuance itself that's in this point by point quickie review here.

The draft chapter and the plant specific procedures which were prepared with that chapter went to the Commission in August, '83, having been concurred in by all the affected offices and the regional administrator.

The Commission deliberated on that a while, and they approved it in February, '84. We, or Mr. Dirks received a memo from the Secretariat that said, "Implement these procedures now, immediately. Send them to all the licensees. Put them into effect and report to us"-- actually he said put them into effect, put them in the public domain and

13 solicit and receive public comment on the procedures. Then there was a report to the Commission on what the public comment brought out and what the staff had developed in its use of the procedures to that point, and we were to report to the Commission on what, if anything, we wanted to do with the procedures as well as present an analysis of the public comment.

That was done in September of this year. I should back up a little bit and say that in February, February 10 of this year, just after we had been told to put the procedures out, make them effective, I came down here and briefed the ACRS on that chapter and those procedures.

At that time, we went through chapter and the procedures sort on a point by point way. Darrell Eisenhut was here and made a few comments on those things, and I would commend also to your attention a couple pages in that transcript where Darrell was talking about the office's use, in particular his use, of those procedures, and I think germane to some of the things we've been talking here today, Darrell mentioned that when a licensee comes in and petitions, essentially, that a requirement that he has been given is a backfit, then it is considered a backfit, or a potential backfit that will be discussed. That was a statement by Darrell in that meeting.

Following the issuance of those procedures to the public and to the industry, NRR issued a generic letter 84-08 implementing the procedures for operating reactors and saying that in the interim, pending Commission approval or direction on a paper that was already down to the Commission, that NRR would essentially process oral applicants' petitions in a similar way, even though the formal procedures, as issued, were entitled and intended to be used primarily on licensees, or for licensees, operating reactors.

And, of course, for the operating reactor, that baseline from which to measure a change in a position or a new requirement is easier to measure than with respect to an applicant because for an operating reactor, it is, of course, the date of license and the commission of the license.

I'm going to skip number 9 because I've already mentioned that to you. The staff briefed the ACRS Subcommittee on Policies and Procedures in September of '84, that was just a few weeks ago, Dr. Lewis' committee. And on September 19, the EDO did submit this paper covering an analysis of public comment on the chapter and procedures and, in fact, recommending some relatively minor changes to the procedures as a result of all of that.

Now I'd like to just make a couple of more comments that aren't on the Vu-Graph there. The manual chapter and the procedures associated with it have been used for less than a year. NRR is the primary user. In fact, we have polled

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the other potential users of these documents and have received a negative report that they have not initiated potential backfits, but NRR has established a status tracking system which has been referred to here earlier, and they issue periodic progress reports on the status of the backfit actions that are underway and, at anytime, you can get the status of any one of those actions, and I think there have been on the order of 30 that have been tracked so far.

It is not the intent here, because of the formal and eye level attention that these procedures have received, it is not the intent to indicate that these things are rock hard, fixed procedures.

We are expecting them to evolve as use shows that change might be warranted. We're always monitoring the potential change, and where that is indicated, we are going to propose appropriate changes as they show up as being needed.

That having been said -- since I'm not getting any questions and you are letting me continue -- let's just go to the manual chapter itself.

It's organized the way many NRC manual chapters are, with a set number of paragraphs, each of them having a number there, and I am just going to go through them and make a few comments on each one.

Under Coverage, it states the purpose and objectives. It gives a definition of backfitting as the imposition of new

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plant specific requirements on power reactor licensees. It also states that this backfitting that occurs, occurs when the staff takes a new position or changes its interpretation of an existing position with respect to the power reactor licensees.

DR. MICHELSON: Again, I think it's important to make sure that everyone understands that under this definition, it's only a backfit after the licensee is told to do it and he says, "No, I won't because I think it's a backfit". If he is told to do it, and he agrees to do it, then it is not a backfit, irrespective of its cost or whatever. He has to make the decision on the basis of cost and other considerations, but the whole process doesn't even start until the licensee resists the requirement by declaring it a backfit.

MR. COX: The plant specific process, that's true.

MR. STELLO: Excuse me. The licensee is provided in writing an identification of what is being advertised as a potential backfit, and he is given the reasons why it is appropriate, the analysis of why this is a proper backfit.

DR. MICHELSON: That's not my understanding.

MR. LEWIS: That's not plant specific.

DR. MICHELSON: Oh, that's not what we were told.

MR. LEWIS: That's the whole point. That's the reason you are here, to compare your procedures with theirs.

DR. MICHELSON: They are not told that. There is no

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analysis to make that decision at that point yet.

MR. STELLO: He is -- unless someone will correct me -- he is given -- this is a backfit. I'm asking you to do, and I'm asking you to do this backfit because. The amount of analysis that goes in here is very, very brief. It is a summary of the reasons why it is a backfit, at the beginning of the process, am I right?

Now, the full-blown cost-benefit detailed analysis that is the kind of thing -- and I want to get this comparison immediately -- that you get for generic backfit issue, that entire package would not be developed until the end of this process he is going to describe, but at the beginning there is a reason given for the backfit.

DR. MICHELSON: Why don't we just use a little brief example like, say, the CO2 system. A licensee comes in and says, "I've got CO2 in the spreading room", what happens then.

MR. MORRELLI: Frank Morrelli, Division of Licensing.

The procedure specifically says that a backfit item, a change in position by the staff requires it to be identified to the licensee, and to indicate how the implementation of this requirement would change, would improve safety how, the how part. This is the point that Tom raised in his discussion of the Staff Requirement Memo.

So the licensee is informed that here is a change in staff position, it is backfit, and it is subject to appeal. The specific example that you raise, Dr. Michelson, is one that I can't address in specifics because it rose in context of an OL review, and the context that it raised itself in -- these procedures now, and this manual chapter -- one has to understand are directed at backfits and operating reactors.

MR. WARD: Can he give another example, maybe, would that help?

DR. MICHELSON: My problem is that word backfit, see? When is a backfit a backfit? If I, as a licensee, come in to you and I tell you I have CO2 in the spreading room, and your lowest level man at the bottom says staff just doesn't buy CO2, they want a sprinkler, at that point it is not yet a backfit. If that licensee goes back on the basis of that statement, and puts in sprinklers, nothing more is said. But if he says, no, I'm not going to do it, then you start the process.

MR. MORRELLI: That's correct, sir.

DR. MICHELSON: And it's that first step that bothers me. You can coerce people into doing things that are actually very expensive because waiting is even more expensive.

MR. MORRELLI: That's correct, if the subject hasn't been identified as a backfit item, or if the specific requirement got out and the licensee doesn't respond in any way or other, that is correct, it won't be captured in the system.

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DR. MICHELSON: And many of them are handled just that way, and they escape because benefit analysis, they escape even a basic safety analysis --

MR. MORRELLI: These are the items that Victor addressed in his remarks about those kinds of judgments.

DR. MICHELSON: That was my understanding.

MR. MOELLER: A question on this definition. It says the imposition of new plant specific requirements. If backfitting is defined that way, then it never could be generic.

MR. MORRELLI: I think, Dr. Moeller, the intent of that in context of the staff requirements memo and in the context of the manual chapter, it talks about requirements that have gone through the CRGR process and you are imposing a generically approved requirement, one that has gone through the entire CRGR process. It is exempt from this process.

MR. STELLO: Frank, I think I understand the question that's being asked. If you look at the history of each plant. Each plant has a baseline of interpretations of requirements that were appropriate at the time it was licensed. You look at a new requirement that is being used today for a plant licensing process, an appropriate one, and that clearly will represent a change for an older plant.

So, with respect to the baseline for the older plant, it is a changed position, a changed requirement, therefore, a backfit.

MR. WARD: I think Mr. Tourtellotte has a comment.

MR. TOURTELLOTTE: There are two or three things I wanted -- two or three points I wanted to make. One, this entire SRM was really developed because it became quite clear early in the game that we weren't going to get a rule out right away, so we tried to develop an SRM, something that would give guidance to the staff that would tell them how to handle the backfits before the rule actually got passed, and that's how the SRM came into being.

Now, when it did, one of the things that I was complaining about, one of the bases for issuing the SRM was to require the staff to make its analysis before they impose the backfit. That was an argument -- that was the position I took. It was an argument that I lost, and the Commission said, no, the staff doesn't have to make a full analysis, but they ought to give some reason, and I think it you look back in the transcripts, one of the Commissioners -- they always give some kind of little reason as to why they are doing what they are doing.

Now, Vic has said, well, they have to state how safety would be improved, and I think that probably is at least what management believes, but I can also tell you that from the investigations that I've made, that that is not the way it is working currently, that indeed the meeting that we had before, going back to Beaver Valley, all Beaver Valley was asking for was some kind of a justification. They didn't get any on the two issues that we had, until we got into the meeting, and so they didn't even know how to prepare for the meeting.

Insofar as the one comment, I agree 100 percent. The staff really should have an analysis, a full analysis at least that would demonstrate clearly that this is something the is needed for overall plant safety before they impose it, but under the SRM, that is not exactly what is required. Even so, I think there is probably a disparity between the way it is perceived managerially, and the way it is actually carried out.

Let me give you another example. In one case, in a Q&A situation, a reviewer asked a given question, that question had been responded to in we will call it plant A, in a certain way, and the reviewer had accepted it.

He asked it of the second plant. The second plant, because they were in touch with the first plant, said, hey, did you get a question like this? The answer is yes. What answer did you give? And so they look at the answer and they give exactly the same answer.

The reviewer turns it down. Why does he turn it down? Well, let's talk to him about it. Talked to him about it, and he said, well, how about Millstone? Did they give

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a good answer to that question? The answer, oh, yes, Millstone gave a good answer to that question.

Well, now, if you will look, you will see that our answer is word for word the same as Millstone. Now, why isn't that good enough? The answer the reviewer gives, oh, I'm a lot smarter now.

Now, I don't believe that's saying how that will improve safety.

MR. LEWIS: Or maybe it will.

MR. KERR: You are discovering one of the secrets of those of us who give examinations in teaching. You use the same examination year after year, but you change the answers.

(Laughter.)

MR. LEWIS: I'm going to make us move right along because we have, after you are finished, three 15-minute talks in our remaining 45 minutes, and you were well overtime before you got any interruptions, so I'm going to lay it on you to move along fast.

MR. COX: The objectives part of this chapter essentially parallel those of the CRGR, and I will just tell you four of those very quickly, including the removal of unnecessary burden on the regulated industry, reduce worker exposure in implementing requirements which I think addresses Mr. Reed's concern --

MR. WARD: You say removal of unnecessary burden. You mean avoidance of unnecessary --

MR. COX: Yes, avoidance is probably a better word, but it is written as removal. Conserve NRC resources while not reducing public protection levels, and to assure that the requirements that are levied do contribute effectively to health and safety.

Okay. The 03 paragraph, Responsibilities and Authorities. Essentially, these are generally office directors having authority to make final determination on backfits within their functional areas.

Basic Requirements. Here is perhaps the meat of the chapter, and the basic requirements are as you see there, and starting out to identify the requirements, users are required to provide a description of the requirement, state how it improves safety, obtain management approvals and formally transmit it to the licensee.

I think we've seen several times this is an area where there are some problems in effectively putting these procedures, if not the chapter, into effect, and that in not all cases, of course, do you have reviewers, through their management, identify a new requirement as a backfit. So a licensee gets a requirement, as Mr. Michelson described, and he takes the initiative to petition saying, I think this is a backfit, let me get into this procedure and let's talk about

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it, and that is hwat has happened.

That's why I brought out earlier -- I'm sorry Darrell isn't here to reaffirm this -- but Darrell said long ago that when the licensee does this, when he makes a petition that he believes a requirement is a backfit, no matter how it has been presented to him, that DL does take this under consideration and deal with it in a responsible way, under the intent and the -- well, under the intent of these procedures.

DR. MICHELSON: That also triggers the need for the cost-benefit study, as I understood it, is that correct?

MR. COX: No, not yet.

DR. MICHELSON: The next step, after he loses the -- in the appeal process --

MR. COX: If he loses what is now a two-step appeal process at the Assistant Director and then Director level in Division of Licensing, he can then ask for further consideration and a cost-benefit analysis.

MR. LEWIS: Are you saying the staff cannot deny it's a backfit if the licensee says it is?

MR. COX: I'm saying the staff has said that it would not deny it's a backfit.

MR. LEWIS: The staff has been directed to not deny that it is a backfit by higher authority than the staff?

MR. COX: I'm not sure you can see a written document to that effect, but that is certainly the intent of these

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procedures as approved by the Commission.

MR. STELLO: Well, let me clarify that. It wouldn't really make any difference because he comes in in an appeal process. An appeal process is available to him whether the staff agreed to it was a backfit, or he disagreed, he's entitled to that same process.

MR. LEWIS: I won't argue this, but I'm not actually sure because I'm beginning to see a loophole that troubles me. If the staff says it isn't a backfit and he says it is, and the staff denies that it is in the appeal process, the whole procedure then changes.

MR. STELLO: No, no, no. He still has an appeal process independent, for that reason.

MR. LEWIS: Because anyone can appeal.

MR. STELLO: That's correct.

MR. LEWIS: But that appeal does not trigger a cost-benefit analysis.

MR. STELLO: Well, you're right. It wouldn't automatically one. He couldn't get one if the staff decided it wasn't backfit and they wanted to fight him on the issue, he would then have to take it up -- in fact, it may come up to the EDO office.

MR. LEWIS: But it's only appealed under these procedures that automatically triggers --

MR. STELLO: Right. That's correct. The automatic cost-benefit comes out of this process, but independent of that, up to getting the cost-benefit, the appeal process is the same.

MR. COX: Well, under the appeal process, item 2 there, the licensee can appeal to the staff management, either the Director of Division of Licensing of NRR or the Regional Administrator in the regions.

The final decisions -- and I said final -- are made by the Director of NRR or the Director, IE. This is after it's gone all the way through a cost-benefit analysis.

The meeting summaries of this process go to the PDR, and during these appeals, consideration is given to why the requirement is needed to achieve or maintain an acceptable level of safety. That's during those appeals.

Item 3 is the cost-benefit analysis. Again, these considerations are nearly identical to those in Section 4B of the CRGR charter. That's how -- I mean, those are the kinds of factors, attributes that should be considered during this cost-benefit analysis.

Item 4, Implementation of Requirements. How are they implemented once it is decided that a requirement will be imposed? They may be issued prior to the appeal process, that is, the completion of the appeal process and its cost-benefit analysis, provided that an appropriate director determines that the prompt imposition is necessary. This is that prompt imposition clause again. It's part of all or our regulatory bases. If an office director decides that something is important to public health and safety, he can simply do it. That is within his authority but, otherwise, if we are in this process, and we are going through the appeals, and we are going through a cost-benefit analysis, and there is going to be a deliberate considered decision through this process, requirements are not imposed until the entire process is completed -- that is, the licensee is not held up from operating.

MR. LEWIS: I'm going to make you sit down at 3:00, whether or not you are finished.

MR. COX: Oh, I'll be done. Recordkeeping and reporting. The current status, it's got to be retrievable at anytime by the NRC managers, and that's taken care in NRR by this tracking system.

What are the exceptions? In this chapter, what it says the exceptions are, are essentially two: Requirements that have been reviewed generically by the CRGR and approved by the EDO are not subject to backfit appeals unless the EDO determines that there were some specific plant specific issues here that weren't considered by the CRGR in imposing this requirement.

For instance, if the CRGR imposes a generic requirement and an individual licensee, in looking at his plant with

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respect to this requirement, thinks that he has a logical argument why it should not be imposed on his specific plant because of his specific design or operational scheme, then he could appeal on that basis, but it would have to be established that the CRGR had not considered those things which this particular licensee wants to bring up.

And the chapter ends right there with a definition -- I'm sorry, I skipped one -- References. It refers to the CRGR charter and the June 22 memo from the Commission, Staff Requirements Memo, which directed that this chapter or a plan be produced.

And then like other manual chapters, it has definitions at the end. This one had at the end a definition of a staff proposed requirement. That is one that includes all the mechanisms used by the NRC staff to set forth regulatory positions requesting compliance by an operating license holder that involve, one, a new interpretation or a change in the existing interpretation of rules and regulations; secondly, a new staff position or a change in an existing position set forth in, for example, safety evaluation reports, standard review plans, reg guides, branch technical positions, inspection reports, temporary instructions, inspection manual chapters, and official licensing documents of another kind.

That's the elements, in some detail, of that chapter, from which the procedures were developed.

DR. MICHELSON: Typically, how long does it take from the time a licensee appeals until a decision is made on the appeal? Is there a typical --

MR. COX: I would let Frank Morrelli answer that. Is he still here?

MR. MORRELLI: Since these procedures were implemented, which was October of '83, even prior to the Commission approving the procedure for operating reactors, Mr. Denton instructed the staff to implement the procedures that were circulated to staff and, since that time, approximately 30 items have empted the appeal process in some form or another.

About half of those are resolved even before they get to the first level of appeal, or at the first level of appeal.

MR. SIESS: How long does it take to get that resolution?

MR. MORRELLI: I would say, in looking at them, there are some that have been in the process for probably four months or more. Some have been a relatively short period of time, so I don't know what the average is.

DR. MICHELSON: Are you referring now, though, to that 30 percent or so that are settled off the top?

MR. MORRELLI: I think the bulk of those are settled soon after the first appeal meeting. The issue is identified, the meetings are held, and I would say that process would take on the order of a couple of months or more.

Of the appeals that have gone to date, several have gone to the second level of appeal, and none have risen to Mr. Denton's level as yet, and there probably are about four or five issues in the appeal process somewhere, at this point in time.

MR. SIESS: There's two case histories of something we've gotten so far, Farley and La Salle. Did those come from the staff?

MR. MORRELLI: May I see them?

MR. SIESS: Yes. You might notice the dates, that might help you identify them.

MR. MORRELLI: These were provided to the subcommittee. Well, for the particular examples, what we have here is the one on Farley was identified in 10-82.

MR. SIESS: I was looking at the date the appeal was requested.

MR. MORRELLI: The appeal meeting was -- the first appeal meeting was held in March of '83 and the resolution was December of '83. Now these even pre-dated the procedures that we're talking about. These would be the normal appeal process that was available for licensees even before this procedure was developed.

The second one here on fire protection, I guess the issues were identified in November of '83 and resolution was

June of '84.

MR. COX: This is pretty brief. I'm going to make it by 3:00. 84-371 went to the Commission reporting on the current status of these procedures, incorporating some changes -- they were really all minor -- and it now sits on the Commission's desk, and they were asked to approve the proposed revised procedures and the chapter, to direct the staff to make the procedures and manual chapter effective, and to direct the staff to inform the regulated industry of those revised procedures.

Pending that Commission action, the manual chapter, as it went out in April, are implemented and are being used. When and if the Commission so directs, we will make this what is now referred to as a draft chapter, a final one.

MR. LEWIS: I propose that we move right along because we are way behind at this point, if that's agreeable to you, Dave. You are our boss today.

MR. WARD: Yes.

MR. LEWIS: Now, what are the legalities of all this? I think that's our next move, and in particular, the apparent discrepancy between the draft manual chapter and the proposed rule.

MR. SHIELDS: I guess I'm not prepared to address the legalities of all of this. I was asked principally to mention what the problems might be in approving a final manual which I suppose is imminent.

When one is in the process of developing a rule, which despite, I think, Jim's optimistic prediction is maybe not that imminent, at least a final rule, a proposed rule might be out fairly soon.

I can't say very much about that except to say that if the Commission does finally develop and publish a final rule which, under any circumstances, would be different from the current 50.109, one would have to change the manual chapter. There is no doubt that the rule takes precedence, and I am sure that as the Commission proceeded to reach agreement on a final rule that, at the same time, they would be proceeding to revise the manual chapter to be consistent with that, and I would expect that if they got close to a final rule, that they would instruct that the manual chapter would be revised at the same time so that when the final rule became effective, the manual chapter would then match with the provisions of the final rule.

Other than that, I guess I understand why the situation has evolved as it has. As Jim pointed out, the Commission has been at this for about three years and has been working on a bacfit rule almost exclusively for a year, and we still don't have a proposed rule.

So, I think it was understood last summer, last fall, that this process was likely to drag on for a long time and, in the meantime, it was valuable to have something in place to operate internally consistent with the existing rule, and so we have that.

The only other thing I might add in addition to what Jim mentioned earlier was that I'm really not prepared to address the cost issue generally, but I think you are aware that there is a wide variation of legal view on the consideration of cost in backfitting, and some of those views are held by persons outside of the agency, including the unit concerned scientists which is following this issue which is following this issue carefully, and should we develop and publish a final rule which considers costs in a way that they feel is inconsistent with the Atomic Energy Act, then I would fully expect that they would challenge that rule in the Court of Appeals and who knows how that would come out. Our success record in recent years in the Court of Appeals has been quite poor when it comes to interpreting the Atomic Energy Act, so I wouldn't want to make a prediction as to how long that process would take and where it would end up.

MR. LEWIS: Hasn't the record in recent years of overturning the Appeals Court decisions been pretty good?

MR. SHIELDS: No.

MR. LEWIS: It hasn't?

MR. SHIELDS: Well, we've won one or two decisions in the Supreme Court, but a number of others have not gone to the Supreme Court and, in many cases, the Attorney General of the United States has chosen not to take an appeal.

MR. LEWIS: As I read the OGC memo on the question of cost, it made sense to me, and correct me if I misunderstood it. I understood it to say that you could consider cost unless the issue was one of bringing the safety of a plant up to the statutory standard and, in that case, of course, you couldn't consider value. That made a lot of sense to me, and that's not what we're talking about here.

MR. SHIELDS: Well, I think that is probably a fair representation. I haven't read that memo very recently. On the other hand, I suppose one could say that if the requirement that is proposed is intending to carry the plant beyond adequate protection, then what business do you have imposing it in the first place.

MR. LEWIS: Well, that question does jump to mind.

MR. SHIELDS: But then cost is not necessarily the relevant issue. The issue then is whether the requirement itself is proper under the Atomic Energy Act. So, it's a little hard to find where cost is exactly relevant.

If you can't consider it in an instance where you think the plant is not adequately safe and you probably ought not be considering the requirement at all if you think the plant is already adequately safe without it, then it is a little unclear where cost becomes the most important factor.

MR. KERR: Well, it seems to me that cost is implicit in the whole process because the Congress made the development of nuclear power policy, and one certainly can't do that without considering cost.

You could make any of the plants so costly that none of them could be operated if cost were no consideration.

MR. SHIELDS: That's true. I don't disagree with that.

MR. REMICK: I have a question. I guess I don't see a problem of why the draft manual chapter has to be consistent with a proposed rule, which we don't even know what's proposed yet. I don't see any problem there, but I guess a more pertinent question, in my mind, is how does the draft manual chapter compare legally with the current 50.109, the current rule. Is there any major inconsistency there?

MR. SHIELDS: Well, as you just saw, the manual chapter itself is largely, and I guess maybe entirely, a procedure to utilize in the case where a utility objects to a proposed backfit. It doesn't contain any substantive standard for when you can or cannot impose the backfit. That standard today, as in 50.109, as the substantial increase in protection to public health and safety standard, the current 50.109 doesn't talk about cost.

A manual chapter is never intended to contain substantive legal decisions of that kind. It is only intended to be an internal implementation of any rule. So whatever -- now, of course, a rule can have procedural aspects, and the rules that have been kicking around as proposed rules do have some procedures and elements of analysis built into them, and so if you ended up with a rule that has some procedural requirements in it, then you would -- I would presume you would also include those procedural elements in your manual chapter, but at the moment there really isn't any problem with that.

MR. WARD: That's what I was going to ask, but I thought the old rule, existing rule, required -- in effect, required the licensee to show why a backfit was not necessary.

MR. SHIELDS: It doesn't say that.

MR. LEWIS: I thought quite the opposite. I thought it requires that the staff show that a backfit is necessary, and that's what the manual chapter is doing, and it seems consistent with the old 50.109.

MR. WARD: Well, the old 50.109 requires the Commission determine that the backfit provides a substantial increase in public health and safety.

MR. LEWIS: That's right, substantial.

MR. WARD: It doesn't go into any detail as to how one reaches that determination.

MR. LEWIS: But the new draft manual chapter drops that requirement until the appeal process is an issue. Even

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

there it doesn't say how to interpret the cost-benefit analysis.

MR. SHIELDS: Well, it depends on how much you want to read into current 50.109. All it says is that the Commission has to make a determination. It doesn't say at what point one needs to consider cost benefit, for example.

I don't think there's any doubt that it hasn't really been used, so it is very difficult to say whether any existing procedure is or is not consistent with what 50.109 says.

MR. LEWIS: Well, 50.109, if I remember correctly, doesn't mention cost-benefit. It simply says the Commission must determine that it makes a substantial improvement in public health and safety.

MR. SHIELDS: Right. So that's why I don't see that there is really any problem with this -- the current one is intended to impose a standard, and that standard was never really applied. The proposed rules, in various versions for the most part, try to put meat on those bones, so to speak, and in addition to a standard, include some elements of analysis and requirements for when you do the review and how you arrive at a conclusion.

MR. LEWIS: But even the draft manual chapter doesn't provide any guidance whatever after it defines what cost benefit analysis is done. It doesn't say if the costs exceed the benefits, or substantially less than the benefits, or anything.

MR. SHIELDS: Well, for the moment, one would have to apply existing 50.109 to that decision.

MR. LEWIS: Substantial.

MR. SHIELDS: Right.

MR. LEWIS: That's what I was looking for. Well, thank you.

Victor, it's your turn.

MR. STELLO: I don't think I want to go through, unless you want me to, what CRGR does and why --

MR. LEWIS: Well, if I could interpret it, there is a clear contrast between the way you envision it and the way -- or perhaps there isn't.

MR. STELLO: No, there is. I wanted to try at least to emphasize it, it's pretty different.

Let me go back to the point of when a decision is made by a reviewer who wants the backfit. And he writes out his brief reason, I'm going to backfit and this is how I'm going to improve the safety of the plant.

That's the striking difference. CRGR, you are already at the end of the process and have the full cost-benefit analysis before you are trying to weigh and make the judgment of whether you ought to issue the requirement or not.

So CRGR starts with the body of information that would be available only at the end of this appeal process

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with the manual chapter. When you get to that point and you are trying to decide the issue, then I think you are basically the same in terms of information available for a decisionmaker.

Now, why it was difficult for these plant specific issues and why there is a problem with this issue, one has to recognize that there's two competing management concerns. The one is to try to find a way to orderly manage the backfit question, but in the process of doing that, not to create an environment where you are telling the whole staff, my heavens, just don't bother to come up with anymore new ideas about safety, and kill that whole process of how new ideas are generated.

You still want to have a reasonably healthy environment for the reviewers to bring up issues and having a channel to bring these safety concerns up, which very often clearly are backfit. I mean, that's how a lot of them begin. And it's a very difficult judgment to make, and that was a central part of the discussion that led to this particular version that's in the manual chapter.

Now, in making the process more formal and going out with a proposed rule, it also is bringing these two back into the line again, where the case specific issue will have the cost-benefit analysis done. Now, how we change the process or how we go in a plant specific and get them to be made with essentially the same kind of information that you have for generic issues, as I said earlier, it's going to take time, and I think management has to be concerned all of the time with the competing need not to completely stifle new ideas and new questions that are a part of the process. So, you are managing something for which you have clearly two competing interests that you are trying to satisfy, and that's a delicate balance, a difficult one.

I don't ever want to get to the point where we are telling the whole staff, don't bother to come up with another new idea. That would just be insane. I don't think you want to ever develop a process for it, it needs to be a healthy one.

At the same time, we have to be very, very concerned, for the reasons that Glenn talked about that was basically behind all of this, to not let backfit issues arise for which at least Glenn told me in his opinion that were clearly counterproductive to safety. They made, in his judgment, his plant less safe, and I suspect that there are a number of cases where that is, in fact, true. And I think we do have requirements for which there is real concern as to whether they are producing enough benefit to safety or not.

That thorough kind of analysis is what is needed to bring that into line, and it will have to be done in a system which allows both processes to be in balance.

Now, if you have some specific questions about CRGR, or whatever, review or the whole thing --

MR. REMICK: I have a question that goes back, not to what you just said but what you said earlier this afternoon. You made some statement like you wanted to make it clear that you believe in the backfitting rule.

Now I inferred from that you are talking about the current 50.109, or were you talking in general, or were you talking about one of the proposed versions that is floating around? What did you mean by that statement?

MR. STELLO: Well, the one that is before the Commission now has been ventilated rather exhaustively, and there's been some comments now going back and forth between Commissioners. That version and several of the other versions are not significantly different, in my mind. So any of the last, I guess, two or three versions I would find I'd be quite comfortable with.

MR. REMICK: So you weren't endorsing any particular draft, you were just talking --

MR. STELLO: Any of the last two or three are probably all right. I wish we'd just soon get one out.

MR. LEWIS: Are there any other questions?

(No response.)

MR. LEWIS: I guess not. Mr. Chairman --

MR. STELLO: You owe me 13 minutes.

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MR. LEWIS: We owe you 13 minutes. I would recommend, Mr. Chairman, that we use those 13 minutes to -- in a constructive way, like come back at 3:30.

MR. WARD: Very good.

(Whereupon, a short recess was taken.)

MR. EBERSOLE: Let's resume with the next session for this afternoon, which is a one hour session, 11.1 on Reactor Operating Experiences. It involves three particular events at Palisades, WNP 2 and Brunswick. You've been handed a white handout for this, and I'm going to call on the staff representative here just to take over this. Ernie, it's going to be your hour, okay?

MR. ROSSI: Thank you. I'm Ernie Rossi, from the Office of Inspections and Enforcement. We have with us today, George Lanik and Eric Weiss from the Office of Inspection and Enforcement, who are going to give the presentations on the event.

We also have Ed Jordan from the Office of Inspection and Enforcement, Paul Bemis and Tom Hicks from Region 2, and Irwin Spickler and David Teraho from the Office of Nuclear Reactor Regulation, who are here to answer questions that may arise on particular events.

The three events that will be discussed this afternoon were selected for discussion with the full Committee from eight events that were discussed on Tueday, with the

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Subcommittee on Reactor Operations.

The first event will be the reactor coolant pump failure which occurred at Palisades on October 2nd, and George Lanik from the Office of Inspection and Enforcement will make the presentation on this event. George?

MR. LANIK: This event started out on September 16 as a reactor coolant pump seal leak, and the plant was shut down, and then they later disassembled the pump and found that the impeller was separated from the pump shaft. The reason we are discussing that today, first of all, this is a rare occurrence and, second of all, the safety significance of it is that this is the kind of event that approaches a what is called a locked rotor event which on at least new CE plants could result in some fuel damage, although it is not as serious on the old plants. That is the reason we are discussing it. These are the subtopics that I will be discussing.

Basically, the pump is a Byron Jackson pump. It's a fairly low rpm, 850 rpm pump. The impeller is about 42 inches in diameter. 4,000 horsepower motor, four seal stages, and has controlled bleed off rather than CO injection as we are used to seeing on reactor coolant pumps.

Here is a picture of the pump. There is a removal coupling which is of some significance here. This is the impeller, the shaft and the seal. One characteristic about

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this pump that helped them discover this event is that following -- when they are going in to replace seals, what they do is they remove this coupling here and the impeller drops down and forms a seal here with the primary system so they don't have to drain down the vessel.

Prior to shutting down for this event on September 15, they had been getting indications of seal pressure and pump vibration. They were operating at about 60 percent power.

On the morning of the 16th, they noticed they had some seal failure. This was detected by the pressure traces which I will show you in a minute, and as you see here they had -- first of all, it failed, then the middle seal reseated, and since they have four seals in this pump, they can run with one seal non-functioning, however, they would not choose to operate probably if two of them failed, even though each one of those seals will withstand reactor pressure.

As you see, it progressed here, and finally the -- basically, all three of the primary seals failed, and they are left with what is called the "seal that causes the vapor barrier", which is the final barrier to the containment.

At that point, the bleed off temperature went high, the flow went high, they got a vibration alert. They had been getting some of these vibration alerts prior to the failure here, but they were intermittent and, at 5:44 they

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got the reactor off-line and the vibration went to the danger level, which is 10 mil. The alert level is 7 mil, and they tripped the reactor coolant pump.

MR. OKRENT: Is it normal to wait in a situation like that until the vibration level goes real high?

MR. LANIK: Well, I think that the tripping of that pump and the danger signal and vibration were about at the same time. I'm not even sure which came first. We have the plant manager here. He could address that. They both happened at the same time. In other words, they really did not have the danger level until they turned off the power to the pump.

MR. OKRENT: I guess I was just wondering if the erratic vibration signals that you mentioned earlier are not normally enough of a signal that you try to find out why and due to the size of the component --

MR. MONTROSE: We'd had vibration readings, sporadic vibration readings over several days before that. We'd taken the portable equipment in to evaluate what the level is, is the vibration indicator bad or is the instrument bad or do we have real vibration.

The vibrations we were getting sporadically never even hit 7, they were up around 4 to 6 mil, and that is not the kind of thing that's unusual.

The problem with that is it tended to be irregular

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and that was still under evaluation when that morning we had the catastrophic failure.

MR. LANIK: I think the other point was that the other pumps were behaving somewhat similar to this. In other words, it was not a real outstanding -- this particular pump, up until the time where it degenerated here in the last few hours, was behaving very similar to the other one.

MR. EBERSOLE: Is vibration the only parameter of interest when you are having trouble like that? Do you do any monitoring, or put a mike on or a stethescope on or something?

MR. LANIK: As a matter of fact, in this plant they don't have an accoustic monitor. In some surveillance tests, they can use some special vibration instrumentation, but I don't believe that at this point it had been installed on this one.

The other thing you look at, obviously, is seal pressure. This is a trace of seal pressure the day prior to the catastrophic failure, and you see that you do have some.

This is the upper seal area which is basically reactor coolant system pressure. The fourth seal up here would be shown on the other side of the fourth seal, this is reactor coolant system pressure. This is after the first seal. This is after the second seal, and this is after the third seal, but down here you are at basically atmosphere. So, you see, they had some variability in that pressure reading.

MR. MONTROSE: It might help if I could point out that the way our cooling system is designed is every time we had a light turnover in temperature, that will vary with the direction of the wind because we have on-shore and off-shore breezes. Just having one of those phases pressure off like that is not an uncommon occurrence. Internally it seals itself.

MR. LANIK: This is the seal pressure at the time of failure. You see at one point the middle stage went up, recovered, and then here the pressure went up on the middle stage, and then I think both the middle stage and the lower stage -- or the upper stage, they both went up to reactor coolant system pressure, so all they had left was -- and you see the pressure on the vapor barrier, which is the last seal, went up to reactor coolant system pressure, but as a matter of fact, that seal was still able to hold.

At this point, the bleed off did go to high level and they have access flow check valves in that line, so it can go to a maximum of 10 gpm and then it isolates that seal leak off.

At this point, however, they had no idea what was

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really happening in that pump. I'm sure they thought it was just a seal problem.

There are the seal bleed off values. As you see, basically, the plant rode this out without any change in the normal parameters. One of our concerns at first is that they might have gotten some variation in flow, and they indeed have a 97 percent reactor -- reactor trip on 97 percent flow and they never reached that point.

There was no loss of coolant because the bleed off goes directly to the volume control tank until that excess flow check valve isolates and it just is held in there, and they just did a normal, basically a rapid shutdown so they could replace the seal.

This is pump disassembly. And as I mentioned earlier, the removal of that removal piece between the motor and the pump, that the pump shaft is supposed to drop down and seal the reactor coolant system. While the technician is doing this, notice that it did not drop down, so they knew that they had some kind of an anomaly here.

And on inspection of the seals, they saw that the graphite stationery part of the seal was very badly worn. They took the pump apart and they found that all eight bolts holding the impeller were broken. Two of them, the head was broken off and six were broken off at the point where the bolt attaches to the flange.

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MR. EBERSOLE: What was holding the impeller then up?

MR. LANIK: Well, there is just a minimum of clearance in there. It cannot drop down too far because --

MR. EBERSOLE: So it was riding on its own bottom?

MR. LANIK: There is a wear ring in there, it is basically riding on its bottom, and I can show you a picture of.

MR. EBERSOLE: And it was being driven in torque by two pins out of four?

MR. LANIK: And actually you might say that the bolts that had broken off at the head probably were still providing some torque.

Here are the bolts and the pins, and there is a wear ring down here. I do not know what the clearance is, but it cannot drop down too far, I think maybe about a half an inch, and it looks like these pins are two to three inches long.

And as a matter of fact, you can see on the pins how it dropped down, and the first part of the pin is straight and the rest of it is bent.

MR. EBERSOLE: It was on the verge of going to zero flow, or rather backflow really.

MR. LANIK: Reverse flow, really.

MR. EBERSOLE: Reverse flow from the other pumps.

MR. LANIK: Yes.

MR. EBERSOLE: That would be unfortunate for a CE plant, wouldn't it?

MR. LANIK: Yes. I think in some way it was fortuitous that the seal leakage developed as it did so that they were encouraged to shut the plant down. And, obviously, vibration is a very significant part of causing seal failure, so it's just reasonable that that would happen.

MR. EBERSOLE: Do the CE plants have this type of drive configuration?

MR. LANIK: The CE plants?

MR. EBERSOLE: The ones that have the geartooth trip device.

MR. LANIK: I haven't been able to find out about that yet. I think they have the other kind of connection on the impeller here. I think this is relatively unique except there are about seven plants that have this pump, with the eight bolts and the flange.

Typically, the shaft goes through the impeller and it's held on by a large nut on the bottom, so it is centrally large nuts that this type of failure couldn't occur, but this is the case on about seven CE plants, some of the older ones.

This is just speculation, but this is probably the most likely sequence of failure, and the big question is, what caused the initial bolt failure. The two where the head came off on, it looks it could easily be stress corrosion cracking. The others it is not -- at least not that obvious that it would do that.

MR. SHEWMON: What was the material in the bolt?

MR. LANIK: I don't know.

MR. SHEWMON: Were they stainless, or don't you know that, or ionized?

MR. LANIK: I don't know.

MR. REED: From the picture that was passed around, they looked to be a stainless bolt, perhaps 4-10 or something like that.

MR. LANIK: At this point, I'd like to show you some of the pictures of that. This is what you see when you take the top of the pump off and you are looking down into the pump casing.

This is further down into the casing, on the wear ring, and you see all this where it is rusted here. That is all part of the casing in the wear ring that was abraded off by the turning of the impeller.

This is the shaft, and this is that flange with the bolt, and as you see, the bolts are all numbered here, and the pins are lettered, I believe.

These are the two bolts which the head broke off.

MR. REED: Don't you think it's interesting to note that bolt number or cap screw number 5 is really displaced and bent and here it is in a threaded section and it tells me that as far as stress corrosion cracking is concerned, that was not a factor because a bolt with those sharp V-notches right where you displace it and bent it, moved it, in the thread zone, that doesn't fracture. Certainly, it's a tangled bolt. It has no tendency to crack.

MR. LANIK: I guess the question is in those two bolts, why did the head break off, and that looks like --

MR. REED: Well, visualize if you will that the impeller was here flapping like a lose wheel on an automobile. This almost looks like a common automobile wheel attachment to the hub, and visualize it flapping, and now you are getting bending right at that point, and you've got the fatigue fracture.

MR. LANIK: I guess my point is it had to be somewhat loose before the final bolts were breaking.

MR. REED: Let me just ask a real simple question. What was the thread, were these left-hand or right-hand threads, and what was the direction of rotation? That might be interesting, but, of course, you had locking devices, but if it was a Chrysler automobile umpty-ump years ago, they would have had right-hand and left-hand threads, depending on the direction of rotation.

MR. LANIK: There are locking devices that fit over the tops and, in fact, there is a bolt that holds that cap on there, that fits through the middle there.

This is another view of the pump shaft, and this is the hydrostatic bearing, and on this one you can see the two bolts there again.

This is the impeller and this is 42 inches wide, and this is where the wear shows up on the impeller. And they took a ruler and laid along the edge of that impeller where the wear was shown, and some of the grooves were up to a half inch deep.

This is the top of the impeller, and you see those two pins there. If we went back to the picture of the shaft, and I think I have another picture in here of that, it shows an elongated hole at one of those -- this is the elongated hole made by that pin, so obviously it was under a certain amount of stress at that point.

This is on the hydrostatic bearing. Normally, there is a film of water, and this thing is sitting off from the top part of the pump, but they wore this down to about an eighth of an inch, and that's a very large surface area there.

MR. EBERSOLE: Pardon me, is that a side bearing?

MR. LANIK: Yes.

MR. EBERSOLE: What sort of clearance, or should have been?

MR. LANIK: I don't know exactly, but it is probably about a sixteenth of an inch, or an eighth of an inch.

MR. EBERSOLE: It's got a pump waterflow or just the pressure?

MR. LANIK: I can tell you a little bit about this pump. It's sort of a complicated -- this pump has an auxiliary impeller. Here is the main impeller, this little impeller which puts pressure on this hydrostatic bearing. This is the hydrostatic bearing surface here. And that keeps the lateral placement of that. And then there is another impeller up here in the pump, which drives water in and out through those seals.

MR. LEWIS: As a non-mechanical engineer, what is a hydrostatic bearing?

MR. LANIK: Well, basically, it's relying on the pressure in here to hold that metal surface up from this one.

MR. LEWIS: Pressurized water. What are the dynamics of the water?

MR. LANIK: Not the flow of the water, but it's just in there under pressure.

MR. LEWIS: Even though the water is carried around.

MR. LANIK: Actually, the outer part of this bearing has six or eight sections, lime you see on a commutator on a motor, that are sort of hollow.

MR. EBERSOLE: There are no shoes in that side bearing, no shoes?

MR. LANIK: I don't think so.

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MR. LEW[illegible] There's just a vertical waterflow as the picture describes it, under pressure, that is designed to keep the channel open.

MR. EBERSOLE: Well, it doesn't seem like that's a very positive centralizing --

MR. LEWIS: What is centering the bearings?

MR. EBERSOLE: What is centering the bearings? Is it that shaded section? No.

MR. LANIK: Well, I expect what happens is that as this thing moves over closer, the clearances here close up and the flow into there, the pressure would go up a bit because the flow into there -- the impeller is still driving the water into there, but --

MR. EBERSOLE: No, unfortunately.

MR. LEWIS: No. It's like a reservoir that supplies the water. Isn't that what determines the pressure?

MR. LANIK: No.

MR. LEWIS: Well, how can you control the pressure inside the bearing?

MR. EBERSOLE: It seems like it has a common pressure source, and that wouldn't contribute to any rising.

MR. LEWIS: It has a common pressure source and when it closes up, it would reduce the pressure inside.

MR. EBERSOLE: It looks like it's autocatalytic to failure.

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MR. LEWIS: Well, anyway, at some point somebody should teach me about hydrostatic barriers.

MR. LANIK: I didn't get into it that deeply.

MR. LEWIS: Maybe that could happen.

MR. LANIK: As you recall from the readings on the vibrations, I didn't mention, though, the vibration readings they take are up here on the shaft so that it is questionable the effect of something happening down here, how that really transmits up onto the shaft.

They probably could have had quite a significant vibration down at this point without it monitoring up there on the shaft.

MR. EBERSOLE: Against this background, what are you going to do with that geartooth counter on the CE plants? I'm trying to focus on the safety issue, and that's the only one I see other than the fact that you might chew the casing up here and blow up the casing.

MR. LANIK: I wasn't able to get in touch with our NRR staff member that knows the most on that.

MR. EBERSOLE: Well, that is true, isn't it, the only two safety issues is, are we going to expect impellers to shear off and compensate for them in the controls, and then the other one I think was, can we chip the casing and have a LOCA from a disintegrated casing?

MR. LANIK: EPRI has done a few pump studies and

I've looked through them, but I haven't been able to find anything addressing the problem with the impeller in the casing.

The one thing about this pump which was discussed at the subcommittee meeting is if the mass of the impeller compared with the rest of the rotating mass is only about one-seventh of the total mass of the rotating part of it and the casing of the pump is about 160,000 pounds versus 16,000 pounds for the rotating part of it.

MR. EBERSOLE: Did you find out whether you could shear those hold-down bolts, those stud tensioners up there, if you got some sort of lockup?

MR. LANIK: I wasn't able to find anything that addressed those issues.

MR. EBERSOLE: So it is still an open issue as to whether there is a potential shock force in here that might take the casing out ?

MR. LANIK: I think that that -- I talked to the people who addressed the generic issues, and I can tell you what their answer to this was, which I consider somewhat unsatisfactory, but they are not interested in addressing -- they hadn't thought of addressing this part of the problem, but since we've already addressed the LOCA, the consequences can't be worse than the LOCA. They don't mean that that shouldn't be looked at, but that's as far as they've gotten.

MR. EBERSOLE: I can imagine that the LOCA at that point, if you sheared those, could toss that entire pump straight up in the stack.

MR. LANIK: This is in a compartment, so you wouldn't probably have to worry about it from --

MR. REED: From a practical point of view, I would expect that this pump is fairly slow speed, 600 rpm or thereabouts --

MR. LANIK: 850.

MR. REED: -- 850 -- and that the casing and the pressure design and the mass and the rotation that, if broken off, this is just going to spin down with a little crunching, lubricated by water, without any particular problem to jeopardizing the integrity of the boundary.

One thing I'd like to find out, as I said in the meeting the other day, is this a chicken or egg thing. My personal opinion is that the impeller came loose first, and that the particles going up the shaft wiped out the seal, that the impeller was the first failure.

So maybe from a safety point of view, you have to worry about this kind of attachment because it could lead to what we've talked about, namely, a pump seal valve.

MR. LANIK: We do have one datapoint on pump failures of a similar type, and that was 1973 at Surrey, they broke a pump shaft, and in that case it was an inocuous event.

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As a matter of fact, they did get a trip on low flow, I guess, but not -- any other questions on this?

(No response.)

When it was found out that there were some problems with this pump, Region 3 sent people to the site. The licensee plans to do metallurgical examinations. I believe they are going to do some of their own and they also have a lab that they are going to have do that independently.

I believe that the NRC is also going to contract to have the metallurgical study done on some of these bolts.

The history of this impeller was that it was in the plant back in the early '70s and then was taken out, and had been out of the plant until January of this year. And, in fact, since January of this year it was only run for about three weeks prior to this event.

MR. REED: Question. You said impeller.

MR. LANIK: Impeller and shaft unit.

MR. REED: It was a factory assembly? It had never been disassembled?

MR. LANIK: Right. It was stored as a unit.

MR. MOELLER: Then why was it suddenly installed?

MR. LANIK: Well, last November when they shut down for refueling and some other work, apparently they found that there was chunk missing out of the impeller that was in there.

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Since it was in storage, they are looking into the means of storage and if anything happened to it while it was out there, and I guess there's some concern because Michigan winters are pretty cold. I don't know if that has anything to do with it, but -- in speaking to Mr. Montrose, I find that maybe not all the loose parts are -- they think that it is 99 percent sure that all the loose parts have been reclaimed.

Apparently there is one piece that they are not sure how these little pieces fit together in the ones that they have assembled, but it is not a large piece, in any case. They plan to replace all the damaged parts with a new impeller and shaft and try to startup.

As I mentioned, because of the number of other seven CE plants that have pumps like this, at this point, I&E is considering writing information notes to inform all the other plants out there about this shaft.

MR. EBERSOLE: The level of damage of a CE plant at full power, is it such that it is worthy to look harder at a pump failure for them? Up to now, you know, it's considered virtually impossible to lose a rotor.

MR. LANIK: I do believe on the new plants, if you do have fairly significant fuel damage, on the old plants we are not sure about that.

MR. EBERSOLE: Well, is there a proper balance between

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the degree of fuel damage and the likelihood that you will lose a rotor?

MR. LANIK: Yes. I think that -- well, the SFAR -- I think as we discussed in the subcommittee meeting, the SFAR does not address this problem in a very thorough way. It's a cursory look at the --

MR. EBERSOLE: I think they just dismissed the theory that you'd lose a rotor.

MR. ROSSI: This is one of the aspects of this thing that's going to have to be looked at, is the probability compared to the consequences --

MR. EBERSOLE: Going to do a PRA?

MR. ROSSI: I'm not sure how --

MR. HICKS: I hope it's not going to take that long.

MR. REED: Well, isn't it true that a locked rotor which is part of the basic design analysis is more serious than a rotor just coming loose?

MR. EBERSOLE: Well, a locked rotor would be picked up on their geartooth.

MR. LANIK: I think it's arguable whether this would result in the exact same consequence as a locked rotor, but to me it looks like it could.

MR. EBERSOLE: Well, a locked rotor would tell the control to scram the reactor on the CE plant because it's counted by a geartooth gizmo.

MR. REED: What are you telling me, that they don't have a flow --

MR. EBERSOLE: Right.

MR. ROSSI: On some of the later CE plants, they were intending to account for the locked rotor by counting the speed of rotation of the shaft, and if the impeller would come loose from the shaft, the shaft could continue to turn with the impeller loose and you wouldn't detect it that way. So one of the things that has to be looked at is whether that is, indeed, the design that's still there on the later plant, and that's the thing that's being referred to here.

We have not had a chance to get to the people that were involved in the reviews of those later plants, to check what they currently have and what the current resolution of the discussions on this.

MR. EBERSOLE: This came up about three years ago -- more than that, I guess.

MR. ROSSI: Yes, we just haven't gotten to the people yet.

MR. SIESS: Can somebody help me as to what the public safety consequences are of the locked rotor?

MR. ROSSI: In some plants, if you have a locked rotor because of a sudden decrease in flow, by the time you trip the reactor, you get some departure from nuclide boiling in significant parts of the core, like 10-20 percent of the core under the worst case, could go through DNB, and then you would assume that that amount of the core -- the clad is perforated.

MR. SIESS: And then we'd get increased activity in the primary system, and then where do I go from there? Have a steam generator leak and --

MR. KERR: That's probably as far as you'd go.

MR. SIESS: I can see where we're going to violate tech specs, but --

MR. ROSSI: You're not talking about clad melting or anything like that, as far as I know. What you are talking about is a significant amount of DNB and assumed failure of --

MR. KERR: Well, DNB is a tech spec requirement. For purposes of calculation, it's usually assumed that DNB produces significant fuel damage. Actually, it might not produce all that much.

MR. EBERSOLE: From that standpoint, it's probably the biggest dose, it's just trying to clean up the mess.

MR. ROSSI: We do have to make sure that the design consider the possibility of an impeller coming loose from the shaft and not just the locked rotor because, depending on the instrumentation that you have, you may get a different answer for the two occurrences.

MR. LEWIS: There may have been some important point that went by when I wasn't paying as much attention as I should, but I've seen a lot of secondary damage. Are you yet clear on what started this disintegration?

MR. LANIK: (Shaking head.) No.

MR. LEWIS: You're not, because certainly no eight bolts suddenly decided to let go at the same time, so there is some initiating feature of this which you are still searching for. I was afraid I didn't hear it when you said it.

MR. EBERSOLE: Ernie, isn't the geartooth counting mechanism just an attempt to get a fast response time of the flow parameter?

MR. ROSSI: That was my understanding.

MR. MOELLER: And the crew, the maintenance crew that made the changes in the pump, they have done this many times before on similar --

MR. LANIK: Seal replacement?

MR. MOELLER: No, the shaft.

MR. LANIK: Probably not. They had replaced all these impellers back in the early '70s also.

MR. MOELLER: But that was probably different people?

MR. LANIK: I think in this case they had -- Byron Jackson had a representative on-site and during the installation --

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MR. MOELLER: And when you put such a pump back into operation, there are tests or something that you do that assures you that it is properly repaired?

MR. MONTROSE: So far as all the analysis that we have done, we have found these are human error or procedural error in the installation of that impeller.

One of the things that you're talking about, there was an earlier statement made on stress corrosion cracking, I think it's probably a combination of both. There was some modelling of that. If we were just betting men and playing poker, we're putting our odds down that the initiating event was stress corrosion cracking on two bolts, and on the others they failed tensil stress. When we get all those back for metallurgical analysis, we'll be able to put that together better.

MR. LEWIS: There's very little stress on them, shear stress.

MR. MONTROSE: The bolt, if you remember, some of those bolts were actually leaning over at some 45 degree angle.

MR. LEWIS: But when it was assembled, there was no --

MR. MONTROSE: Those bolts were assembled in-factory.

MR. LEWIS: Yes, I understand, but then they are under tensil stress.

MR. MONTROSE: Tensil stressl.

MR. LEWIS: They sheared after the accident.

MR. MONTROSE: That is correct.

MR. LEWIS: This next event, I think, if the members didn't realize it, I didn't hear it before, I think it has some far-reaching effects.

MR. ROSSI: The next two events are going to be discussed by Eric Weiss of the Office of Inspection and Enforcement. The first of these is an event involving damage to a feedwater line at WNP-2 on September 10, as a result of differences in temperature of the water between the upper part of the pipe and the lower part, and the second is the effects of Hurricane Diana on the Brunswick plant in mid September. Eric?

MR. WEISS: Good afternoon. This event was first reported to the NRC as a water hammer, but it was later reported as a pipe deflection caused by laminar flow, a new and previously unrecognized phenomenon. Today I am describing another occurrence of the same phenomenon at WNP-2, but this time the licensee had a substantial amount of additional instrumentation in place. So we now know more about the phenomenon and and can rule out other explanations for the event.

The safety significance of this event is that it may be an explanation for events at other plants and other

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systems that we previously thought were waterhammer. Systematically, this type of event is similar to waterhammer.

There is a loud boom in the plant, accompanied by damaged hangers and snubbers. To begin with, the plant was at 60 percent power, both feed pumps tripped, RCIC is started, and because of the instrumentation, we know that one of the two feed lines, which I will show you later, was hotter than the other; feedwater is slowly admitted with a flow control valve pin when RCIC is terminated. They use this admission of feedwater to control vessel level, and were using condensate booster pumps at this point, about 670 pounds.

We know that the top of the feedwater pipes was over 200 degrees hotter than the bottom and, again, hanger 114 was deflected, and hanger 114 had a weld broken -- this was one of the three hangers that were broken in the previous event that I described to you on September 6.

Now I would like to show you a general arrangement, a highly simplified diagram. These were the three hangers that were broken in the previous event. This hanger was removed. This floor support strap was removed during the September event and replaced by a snubber. This is hanger 114, which is actually a springcan and it had a weld broken.

The flow control 10 over here is used to slowly admit feedwater into the heavy gauge feedwater piping. We have 24-inch piping here, 30-inch piping here. The 24-inch piping is schedule 160 and this has a nominal wall thickness of almost two inches in the 30-inch piping.

The feedwater comes around at relatively slow rate, a few hundred gpm, and apparently -- which I will demonstrate later -- slides underneath the hot water.

Now the next thing I want to explain is that this plant has a relatively unusual configuration regarding the reactor water cleanup system. This unusual configuration explains why this piping is particularly hot, but in any case I would suspect that we'd still see the same phenomenon in this particular plant.

What is unusual about this configuration is that reactor water cleanup is upstreat of two check valves. In some plants, there is a check valve here instead of an MOV, so there is no possibility of reverse flow, but what happens in this plant is that with low flow rates of reactor water cleanup while the plant is in hot standby, one set of check valves does not open, it sticks a little bit, and you get reverse flow of reactor water cleanup and then into the vessel. So this long run of pipe here is heated to high temperatures, on the order of 400 degrees.

Now I have a slightly more detailed and much more accurate diagram of the plant.

MR. LEWIS: What was the diameter of that pipe? It said it on the previous diagram, but I didn't notice.

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MR. WEISS: The portion beyond the wire are 24-inch piping, shedule 160. This portion here is 30-inch pipe. This long run of pipe, by the way, is in there so they can get very accurate flow readings out of their flow elements, and there is a flow straightener in the pipe.

At hanger 114 that ripped loose, the licensee installed instruments to measure differential movement. Here at 114, they are measuring movement in the east-west direction, north-south and up and down. And on temperature element 41, which was on that vertical run of pipe at the turbine wall went up 22 feet, they are looking it up and down, and here they are looking at north and south, but this is an interesting trace right in here, where you can slowly see the pipe deflect until you get to the point where the hanger breaks, and then you see a small step jump.

Another interesting aspect is that in front of those flow elements on that long run of pipe -- maybe I should go back and show you where they were -- right before these flow elements, they strapped on additional thermal couples to measure the temperature on the top and bottom of both of these pipes. And this is hwat they see.

They see that the bottom of the pipe is much colder than the top of the pipe, and so we are planning to issue an information notice on this subject and let other licensees know about the phenomenon.

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MR. EBERSOLE: The reason that that pipe is that it's the incoming feedwater, isn't it, that keeps it that way?

MR. WEISS: Well, that's only partly true. The pipe is kept very hot because of reactor water cleanup in this particular plant.

MR. EBERSOLE: And it has been heated in a regenerator?

MR. WEISS: No, reactor water cleanup goes through a regenerative heat exchange --

MR. EBERSOLE: Yes, that' why it's hot.

MR. WEISS: -- to about 400 degrees.

MR. EBERSOLE: What's the cold stream, incoming feadwater?

MR. WEISS: The cold stream is coming from the condensate booster pumps, ultimately from the condensate storage tank.

MR. SHEWMON: Would you go back to that first or second diagram, the one that showed the pipes as little wide pairs of lines instead of just single lines, and answer Brother Ebersole again, and maybe even move it up high enough so it's not behind -- now, which is the hot section?

MR. WEISS: This section drawn in red is kept hot by reactor water cleanup.

MR. EBERSOLE: Because the check valves at the top don't open so it runs around the path of least resistance.

MR. WEISS: That's right. Now this system is hot to about 377 degrees --

MR. SHEWMON: Where is the pump and where is the heating part of that?

MR. WEISS: Off the diagram. They are the condensate booster pumps that are upstream of the feedwater pumps, which have tripped.

MR. EBERSOLE: But they are pumping in a cold stream?

MR. WEISS: They are pumping in a cold stream because you have lost extraction steam to the heaters.

MR. EBERSOLE: Okay. The switch up there, you've lost extraction steam.

MR. WEISS: Right. So you're not getting any heat.

MR. SHEWMON: Jess, Jess, please be quiet for a minute, I'm three miles behind you and I'd kind of like to whiz on by you.

MR. LEWIS: And I'm right behind you.

MR. SHEWMON: Now where is the heat being supplied and where is the pump and the flow from the pump?

MR. WEISS: The heat in this event is being supplied by the reactor water cleanup.

MR. SHEWMON: I see. And that arrow is the heat source.

MR. WEISS: That arrow is the heat source. And there is reactor water cleanup penetration, source for reactor water cleanup return on both of these lines, and I believe it was the design intent that that go into the vessel, but there is a sticking check valve here, it does not, and it follows the path of the red arrow.

MR. SHEWMON: The other line is open, though, is that right?

MR. WEISS: No.

MR. SHEWMON: Down at the bottom, are both of those check valves closed?

MR. WEISS: These are open. These are closed.

MR. SHEWMON: So both heat sources operate, but only one type has an outlet into the containment?

MR. WEISS: Into the vessel.

MR. SHEWMON: Well, it's wave of containment, but, fine.

MR. WEISS: Yes.

MR. SHEWMON: And the cold water then comes in from up behind your right ear then?

MR. WEISS: Correct.

MR. ROSSI: You understand that the reason that the reactor water cleanup system water is flowing that way is because one of those check valves is probably just not quite opening but the other one is , so that the flow coming into that one side is going around that loop back to the

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check valve on the other side. And in actual fact, the design intent was for it to -- the reactor water cleanup water to go through the check valves in both --

MR. SHEWMON: Fine. Which one popped the gussets, or which one did the particular bowing then, both of these straight sections, or only one?

MR. WEISS: Yes, they both --

MR. SHEWMON: But the cold water came into the bottom one preferentially because that had flow in it?

MR. WEISS: The cold water comes into the pipe and flows underneath the hot water. When I first heard about this, I thought, well, I'll look it up on a Moody diagram and I will see whether I could really have laminar flow at these flow rates, with these Reynolds numbers, in this sized diameter pipe. And I looked it up and it looked marginal. When they were pumping fast, it didn't look like it was possible, but what I neglected was there is a large difference in density between 90-degree feedwater and 430-degree water that's in the pipe, so I could have much higher Reynolds numbers and still get laminar flow.

One of the interesting things I learned yesterday was that they put thermal couples up here on these pipes. And I would have thought going up a 22-foot rise of pipe you would get mixing. Well, the thermal couples up here show they still have stratification. They have 100 to 150 degree difference even after they go up a 22-foot run of pipe.

MR. LEWIS: You really shouldn't use the term laminar flow, you should use stratified flow because it surely is not laminar, but it is stratified. I get a Reynolds number of 50,000 using the numbers that you are giving me. Is that about what you got?

MR. WEISS: Yes.

MR. LEWIS: That seems odd to maintain -- it seems odd, but you can't quarrel with thermal couples.

MR. EBERSOLE: At the time this occurred, I believe you said the instrumentation was in place which displayed this differential.

MR. WEISS: Yes.

MR. EBERSOLE: But nature caught up with you before it caught up in analysis, right? I mean, you would have ultimately determined this pipe would have bent?

MR. WEISS: I must confess that the licensee was saying that it was laminar flow or stratified flow and did not have me convinced. I had a lot of explanations that I won't bore you with, but I had five explanations for every one of theirs as to why it couldn't have been laminar or stratified flow.

MR. EBERSOLE: What I'm trying to find is, see, is whether there were any arguments going on about the prospect of handling the accident which, in fact, did occur. Hasn't

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anybody been saying, in short, well, this is going to pull the roots out?

MR. WEISS: Yes. Region 5, as a matter of fact, asked me to mention that they are very pleased with the licensee's expertise and dogged pursuance of this issue, to put it to bed unequivocally.

MR. EBERSOLE: I don't mean that. I mean, prior to the actual physical event, had it been predicted that these loads existed on these hangers?

MR. WEISS: Yes, as a matter of fact, there were two previous events that I know of. There was one in June which was dismissed as a gremlin, I think, and one in August that I described to you where I was saying, well, it looked like it might be waterhammer, it might not be, and now I'm coming about and telling you about this event. I understand there's even been one subsequent, where they have seen the pipe bowing, but what the licensee is doing is designing the system so it will accommodate the deflection, and doing analyses to show that it's safe.

MR. MICHELSON: Eric, I have a little problem with the locations of the hangers that actually failed relative to where we think the bowing of the pipe was occurring, particularly hanger 115 which isn't shown on your drawing is between 114 and 116, and I guess it didn't get pulled out.

MR. WEISS: I think you will see that 115 is a spring can.

MR. MICHELSON: 115?

MR. WEISS: Yes. Here's 115, it's a spring can. Here's 114. Here are two hangers that acted like a fulcrum and took the upward force. This hanger was removed in the September event, with the floor struck that was crushed in the August event.

MR. MICHELSON: It's not there anymore.

MR. WEISS: It's not there anymore now. This is the one that had the weld ripped twice, and you're right, this one, to my knowledge, didn't fail. This one in the August event, I believe, had -- was rocked off of its bolts. It wasn't completely broken, but it was bolted into the ceiling and there was some rocking in the plate that loosened the bolt.

So this hanger could give a little bit whereas this one I don't think is a spring can.

MR. LEWIS: Could I just make a suggestion -- this has nothing to do with Reynolds number, and this is a case in which the teller helmhost (phonetic) is stable, as nearly as I can check my numbers, so you have helmhost teller stability with these two fluids of different temperatures and at those flow rates, and you are well below the criterion for well into the stable region for that, and that's what's causing the separation. It has nothing to do with the Reynolds number.

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It would happen at zero viscosity.

MR. REED: Did you say the licensee's fix would be not to correct the flow problem, but to allow these differentials to continue 200 degrees across the pipe?

MR. WEISS: That's my understanding. The licensee is coming out with a report shortly -- I believe it will be in the mail tomorrow, if it isn't already in the mail -- that will describe their analysis of the event and their corrective action, but that's my understanding.

They are going to design the system so that it will accommodate the deflection.

MR. EBERSOLE: Aren't there any pipe wall stresses that are significant, even though you have it free-floating?

MR. WEISS: They've analyzed pipe wall stresses and I believe that they've shown that conservatively there's not a problem.

MR. SHEWMON: Now, if you want to make the hangers ten times stronger, we might be able to get some action.

MR. WEISS: That's an important point, that these hangers are very small relative to the forces that are being generated by the pipe. Remember, you have a 30-inch pipe with a 2-inch wall thickness. You are generating tremendous forces. That strut that failed was a 2 1/2 inch thread of rod into a turnbuckle, essentially, in layman's terms, and it just couldn't take it.

MR. EBERSOLE: Is this a case for having weak hangers, Paul?

MR. LEWIS: Well, he thinks they should be made of titanium but sized the same.

MR. SHEWMON: No, I know fewer hangers is often better, at least sizes.

MR. EBERSOLE: I'm thinking of Diablo Canyon and the hanger problem.

MR. REED: I don't know that I feel all that comfortable with allowing the differential temperatures --

MR. EBERSOLE: I hate to see a 24-inch pipe being made into a bouillon cube.

MR. WEISS: I think what we want to do, as a first cut, is to make sure that other people in the industry know about this event so that if they have a "waterhammer" and they can't find the steam pocket or the air pocket that caused the waterhammer, they can look and see if this is a possibility.

MR. SHEWMON: Is the philosophy to try to get mixing or to suspend it so it can flex?

MR. WEISS: The philosophy that the licensee is taking is to suspend it so it will flex.

MR. EBERSOLE: Is there any possibility that something can be made to assure operation of the check valve, or would that have any influence?

MR. WEISS: I'm not aware of a solution like that.

MR. ROSSI: I would think that that would be unlikely that they would do that with high assurance.

MR. EBERSOLE: This is a boiler, isn't it?

MR. WEISS: Yes.

MR. EBERSOLE: All these check valves have those things imposed by NRC called exercisers on the check valves which inhibit their motion.

MR. MICHELSON: No.

MR. EBERSOLE: Don't these have test exercises?

MR. MICHELSON: Not the feedwater line.

MR. EBERSOLE: The main feedwater doesn't have that?

MR. MICHELSON: Is there any reason why they don't want to close their main feedwater valves when they are on reactor water cleanup in this situation?

MR. EBERSOLE: That's where auxiliary feed comes. They are on aux feed.

MR. MICHELSON: RCIC doesn't come in there, does it? It comes in from the back on this one, doesn't it?

MR. EBERSOLE: That's where aux feed comes in, isn't it, RCIC?

MR. WEISS: RCIC comes in outboard of these two check valves, but inboard of two MOVs.

MR. MICHELSON: Well, it comes out the same location so you can close the MOVs then and still run RCIC, reactor water cleanup and so forth.

MR. EBERSOLE: You could close them.

MR. WEISS: Yes, I heard that mentioned, as a matter of fact, in passing, and I believe that someone on the Operations staff mentioned to me that they didn't think it was a good idea based on past experience. I believe some of their operators came from another plant where feedwater was very helpful.

MR. EBERSOLE: It denies them the access to main feedwater, Carl, which is not a good practice, without opening the valve.

MR. WEISS: I'd like to go on to Hurricane Diana. Hurricane Diana passed near, and then ultimately over, the Brunswick Nuclear Power Plant in the period from September 11 through 13. We are presenting this event to show how a nuclear power plant responds to a hurricane passing directly over the plant.

At the time of the hurricane, unit 2 was down for refueling, and unit 1 had a lightening strike on September 10 that caused a scram on a spurious main steamline radiation monitor spike.

The plant went to hot shutdown and then waited to see what way the hurricane would go, and the plant was in cold shutdown by approximately 1800 hours on the 11th. The damage from the hurricane was relatively minor. That is to say they lost three of four transmission lines to unit 1, two of four transmission lines to unit 2. They lost radio control of some pumps in the discharge canal, but the pumps continued to work. They lost the roof on a small temporary building like a 9 by 12 shed. They had minor rain inleakage into the turbine building. I understand that one of three access roads was taken, and on the morning of the 13th, they missed a tech spec. They couldn't get a volunteer to go out in a 95-mile-an-hour wind to take a grab sample of the stack.

(Laughter.)

The inline radiation monitors were functioning. Bottom line is no safety systems were affected. The NRC response to this included augmenting the resident inspector who is here, by the way, with additional regional personnel and the regional IRC was manned, the region installed a high frequency radio that was kept up and running, and we in headquarters monitored the conversation between the region and the site.

We had at least six people in the operations center 24 hours a day for three days in a row and we were listening to their radio and their telephone conversation. We had a project manager, a hydrologist, a meteorologist -- we have a meterologist here by the way, who was there -- a reactor safety systems person from I&E and a response coordination team member and a management rep in headquarters operation center.

The licensee made a number of preparations prior to the hurricane approaching site. They decided on a shift rotor who would stay onsite and what shift they would take. They'd check and test the diesels, they pumped down the discharge canal, they tested turning gear and aux OL pumps, they manned the technical support center, they tied down or brought inside loose material, raised the crane hook to the top, boarded up windows, placed station batteries on equalizing charge, switched on external lights, and throughout the event monitored water level at the intake structure.

Here is the path of the hurricane, and you can see on the 11th where about 60 miles or so away from the plant, and by about midnight between the 11th and 12th, it looks as though the hurricane is moving very slowly and then it slowly heads out towards shore, but by noon on the 12th it's coming back and goes right up over the top of the plant, and by the time it's out here, it's downgraded to a tropical storm.

This chart, by the way, is interesting in that it shows the path of the hurricane that would produce the maximum storm surge onsite because the flow of winds are counterclockwise around the hurricane. The winds into the Fear River would raise the water level. And, conversely, this path shows the path that would produce the lowest water level because the winds would sweep the water out of the mouth of the Fear River. As a practical matter, the hurricane did not result in any significant storm surge at the site.

The subcommittee expressed some interest in the power lines, transmission lines that were lost, and this is a chart to show which ones were lost. The predominant failure mechanism was pulling loose of the static wire, although a couple of structures were blown over.

Next I want to show you --

MR. SIESS: These line failures were at the site or how far from the site?

MR. WEISS: I beg your pardon?

MR. SIESS: The line failures.

MR. WEISS: I'll show you where they were in just a moment. What I am going to show you is a closeup, a detail of this section of North Carolina. There's the plant, and I'm going to show you a more close up map that just covers this area to show you where those lines went down.

The plant is down here, and here is structure 36, 58, 186 and 185, and it looks like number 7 is down there. Now, the subcommittee was interested in whether they were metal or wood towers. I told the subcommittee they were metal towers, but I've since learned that as you get into the corridors, they are H-frames that look like this immediately north of the plant, and the failure mechanism is explained

85 by this slide where the static wires that run on top of the plant were pulled out of the brackets that held them in place, presumably because this nut wasn't sufficiently tightened.

And the subcommittee was also interested in --

MR. SIESS: What was the significance of wood versus metal since it wasn't the tower that failed, it was the wire that failed?

MR. WYLIE: I was just curious whether they had wood H-frames. That is CP&L's normal construction, and whether they had any wood failure damage. They also showed they weren't cross-arm bent, and that was confusing.

MR. KERR: It wasn't real clear how your wires pulled out of your supports. You said the nut dropped off, is that your model?

MR. WEISS: The nut wasn't sufficiently tightened, so I understand that this pin came loose and the spool came out of the bracket.

MR. KERR: It's got to come loose some funny way because gravity is keeping the pin in, and it's got to shake and pull and tug and work it out --

MR. WEISS: Over 100-mile-an-hour winds will induce significant vibration in that static wire so they will --

MR. SIESS: Maybe the wind was blowing up, Carl. Maybe the wind was blowing up.

MR. WEISS: The subcommittee was also interested in me, putting in perspective as best I could how bad was this hurricane, and were there any procedural imperatives on them shutting down.

I think you can see from this chart that Hurricane Diana was not a probable maximum hurricane, it was one that we would expect to occur on this section of the coast about once every 25 years. It was a severe hurricane, but not the hurricane to which the plant is designed. And, by the way, the plant is designed to accommodate wind for a tornado which really are about 360 miles an hour, about 300-mile-an-hour circulatory winds plus a 60-mile-an-hour translational velocity, so in terms of wind, the nuclear power plant itself is very conservatively designed. In terms of storm surge, again, there is very conservative design, and Hurricane Diana did not produce significant storm surge.

MR. KERR: Was it designed to have that many NRC personnel onsite during the hurricane?

MR. SIESS: That was the safest place to be, Bill. They are smart.

MR. WEISS: There is a technical specification when the water level at the intake structure reaches 17 1/2 feet and there is a plant administrative instruction 68 which tells them within 24 hours before the wind speed is projected to exceed 75 miles an hour at the site, as condition warrants, bring the unit to cold shutdown.

MR. EBERSOLE: Hang on just a minute. Now here is a case that we were talking about in an earlier part of the day with Mr. Denton, about tech specs. The order is to shut down. To shut down destroys a local source of power and imposes on the plant a loss of lines anyway.

MR. KERR: Jess, I thought that was not an NRC rule. That was a local administrative rule.

MR. EBERSOLE: No, no. The tech specs here he says requires shutdown.

MR. WEISS: That's for water level at the intake structure if it exceeded 17 1/2 feet, and the concern there is loss of ultimate heat sink because there is potential of flooding in the service water motors.

MR. EBERSOLE: So what good does it do to shut down?

MR. WEISS: Well, if you are going to -- I am hypothesizing -- but if you are expecting to lose your transmission lines, it's not going to do you a lot of good to have a source of power.

MR. EBERSOLE: But here you say you shut down when the water level is high.

MR. WEISS: Yes. This requirement, as I said, has to do with heat sink.

MR. EBERSOLE: So when you shut down, what good does it do?

88

MR. ROSSI: Well, when you shut down, depending on how long it's been since you shut down before you get into a problem like this, it gives you lower heat levels and less heat that you have to remove, and it gives you a longer length of time to deal with any problems that come up. That's basically what it does.

MR. EBERSOLE: Why do you shut down completely rather than pull back to a low stable which gives you all the benefits of that and retains your power source?

MR. ROSSI: I don't know that it's been carefully looked at as to the advantage of going all the way down compared to staying at 15 percent power or something like that. But when you are shut down, the further down you are the less heat you have to remove and the more time you have to deal with problems and the more margin you have.

MR. EBERSOLE: It's a case where it would appear that the smart thing to do would be to shut down to the lowest stable output and hold steady to retain your AC power supply, which you are going to need.

MR. ROSSI: I think there was a flood that occurred in Nebraska, as I recall, had a similar kind of requirement on plant shutdown, and they never got up to that, and as I recall, the plant continued to run its power throughout it. And I think we've had a number of cases where that's occurred and plants have continued to run at power and they have a bay level that it is unlikely that they will get to, that if you get there, then you do decide you've got to shut down to give you the extra margin when you're shut down.

MR. REED: I think I agree with you, Jesse. I think this administrative procedure that they have is overly conservative and perhaps not well considered. We used to, many years ago, talk about self-sustaining power level, which is a low level. If anything disconnects, you've got another source of power in addition to your diesel or gas turbine or whatever.

MR. EBERSOLE: You are turning the major advantage of reducing to K energy.

MR. KERR: The term administrative rule, does that mean it's a local rule, not an NRC, or is it an NRC rule?

MR. ROSSI: It was the licensee's rule.

MR. KERR: That was the impression I got, and I just wanted to be sure.

MR. SIESS: What particular concerns inspired NRC's rather heroic efforts?

MR. ROSSI: In general, on events, we tend to be very conservative in having people stand by and let things degrade. I guess we are just skeptical by nature that things might get worse, and we try to be ready in case they do.

MR. SIESS: Have you got enough people in case there were two plants in the area?

MR. ROSSI: Yes, we have one operations center and I guess region has a number of people

MR. SIESS: I thought he listed quite a few more.

MR. ROSSI: There were a number of people in the operations center in Washington.

MR. SIESS: Oh, I'm sorry. They just sounded a lot more because I didn't get the distinction. Thank you.

MR. REED: It didn't sound like they were totally heroic because they could have volunteered to take that test.

MR. SIESS: I was wondering about that.

MR. EBERSOLE: There was no attempt to reduce power at all here in the face of this hurricane, was there?

MR. ROSSI: They were down.

MR. EBERSOLE: Oh, they were down already. Sorry. If they had been up and running, would they have tapered off?

MR. ROSSI: That's very difficult to answer. My recollection of the flood out in Nebraska, they didn't come down, they just stayed at power. I don't remember whether they were all the way up at 100 percent.

MR. WYLIE: Well, I would gather that the adminstrative procedure would have took them down.

MR. BEAMIS: There was something even more than that. The plant manager was up at hearings in Raleigh at the time, and before he left, he had left word at the plant, with the acting plant manager, to shut the unit down if the winds got to 50 miles an hour. But in the meantime, we had the lightening strike --

MR. EBERSOLE: Took them off anyway.

MR. WYLIE: I'd like to ask something about that lightening strike. Is anyone looking into that, to see why that tripped them?

MR. BEAMIS: They are looking into it. They feel that what it did was hit the pole or train and transmitted the force down in the ground and back up into the transmission yard. They are looking into it.

MR. JORDAN: There were two people that saw the strike simultaneously with the scram.

MR. WYLIE: I understand, there's no doubt about it that it did. I'm just wondering why.

MR. EBERSOLE: So Mother Nature tripped them off.

MR. WYLIE: No, I mean why it got in the plant.

MR. EBERSOLE: Through what path and so forth?

MR. WYLIE: Yes. It shouldn't.

MR. EBERSOLE: Well, if it could get in in an unexpected way, it bodes the old fair for the solid state equipment.

MR. WYLIE: Well, I just looked at this plant layout a few moments ago, and that train -- this is the gantry which runs over the feedwater heaters, I believe, between the turbine room and the reactor building, that's the only outside crane, but that's also right close to the control room, right over it.

MR. MOELLER: Could you tell us if there were any surprises and what were the key lessons learned?

MR. WEISS: Well, I could only speak from where I stood, which was in the operations center. It appeared as though the licensee had prepared well for the storm and that the plant responded very well to the storm.

There was a surprise on the morning of the 13th. We had a problem with an erroneous report. The National Weather Service put out a report that the Brunswick plant had been destroyed, and this was caused by the Wilmington office reporting a substation having been destroyed in Brunswick County, but one of the lessons learned was that the operations center served its function, and ABC News and the others that called in were told that it was an erroneous report right away so that no misinformation was distributed.

MR. EBERSOLE: I believe, didn't you say when you went, though, to check the diesels, one of them didn't work?

MR. WEISS: That was prior to the hurricane reaching the site. They decided to test the diesels, and one of them, I believe, was technically inop because it would not remote shutdown, but that was repaired to the hurricane arriving onsite.

MR. JORDAN: It actually was on the scram. The diesel came up and ran and then they couldn't shut one down. It was that Monday.

MR. SIESS: That's fail-safe, Jesse.

(Laughter.)

MR. WEISS: Thank you very much.

MR. EBERSOLE: Yes, very interesting. Was that it, Ernie?

MR. ROSSI: That's all.

MR. EBERSOLE: Well, I want to thank you and your fellows for a fine presentation. Any other questions on this?

(No response.)

Would we like to take a break? Ten minutes.

(Whereupon, the Advisory Committee on Regulatory on Reactor Safeguards was recessed for ten minutes at 4:50 p.m., after which it went into closed session.)

CERTIFICATE OF PROCEEDINGS:

This is to certify that the attached proceedings,

IN THE MATTER OF:

294TH MEETING OF THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

DATE: 12 OCTOBER 1984

PLACE: WASHINGTON, D.C.

were held as herein appears and that this is the original transcript for the file of the Commission.

REPORTER: PHYLLIS YOUNG

SIGNED: Phyllis Young

TRANSCRIBER: NEAL R. GROSS

SIGNED: Neal R Gross

HSST RESEARCH TOWARD RESOLVING UNCERTAINTIES IN FRACTURE MECHANICS AS PERTINENT TO THE PRESSURIZED THERMAL SHOCK ISSUE

PRESENTED TO THE
ACRS

AT
NRC HEADQUARTERS

OCTOBER 12, 1984

BY
MILTON VAGINS

Research Directed Toward Resolving Uncertainties in Fracture Mechanics as Pertinent to the Pressurized Thermal Shock Issue

Issues

1. Applicability of Linear Elastic Fracture Mechanics (LEFM) for initiation, propagation and arrest for reactor pressure vessels subjected to a pressurized thermal shock scenario.

2. Effectiveness of Warm Prestress

3. Vessel failure under nonpressurized thermal shock conditions.

4. Behavior of small finite flaw when subject to PTS conditions.

5. Cladding-flaw interaction; bimetallic effects.

6. Irradiated cladding material and fracture properties.

7. Arrest on the upper shelf.

8. Postarrest performance for a deep crack in upper shelf material toughness.

9. Definition of margin when using RT_{NDT} to set fracture toughness curves.

10. Variation of through-wall fracture toughness degradation.

11. Validation of fracture toughness degradation as a function of fluence for ferritic, welds.

12. Effect of trace elements (copper, nickel, phosphorus) on the embrittlement rate of RPV steels at reactor operating conditions.

13. Effectiveness of thermal annealing on fracture toughness recovery and reembrittlement rate.

14. Establishments of criteria and standards to be applied to any proposed, in situ thermal annealing of operating reactor vessels.

PRESSURIZED THERMAL SHOCK EXPERIMENT

PTSE-1

OBJECTIVES

A) VALIDATE DEVELOPED FRACTURE MECHANICS COMPUTER CODES

B) VALIDATE OR SHOW CONSERVATISM OF THE ASME, B&PV CODE, SECTION XI CRACK EVALUATION ANALYTIC PROCEDURES FOR PTS SCENARIOS

C) DEVELOP DATA INTO REACTOR PRESSURE VESSEL MATERIAL FRACTURE BEHAVIOR AS REGARDS FAST RUNNING CRACKS AT HIGH TOUGHNESS LEVELS

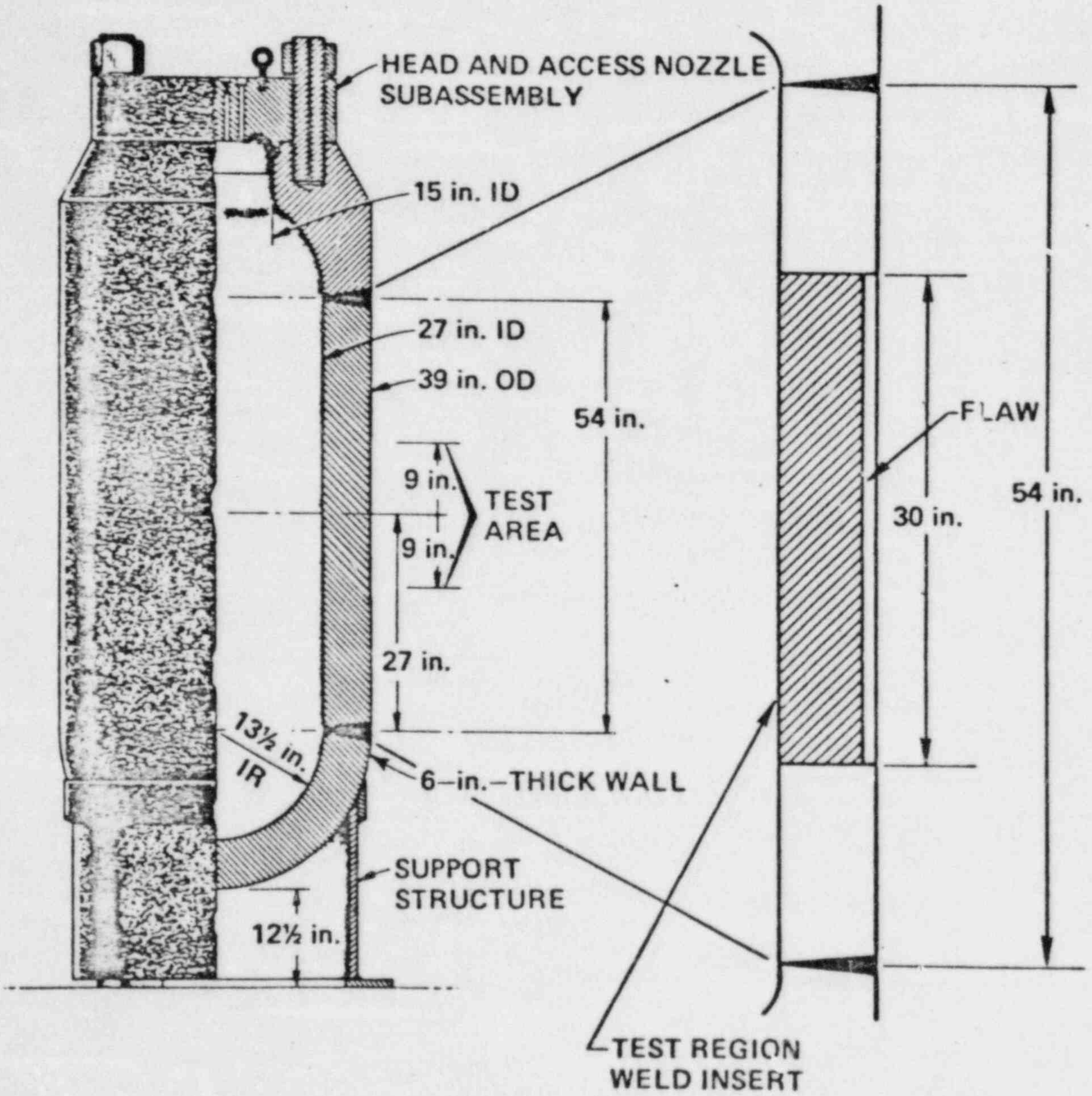
D) VALIDATE NEW METHODOLOGY FOR ACCURATELY DETERMINING REACTOR PRESSURE VESSEL IN-SITU FRACTURE TOUGHNESS CHARACTERISTICS FROM SMALL LABORATORY SPECIMEN DATA

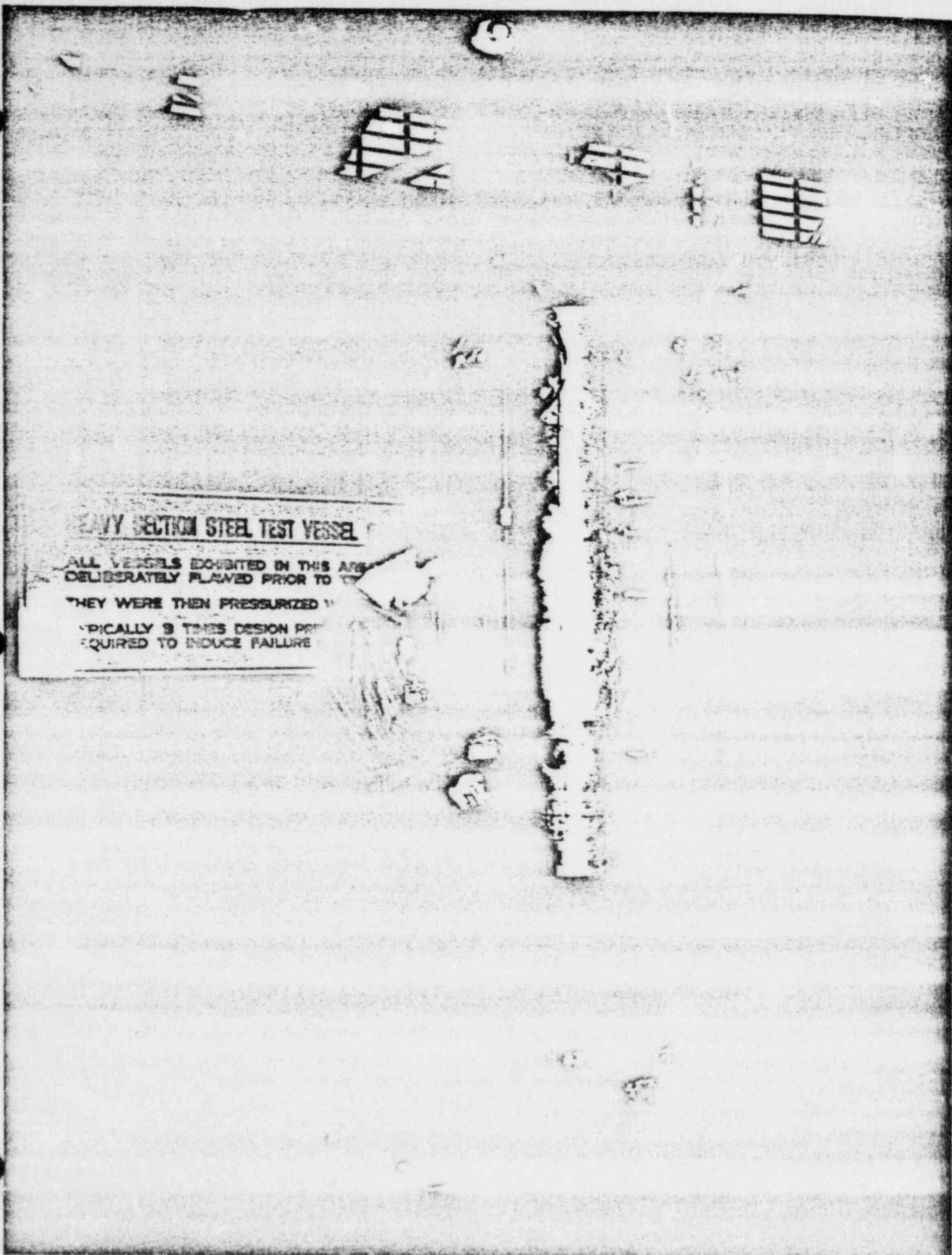
E) VALIDATE OR SHOW CONSERVATISM OF PRESENT POSITION OF THE NRC AS REGARDS THE PTS ISSUE

ORNL–DWG 82–6072 ETD

UNION CARBIDE ORNL

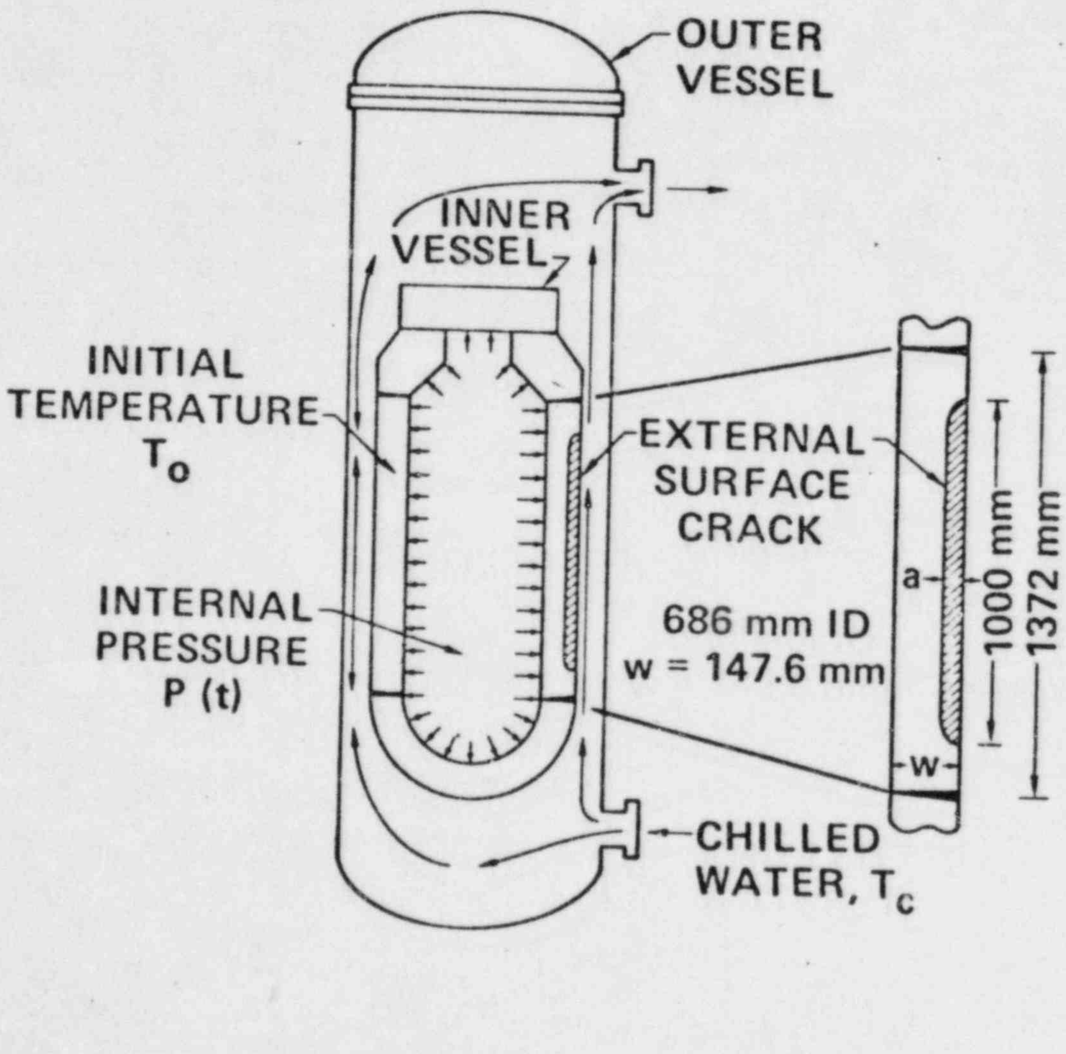
LONG FLAW CONFIGURATION FOR PRESSURIZED–THERMAL–SHOCK EXPERIMENTS




EAVY SECTION STEEL TEST VESSEL
ALL VESSELS EXHIBITED IN THIS AR
DELIBERATELY FLAWED PRIOR TO
THEY WERE THEN PRESSURIZED
PICALLY 3 TIMES DESIGN PR
EQUIRED TO INDUCE FAILURE

ORNL-DWG 83-5459 ETD

PRESSURIZED–THERMAL–SHOCK TEST VESSEL WITH LONGITUDINAL OUTER SURFACE CRACK



ORNL-DWG 83-5293 ETD

THE PTSTF PROVIDES KEY PARAMETERS NECESSARY TO SIMULATE A PTS TRANSIENT

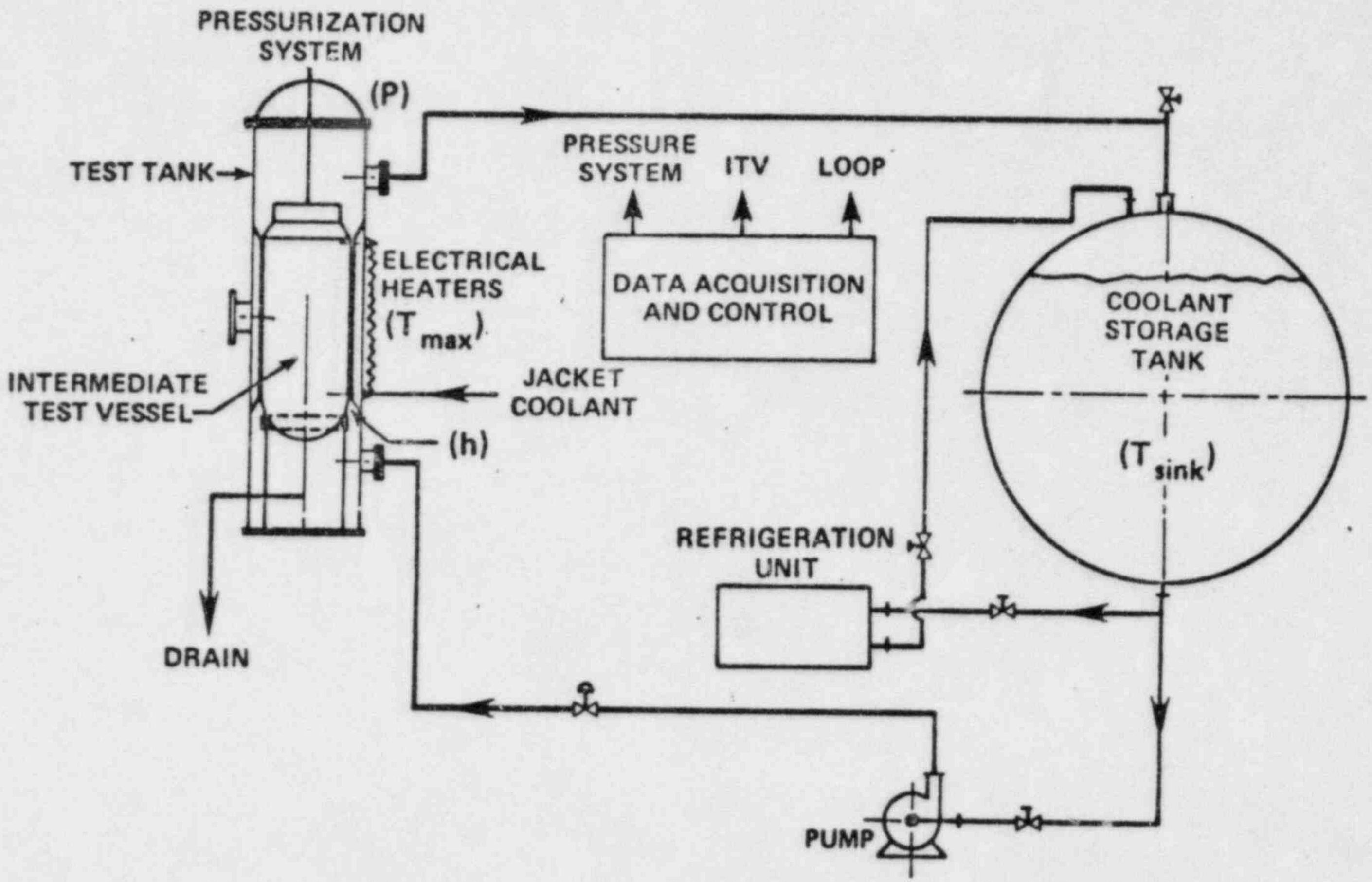
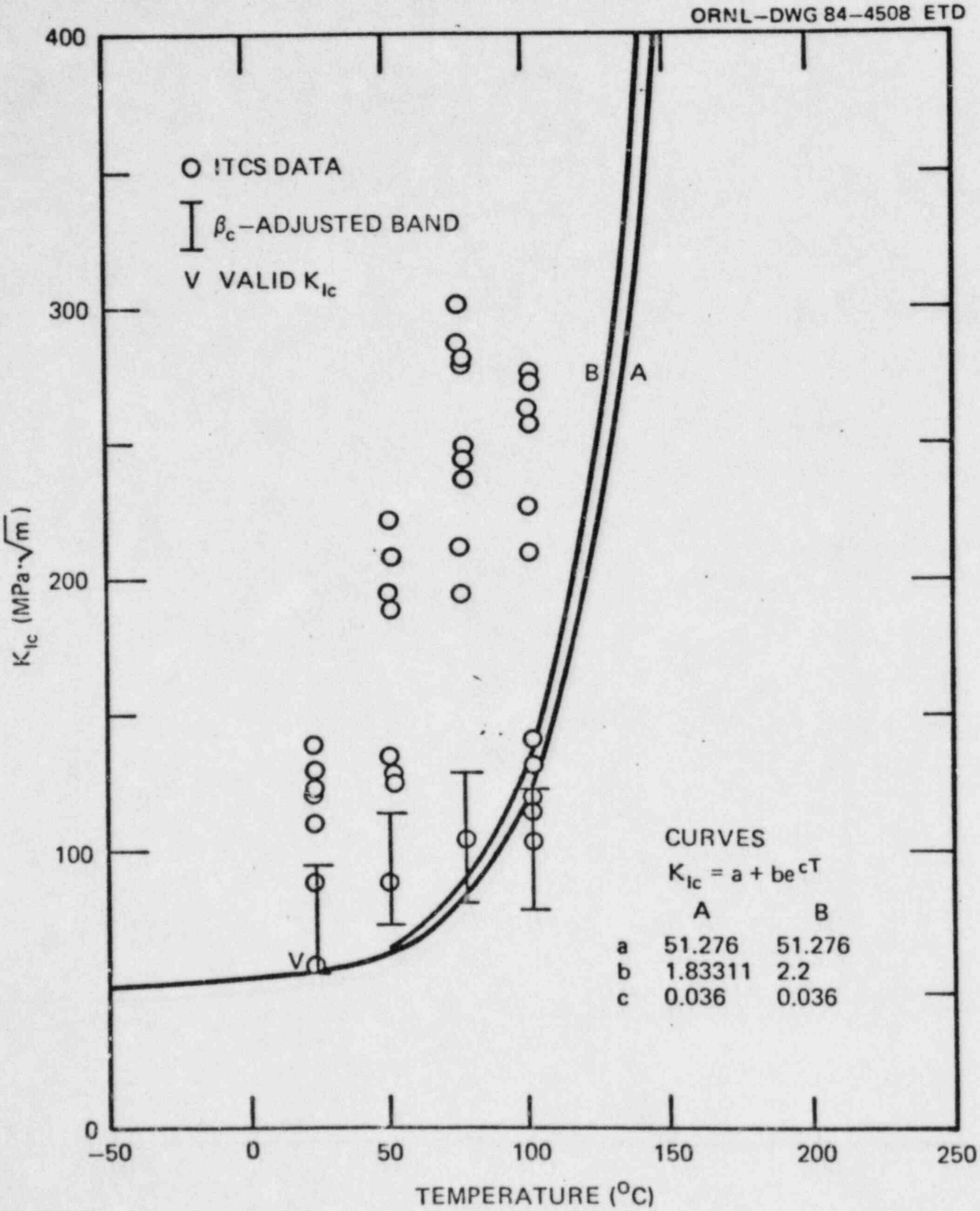
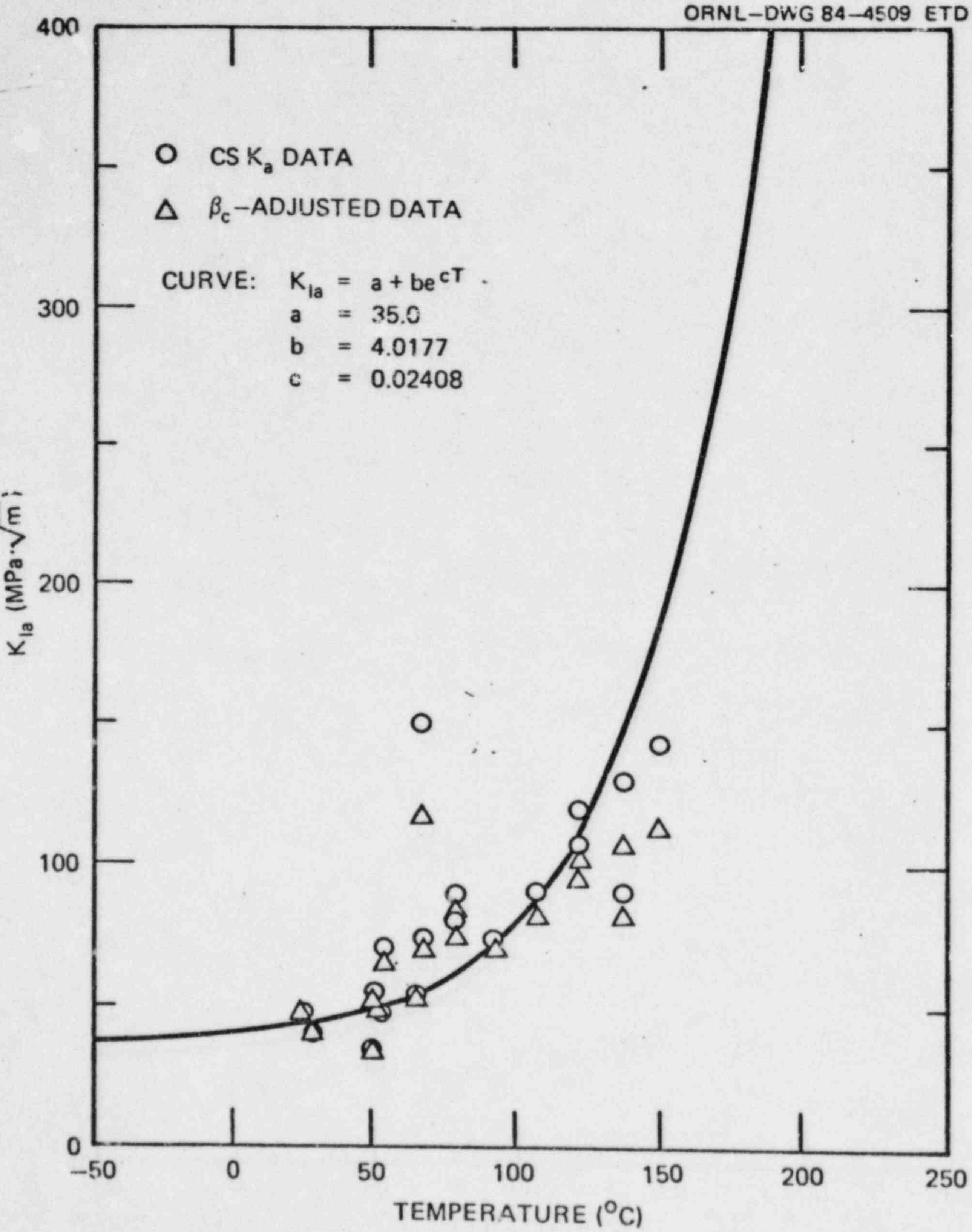


Table 1. Nominal test facility operating characteristics and limitations

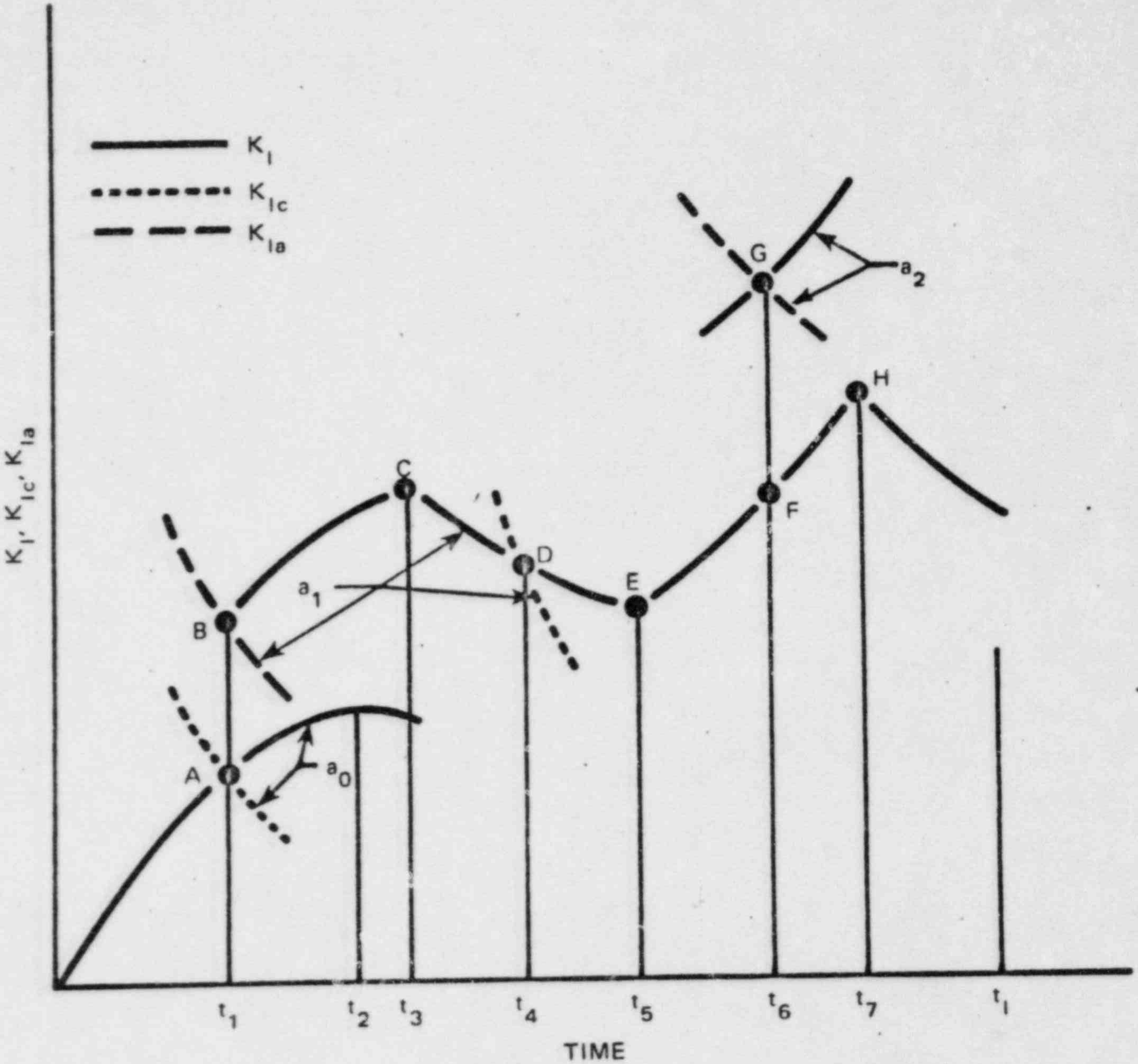
Initial vessel temperature (°C)	Ambient to 290
Coolant temperature (°C)	
Water coolant	5 to 35
40% methanol by wt in water	−20 to 30
Test section flow (m^3/s)	0.13 (2100 gpm)
Convective heat transfer coefficient, h ($w \cdot m^{-2} \cdot K^{-1}$)	<10,000
Test vessel pressure	
Maximum static (MPa)	138[a]
Maximum transient (MPa)	110
Maximum rate (MPa/s)	
Positive	0.8
Negative	1.0
Working fluid	Dimethyl polysiloxane (Dow Corning 210 silicone)

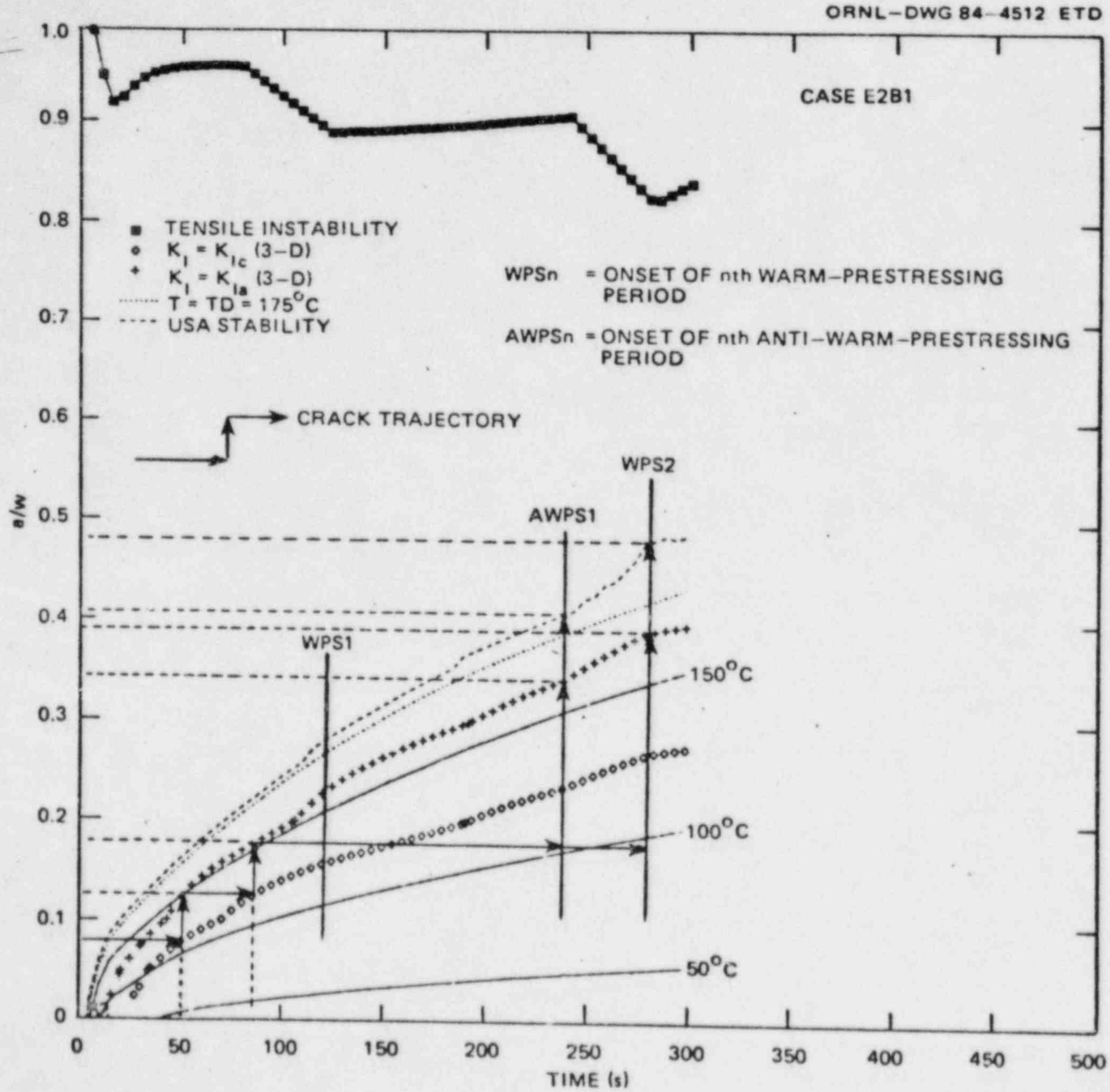
[a]About twice the test vessel design pressure.


ORNL–DWG 84–4508 ETD
O ITCS DATA
β_c–ADJUSTED BAND
V VALID K_{Ic}
K_{Ic} (MPa·√m)
TEMPERATURE (°C)
B A
V
CURVES
$K_{Ic} = a + be^{cT}$
A B
a 51.276 51.276
b 1.83311 2.2
c 0.036 0.036
400
300
200
100
0
–50
0
50
100
150
200
250

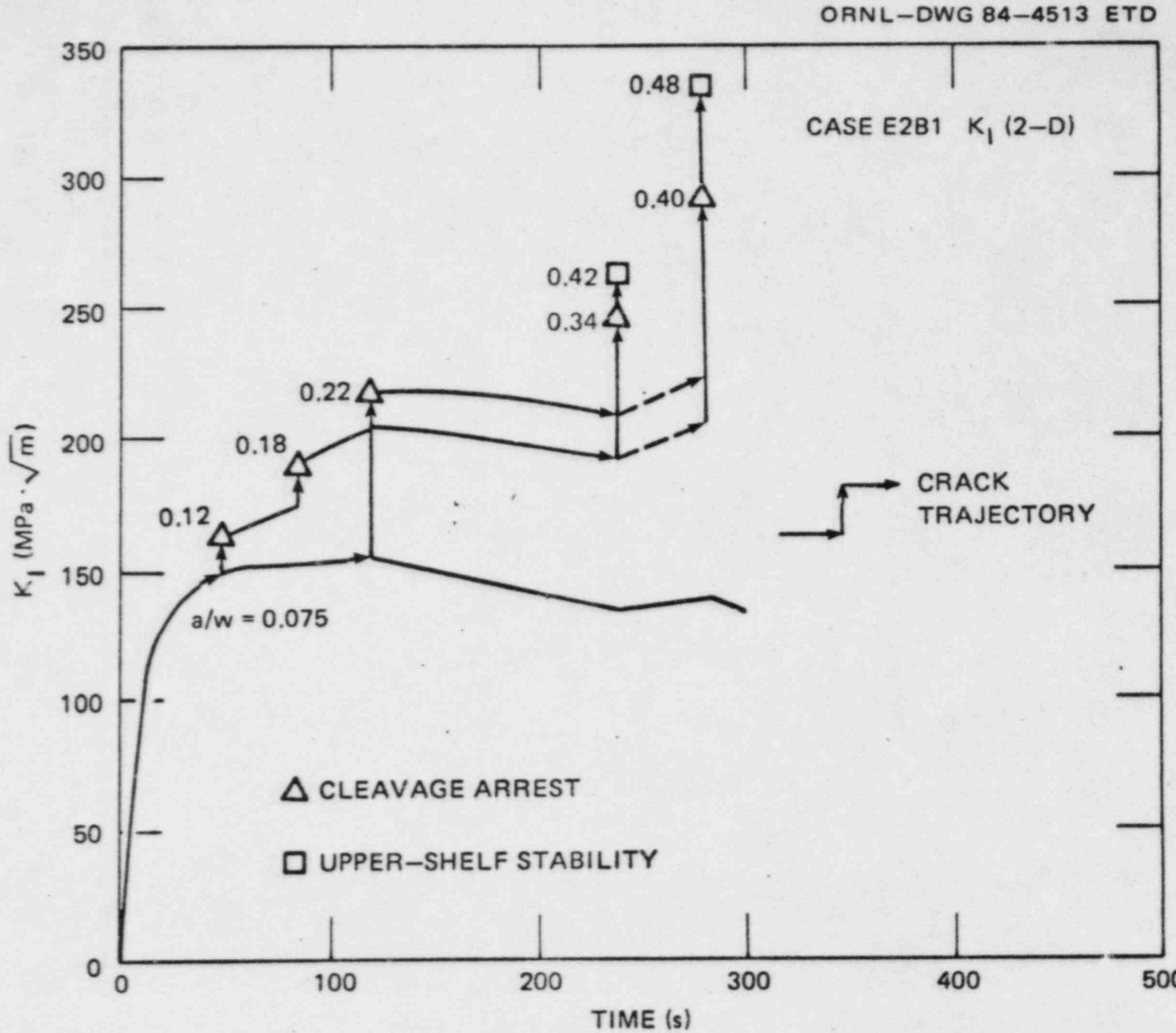

ORNL-DWG 84-4509 ETD
CS K_a DATA
β_c–ADJUSTED DATA
CURVE: $K_{Ia} = a + be^{cT}$
a = 35.0
b = 4.0177
c = 0.02408
K_{Ia} (MPa·$\sqrt{m}$)
TEMPERATURE (°C)
400
300
200
100
0
–50
0
50
100
150
200
250

ORNL–DWG 84–4510 ETD



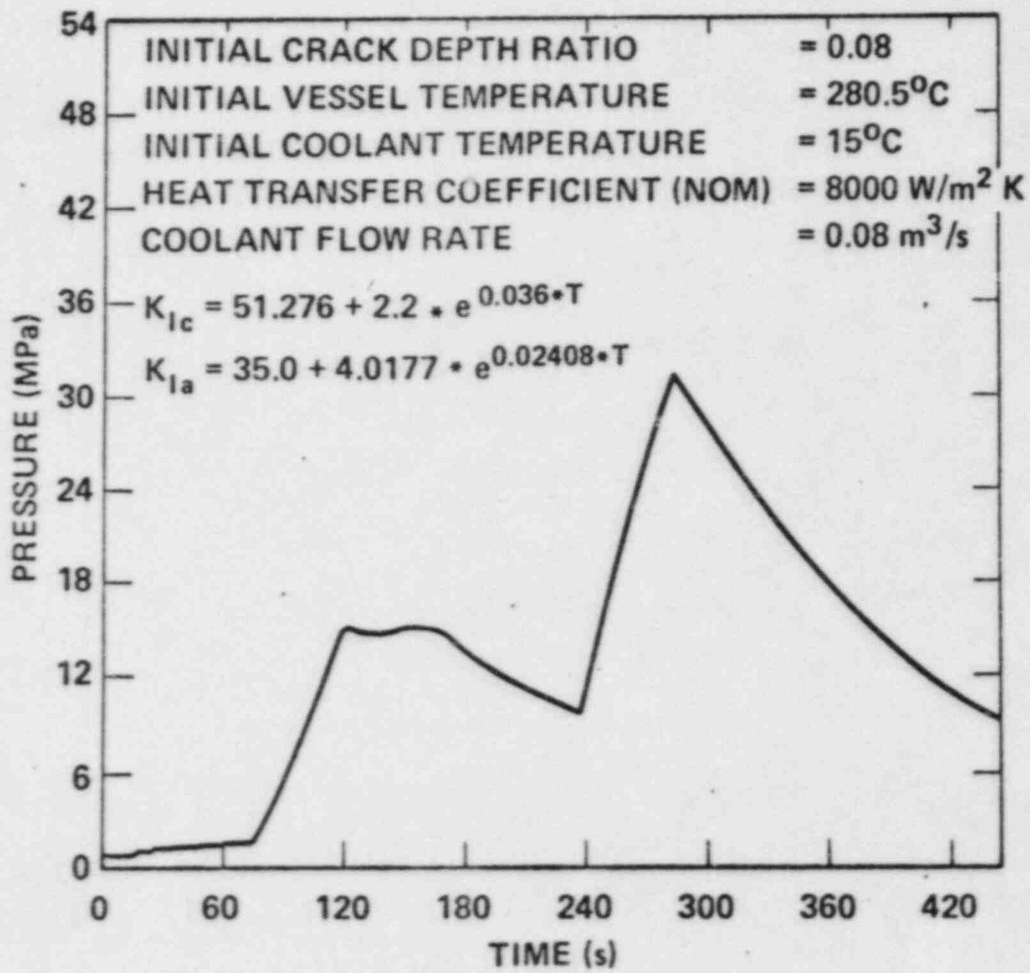


ORNL-DWG 84-4512 ETD
CASE E2B1
TENSILE INSTABILITY
$K_I = K_{Ic}$ (3-D)
$K_I = K_{Ia}$ (3-D)
T = TD = 175°C
USA STABILITY
WPSn = ONSET OF nth WARM-PRESTRESSING PERIOD
AWPSn = ONSET OF nth ANTI-WARM-PRESTRESSING PERIOD
CRACK TRAJECTORY
WPS1
AWPS1
WPS2
150°C
100°C
50°C
a/w
TIME (s)


ORNL-DWG 84-4513 ETD
CASE E2B1 K_I (2-D)
K_I (MPa · $\sqrt{m}$)
TIME (s)
0
50
100
150
200
250
300
350
0
100
200
300
400
500
0.48
0.40
0.42
0.34
0.22
0.18
0.12
a/w = 0.075
CRACK TRAJECTORY
CLEAVAGE ARREST
UPPER-SHELF STABILITY

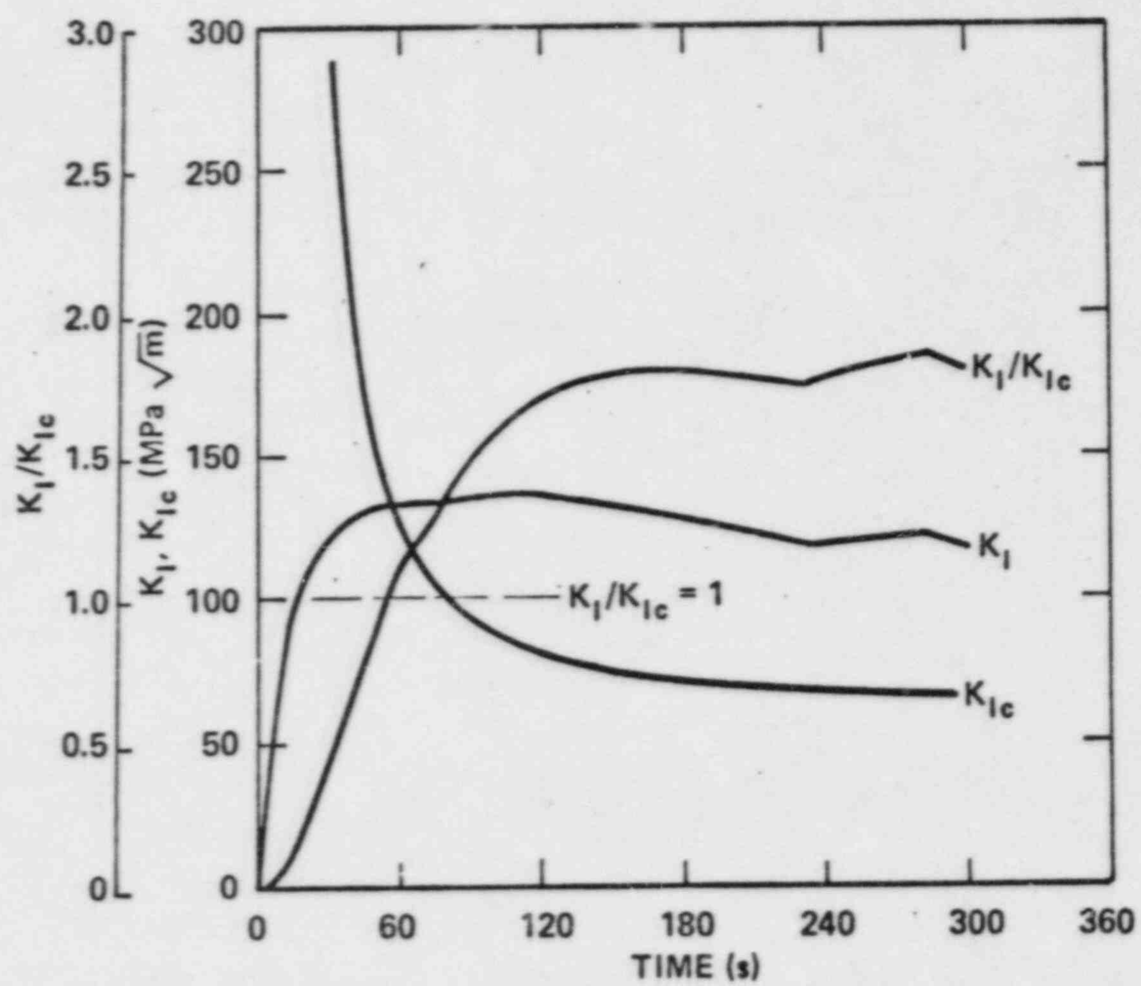
ORNL–DWG 84–4307 ETD

TEST PTSE–1A: PRESSURIZED–THERMAL–SHOCK PARAMETERS



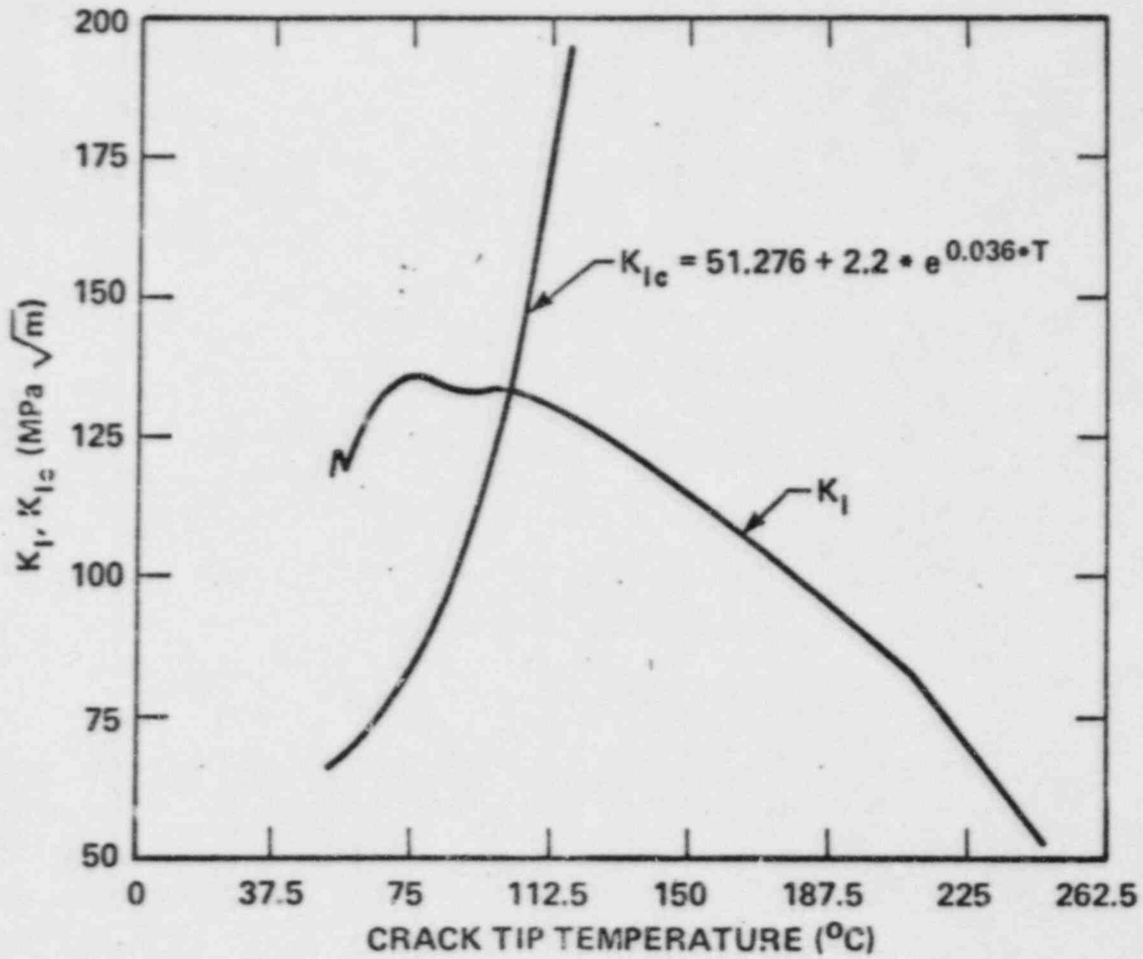
ORNL-DWG 84-4309 ETD

TEST PTSE-1A: K_I, K_{Ic}, K_I/K_{Ic} VS TIME FOR CRACK DEPTH RATIO a/w = 0.08

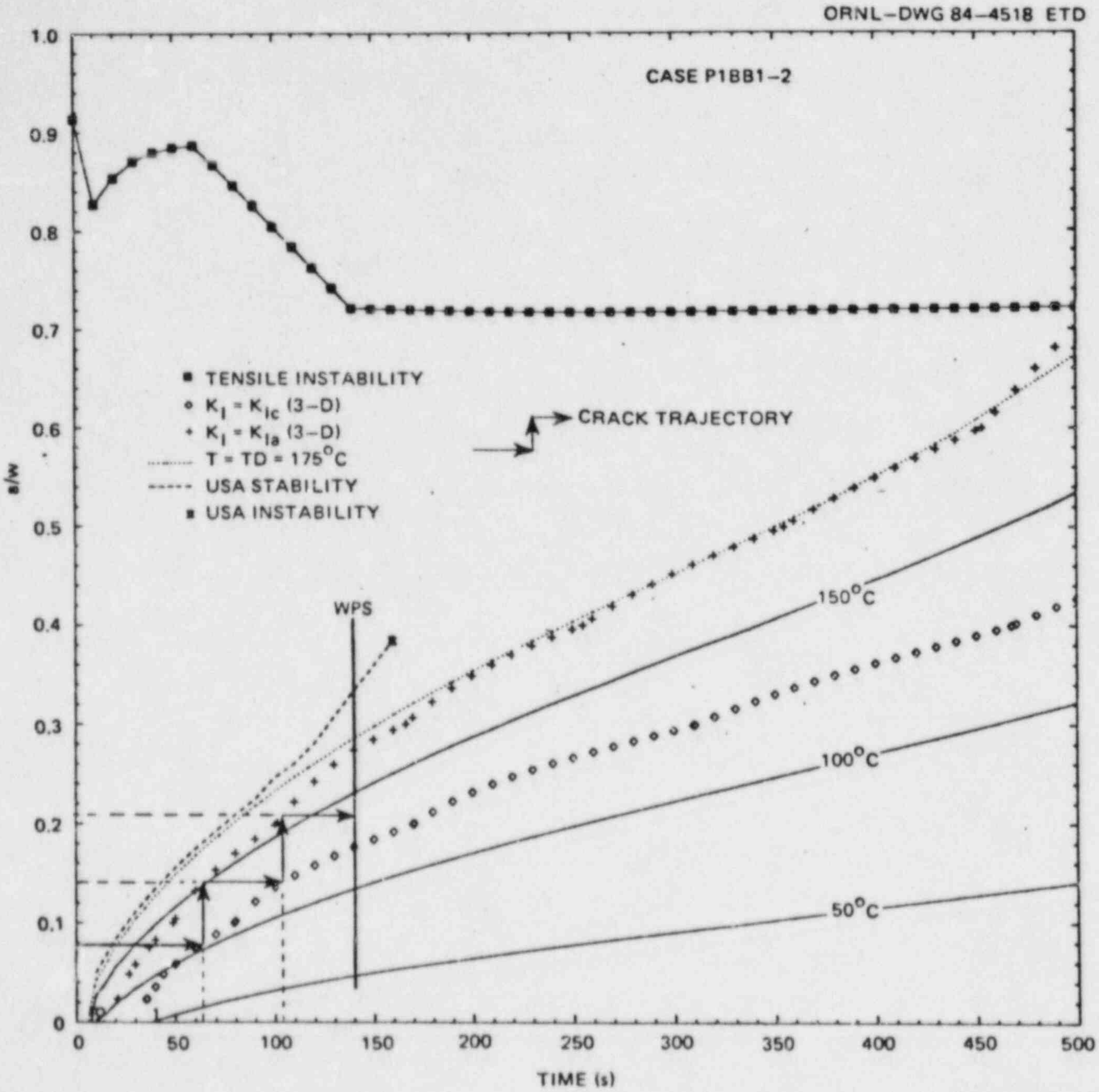


ORNL–DWG 84–4308 ETD

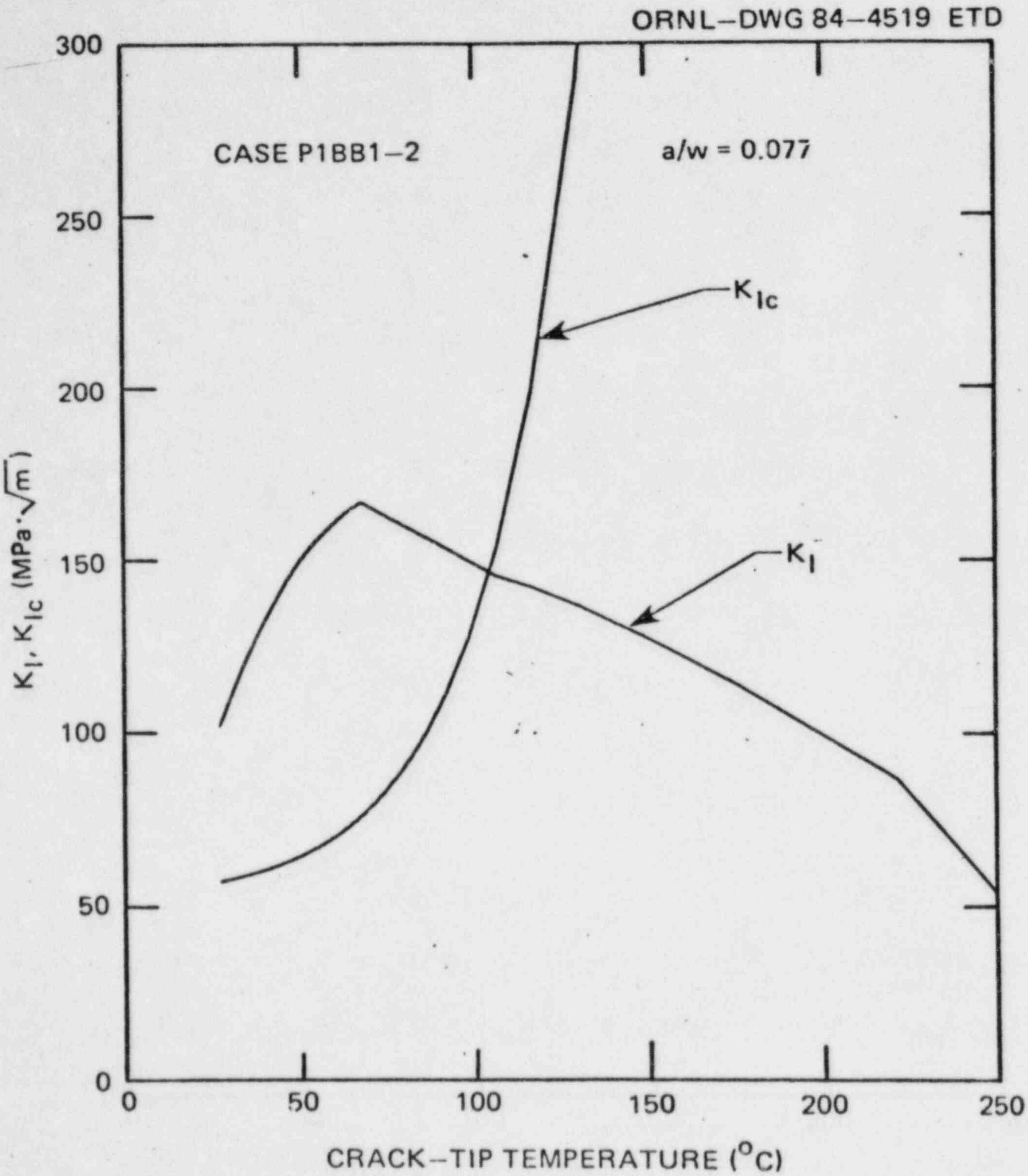
TEST PTSE–1A: K_I, K_{Ic} VS CRACK TIP TEMPERATURE FOR a/w = 0.08



15.



ORNL-DWG 84-4518 ETD
CASE P1BB1-2
TENSILE INSTABILITY
$K_I = K_{Ic}$ (3-D)
$K_I = K_{Ia}$ (3-D)
T = TD = 175°C
USA STABILITY
USA INSTABILITY
CRACK TRAJECTORY
WPS
150°C
100°C
50°C
a/w
TIME (s)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
50
100
150
200
250
300
350
400
450
500

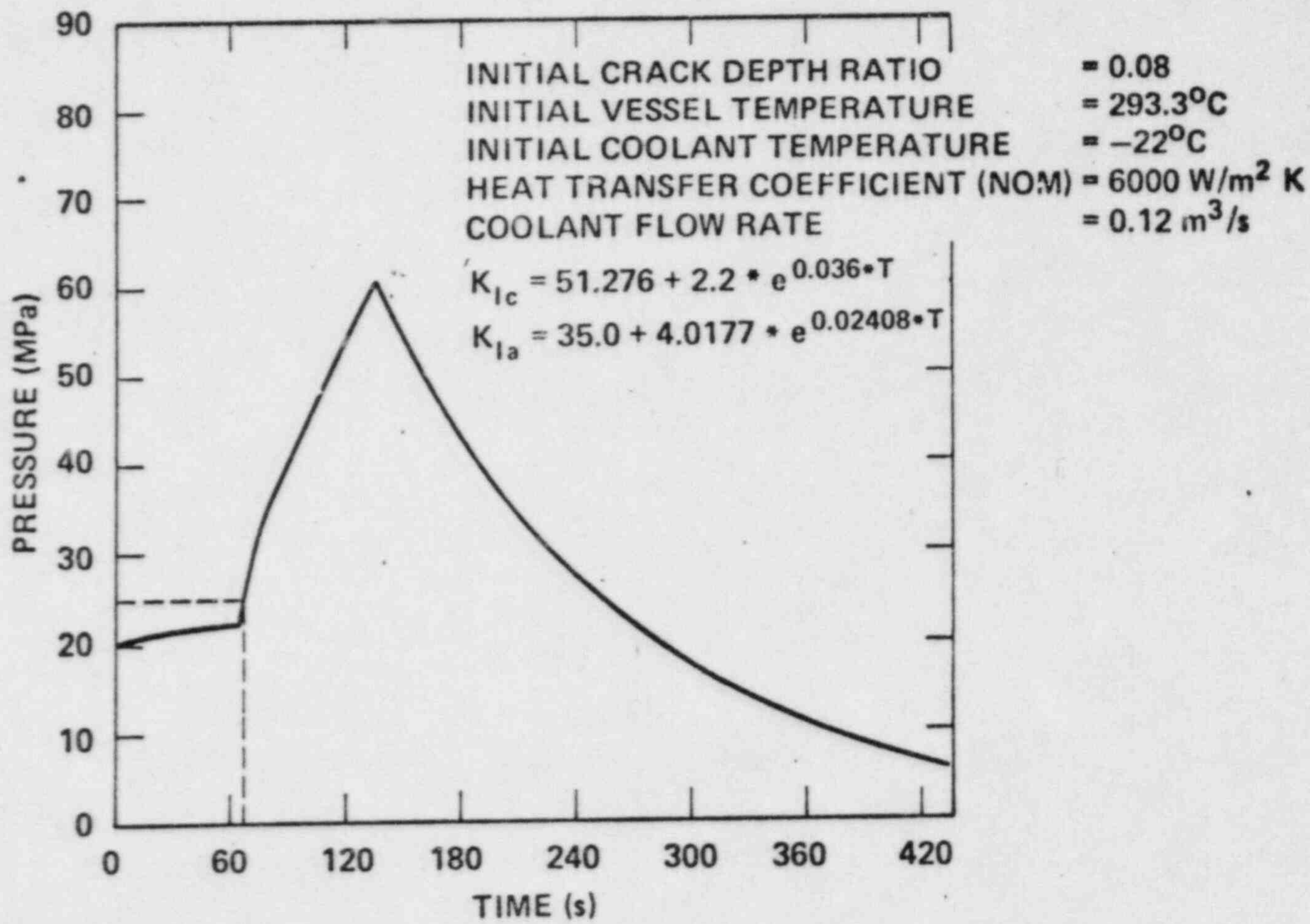


ORNL–DWG 84–4519 ETD
CASE P1BB1–2
a/w = 0.077
K_{Ic}
K_I
K_I, K_{Ic} (MPa·$\sqrt{m}$)
300
250
200
150
100
50
0
0
50
100
150
200
250
CRACK–TIP TEMPERATURE (°C)

ORNL–DWG 84–4306 ETD

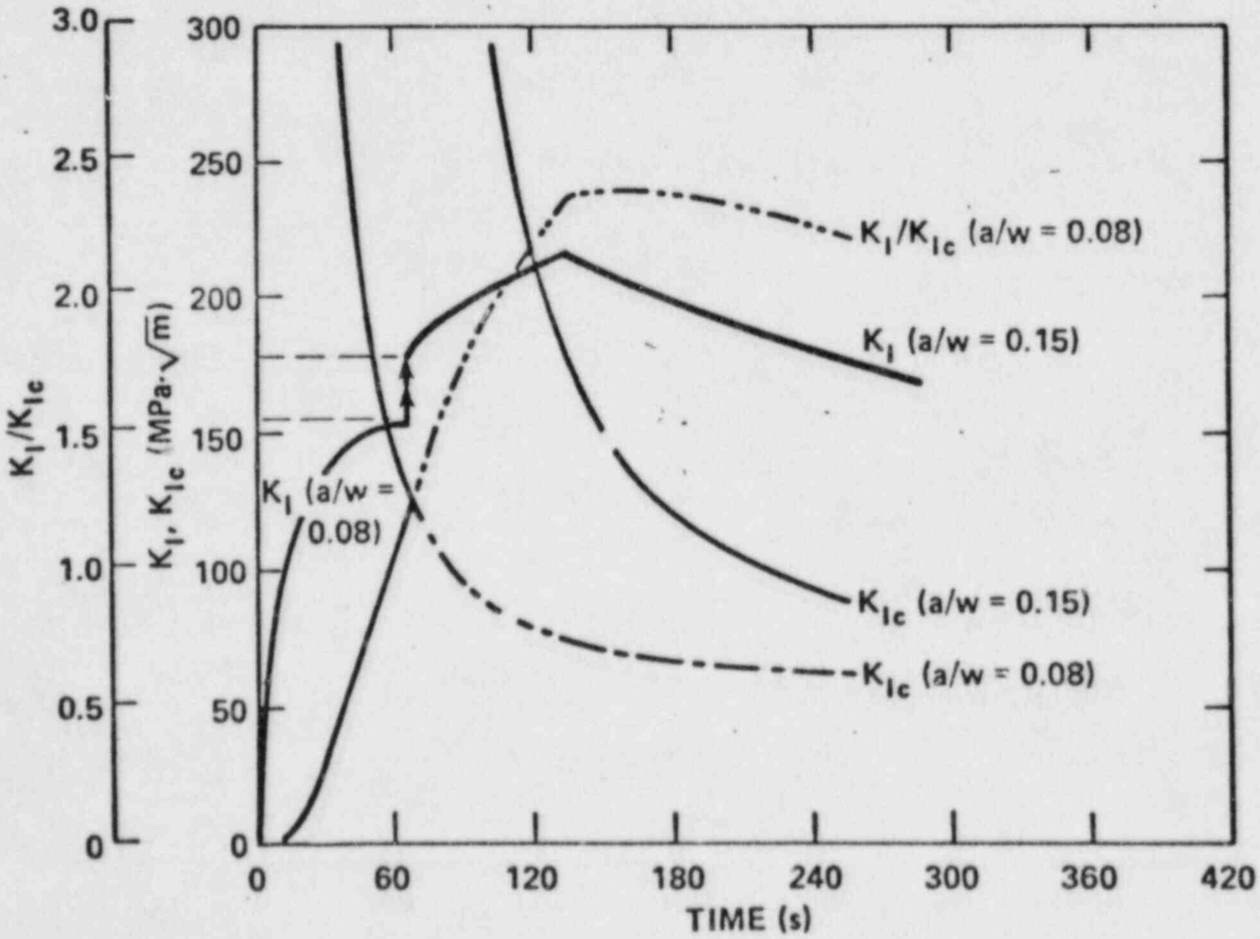
ornl

TEST PTSE–1B: PRESSURIZED–THERMAL–SHOCK PARAMETERS

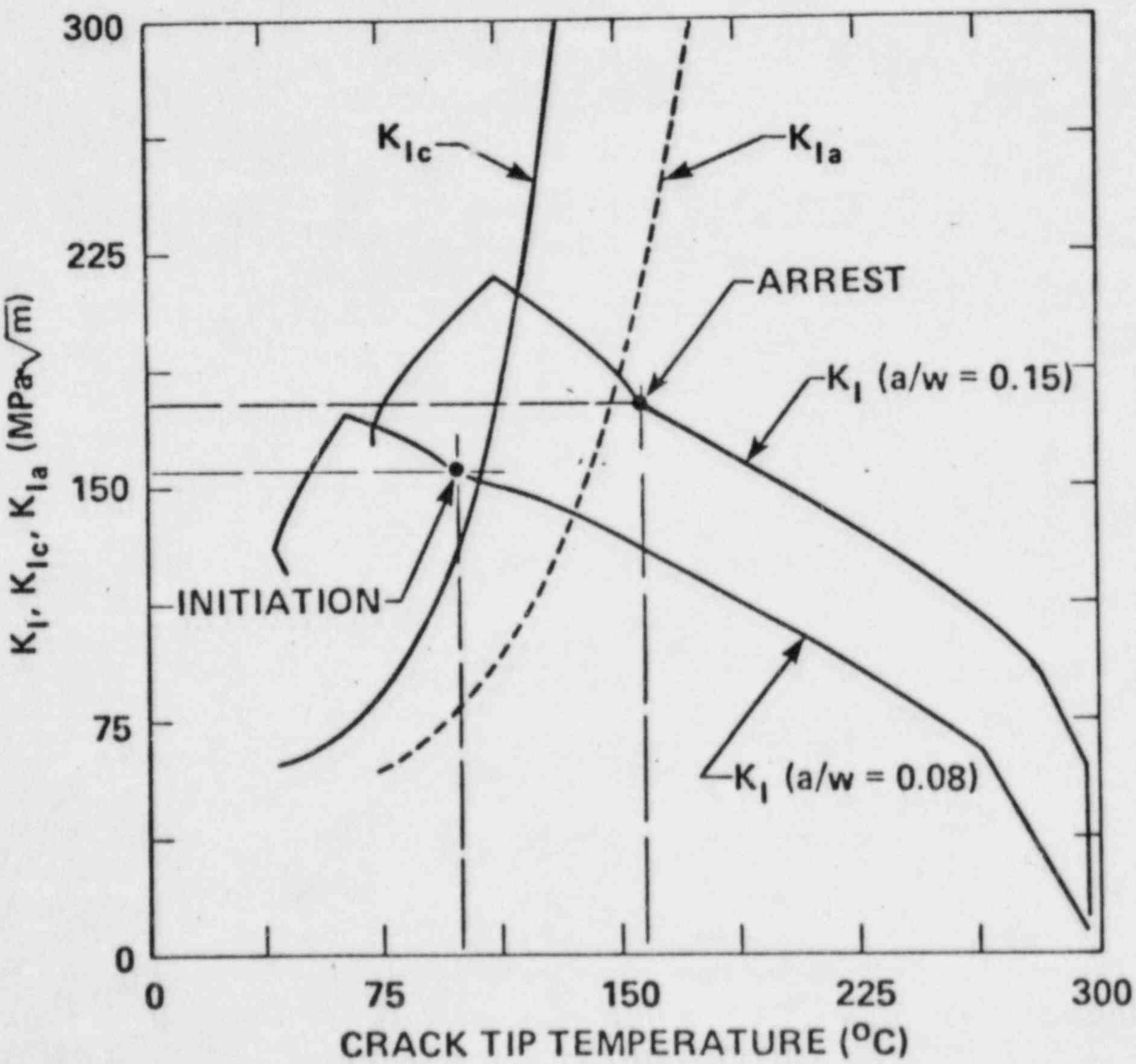


ORNL–DWG 84–4310B ETD

TEST PTSE–1B: K_I, K_{Ic}, K_I/K_{Ic} VS TIME FOR INITIATION AND ARREST EVENTS

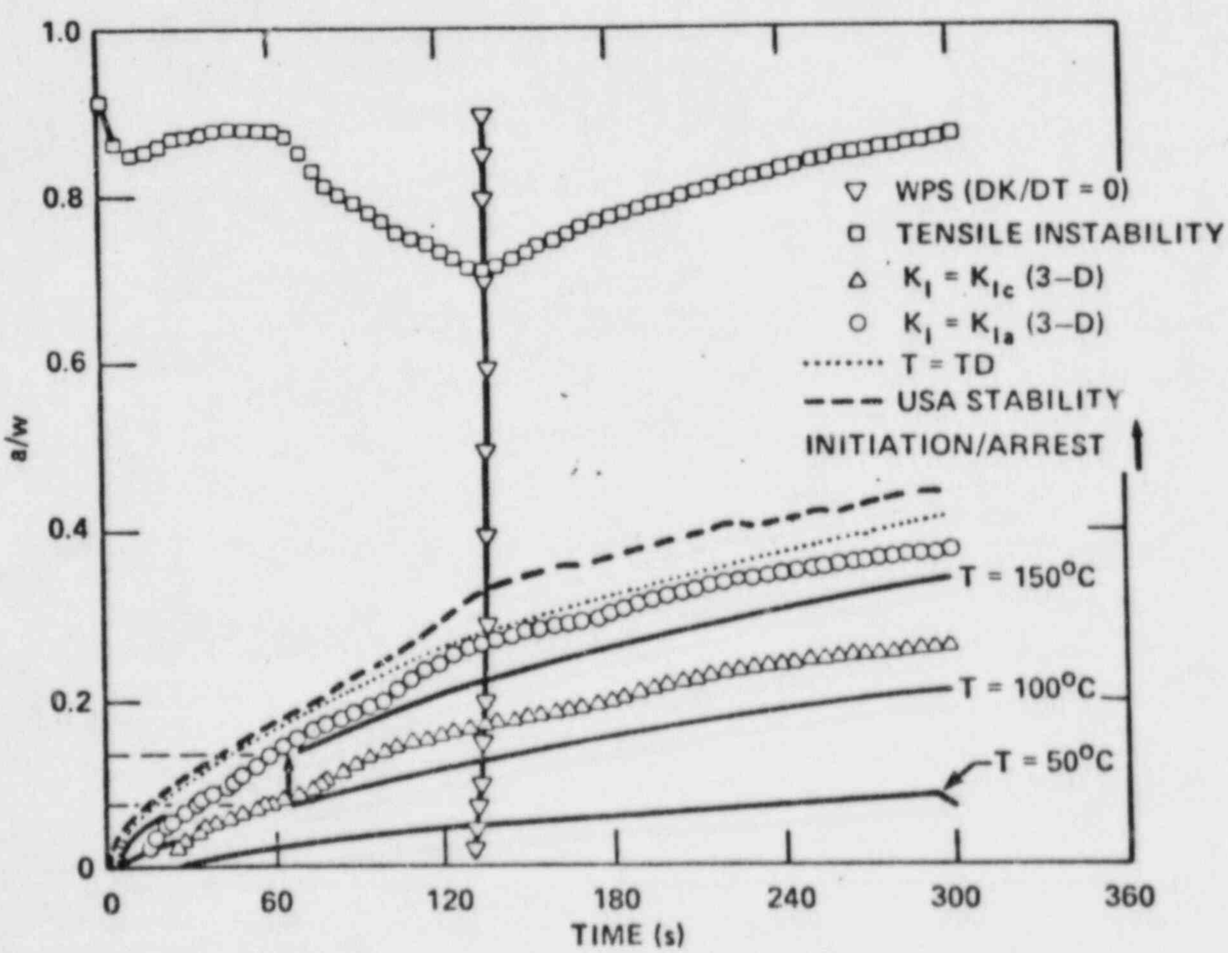


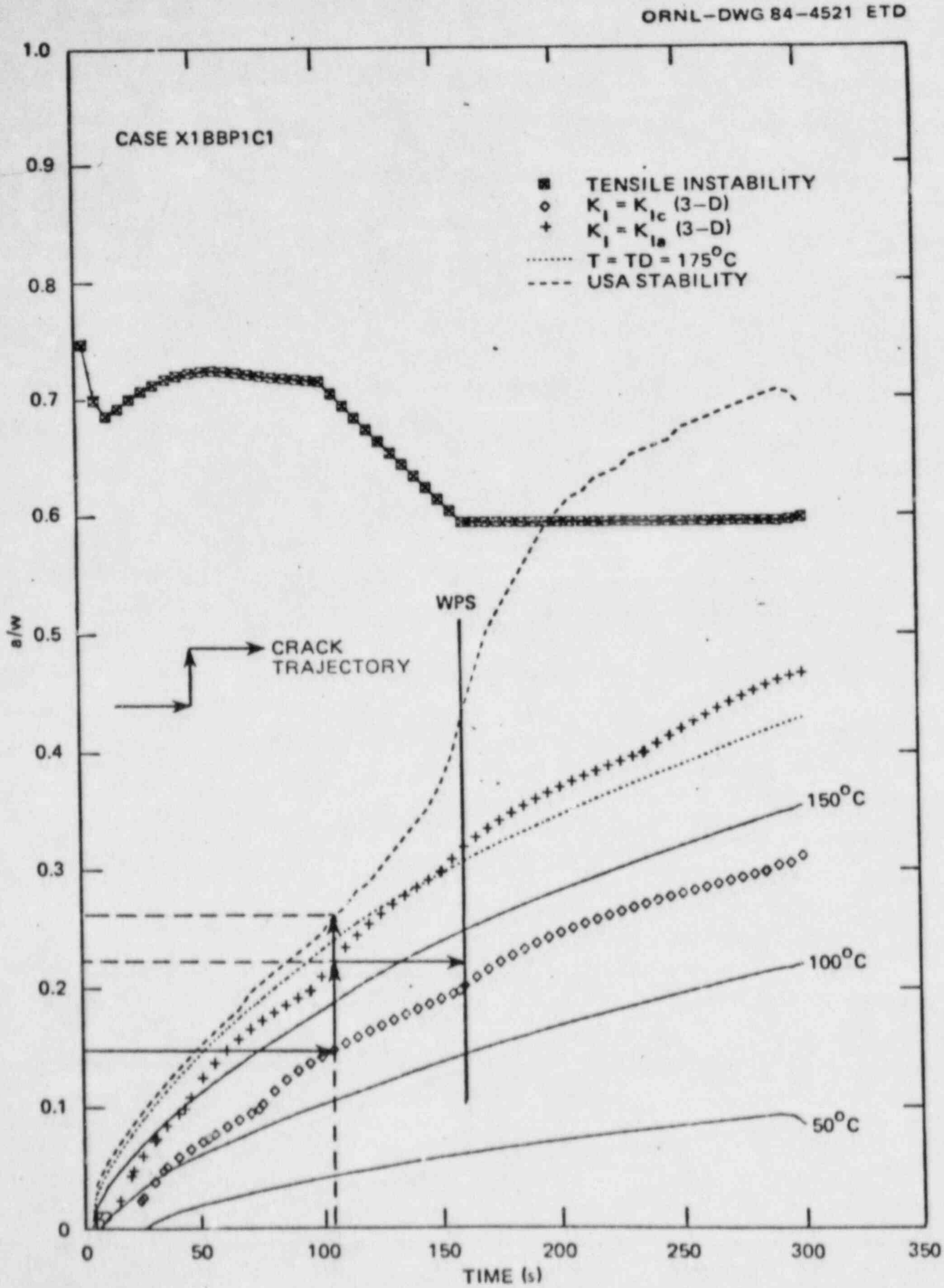
TEST PTSE–1B: K_I, K_{Ic}, K_{Ia} VS CRACK TIP TEMPERATURE



ORNL-DWG 84-4305 ETD

TEST PTSE-1B: CRITICAL CRACK DEPTH CURVES ILLUSTRATING INITIATION AND ARREST EVENTS

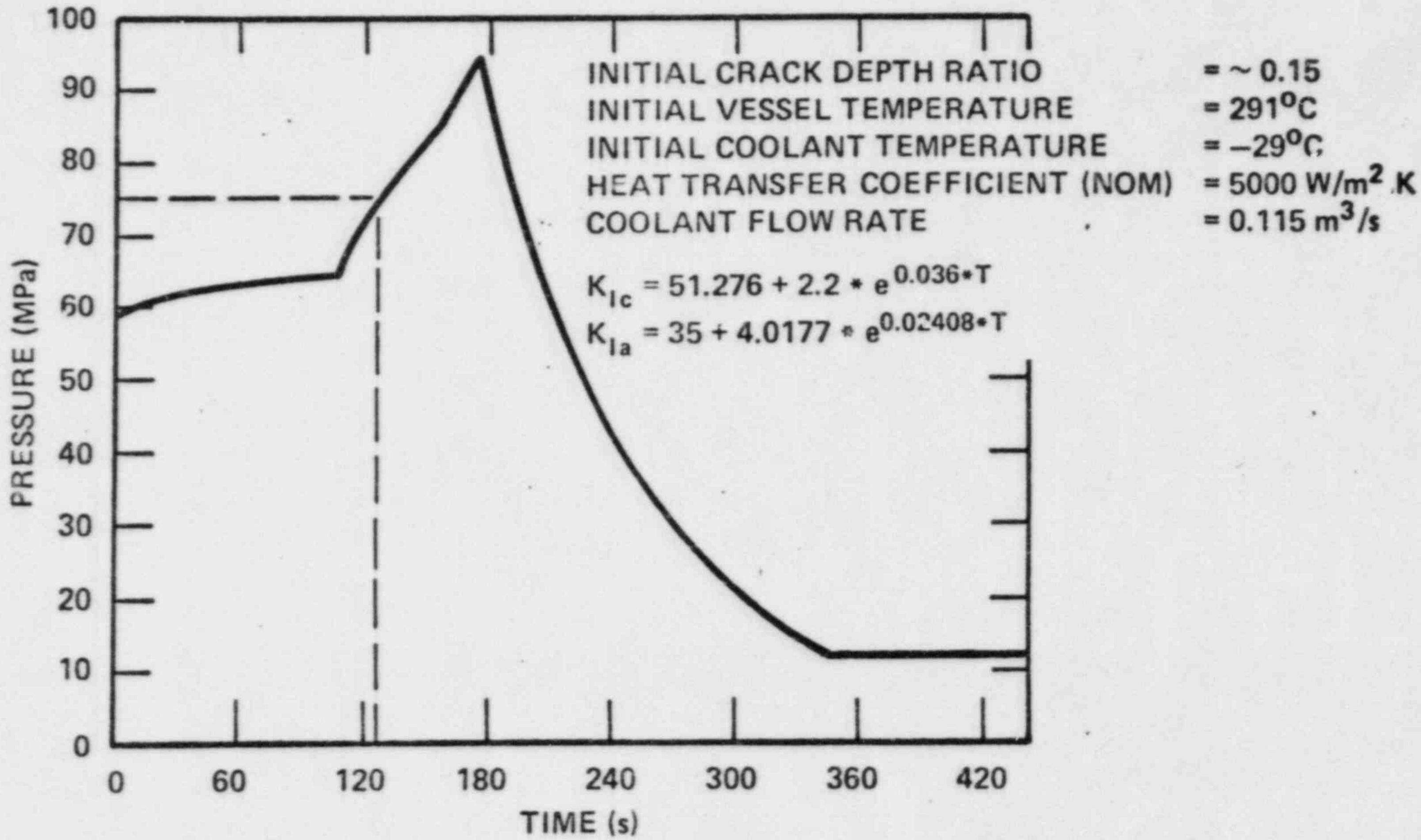



ORNL-DWG 84-4521 ETD
CASE X1BBP1C1
TENSILE INSTABILITY
$K_I = K_{Ic}$ (3-D)
$K_I = K_{Ia}$ (3-D)
T = TD = 175°C
USA STABILITY
WPS
CRACK TRAJECTORY
150°C
100°C
50°C
a/w
TIME (s)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
50
100
150
200
250
300
350

ORNL–DWG 84–4366 ETD

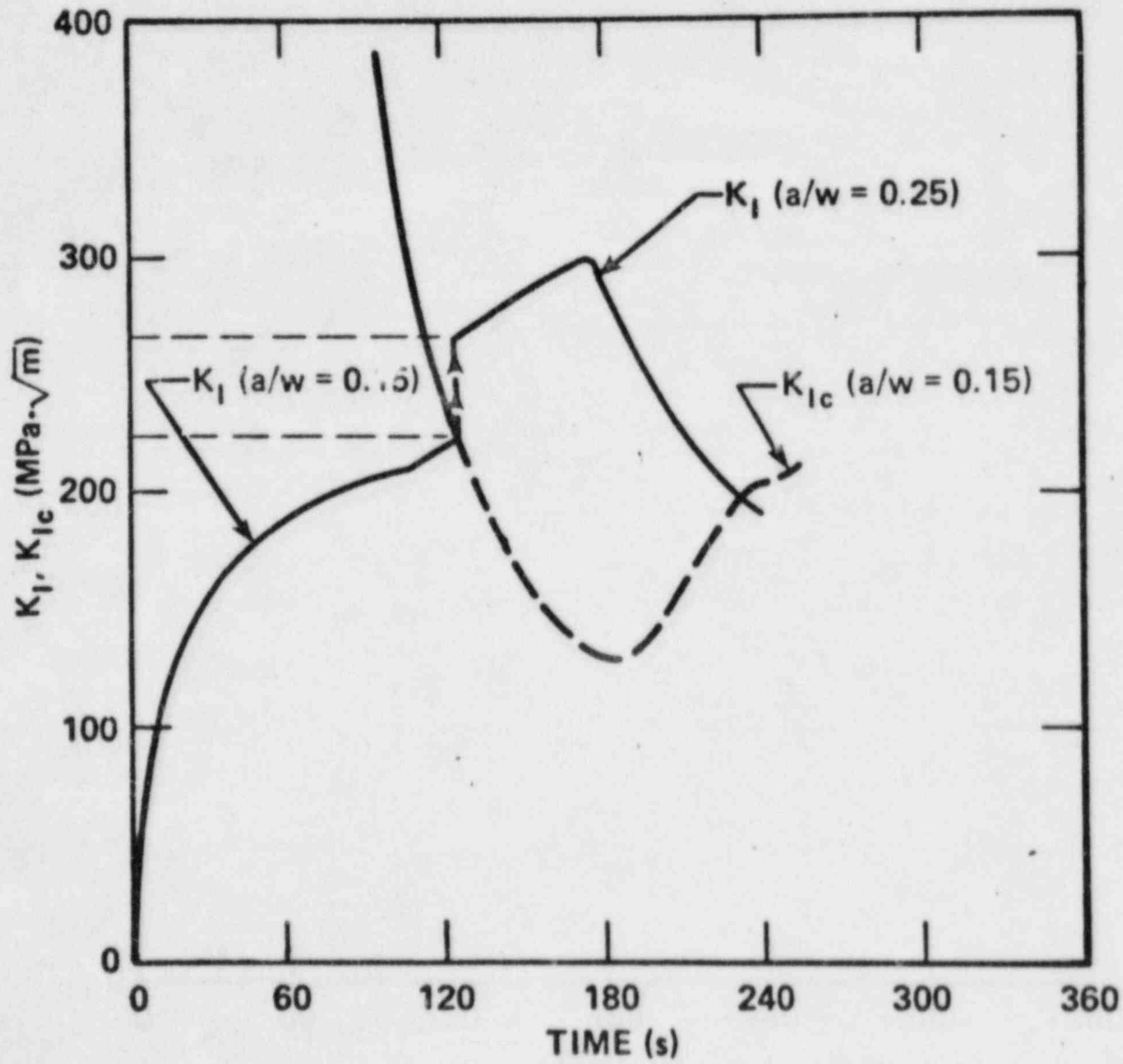
ornl

TEST PTSE–1C: PRESSURIZED–THERMAL–SHOCK PARAMETERS



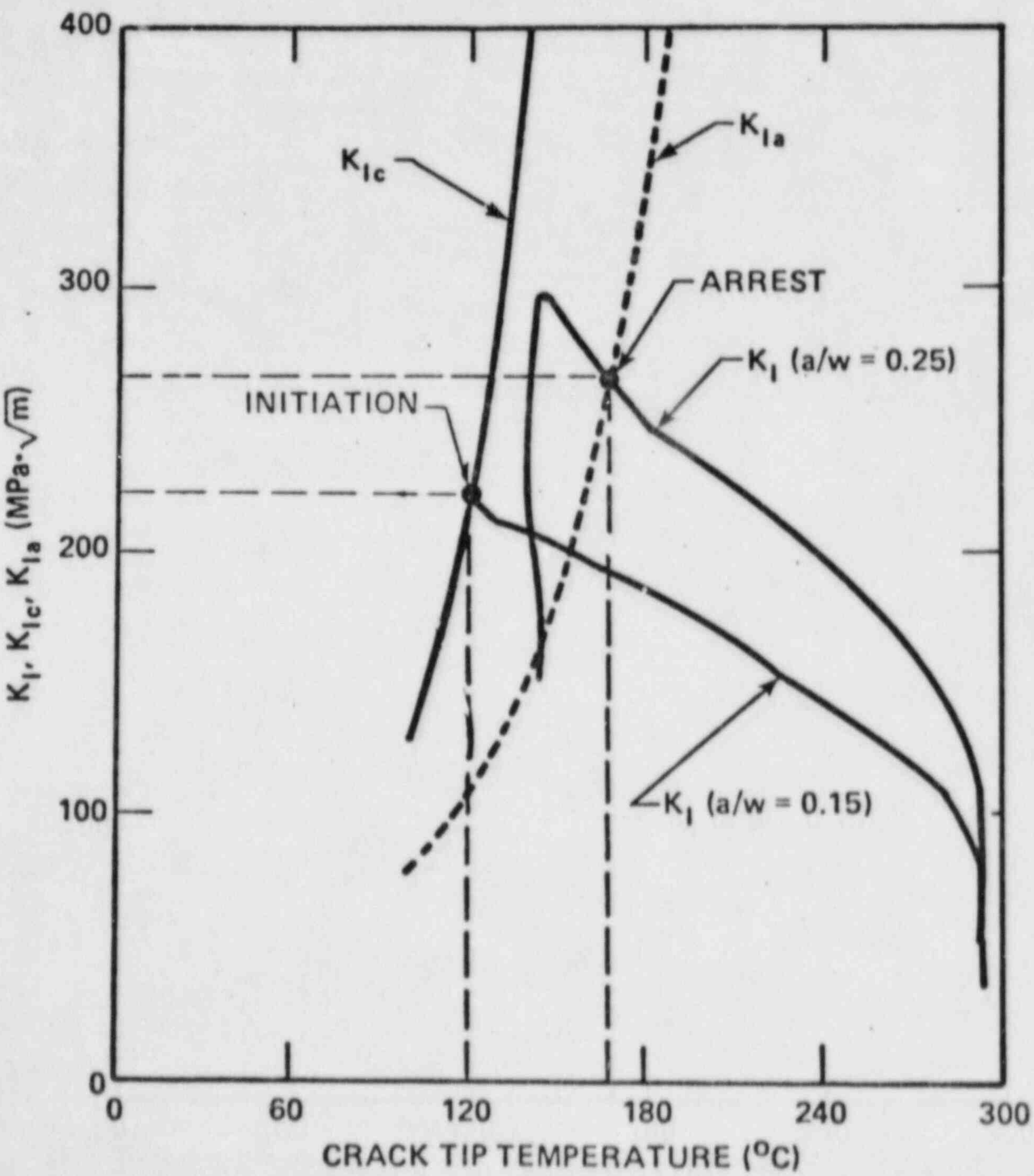
ORNL–DWG 84–4367B ETD

TEST PTSE–1C: K_I, K_{Ic} VS TIME FOR INITIATION AND ARREST EVENTS



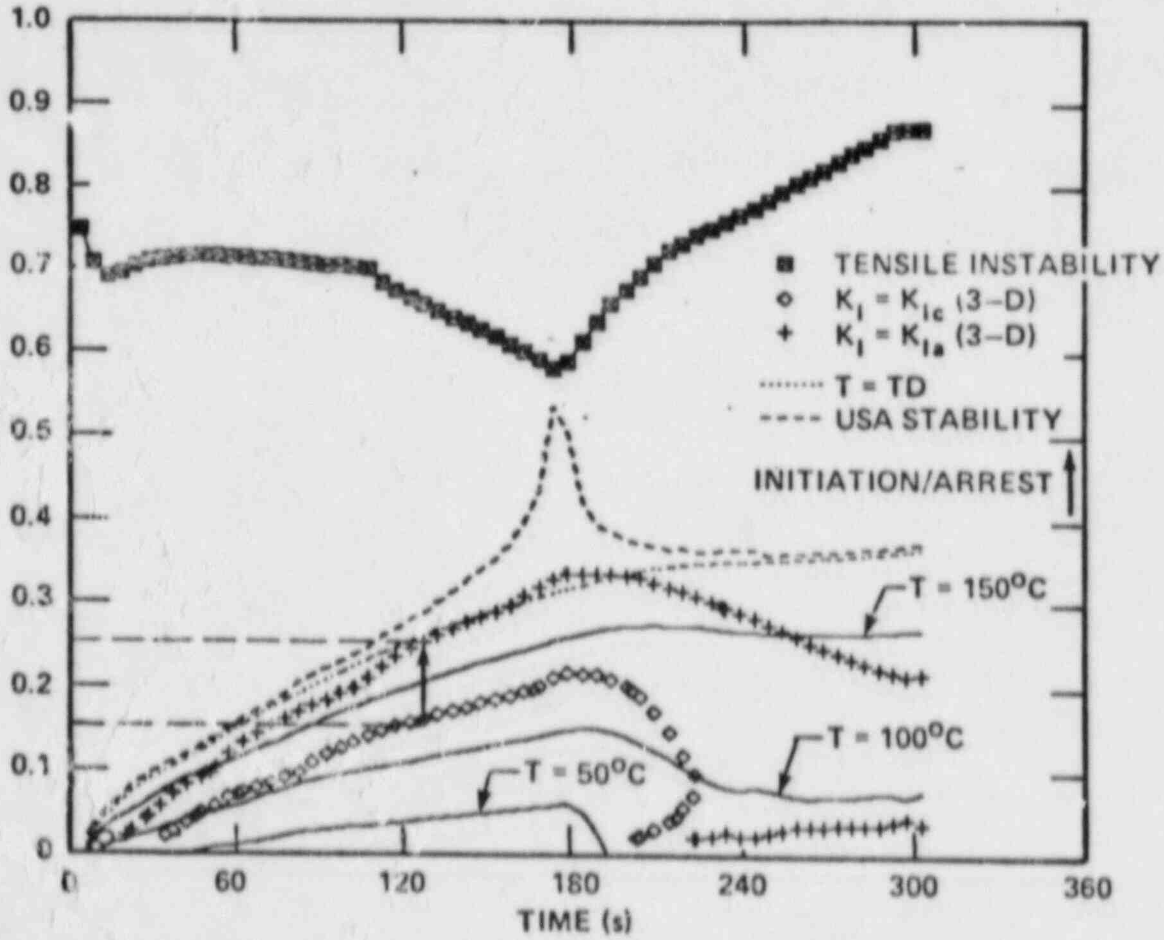
ornl

TEST PTSE–1C: K_I, K_{Ic}, K_{Ia} VS CRACK TIP TEMPERATURE

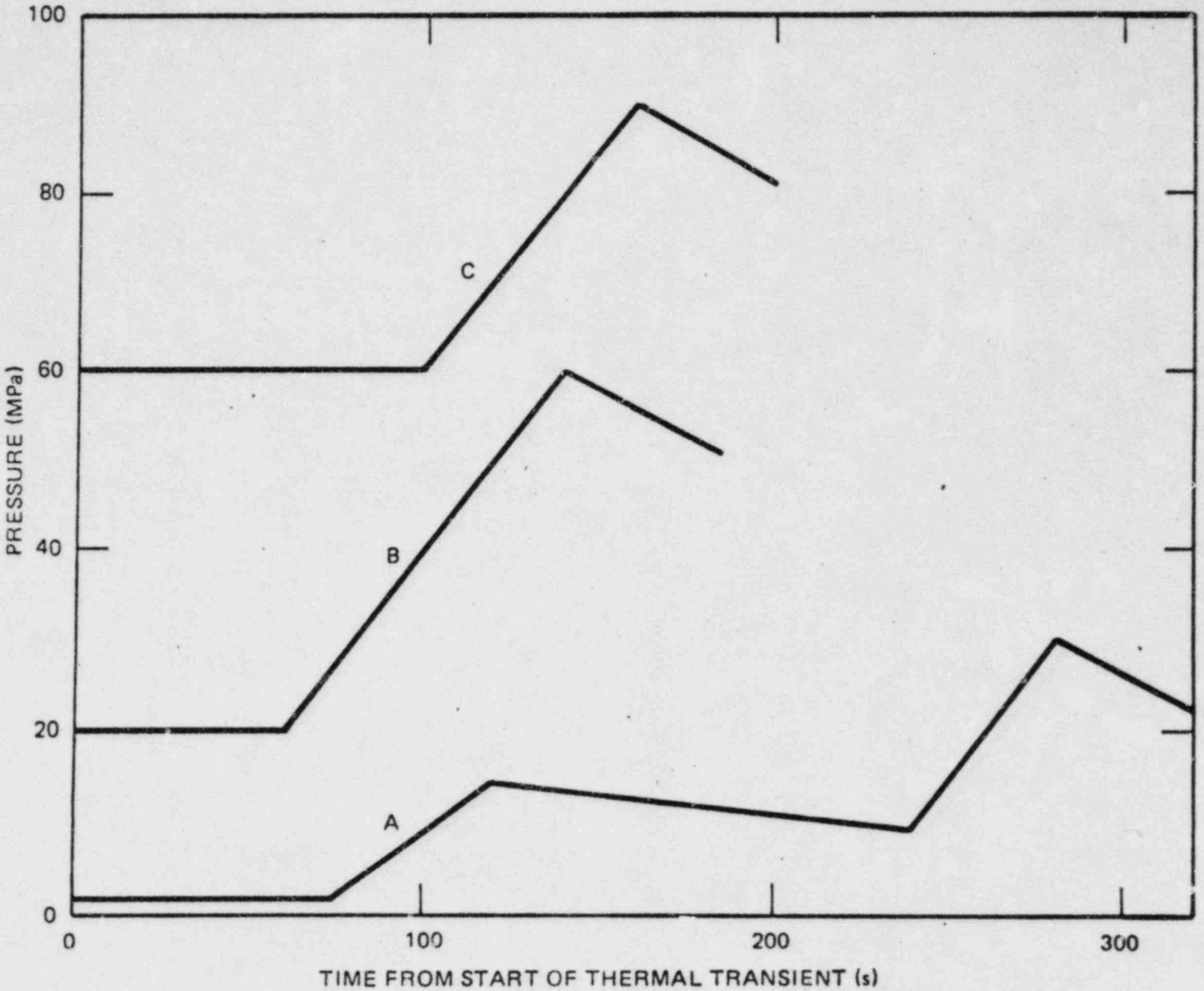


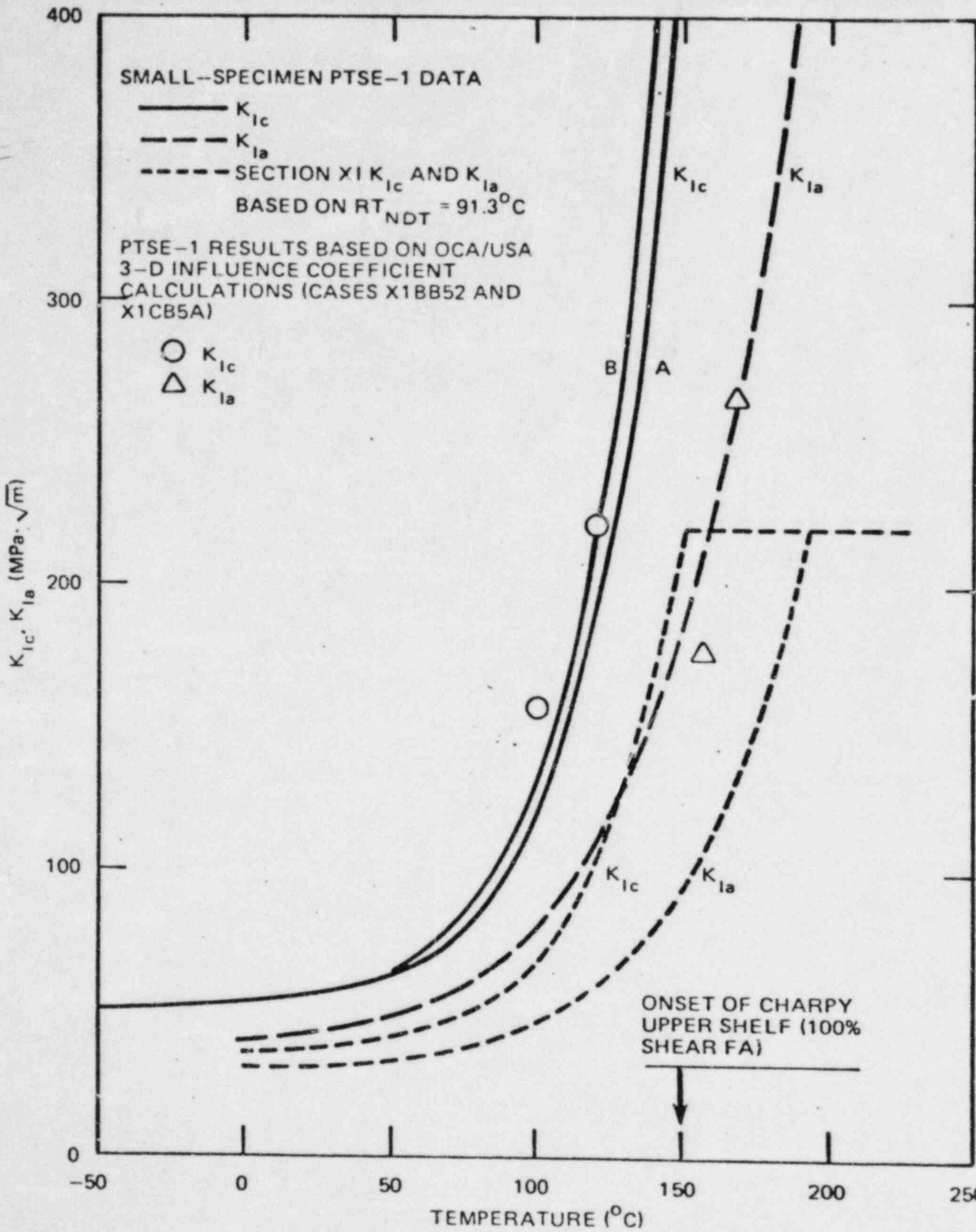
ORNL-DWG 84-4368 ETD

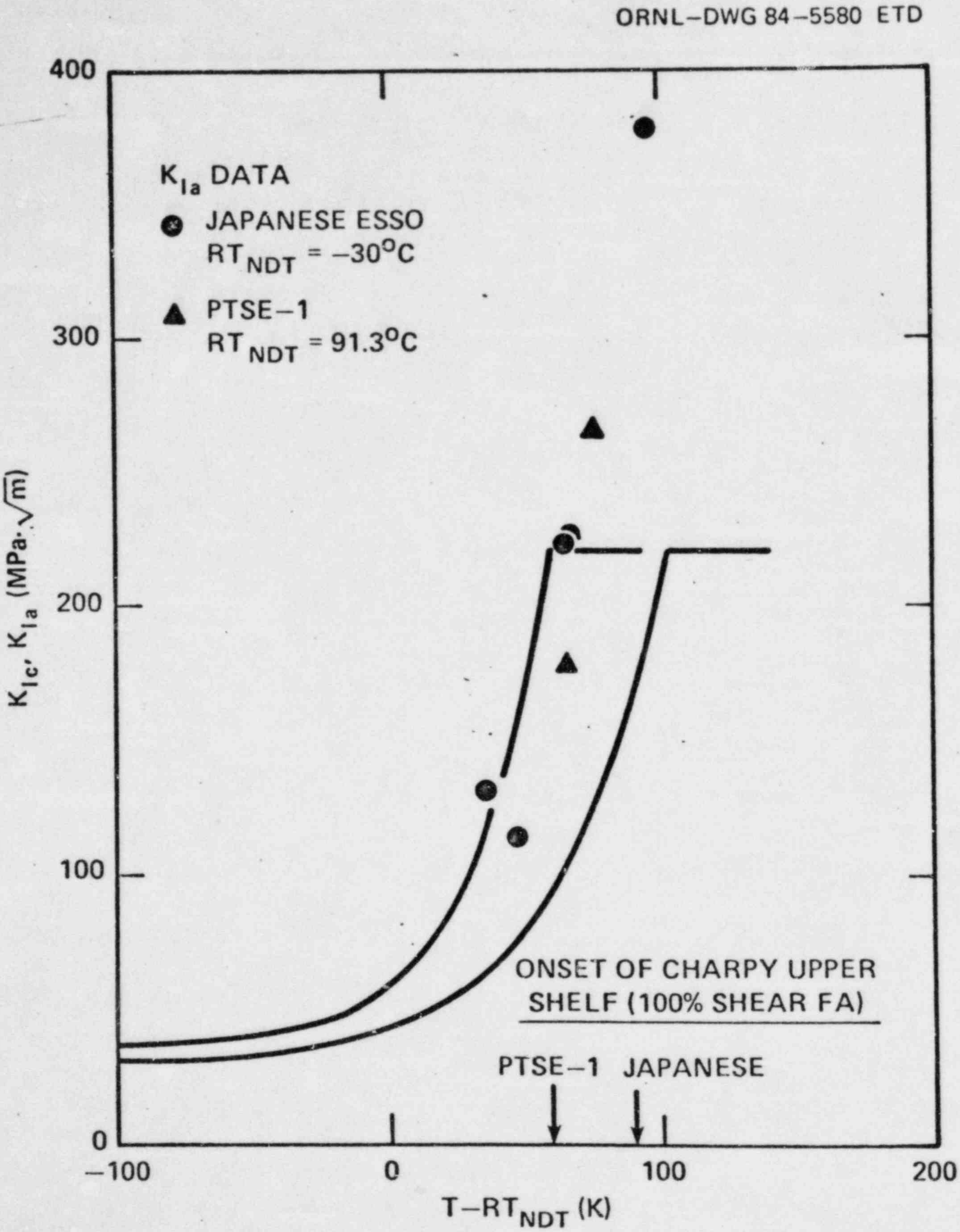
TEST PTSE-1C: CRITICAL CRACK DEPTH CURVES ILLUSTRATING INITIATION AND ARREST EVENTS



ORNL-DWG 84-4511 ETD




SMALL-SPECIMEN PTSE-1 DATA
K_{Ic}
K_{Ia}
SECTION XI K_{Ic} AND K_{Ia} BASED ON RT_{NDT} = 91.3°C
PTSE-1 RESULTS BASED ON OCA/USA 3-D INFLUENCE COEFFICIENT CALCULATIONS (CASES X1BB52 AND X1CB5A)
K_{Ic}
K_{Ia}
B
A
K_{Ic}
K_{Ia}
K_{Ic}
K_{Ia}
ONSET OF CHARPY UPPER SHELF (100% SHEAR FA)
K_{Ic}, K_{Ia} (MPa·$\sqrt{m}$)
400
300
200
100
0
-50
0
50
100
150
200
250
TEMPERATURE (°C)


ORNL–DWG 84–5580 ETD
400
300
200
100
0
−100
0
100
200
K_{Ic}, K_{Ia} (MPa·$\sqrt{m}$)
T−RT_{NDT} (K)
K_{Ia} DATA
JAPANESE ESSO
RT_{NDT} = −30°C
PTSE−1
RT_{NDT} = 91.3°C
ONSET OF CHARPY UPPER
SHELF (100% SHEAR FA)
PTSE−1
JAPANESE

PTSE-1 ACHIEVEMENTS

1. DEMONSTRATED SECTION III & SECTION XI FLAW EVALUATIONS TO BE CONSERVATIVE

2. DEMONSTRATED EFFECTIVENESS OF WARM PRESTRESS EFFECT

3. DEMONSTRATED ACCURACY OF DEVELOPED METHODOLOGY AND COMPUTER CODES

4. DEMONSTRATED REALITY OF CRACK ARREST IN A STEEPLY RISING K FIELD

5. DEMONSTRATED APPLICABILITY OF LEFM FOR THICK SECTIONS, HIGH IN TRANSITION ZONE

6. DEMONSTRATED THAT THE T-RTNDT METHOD OF DEVELOPING FRACTURE TOUGHNESS CURVES VALID

7. DEMONSTRATED EFFECTIVENESS OF NEW METHOD OF DETERMINING FRACTURE TOUGHNESS OF THICK SECTIONS FROM SMALL LABORATORY SPECIMENS

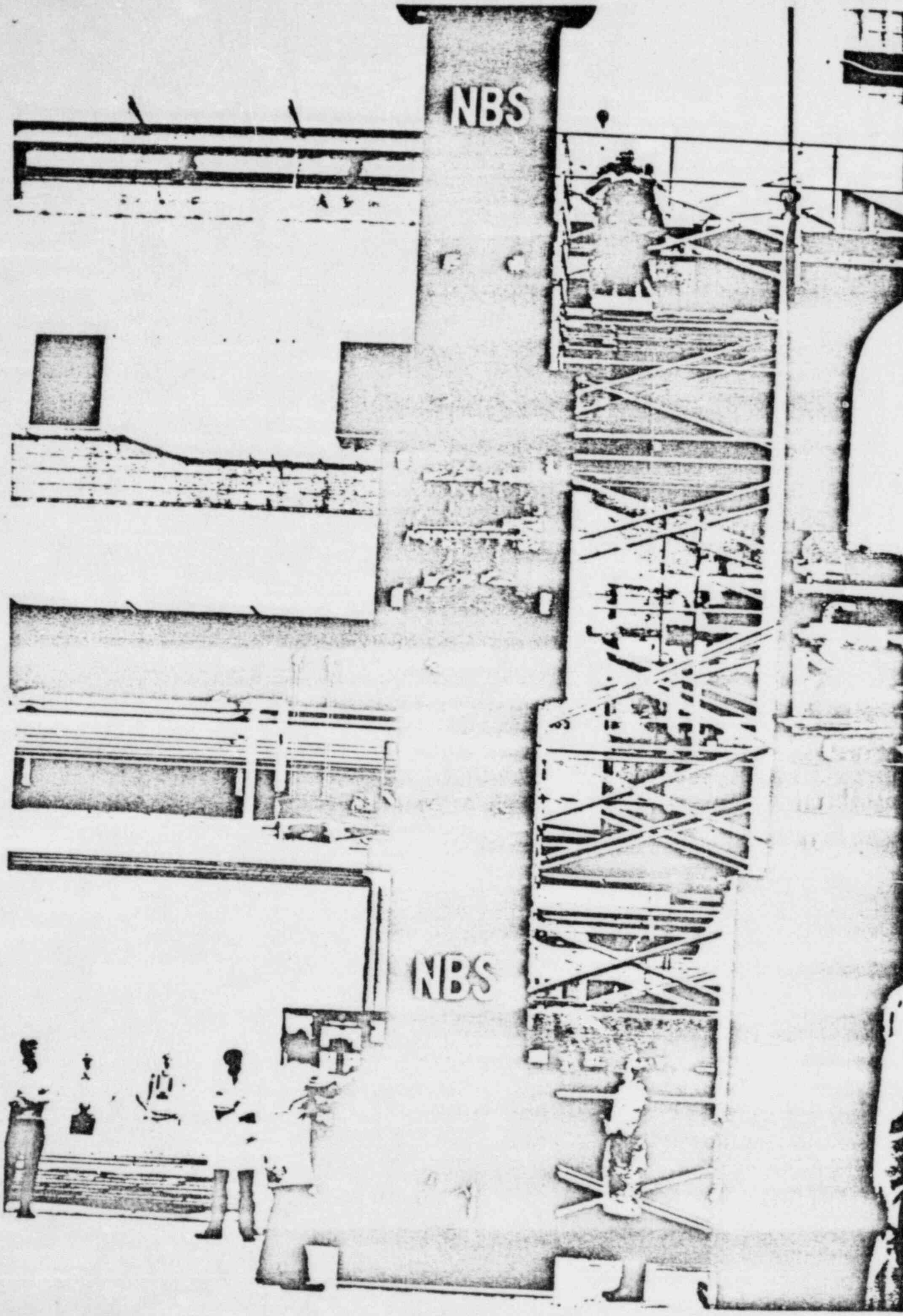
Impact on NRC Regulatory Postions

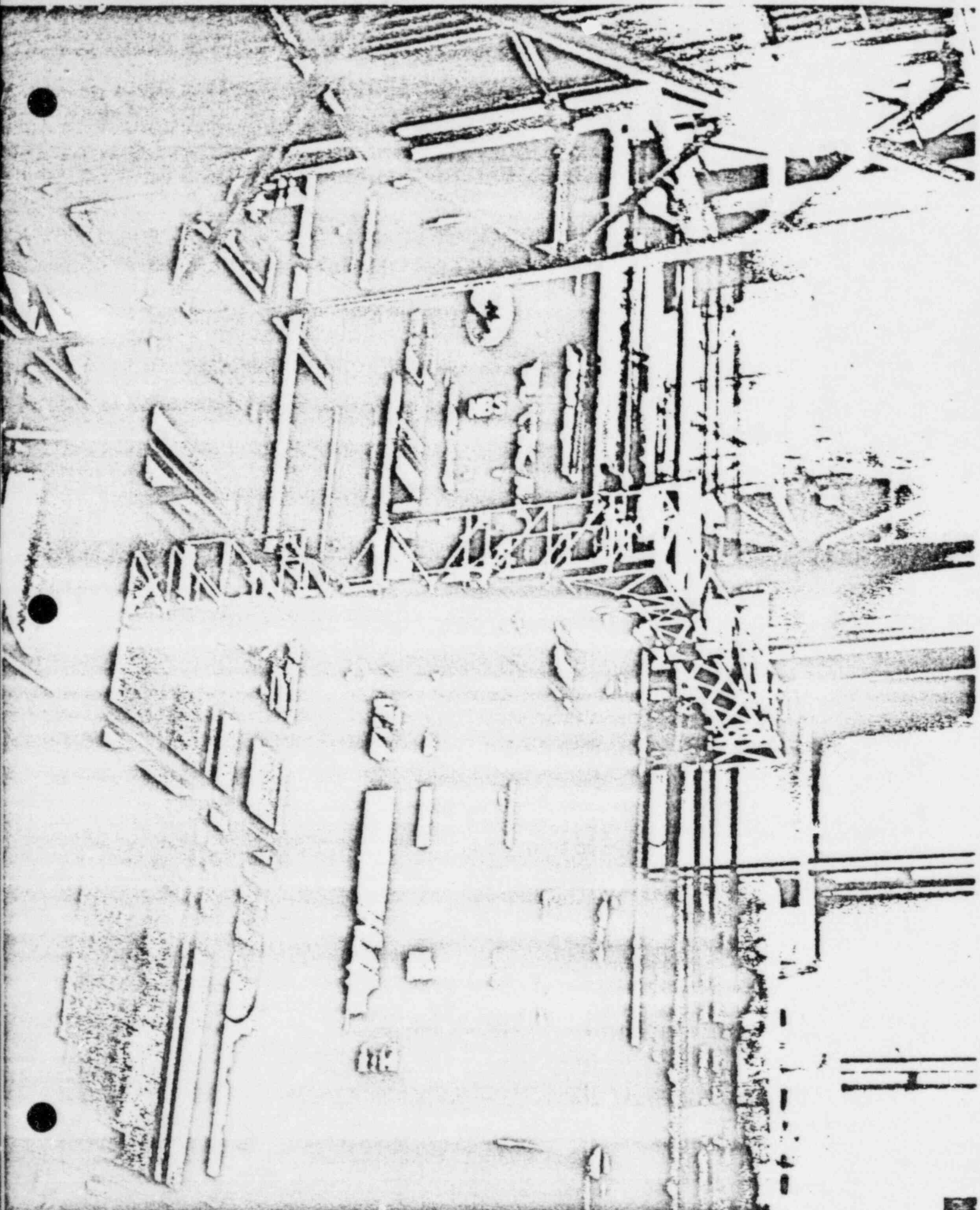
The impact of the results of these tests on the NRC regulatory positions for pressure vessel integrity are clear, particularly as regards PTS and overcooling scenarios in general. This can be summarized as follows:

1. The analysis techniques used to establish the fracture mechanics portion of the PTS position are accurate and slightly conservative. If the loading and material toughness properties are known, then an accurate evaluation of the structural integrity of the reactor vessel can be predicted.

2. Warm prestressing is a real factor in the prevention of initiation or extension of cracks for vessels under going an overcooling scenario. Considering that analysis of approximately 95 percent of actual PTS scenarios that have occurred resulted in WPS preventing pressure vessel failure, and that WPS was not treated as a distributed variable in the probability analysis establishing the PTS screening criteria, indicates that the possibility of a PTS event causing pressure vessel failure is probably an order of magnitude lower than presently estimated.

3. The analysis methodology presently used in the PTS scenarios are completely applicable to the analysis of any transient vessel performance where at least the inner portion of the pressure vessel wall's metal are in the transition fracture toughness range. A case in point is the problem of cold-overpressurization.


NBS
NBS



THERMAL MIXING STUDIES IN SUPPORT OF THE PRESSURIZED THERMAL SHOCK ISSUE

JOSE N. REYES JR.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

WASHINGTON, D.C.

OCTOBER 12, 1984

PTS THERMAL HYDRAULIC ANALYSIS

OBJECTIVES:

1. TO OBTAIN BEST-ESTIMATE DOWNCOMER FLUID TEMPERATURES, PRESSURES AND HEAT TRANSFER COEFFICIENTS FOR THE OVERCOOLING SCENARIOS SPECIFIED BY ORNL FOR USE AS BOUNDARY CONDITIONS IN THEIR FRACTURE MECHANICS ANALYSES

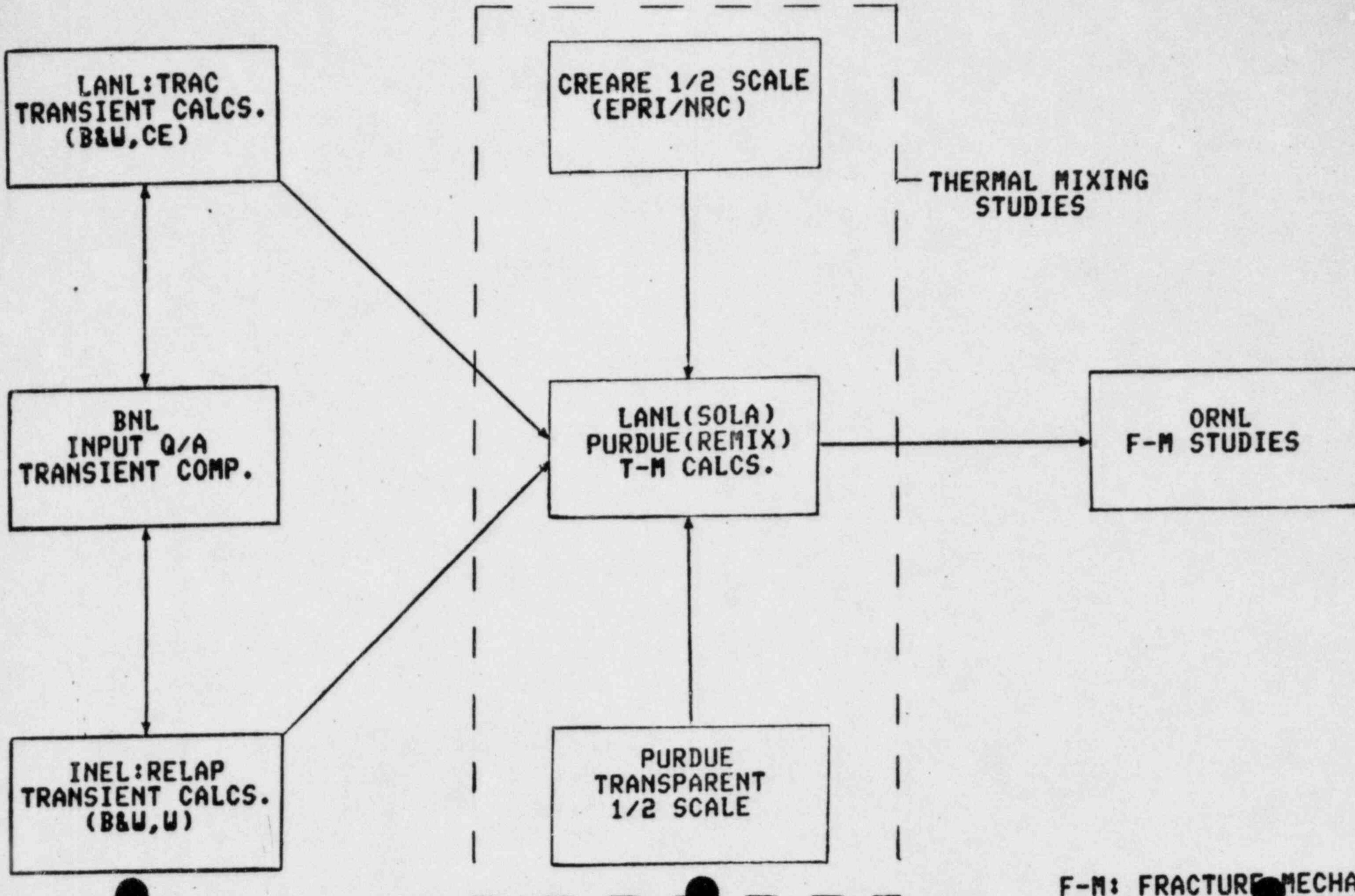
2. TO DETERMINE WHICH OPERATOR ACTIONS, EQUIPMENT MALFUNCTIONS, SYSTEM DESIGNS AND FLUID MIXING PHENOMENA ARE IMPORTANT TO THE ENHANCEMENT OR MITIGATION OF PTS.

STATUS:

1. FORTY-FIVE OVERCOOLING TRANSIENTS HAVE BEEN CALCULATED FOR OCONEE (B&W), CALVERT CLIFFS (CE) AND H.B. ROBINSON (W) USING RELAP5 AND TRAC.

2. APPROXIMATELY 300 ADDITIONAL OVERCOOLING TRANSIENTS HAVE BEEN ESTIMATED USING THE EXISTING TRAC AND RELAP5 CALCULATIONS AND EITHER A SIMPLIFIED RELAP CODE OR A MASS AND ENERGY BALANCE.

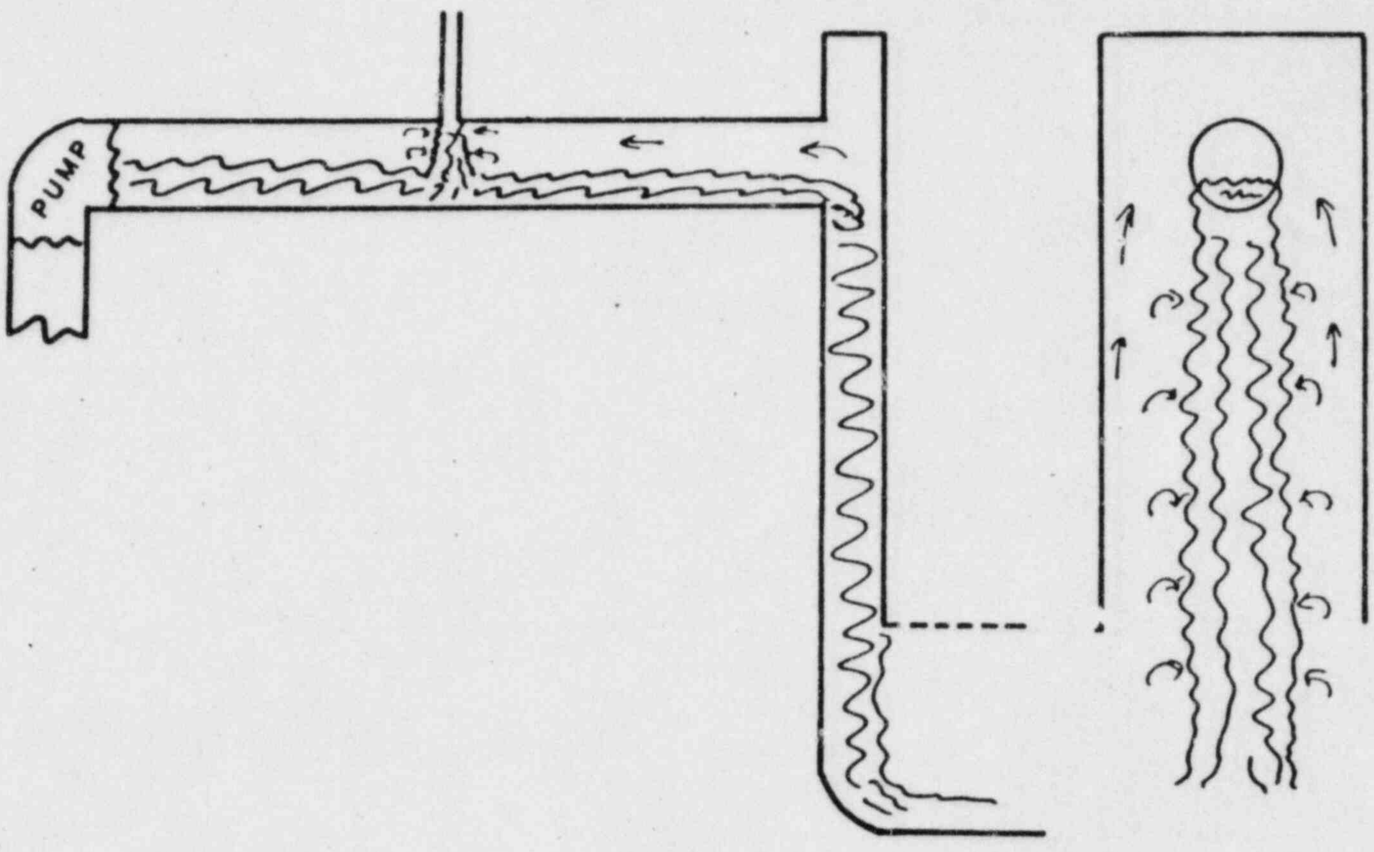
PTS THERMAL-HYDRAULIC CALCULATIONS



F-M: FRACTURE MECHANICS
T-M: THERMAL MIXING

EFFECT OF HPI FLUID MIXING

- THE TRAC AND RELAP OVERCOOLING TRANSIENT CALCULATIONS DO NOT INCLUDE THE DOWNCOMER EFFECTS INDUCED BY THE PRESENCE OF THERMALLY STRATIFIED FLOWS.



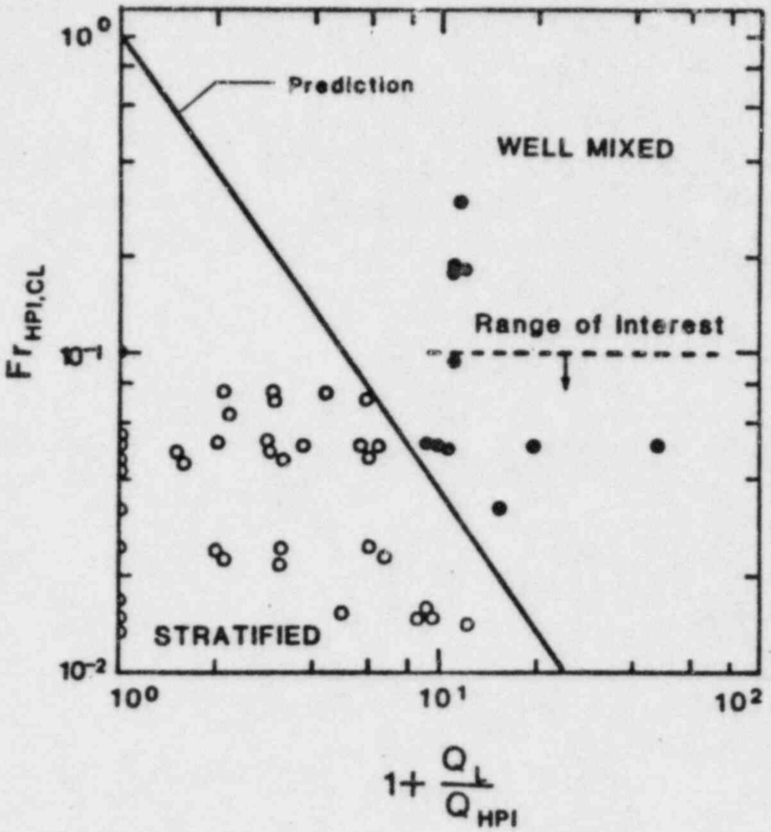
DEVELOPMENTS IN THERMAL FLUID MIXING ANALYSIS

- "STRATIFICATION CRITERION" DEVELOPED BY T.G. THEOFANOUS OF PURDUE UNIVERSITY TO PREDICT THE EXISTENCE OF THERMALLY STRATIFIED FLOWS IN THE COLD LEG. (NUREG/CR-3700)

$$Fr_{HPI,CL} \simeq \left\{1 + \frac{Q_L}{Q_{HPI}}\right\}^{-7/5}$$

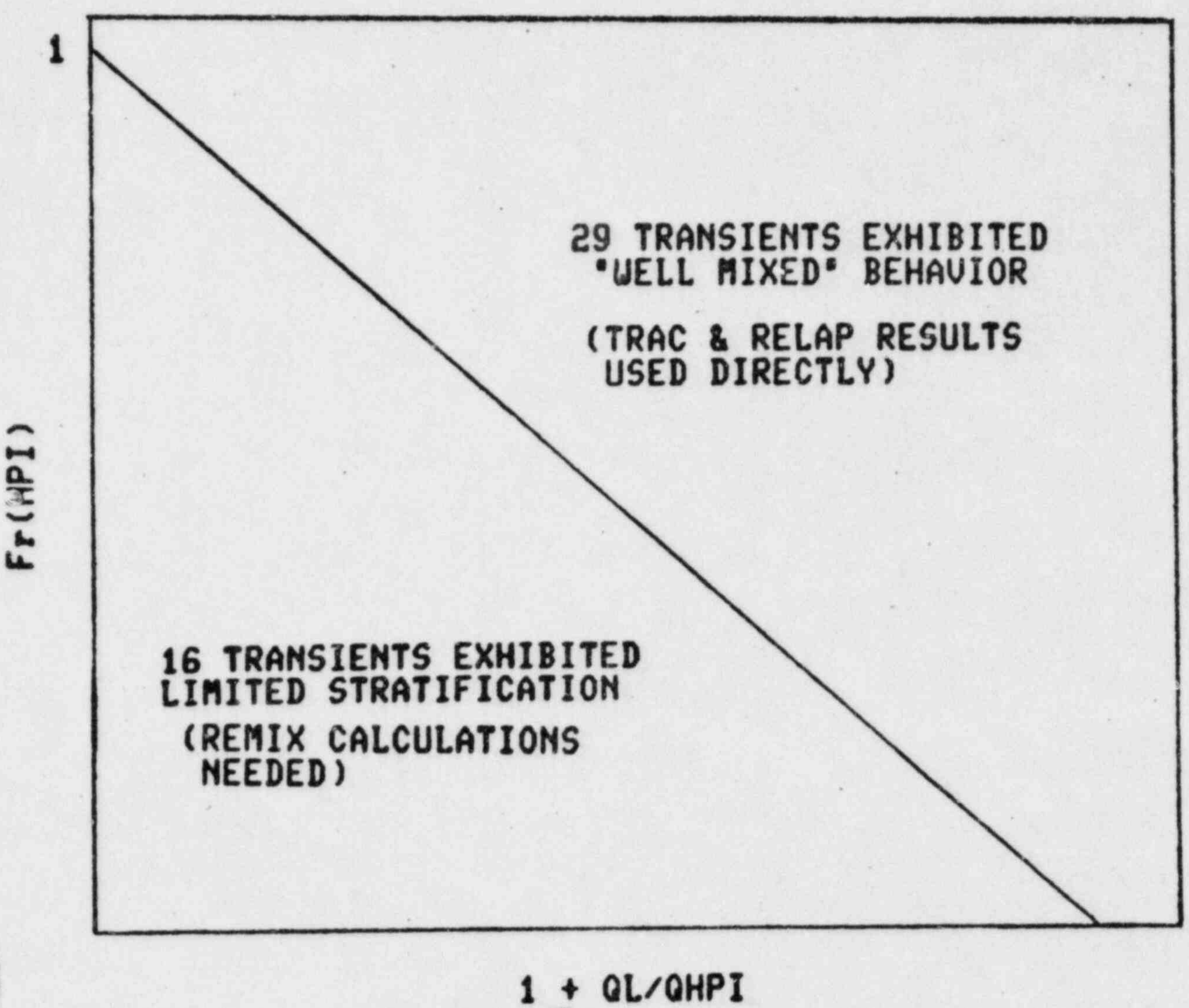
- "REMIX CODE" DEVELOPED BY PURDUE UNIVERSITY TO PREDICT DOWNCOMER FLUID TEMPERATURES AND HEAT TRANSFER COEFFICIENTS FOR VARIOUS HPI FLOWS UNDER STAGNANT LOOP CONDITIONS. (NUREG/CR-3701)

COL LEG STRATIFICATION CRITERION



* NOTE: NATURAL CIRCULATION FLOWS ARE NORMALLY GREATER THAN 10 TIMES MAXIMUM HPI FLOW.

APPLICATION OF STRATIFICATION CRITERIA



REMIX CODE

- DEVELOPED AT PURDUE UNIVERSITY
- BENCHMARKED USING THERMAL MIXING DATA FROM:
    1. CREARE 1/5 SCALE FACILITY
    2. CREARE 1/2 SCALE FACILITY
    3. PURDUE 1/2 SCALE FACILITY
        a. CALVERT CLIFFS GEOMETRY
        b. OCONEE-1 GEOMETRY
        c. H.B. ROBINSON GEOMETRY
    4. IMATRAN VOIMA OY (FINLAND)

THERMAL-FLUID MIXING EXPERIMENTS

- PURDUE UNIVERSITY TRANSPARENT 1/2 SCALE FACILITY

  a. MIXING IN ACCUMULATOR LINES

  b. MIXING TESTS IN OCONEE, CALVERT CLIFFS AND H.B. ROBINSON DESIGNS

  c. DEVELOP AND BENCHMARK MIXING MODELS (REMIX)

- CREARE 1/2 SCALE THERMAL MIXING FACILITY

  a. PERFORM MIXING TESTS AT HIGH PRESSURE

  b. OBTAIN PLUME HEAT TRANSFER COEFFICIENTS (i.e., MIXED FREE-FORCED CONVECTION DATA)

- IMATRAN VOIMA OY FINNISH THERMAL MIXING FACILITY

  a. BILATERAL AGREEMENT TO EXCHANGE PTS INFORMATION

  b. PERFORM 20 MIXING TESTS OF NRC'S CHOOSING

  c. DETERMINE THE EFFECT OF ASYMMETRIC LOOP FLOW ON HPI PLUME BEHAVIOR

- HDR FACILITY IN KARLSRUHE, GERMANY

  a. BILATERAL AGREEMENT TO EXCHANGE PTS INFORMATION

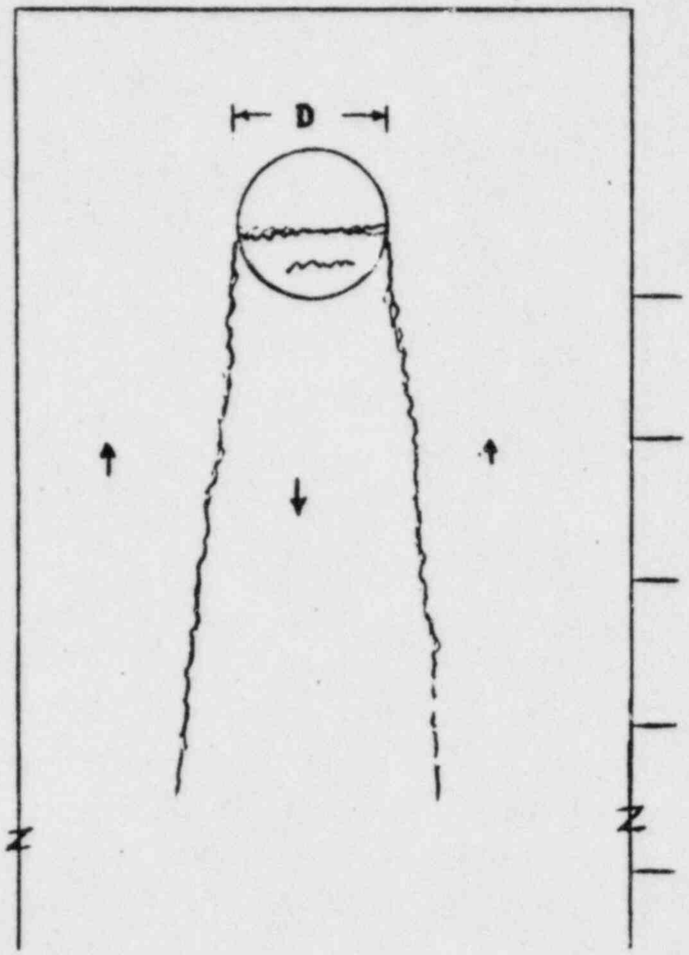
  b. FULL PRESSURE AND TEMPERATURE MIXING TESTS

SIGNIFICANT EXPERIMENTAL RESULTS

1. PLUME HEAT TRANSFER COEFFICIENTS HAVE BEEN OBTAINED AT THE CREARE 1/2 SCALE FACILITY

2. ENHANCED HPI FLUID MIXING HAS BEEN OBSERVED IN THE PURDUE 1/2 SCALE FACILITY FOR CE AND W ACCUMULATOR LINE DESIGNS.

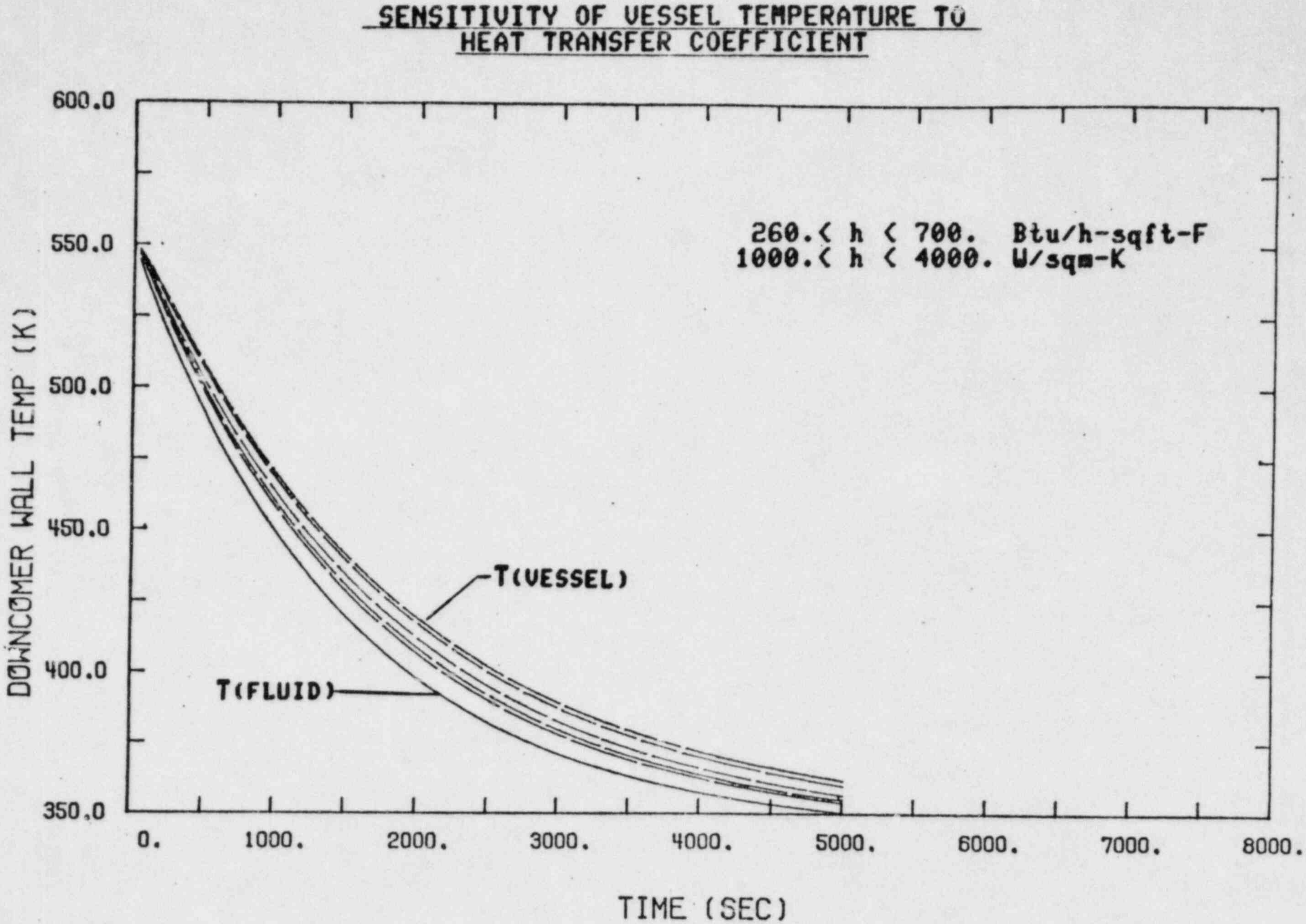
CREARE 1/2 SCALE HEAT TRANSFER MEASUREMENTS



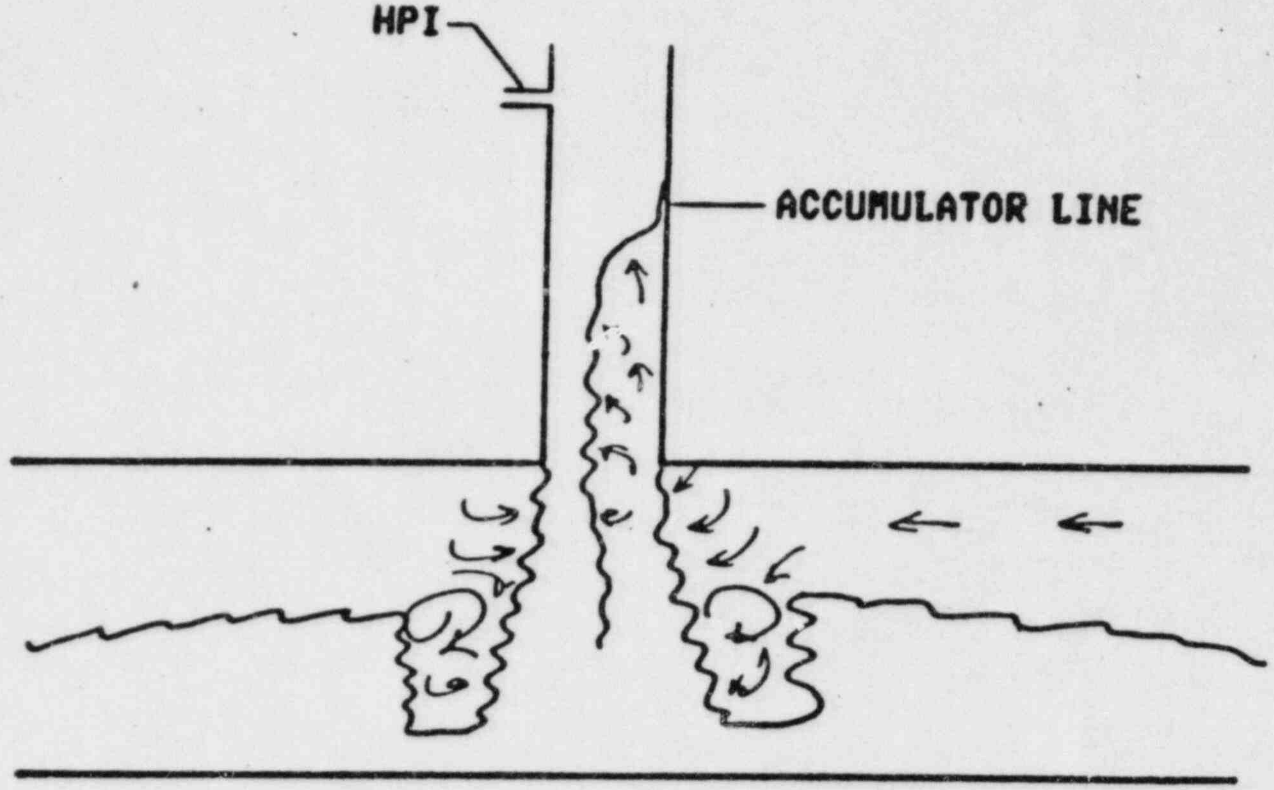
TEST CONDITIONS

Fr = 0.052
QL/QH = 0.0
/ = 0.121
PRESS = 200. psia
TIME = 284. SEC

	V(M/S)	h(Btu/h-sqft-F)	T(F)
0			
1D	0.5	548.	254.
2D		493.	272.
3D		376.	280.
6D		376.	280.


SENSITIVITY OF VESSEL TEMPERATURE TO HEAT TRANSFER COEFFICIENT
260.< h < 700. Btu/h-sqft-F
1000.< h < 4000. W/sqm-K
T(VESSEL)
T(FLUID)
DOWNCOMER WALL TEMP (K)
600.0
550.0
500.0
450.0
400.0
350.0
0.
1000.
2000.
3000.
4000.
5000.
6000.
7000.
8000.
TIME (SEC)

PURDUE 1/2 SCALE ACCUMULATOR LINE MIXING TESTS



SUMMARY AND CONCLUSIONS

1. THE TRAC AND RELAP5 OVERCOOLING TRANSIENT CALCULATIONS HAVE BEEN COMPLETED AND SENT TO ORNL AS BOUNDARY CONDITIONS TO THEIR FRACTURE-MECHANICS ANALYSES.

2. TWO IMPORTANT THERMAL FLUID MIXING ANALYSIS TOOLS HAVE BEEN DEVELOPED AND BENCHMARKED AT PURDUE UNIVERSITY:

   a. THE COLD LEG STRATIFICATION CRITERIA

   b. THE REMIX CODE

3. THE STRATIFICATION CRITERIA PREDICTS THAT COMPLETE MIXING OF THE HPI FLUID WILL OCCUR IN THE COLD LEG WHENEVER PRIMARY SYSTEM NATURAL CIRCULATION IS INDUCED. (i.e., ONLY LOOP STAGNATION CASES PRODUCE SIGNIFICANT STRATIFICATION IN THE COLD LEG)

4. ALL OF THE TRAC AND RELAP5 OVERCOOLING TRANSIENT CALCULATIONS HAVE BEEN SCREENED USING THE STRATIFICATION CRITERIA. THIS RESULTED IN 16 REMIX CALCULATIONS TO BETTER DETERMINE THE DOWNCOMER FLUID TEMPERATURES AND HEAT TRANSFER COEFFICIENTS.

5. THE CREARE 1/2 SCALE DATA SHOWS THAT HEAT TRANSFER COEFFICIENTS IN THE PLUME ENTRANCE REGION ARE ON THE ORDER OF 600 Btu/h-sqft-F AND RAPIDLY DECREASE WITHIN TWO COLD LEG DIAMETERS OF THE DOWNCOMER ENTRANCE.

6. EXPERIMENTS AT PURDUE UNIVERSITY SHOW THAT THE ACCUMULATOR LINE ENHANCES HPI FLUID MIXING FOR CE AND W DESIGNS.

PTS THERMAL-HYDRAULIC ANALYSIS REPORTS

1. B. BASSETT, et al., TRAC ANALYSES OF SEVERE OVERCOOLING TRANSIENTS FOR THE OCONEE-1 PWR, LA-UR-83-3182.

2. C.D. FLETCHER, et al., RELAP5 THERMAL-HYDRAULIC ANALYSIS OF PTS SEQUENCES FOR THE OCONEE-1 PWR, EGG-NSMD-6343.

3. U.S. ROHATGI, et al., ASSESSMENT OF SELECTED TRAC AND RELAP5 CALCULATIONS FOR THE OCONEE-1 PTS STUDY, NUREG/CR-3703.

4. J. KOENIG, G. SPRIGGS and R. SMITH, TRAC-PF1 ANALYSES OF POTENTIAL PTS TRANSIENTS AT A COMBUSTION ENGINEERING PWR.

5. J. JO and U.S. ROHATGI, REVIEW OF TRAC CALCULATIONS FOR THE CALVERT CLIFFS PTS STUDY.

6. C.D. FLETCHER, et al., RELAP5 THERMAL-HYDRAULIC ANALYSES OF PTS SEQUENCES FOR THE H.B. ROBINSON UNIT 2 PWR, EGG-SAAM-6476.

7. J. JO and U.S. ROHATGI, REVIEW OF RELAP5 CALCULATIONS FOR THE H.B. ROBINSON PTS STUDY.

8. T.G. THEOFANOUS, et al., DECAY OF BUOYANCY DRIVEN STRATIFIED LAYERS WITH APPLICATION TO PTS, NUREG/CR-3700.

9. H.P. NOURBAKHSH and T.G. THEOFANOUS, REMIX: COMPUTER PROGRAM FOR TEMPERATURE TRANSIENTS DUE TO HIGH PRESSURE INJECTION IN A STAGNANT LOOP, NUREG/CR-3701.

10. T.G. THEOFANOUS, et al., BUOYANCY EFFECTS ON OVERCOOLING TRANSIENTS CALCULATED FOR THE USNRC PRESSURIZED THERMAL SHOCK STUDY, NUREG/CR-3702.

PTS THERMAL-HYDRAULIC ANALYSIS REPORTS

11. BART DALY, THREE-DIMENSIONAL CALCULATIONS OF TRANSIENT FLUID THERMAL MIXING IN THE DOWNCOMER OF THE CALVERT CLIFFS-1 PLANT USING SOLA-PTS, NUREG/CR-3704.

12. MARTIN TORREY and BART DALY, SOLA PTS: A TRANSIENT 3-D ALGORITHM FOR FLUID THERMAL MIXING AND WALL HEAT TRANSFER IN COMPLEX GEOMETRIES, NUREG/CR-3822.

13. F.X. DOLAN, et al., FACILITY AND TEST DESIGN REPORT: 1/2 SCALE THERMAL MIXING PROJECT, NUREG/CR-3426.

14. P. ROTHE, et al., 1/2 SCALE THERMAL MIXING PROJECT DATA REPORT.

Agenda for ACRS
Meeting on October 12, 1984
3:30 p.m. - 4:30
Room 1046, H Street

RECENT SIGNIFICANT EVENTS

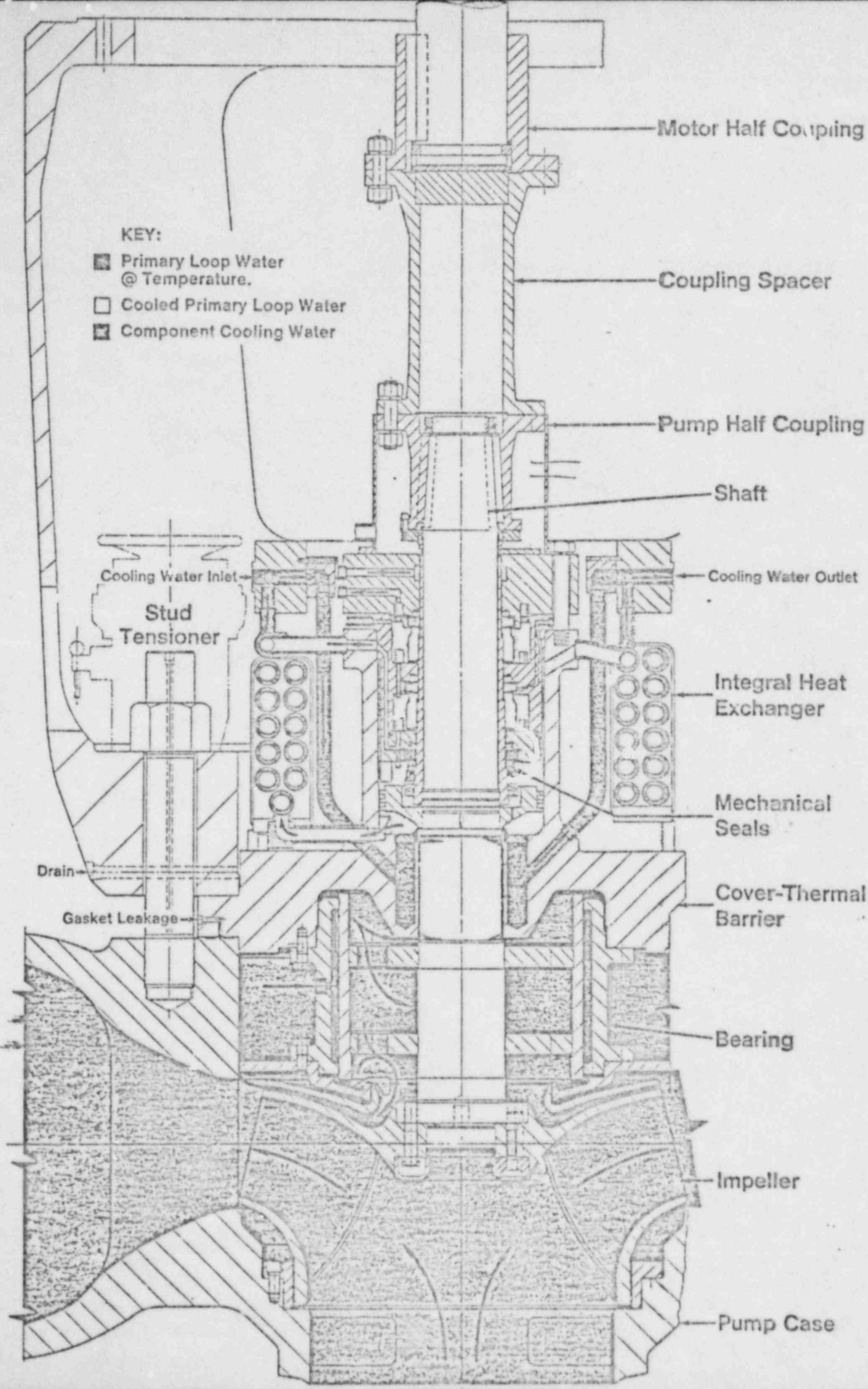
Date	Plant	Event	Response	Presented by
10/2/84	Palisades	Reactor Coolant Pump Failure	Under Study	IE(G. Lanik)
9/10/84	WNP 2	Thermal Transient Damage to Feedwater Line	Info Notice in Preparation	IE(E. Weiss)
9/11-13/84	Brunswick	Hurricane Diana	Under Study	IE(E. Weiss)

PALISADES REACTOR COOLANT PUMP PROBLEM

- PUMP DESCRIPTION
- EVENT SEQUENCE
- EFFECT ON PLANT
- PUMP DISASSEMBLY
- POSSIBLE FAILURE SEQUENCE
- FOLLOW-UP ACTION

PUMP DESCRIPTION

- BYRON JACKSON 850 RPM SINGLE STAGE CENTRIFUGAL PUMP, 42 INCH DIAMETER IMPELLER
- ALLIS-CHALMERS 4000 HP MOTOR
- FOUR SEAL STAGES
- CONTROLLED BLEED OFF


KEY:
Primary Loop Water @ Temperature.
Cooled Primary Loop Water
Component Cooling Water
Motor Half Coupling
Coupling Spacer
Pump Half Coupling
Shaft
Cooling Water Inlet
Cooling Water Outlet
Stud Tensioner
Integral Heat Exchanger
Mechanical Seals
Drain
Cover-Thermal Barrier
Gasket Leakage
Bearing
Impeller
Pump Case

EVENT SEQUENCE

9/15 ERRATIC SEAL PRESSURE AND PUMP VIBRATION - 57 PERCENT POWER

9/16 0345 MIDDLE & LOWER SEALS FAIL, COMMENCE SHUTDOWN

0355 MIDDLE SEAL STAGE RESEATS

0515 MIDDLE SEAL FAILS AGAIN

0520 UPPER SEAL FAILS

BLEED OFF TEMPERATURE HIGH

BLEED OFF FLOW HIGH

VIBRATION "ALERT"

0544 REACTOR OFF-LINE

VIBRATION "DANGER"

RCP P-50C TRIPPED

EFFECT ON PLANT

- PRIMARY SYSTEM TEMPERATURE, PRESSURE, POWER UNAFFECTED
- FLOW SUFFICIENT TO AVOID 97% RCS LOW FLOW REACTOR TRIP
- NO LOSS OF COOLANT, BLEEDOFF TO VOLUME CONTROL TANK
- PLANT SHUTDOWN TO REPAIR SEAL

PUMP DISASSEMBLY

- PUMP IMPELLER DID NOT DROP
- SEAL GRAPHITE SURFACES BADLY WORN
- ALL EIGHT IMPELLER SHAFT BOLTS BROKEN
- TWO OF FOUR ALIGNMENT PINS BROKEN
- STATIONARY PARTS SHOW 360 DEGREE WEAR
- MOVING PARTS SHOW 180 DEGREES WEAR

POSSIBLE FAILURE SEQUENCE

- INITIAL BOLT FAILURE DUE TO UNKNOWN CAUSE
- UNBALANCED IMPELLER RUBS ON CASING WEAR RING
- ADDITIONAL FORCES CAUSE FURTHER BOLT & PIN FAILURE
- SEALS FAIL DUE TO VIBRATION
- IMPELLER ROTATION MAINTAINED BY REMAINING TWO PINS
- PUMP TRIPPED BEFORE LAST PINS FAIL

FOLLOW-UP ACTIONS

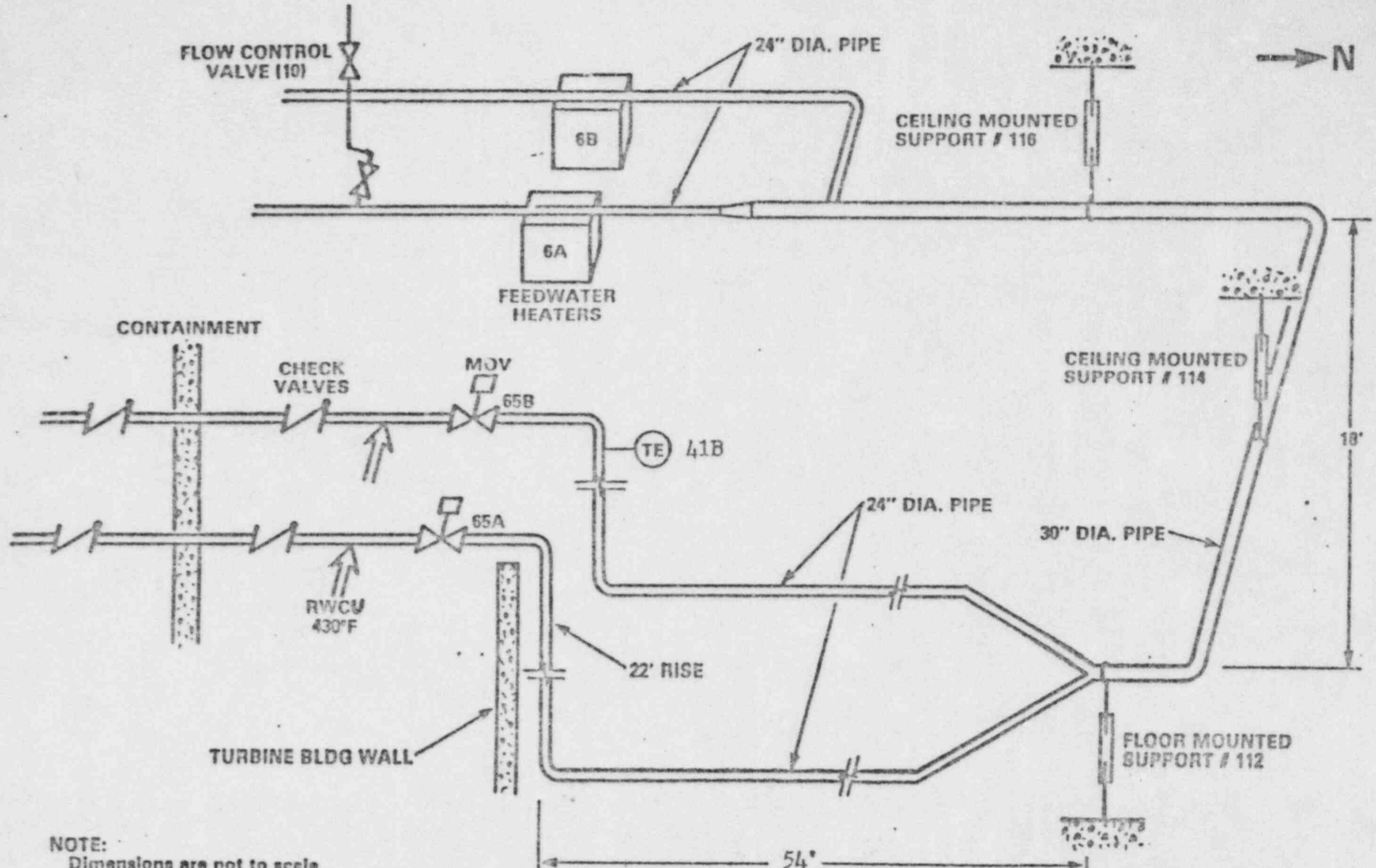
- REGION III INSPECTORS TO SITE FOR PUMP DISASSEMBLY
- METALURGICAL EXAMINATIONS BEING DONE
- EXAMINE DETAILS OF IMPELLER STORAGE, ENVIRONMENTAL CONDITIONS
- RETRIEVED ALL LOOSE PARTS
- REPLACE ALL DAMAGED PARTS
- IE CONSIDERING INFORMATION NOTICE

WNP-2 THERMAL TRANSIENT DAMAGE TO FEEDWATER SYSTEM
SEPTEMBER 10, 1984
(ERIC WEISS)

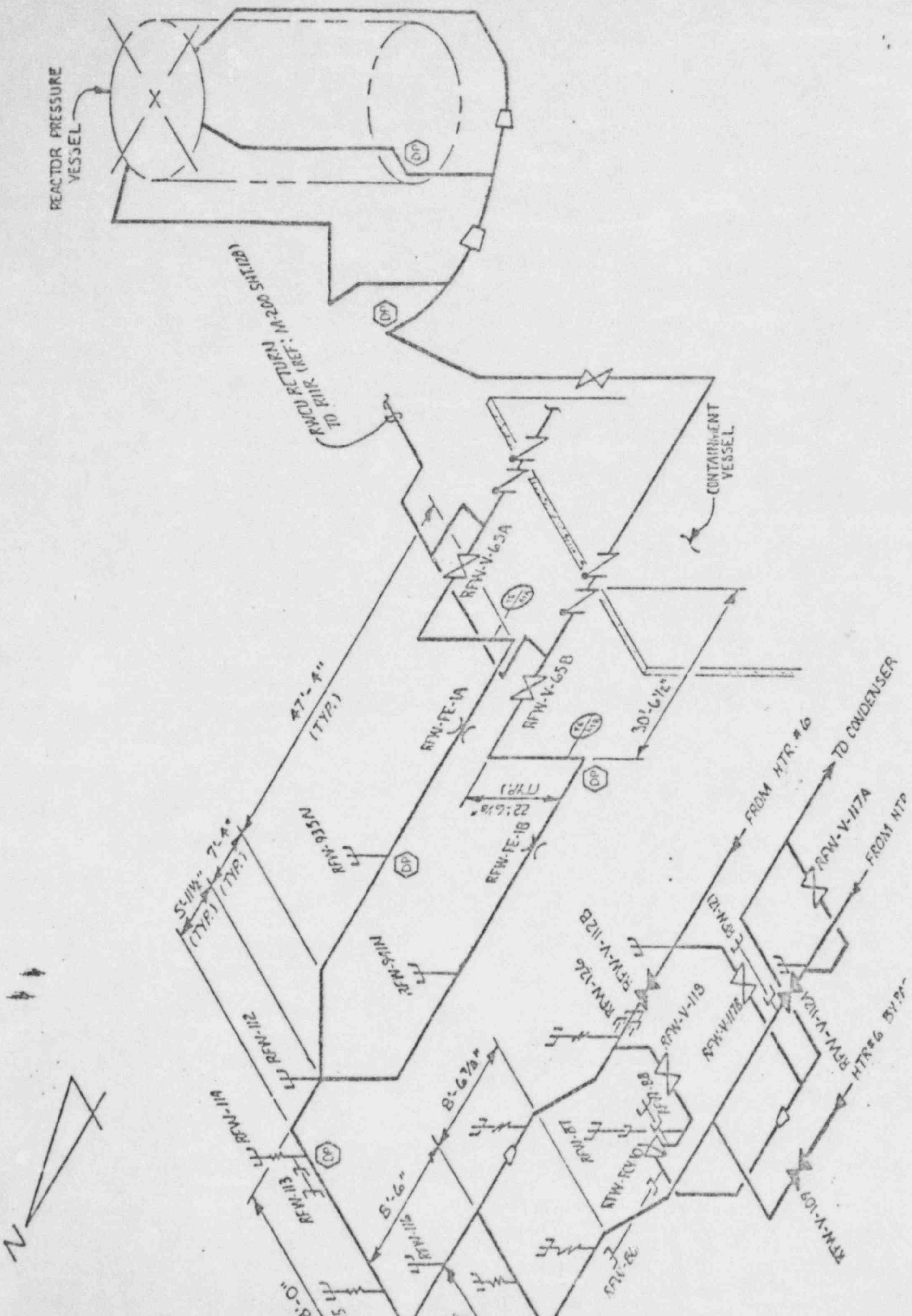
- -REACTOR SCRAM FROM 60% POWER
- -BOTH FEEDPUMPS TRIP AND RCIC STARTED
- -FEEDLINE B SLIGHTLY HOTTER THAN A
- -FEEDWATER SLOWLY ADMITTED BY FCV-10
- -TOP OF PIPE > 200°F HOTTER THAN BOTTOM
- -PIPE AT HANGER 114 DEFLECTED DOWN
- -HANGER 114 FAILS

NRC IS PREPARING AN INFORMATION NOTICE

WNP-2 FEEDWATER
ISOMETRIC SKETCH

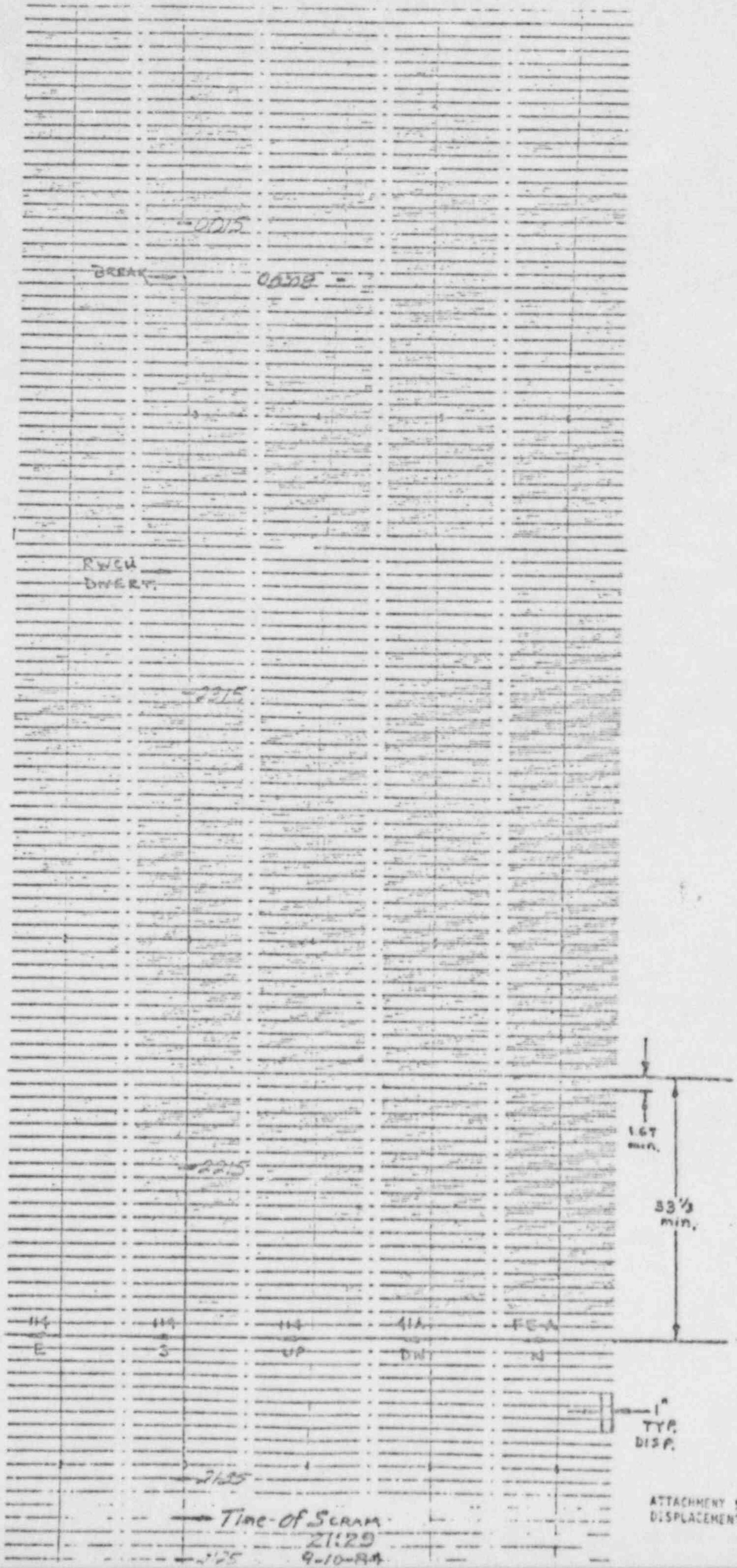


NOTE:
Dimensions are not to scale

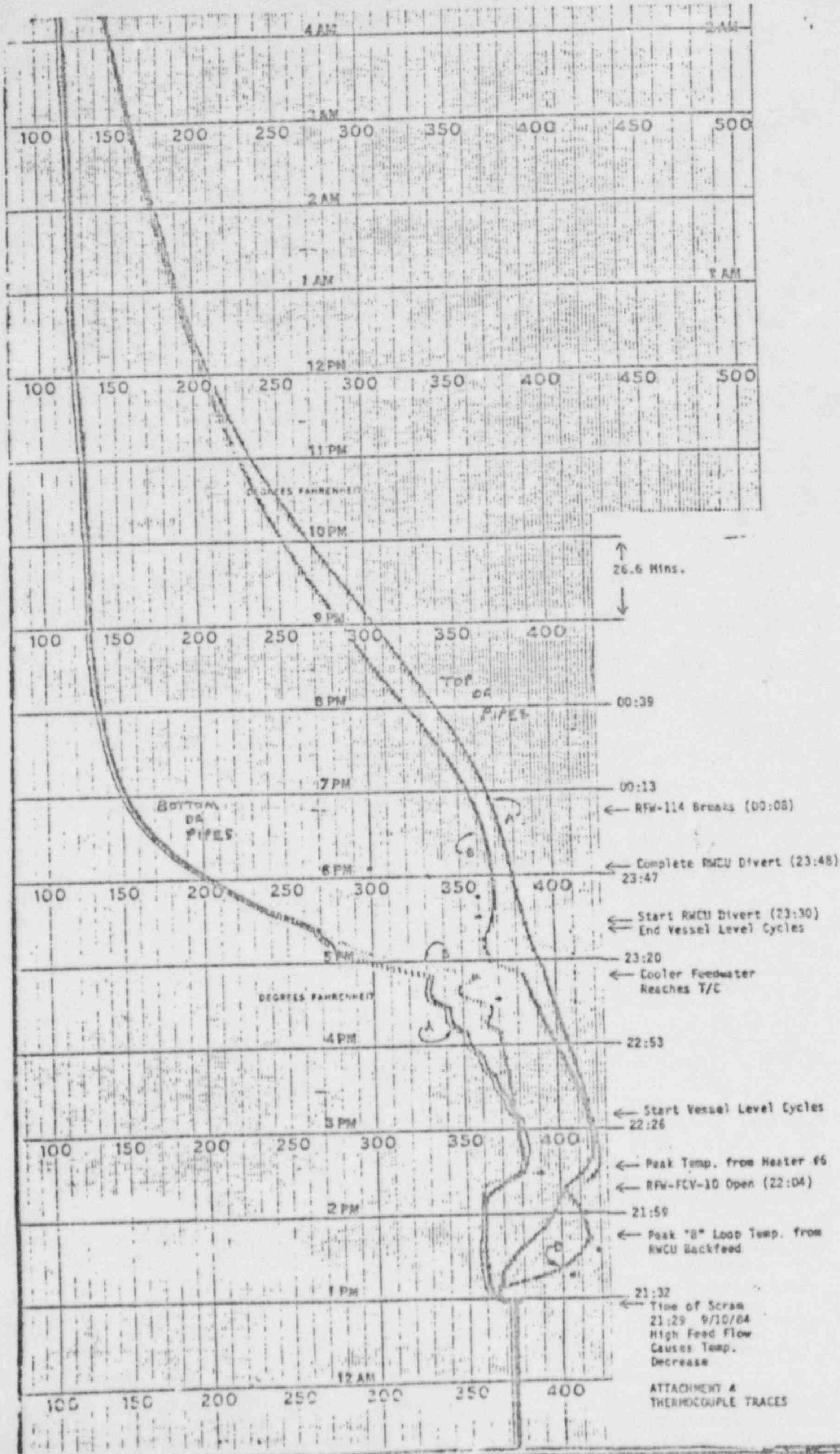


12

ATTACHMENT 1



ATTACHMENT 5
DISPLACEMENT TRACES



ATTACHMENT A
THERMOCOUPLE TRACES

BRUNSWICK - HURRICANE DIANA SEPTEMBER 11 - 13, 1984
(ERIC WEISS)

-PLANT CONDITION

- UNIT 1 - COLD SHUTDOWN
- UNIT 2 - DOWN FOR REFUELING

-DAMAGE & EFFECT (9/13)

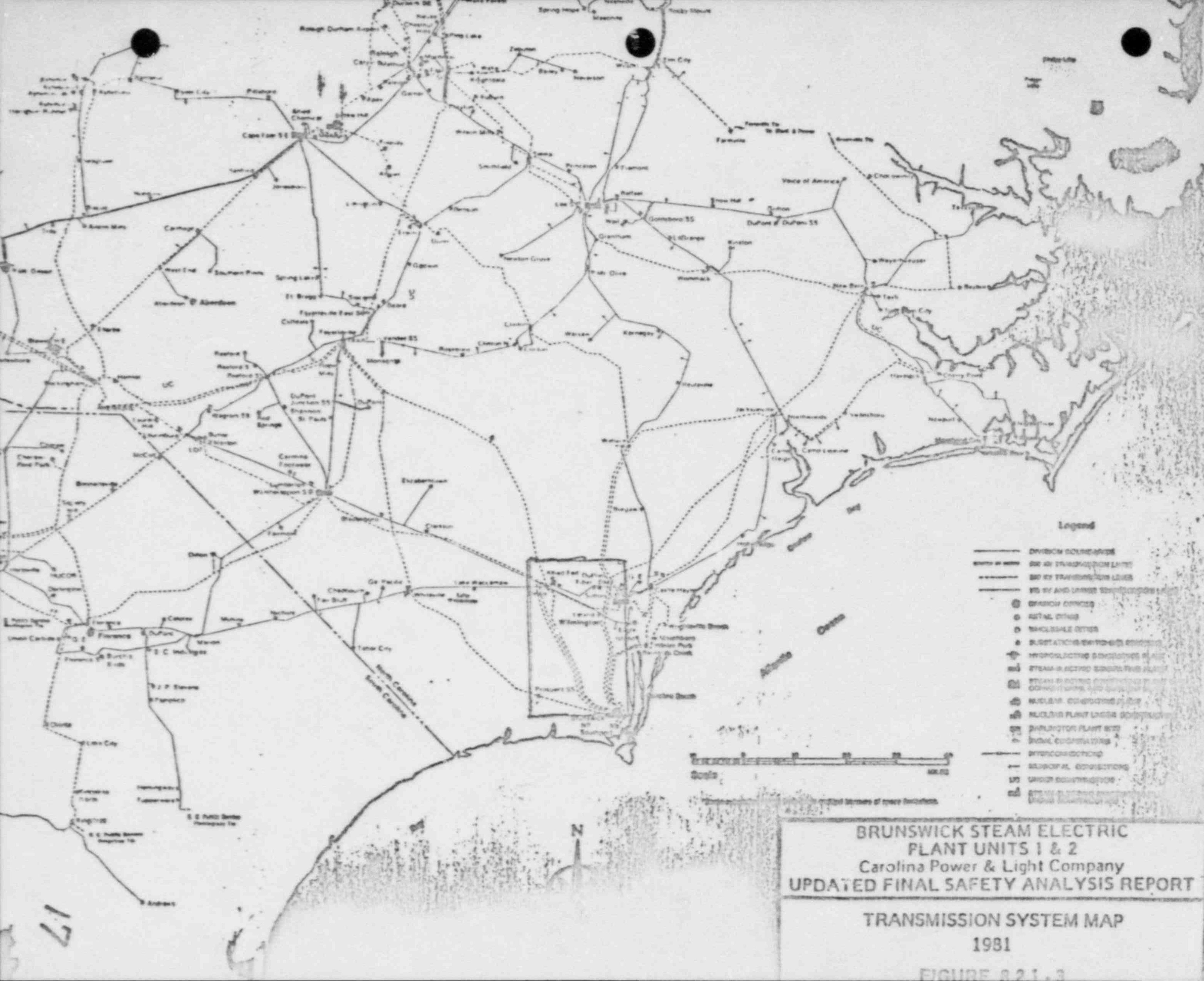
- LOST 3 OF 4 TRANSMISSION LINES TO UNIT 1
- LOST 2 OF 4 TRANSMISSION LINES TO UNIT 2
- LOST RADIO CONTROL OF PUMPS IN DISCHARGE CANAL
- MINOR LEAKAGE IN TURBINE BUILDING
- 1 OF 3 ACCESS ROADS CLOSED
- GRAB SAMPLE NOT TAKEN AT 0735
- NO SAFETY SYSTEMS AFFECTED

-NRC RESPONSE

- RESIDENT INSPECTOR & REGIONAL PERSONNEL ON SITE
- REGIONAL IRC AND HQ OPERATIONS CENTER IN CONTACT WITH SITE

HURRICANE DIANA
SEPTEMBER 13, 1984

L.NE	BRUNSWICK UNIT	OUTAGE CAUSE
WEATHERSPOON 230 KV 1:00 A.M.	1	STATIC WIRF PULLED OUT ON STRUCTURE LANDED ON CONDUCTOR.
JACKSONVILLE 230 KV 2:08 A.M.	1	STATIC WIRE PULLED OUT ON STRUCTURE 36-LANDED ON CONDUCTOR.
DELCO EAST 230 KV 2:26 A.M.	1	STRUCTURE 58, STATIC WIRE PULLED OUT-LANDED ON CONDUCTOR. STRUCTURE 185 & 186 BLOWN OVER.
WALLACE 230 KV 7:39 A.M.	2	STATIC WIRE PULLED OUT ON STRUCTURE 2-LANDED ON CONDUCTOR.
DELCO WEST 230 KV 9:45 A.M.	2	STRUCTURE 185 CROSSARM (STEEL) BENT. STRUCTURE ON DELCO EAST (185 & 186) HIT THIS CROSSARM.



BRUNSWICK STEAM ELECTRIC
PLANT UNITS 1 & 2
Carolina Power & Light Company
UPDATED FINAL SAFETY ANALYSIS REPORT

TRANSMISSION SYSTEM MAP
1981

FIGURE 8.2.1-3

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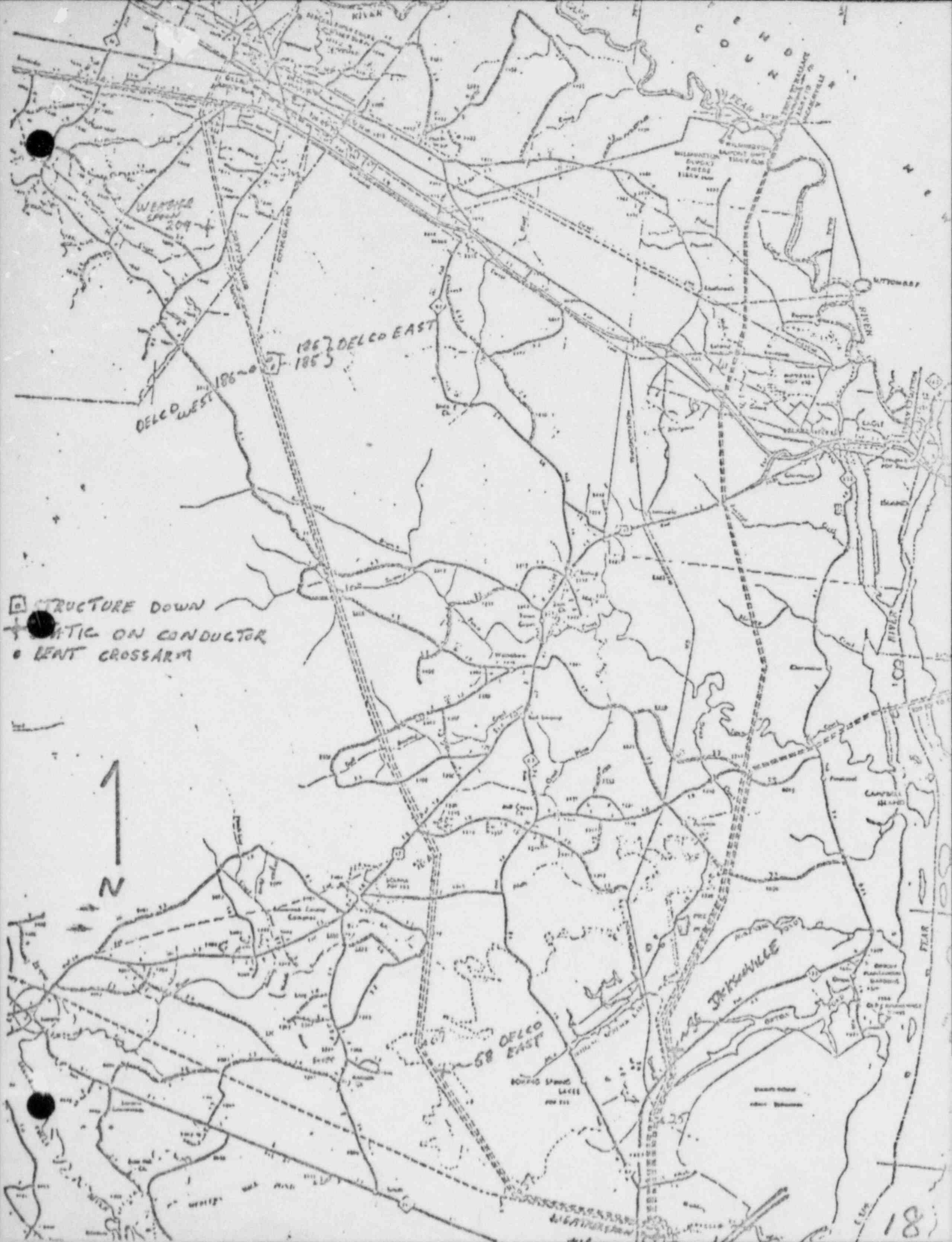
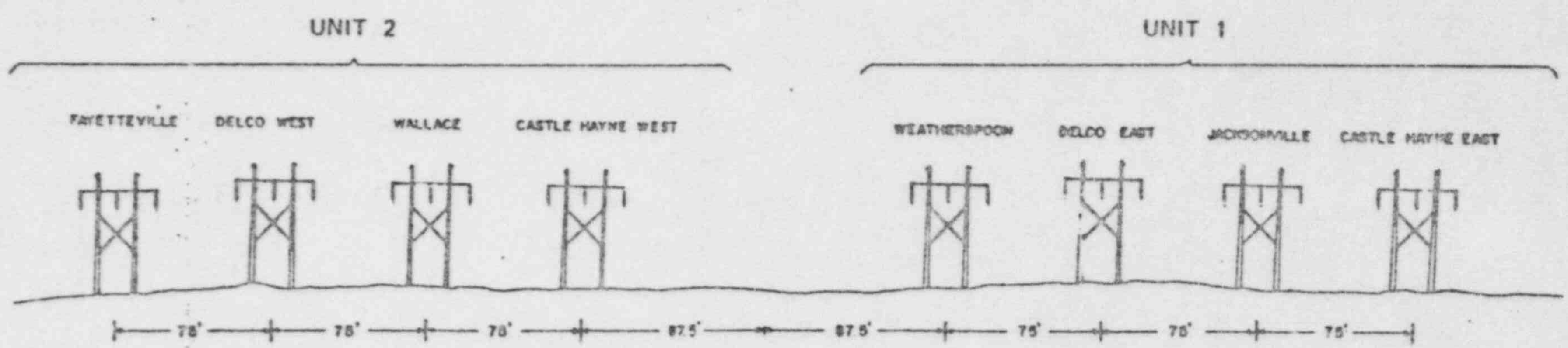
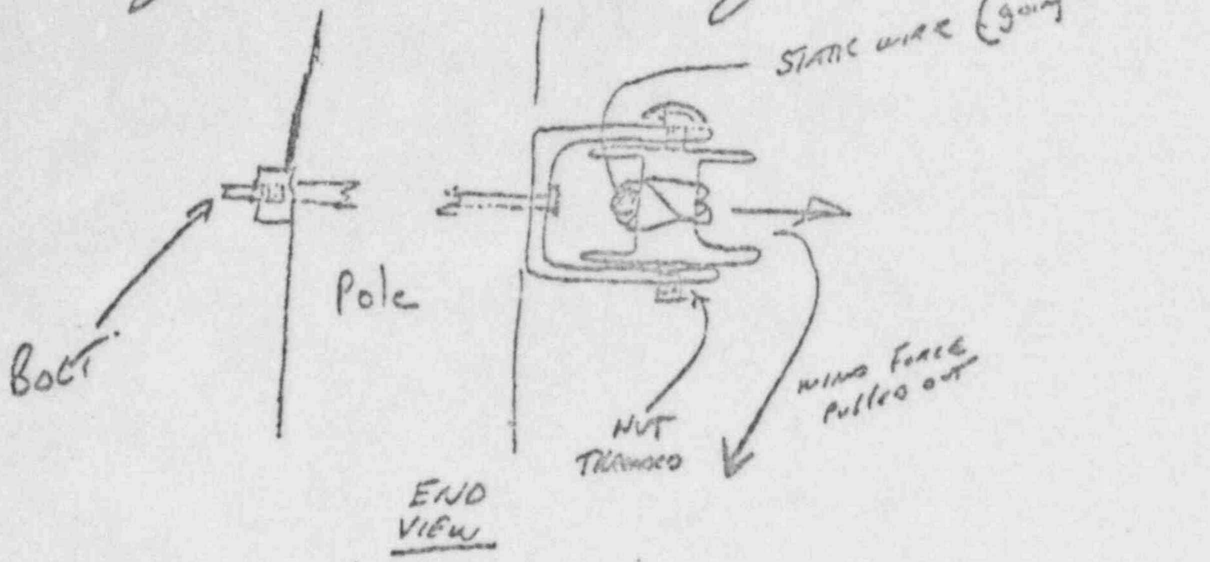
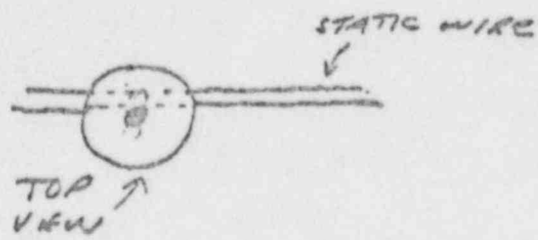


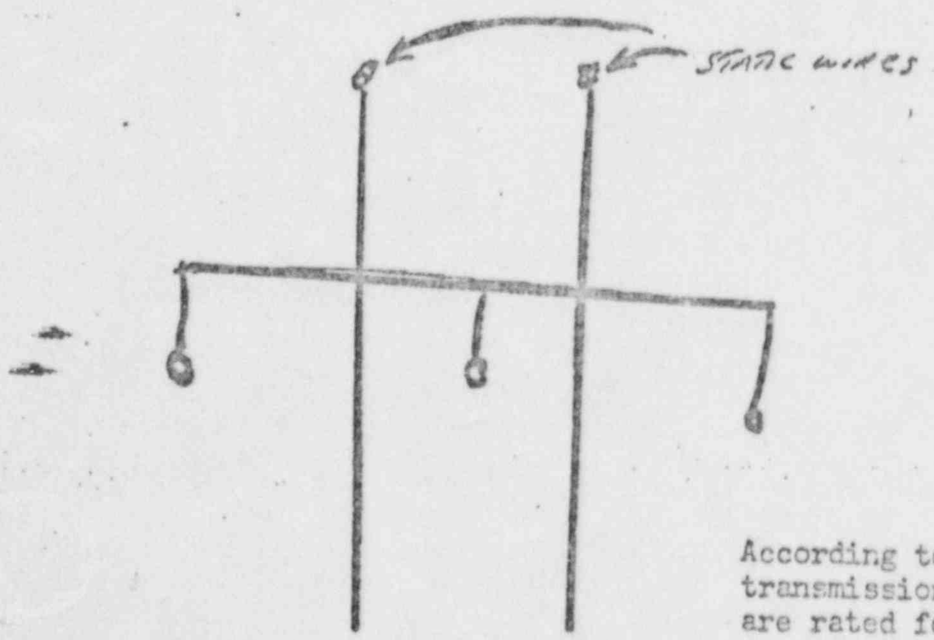
WEATHER SPOON 209
126 185 DELCO EAST
186
DELCO WEST
STRUCTURE DOWN
STATIC ON CONDUCTOR
BENT CROSSARM
N
JACKSONVILLE
68 DELCO EAST
RIVER
FEAR
18


UNIT 2
UNIT 1
FAYETTEVILLE
DELCO WEST
WALLACE
CASTLE HAYNE WEST
WEATHERSPOON
DELCO EAST
JACKSONVILLE
CASTLE HAYNE EAST
75'
75'
75'
87.5'
87.5'
75'
75'
75'

2. Why did static wire fail







According to CP&l transmission towers are rated for 90 m.p.h. wind

PROBABLE MAXIMUM HURRICANE

CENTRAL PRESSURE	26.89 INCHES
MAXIMUM WINDSPEED	149 MILES PER HOUR
STILLWATER LEVEL	22.0 FEET ABOVE MEAN SEA LEVEL

HURRICANE DIANA

LOWEST PRESSURE	28.85 INCHES AT LAND FALL 28.05 INCHES AT 8 P.M. ON 9/11
MAXIMUM WINDSPEED ON SITE	115 MILES PER HOUR

FREQUENCY OF HURRICANES WITH THESE WINDSPEEDS IS ONCE EVERY 25 YEARS.

BRUNSWICK NUCLEAR POWER PLANT DESIGN

DESIGNED FOR MAXIMUM PROBABLE HURRICANE

DESIGNED FOR TORNADO WINDS >300 MILES PER HOUR

PLANT GRADE IS 19.5 FEET ABOVE MEAN SEA LEVEL (MSL).

DESIGNED FOR WATER LEVEL INCLUDING WAVE RUN UP OF:
- 25.6 FEET MSL ON PLANT BUILDINGS
- 28.3 FEET MSL ON INTAKE STRUCTURE

TECHNICAL SPECIFICATIONS REQUIRE PLANT TO SHUTDOWN WHEN:
- WATER LEVEL AT INTAKE STRUCTURE REACHES 17.5 FEET MSL

ADMINISTRATIVE INSTRUCTION 68 SAYS "TWENTY-FOUR HOURS BEFORE WIND SPEED IS PROJECTED TO EXCEED 75 MILES PER HOUR AT THE SITE...AS CONDITIONS WARRANT, BRING UNITS TO COLD SHUTDOWN...."

SLIDE 1

ACRS MEETING - OCTOBER 12, 1984 - REMARKS BY V. STELLO, JR.

GENERIC BACKFIT REQUIREMENTS - OVERVIEW OF REMARKS

DEFINITION - GENERIC VS. PLANT-SPECIFIC BACKFITS

EVENTS RESULTING IN GENERIC/PLANT-SPECIFIC SPLIT

GENERIC ISSUES MANAGEMENT

FUTURE ACTIVITIES

DEFINITIONS

GENERIC	-	APPLY TO CLASSES OF POWER REACTORS SUCH AS CPs, OLs, ORs, BWRs, PWRs, VENDOR TYPES.
PLANT-SPECIFIC	-	APPLY TO A SINGLE PLANT OR TWO IDENTICAL PLANTS AT THE SAME SITE

SLIDE 3

EVENTS RESULTING IN SEPARATE GENERIC AND PLANT-SPECIFIC BACKFIT MANAGEMENT

- Large Number Of Post-TMI Requirements
- NRC Survey Of Licensees Conducted
- NUREG-0839 Issued - August 1981
- commission Formed CRGR in October 1981 To Aid In Managing Generic Requirements
- In Late 1982 The NRC's Regulatory Reform Task Force (RRTF) Proposed Changes To 10 CFR 50.109
- During 1983, The Commission Considered Recommendations Concerning The Backfit Issue

SLIDE 3A

- Staff Requirements Memorandum Directing Interim Control Of Plant-Specific Requirements Issued By The Commission June 1983
- Staff Proposal To Control Plant-Specific Requirements For Operating Reactors Issued To Commission In August 1983
- Commission Issues Policy Statement And Advanced Notice Of Proposed Rulemaking In September 1983
- Staff Proposals To Control Plant-Specific Requirements For CP and OL Applicants Issued To Commission In December 1983
- Commission Approves Staff Use Of Interim Plant-Specific Procedures In February 1984.
- Commission Directs RRTF To Draft Proposed Rule
- Commission Considering Proposed Rule In October 1984

GENERIC ISSUES MANAGEMENT

- The CRGR
- Why CRGR Was Formed
- CRGR Operations
- Progress To Date
- Future Agenda
- Major Accomplishments

SLIDE 5

FUTURE ACTIVITIES

- Rulemaking To Replace 10 CFR 50.109
- Application Of Interim Controls To Manage Plant-Specific Backfits On Plants In Construction And On Operating Plants
- Continued Management Of Generic Backfits Using CRGR Process

ACRS - OCTOBER 12, 1984

PROPOSED NRC DRAFT MANUAL CHAPTER - PROVISIONS AND STATUS

1. Evolution and Current Status
2. Features of Draft Manual Chapter
3. Future Actions

EVOLUTION OF PLANT-SPECIFIC BACKFIT CONTROLS

1. CRGR Was Organized in November 1981.
2. RRTF Submitted First Proposal for 50.109 Revision in November 1982.
3. NRC Staff Does Not Forward Proposed Plant-Specific Requirements for CRGR Review.
4. The Commission Recognized the Need for Interim Plant-Specific Backfit Controls, and Issued a Staff Requirements Memo in June 1983.
5. A Draft Manual Chapter and Plant-Specific Procedures Were Transmitted to the Commission in August 1983 for Approval.
6. The Commission Approved the Manual Chapter and Procedures.
7. In February 1984, the Staff Briefed the ACRS on the Draft Manual Chapter and Procedures.

EVOLUTION OF PLANT-SPECIFIC BACKFIT CONTROLS (CONTINUED)

8. NRR Issued Generic Letter 84-08 in April 1984 Implementing the Procedures for Operating Reactors and OL Applicants.

9. The Draft Manual Chapter and Procedures were Issued for Public Comment in April 1984.

10. The Staff Briefed the ACRS Subcommittee on Regulatory Policies and Procedures in September 1984.

11. The EDO Informed the Commission on September 19, 1984 Concerning Public Comment on the Manual Chapter and Procedures.

DRAFT MANUAL CHAPTER 0514

NRC PROGRAM FOR MANAGEMENT OF PLANT-SPECIFIC BACKFITTING OF OPERATING POWER REACTORS

0514-01 - COVERAGE

STATES THAT CHAPTER DEFINES PURPOSE AND OBJECTIVES: DEFINES "BACKFITTING" AS IMPOSITION OF NEW PLANT-SPECIFIC REQUIREMENTS ON POWER REACTOR LICENSEES.

0514-02 - OBJECTIVES

GENERALLY CORRESPOND WITH THOSE OF THE CRGR.

0514-03 RESPONSIBILITIES AND AUTHORITIES

ADDRESSES FUNCTIONAL RESPONSIBILITIES OF DIRECTORS OF NRR, IE, NMSS AND REGIONAL ADMINISTRATORS.

0514-04 BASIC REQUIREMENTS

1. Identifying Requirements
2. Appeal Process
3. Cost Benefit Analysis
4. Implementation of Requirements
5. Recordkeeping and Reporting
6. Exceptions
7. References

0514-05 - DEFINITION

Staff Proposed Requirements

STATUS OF DRAFT MANUAL CHAPTER

1. SECY 84-371, To Commission on 9/19/84, Reports on Public Comment
2. Pending Commission Action, Current Draft Manual Chapter and Procedures Are Implemented.
3. On Commission Direction, Draft Manual Chapter Will Be Made Final in the NRC Manual.

PRESSURIZED THERMAL SHOCK

(USI A-49)

PRESENTATION TO ACRS

OCTOBER 12, 1984

- STATUS OF PTS RULEMAKING
- CONTINUING USI A-49 PROGRAM
  - OBJECTIVES AND OVERVIEW
  - STATUS REPORTS ON
    - PROTOTYPE PLANT-SPECIFIC-ANALYSES
    - THERMAL MIXING STUDIES
    - PRESSURE VESSEL FRACTURE MECHANICS RESEARCH

PTS RULEMAKING

SCREENING CRITERION APPROACH PRESENTED TO COMMISSION IN SECY 82-465	11/23/82
PROPOSED RULE TO COMMISSION IN SECY 83-288	7/15/83
PUBLISHED PROPOSED RULE	2/7/84
END OF PUBLIC COMMENT PERIOD	5/7/84
FINAL RULE PACKAGE TO CRGR AND ACRS	9/14/84

SCHEDULE

ACRS MEETING	10/12/84
CRGR MEETING	10/17/84
FINAL RULE TO COMMISSION	12/84

ELEMENTS OF PTS RULE

1. ESTABLISH SCREENING CRITERION

   RT_{PTS} = 270°F FOR PLATES, FORGINGS, AXIAL WELDS

   = 300°F FOR CIRCUMFERENTIAL WELDS

2. PRESCRIBE RT_{NDT} CORRELATION FOR USE IN CALCULATING RT_{PTS}

3. REQUIRE PROJECTIONS OF RT_{PTS} TO END OF LICENSE

4. IF VESSEL PROJECTED TO EXCEED CRITERION BEFORE END OF LICENSE:

   - REQUIRE ANALYSES OF REASONABLY PRACTICABLE FLUX REDUCTION PROGRAMS AND SCHEDULE FOR IMPLEMENTATION

5. IF VESSEL STILL PROJECTED TO EXCEED CRITERION (EVEN WITH FLUX REDUCTIONS):

   - REQUIRE PLANT-SPECIFIC SAFETY ANALYSIS 3 YEARS BEFORE EXCEEDING

6. REQUIRE NRC APPROVAL FOR OPERATION BEYOND SCREENING CRITERION

DISPOSITION OF PRINCIPAL PUBLIC COMMENTS ON RULE

- SCREENING LIMIT VS. OPERATING LIMIT - ELIMINATE COMMISSION APPROVAL TO EXCEED SCREENING CRITERION
  - NO, EXPLAINED BASIS

- IF ORIGINAL PLANT-SPECIFIC ANALYSIS NOT ACCEPTED, SHOULD ALLOW RE-ANALYSES OR NEW INFO, AS WELL AS PLANT CHANGES
  - AGREE, ADDED WORDS

- ALL DEFINITIONS OF RT_{NDT} SHOULD BE SAME
  - AGREE, DEFINED RT_{PTS} FOR PTS USE TO AVOID CONFUSION

- PERMIT OTHER RT_{NDT} CORRELATIONS IN PLANT-SPECIFIC ANALYSES
  - AGREE, CLARIFIED WORDS

- PERMIT OTHER RT_{PTS} CORRELATIONS FOR COMPARISON WITH SCREENING CRITERION
  - NO, NEED CONSISTENCY, CONSERVATISM

- USE BEST ESTIMATE TERMS FOR COPPER, NICKEL AND FLUENCE IN RT_{PTS} EQUATION
  - AGREE, FIXED DEFINITION

- ALTERNATIVES TO FLUX REDUCTION SHOULD BE ALLOWED
  - NOT PRECLUDED BY RULE, CLARIFYING WORDS ADDED

- REPORTING OF CHANGED RT_{PTS} PROJECTIONS NOT NEEDED
  - NO, NEEDED TO SPOT TRENDS EARLY

- DELAY RULE UNTIL GUIDANCE AND ACCEPTANCE CRITERIA ISSUED
  - NO, BUT WORDING CHANGED TO ASSURE ANALYSIS NOT DUE UNTIL AFTER GUIDANCE ISSUED

PUBLIC RESPONSE TO COMMISSION QUESTIONS

- ANALYSES DUE 3 VS. 5 YEARS BEFORE EXCEED RT_{PTS}
  - 3 YEARS OK - NO CHANGE MADE

- SHOULD THERMAL ANNEALING REQUIREMENTS TO APPENDIX G BE DELETED
  - YES - NOTICE INDICATES INTENT TO DO SO

CONTINUING PTS (USI A-49) PROGRAM

- TEST GENERIC BASES FOR RULE BY PERFORMANCE OF PLANT-SPECIFIC ANALYSES
- DEVELOP GUIDANCE FOR LICENSEE PERFORMANCE OF PLANT-SPECIFIC ANALYSES REQUIRED BY RULE
- DEVELOP CRITERIA FOR JUDGING ACCEPTABILITY OF OPERATION BEYOND SCREENING CRITERION

MAJOR ELEMENTS OF PROGRAM

- PROTOTYPE ANALYSES FOR 3 PLANT DESIGNS
- THERMAL MIXING STUDIES
- PRESSURE VESSEL FRACTURE MECHANICS RESEARCH (HSST)
- POTENTIAL VESSEL FAILURE MODES
- CONSEQUENCES OF FAILURES
- POTENTIAL CORRECTIVE ACTIONS
- DEVELOPMENT OF REGULATORY GUIDE

ACRS MEETING

OCTOBER 12, 1984

<u>PRESSURIZED THERMAL SHOCK ANALYSIS</u>

0 OBJECTIVES

0 PRELIMINARY RESULTS

CARL JOHNSON

OBJECTIVES OF PTS PROBABILISTIC ANALYSIS

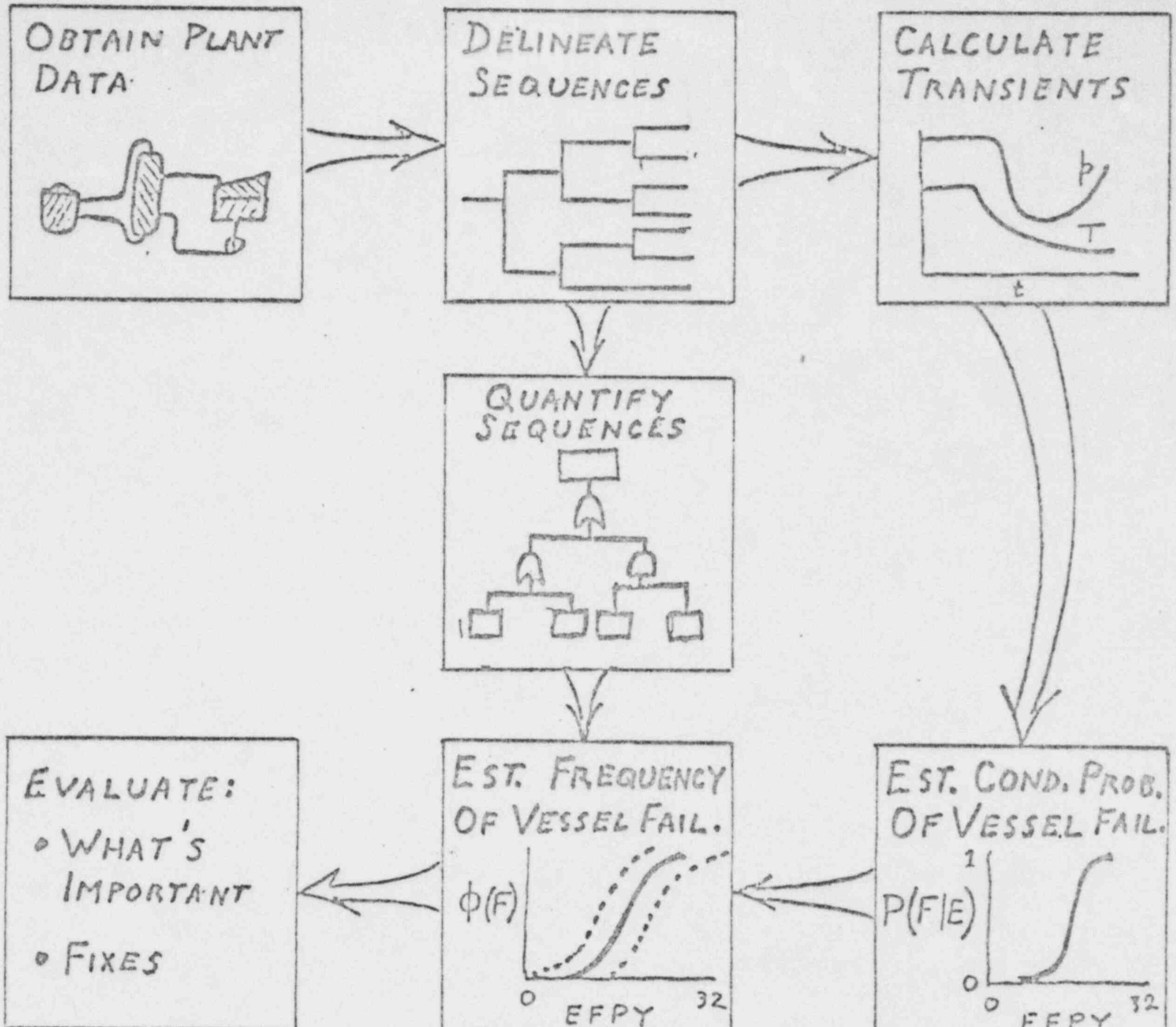
BASED ON OCONEE, CALVERT CLIFFS, & ROBINSON DESIGNS

- o LIKELIHOOD OF VESSEL FAILURE
- o WHAT'S IMPORTANT:
  - SEQUENCES
  - OPERATOR AND CONTROL ACTIONS
  - UNCERTAINTY
- o RISK-REDUCTION EFFECTIVENESS OF FIXES
- o DIFFERENCES BETWEEN A B&W, CE, AND W PLANT

SCOPE DOES NOT INCLUDE

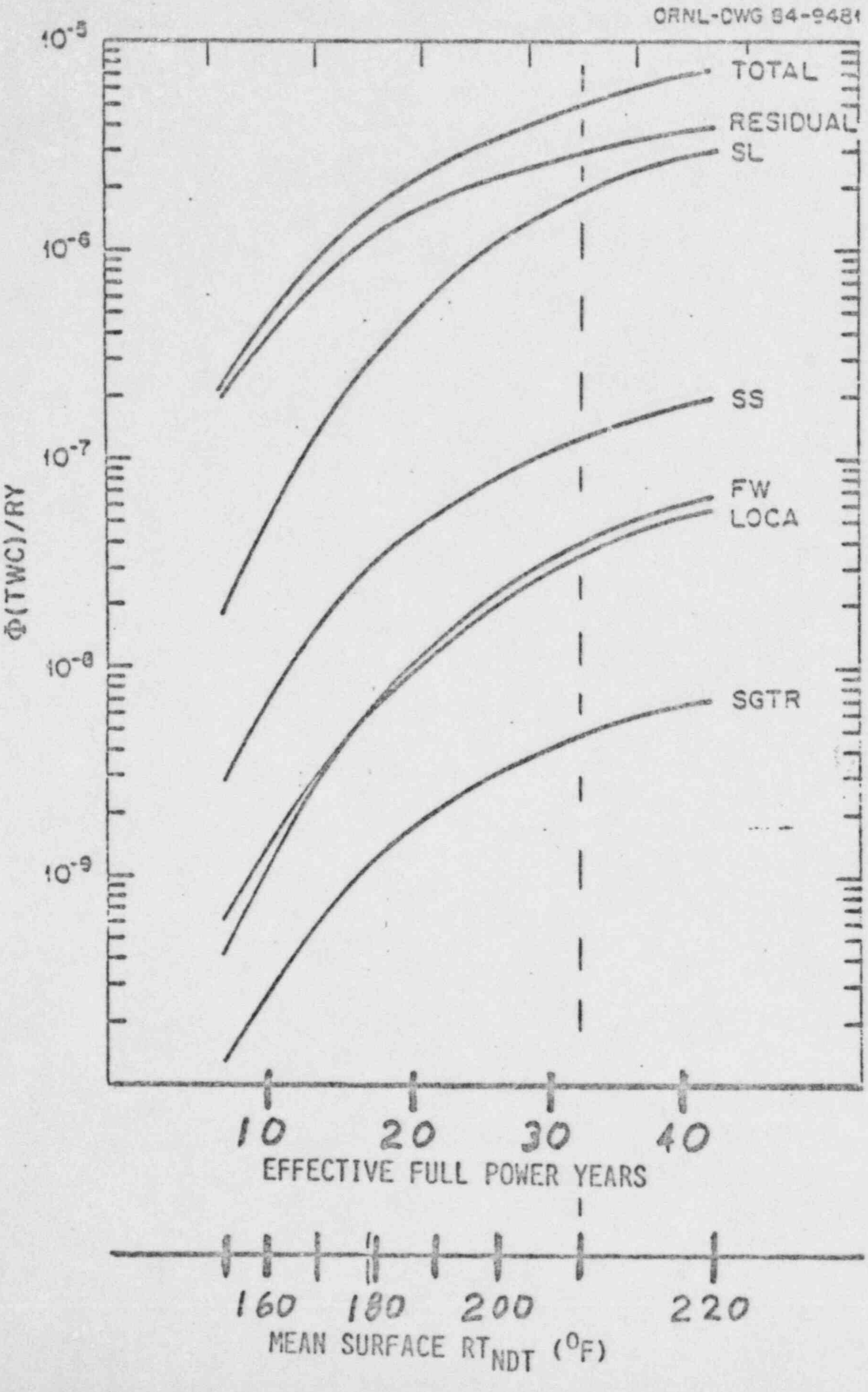
- GENERIC ANALYSIS OF B&W, CE, W PLANTS
- EXTERNAL EVENTS
- SABOTAGE
- DETAILED FAULT TREES
- CONSEQUENCES OF THRU-WALL CRACK

PTS STUDY PLAN



FREQUENCY OF THRU WALL CRACK

BASED ON OCONEE-1 DESIGN



PRELIMINARY CONCLUSIONS FROM OCONEE STUDY

IMPORTANCE SEQUENCES

- DOMINANT SEQUENCES FOR THIS PLANT ARE STEAM LINE BREAKS

IMPORTANT PLANT FEATURES

- VENT VALVES AND MIXING PREVENT FLOW STRATIFICATION
- 1/4" FLAWS ARE IMPORTANT TO PTS

IMPORTANT PROCEDURES

- AFTER MSLB, ISOLATE FEEDWATER TO STEAM GENERATOR
- THROTTLE HPI TO MAINTAIN $< 100^{\circ}F$ SUBCOOLING

UNCERTAINTY FACTOR OF 100 DUE TO

- TEMPERATURE
- FLAW DENSITY

IN BALANCE, THE ANALYSIS APPEARS CONSERVATIVE

NON CONSERVATIVE ASSUMPTIONS

- o IGNORED EXTERNAL FLOODING
- o IGNORED AZMUTHAL TEMP DISTRIBUTION
- o 2 HR LIMIT ON TRANSIENTS

CONSERVATIVE ASSUMPTIONS

- o TEMP $\sigma = \pm 50^{o}F$
- o 20 MIN TO ISOLATE SG
- o NO OTHER OPERATOR ACTION
- o FOR 2 HRS (I.E., NOT MAINTAIN $100^{o}F$ SUBCOOLING
- o LSLB TEMP COLDER THAN BEST ESTIMATE
- o FOR SEQUENCES $< 10^{-6}$/YR
  - NO OPERATOR ACTION
  - WORST P(TWC/T)
- o FLAWS ASSUMED ON SURFACE IN HIGHEST FLUX LOCATION
- o IGNORED WPS

EFFECTIVENESS OF POSTULATED CORRECTIVE MEASURES IN OCONEE STUDY

- REDUCE LEAKAGE FLUX

FLUX REDUCTION FACTOR	RISK REDUCTION FACTOR
2	3
4	6
8	8

- HEAT HPI WATER

  SMALL EFFECT IN THIS PLANT

- LIMIT REPRESSURIZATION TO 1000 PSI

  REDUCE PTS BY $\sim$10; ADVERSE EFFECT NOT EVALUATED

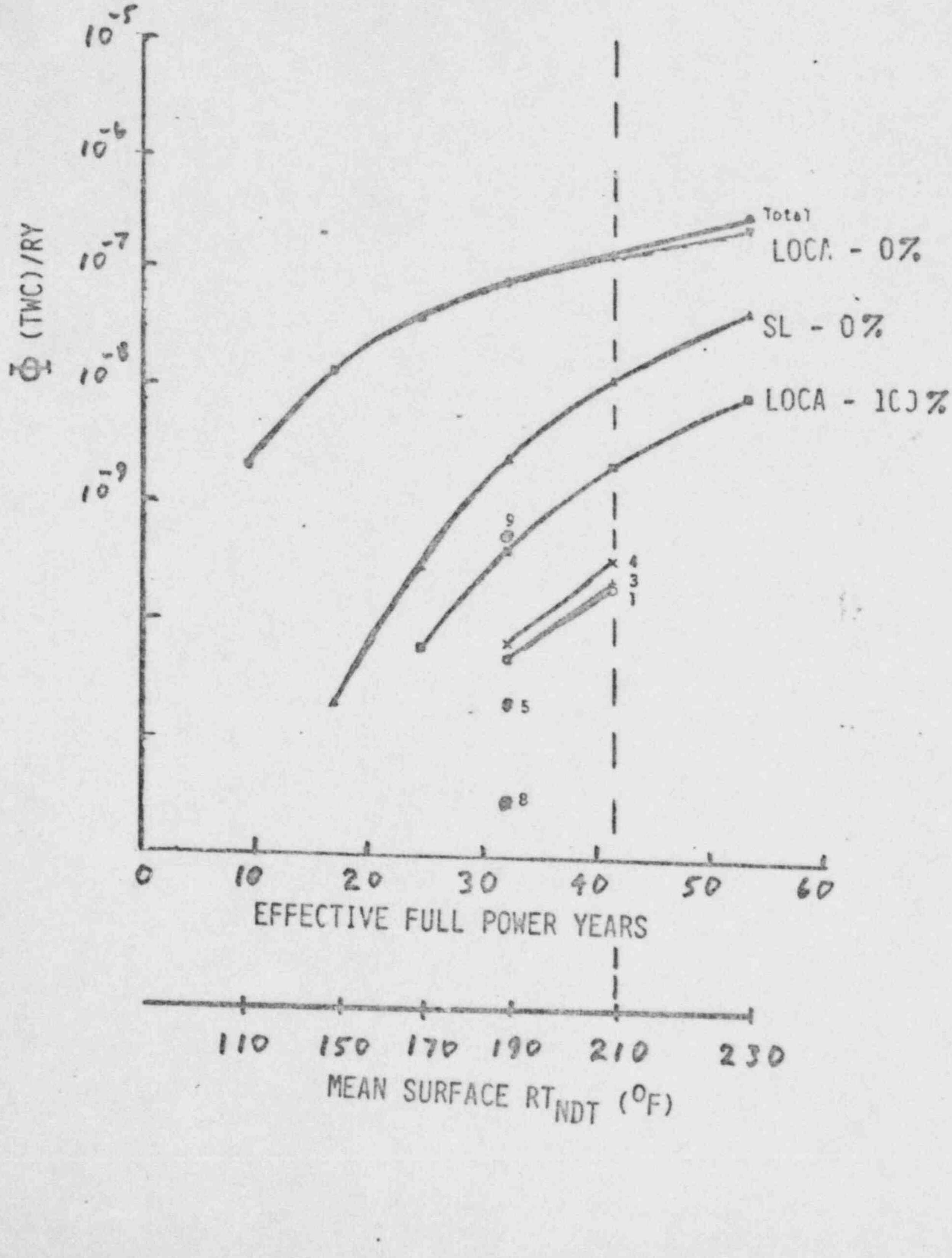
- ISI

  MUST DETECT SMALL FLAWS TO BE EFFECTIVE

- ANNEAL VESSEL

  EFFECTIVE, BUT NOT WELL UNDERSTOOD

FREQUENCY OF THRU-WALL CRACK BASED ON CALVERT CLIFFS DESIGN



CONCLUSION

RESEARCH RESULTS TO DATE SUPPORT THE SCREENING CRITERION