ACRST-1997

ORIGINAL

OFFICIAL TRANSCRIPT OF PROCEEDINGS

Agency: Nuclear Regulatory Commission
Advisory Committee on Reactor Safeguards

Title: ABB-CE Standard Plant Designs Subcommittee

Docket No.

LOCATION: Bethesda, Maryland

DATE: Wednesday, February 9, 1994 **PAGES:** 1 - 287

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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ABB-CE Standard Plant Designs Subcommittee

Nuclear Regulatory Commission

7920 Norfolk Avenue

Bethesda, Maryland

Wednesday, February 9, 1994

The meeting convened at 8:30 a.m., Jay Carroll, Chairman of the Subcommittee, presiding.

PRESENT FOR THE SUBCOMMITTEE:

Jay Carroll

Thomas Kress

Ivan Catton

Peter Davis

Carlyle Michelson

Robert Seale

Ernest Wilkins

ALSO PRESENT:

Doug Coe, Cognizant ACRS Staff Member

PROCEEDINGS

[8:38 a.m.]

MR. CARROLL: The meeting will now come to order. This is a meeting of the Advisory Subcommittee on ABB-CE Standard Plant Designs. I'm Jay Carroll, Subcommittee Chairman. The ACRS members in attendance, miraculously it looks like, are Carl Michelson, Pete Davis, Ivan Catton, Bob Seale, Ernest Wilkins, and I'm told that Tom Kress will be here about 9:30. I don't know the whereabouts of Mr. Linblad and Charlie Wylie is not going to be attending the meeting at all this week. He has a bug of some sort.

The purpose of this meeting is for the Subcommittee to continue its review of the ABB-CE System 80+ Standard Plant Design. Mr. Doug Coe, on my right, is the cognizant ACR staff member for the meeting.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the "Federal Register" on January 31, 1994. A transcript of the meeting is being kept and will be made available as stated in the Federal Register notice. It is requested that each speaker first identify himself or herself and speak with sufficient clarity and volume so that he or she can be readily heard. We've received no written comments or requests to make oral statements from members of the public.

Just to review where we've been, as you recall on December 8th we began our formal review of the FSER, the Staff's FSER, and during that meeting we covered Chapter 7, "I&C," Chapter 8, "Electrical Systems," and Chapter 18, "Human Factors Engineering." Today we have seven chapters on the agenda -- 4, 10, 11, 12, 13, and part of 14 and 17. In addition, we expect to hear from Combustion and the Staff on responses to the questions that we asked during the 12/8 meeting.

I talked to Bill Shack over the weekend about the materials that's used in Chapter 4 and Bill is not going to be able to make this meeting. I don't think there's any reason we shouldn't asks questions about that, but I think we'll save up the materials issues for one meeting because there's some in Chapter 4 and there's some in other chapters. Bill's problem, of course, is unlike a lot of us retired guys, he works for a living and had another commitment today.

The transmittal that Tom Wambach of the Staff have been sending us on the FSER chapters that we'll consider today state that "the enclosed chapters have not received substantial technical editing." You're right.

[Laughter.]

MR. CARROLL: I guess at some point I'd like Tom to give us some idea of what technical editing means and what we will see after that process is complete. Is this a good time to ask that question?

MR. WAMBACH: Yes. The technical editing, number one, takes it out of engineering talk and trys to put it in something that's understandable, tries to get rid of repetition and unnecessary words. In addition, they try to make sure that the references are correct and proper, that the tables fall where they should, all the coordination between different chapters, and sc on. I don't believe any of these chapters that we have today have gone through the technical editing.

MR. CARROLL: No. That's what your notes that transmitted them said. Okay.

MR. DAVIS: Some of that's been very helpful.

MR. CARROLL: But you don't really -- I guess the agreement I have with you and Borshard is that if you do make any changes of substances through that process, you're going to let us know?

MR. WAMBACH: Oh, yes, sir. In fact, when we get it back from the technical editor, we go over it and we also have the review branch go over it to make sure that the technical content hasn't been distorted.

MR. MICHELSON: Is this purported to be the final safety evaluation report?

MR. CARROLL: Draft.

MR. WAMBACH: It's not a draft. We're calling it an advanced safety --

MR. MICHELSON: My concern is we -- invariably in -- the ABWR was the case where we kept showing the same -- we had to keep rereading it. You guys would rewrite it and it would be significantly different each time. You have to keep rereading it, and I was wondering why don't we wait until the final is out and read it once.

MR. WAMBACH: In the chapters that we had go through the technical editing process, and these are the chapters mainly that you covered in the December meeting, in our view there has not been any significant technical change.

MR. MICHELSON: And you're not going to go back and do anything more to those?

MR. WAMBACH: Well, they are now going through the division director concurrence process and then, of course, we go to the ET meeting on the 24th. But there shouldn't be any significant changes.

MR. MICHELSON: That's okay -- the only way we'd know is, of course, we'd have to reread it and reread it again each time a new revision of the SCR comes out, and I just wondered how close to the last one we think we are. This is obviously, what we got right now is no, I hope, the final.

MR. WAMBACH: Well, again, I think it's mainly just making readable comments, not changing the technical issues.

MR. DAVIS: What's your schedule for Chapter 19 of the FSCR? I'm sorry.

MR. CARROLL: Go ahead.

MR. WAMBACH: Well, the part on severe accidents we're planning for the March meeting. We were hoping that the PRA would also be ready for the March meeting. They tell me the Level II aspect, which interfaces heavily with severe accidents, they would be ready, but not Level I. One of the things we wanted to discuss with Mr. Carroll today was would that be all right to split the PRA that way or do you want us to hold on anything to put the two together?

MR. CARROLL: How do you feel about that, Pete?

MR. DAVIS: Well, I don't think it's necessary to have them both ready at the same time. I'm surprised they're reviewing the back end first, but --

MR. WAMBACH: I think it's more a problem. It's not reviewing. It's more a problem of the documentation that they're trying to put together for the SER, and the Level I people have been impacted by other --

MR. DAVIS: Attentions?

MR. WAMBACH: Right.

MR. CATTON: Will there be a fire PRA?

MR. WAMBACH: That is part of the Chapter 19 PRA.

MR. CATTON: Okay.

MR. MICHELSON: Is it a PRA or is it going to be the five methodologies?

MR. WAMBACH: I didn't hear.

MR. MICHELSON: Is it going to be a PRA for fire or using the five methodology?

MR. WAMBACH: Well, the five methodology is what --

MR. MICHELSON: So they won't have a PRA is the answer I think.

MR. WAMBACH: Right.

MR. MCCRACKEN: Conrad McCracken, NR Staff. I like to comment the changes that are being made because I just saw the final on Chapters 10 and 11 went by my desk the beginning of this week and there were no technical changes. They're rhetorical changes. There were a few changes in references, stuff like that, but there was nothing that should impact anything that you'd make a decision on, at least those two chapters.

MR. CARROLL: Now, in those cases, Conrad, you've got a marked up copy so you could see what the changes were?

MR. MCCRACKEN: I got -- the way the process works is it comes out of the technical shop. We send it to Projects. They put it all together, put all the different branch inputs together, send it to a tech editor who edits it. They then modify it, it comes back to our original reviewer. The original reviewer then marks it up for me to make sure that they've not changed intent or there's nothing new or different.

Some cases they may have put in an editorial comment they thought was correct but changed the meaning. That comes back to me then with all the mark ups that my reviewer put on it to make it be what we thought it had said in the beginning. Then it goes from there, signed out by the division director, then up to Projects for a final.

But none of the changes, at least in 10 and 11, which were the two I saw the beginning of this week. They were rhetorical changes. There was one case where they made a change to the turbine. So there's some changes consistent, but I mean there's nothing there of any technical depth or meter significant.

MR. MICHELSON: When is the so-called final SCR going to be issued? The one -- the last one? When is the last one going to be issued?

MR. WAMBACH: The last one is in June. The one that comes to ACRS for you to write a letter to the Commission we're supposed to get out the end of this month, February 28th.

MR. MICHELSON: And that one will be not -- will not be changed further unless you bring each change to our attention. Is that the plan?

MR. WAMBACH: Right. And also --

MR. MICHELSON: In other words, how do we know whether we've read it?

MR. WAMBACH: Also, of course, if it has to be changed as a result of ACRS comments.

MR. MICHELSON: I understand.

MR. CARROLL: Okay. All right, well, my next item here was where are we going and we've really talked about that to some degree. It sounds like on 3/9, the day before the next full committee meeting, we'll have another session and at that time we're going to do severe accidents and I guess the Level II PRA, and also at that time we're going to try to fit in the seismic and structural design issues, since that is a date that the combustion consultants apparently can make it. They've had problems scheduling meetings to accommodate our meetings.

Is it the 8th? Tuesday, the 8th. All right.

MR. MICHELSON: Jay, one small comment. It's awfully difficult to get a FSCR late February/early March and then turn around and have a meeting on the 8th of March on that.

MR. CARROLL: That wasn't the intent, but unfortunately --

MR. MICHELSON: That's the way it's working out. In fact, it's just unrealistic to do it that way.

MR. CARROLL: Well, I put a lot of time in. I did go through it all, but I can understand the --

MR. MICHELSON: You haven't even seen it yet, though, until you get it. Whatever comes out the end of February/early March.

MR. CARROLL: Oh, I'm sorry.

MR. MICHELSON: Yes. That's when they're scheduling their draft FCSR, late February or early March. What we're getting now is the preliminary, preliminaries or something. I'm looking at their schedule halfway down the page, and it's awfully difficult. I think it's just unrealistic to expect us to look at material received in late February/early March and then have a meeting on the 8th of March which is covered. I don't know how the other members feel, but I'm just going to have ask my questions later after I catch up. That's the only way you can do it.

MR. CATTON: In preparation for the next meeting, I'd like to find out is CE planning to flood the cavity to save the vessel in severe accident?

MR. RITTERBUSCH: This is Stan Ritterbusch, ABB. Our design, of course, has cavity flooding. But the level is set such that it does not touch the reactor vessel.

MR. CATTON: Okay. See, both AP.600 and SBWR I understand plan to flood high enough to save the vessel and I have some rather severe, strong reservations about the effectiveness of that for AB.600. That's why I asked the question.

MR. CARROLL: Okay. What else? So, I was going to ask Linblad to make sure he's prepared for the seismic and structural.

MR. CATTON: Some of the E-mail messages I've been getting from him, he's coming up to speed.

MR. CARROLL: And, Doug, you're getting together the material for the transcript of the earlier review that we did there?

MR. COE: On December 8th?

MR. CARROLL: No, no. We did cover seismic at one time on combustion when Chad was still here and he felt pretty good about what was done.

MR. COE: Okay.

MR. CARROLL: So Bill needs that.

MR. COE: I can pull that out.

MR. CARROLL: Then, of course, Tom and Peter are going to be ready for the severe accident PRA part. Okay. Do any of the members have anything else they'd like to bring up at this time?

All right. Let's turn it over to Dr. Matzie.

MR. MATZIE: I'm really happy to be here and actually fortunate, considering the weather. We had a vagabond trip down to Richmond and finally got up here late last night, and I'd like to also say that a number of our team members are not yet here because of the weather.

As you're well aware, our development team includes not only ABB Combustion Engineering, but Stone and Webster Engineering out of Boston and Duke Engineering and Services out of Charlotte, and from both Boston and Charlotte, people are on their way. We've had some of our people coming all night from Windsor by train.

So what is going to happen is we're going to have to rearrange the agenda. We will start with the first speaker on the agenda, which is Dr. Mark Kantrowitz. He will go over Chapter 4. Thereafter, we're going to shift to the last speaker shown here, which is Dr. John Rec, on the initial test program and then Dr. Eric Siegmann on the quality assurance program, in particular designer reliability program. By that time, I think the other people will arrive. We expect them midmorning into National.

We are very happy that we could hold this meeting because there is a tight schedule to go through the various reviews of the chapters that's there completed by the NRC Staff. We're very close to resolving all of the issues on these chapters. My understanding has been that we have resolved the issues and, therefore, there's nothing open or remaining with the Staff.

The other few issues we're hoping to resolve this week on other chapters, which is the reason they will be presented to you later. We've been told by NRC management that the 28th of February is a firm date for release of the FSCR to the Commission and ACRS, and we've all been working very hard and we want to retain that schedule.

We've committed the resources necessary and I know the Staff has to in terms of making that deadline and everybody's working hard. So we appreciate the ability to have these chapters as they're done, even though it may not have been edited fully, to be available to the ACRS so that we could address the various chapters on a schedule that can get us to the issuance of the final SCR to the public in June and then the FDA in August.

I'd like to introduce those other speakers that are here today thus far and we'll have to introduce the remaining speakers when they arrive. We've got Joe Barron of SWEC, Stone Webster Engineering. Joe is going to speak on Chapter 11. Mark Kantrowitz of ABB is going to speak on Chapter 4 first. John Rec of ABB is going to speak on Chapter 14. Eric Siegmann from ABB, who is going to speak on Chapter 17.

Also, we have a number of other people here from Stone and Webster Engineering. Bob O'Meara from SWEC and

Steve Stam from Stone and Webster. I'm sure you all know Stan Ritterbusch from ABB, Charlie Brinkman from ABB, Terry Rudeck from ABB, and Ken Scarola, with sort of an honorary member of this subcommittee I think, and he will be here to go over the instrumentation control question that you asked that we wrote a written response since the last subcommittee meeting and turned them in. But he will be here to follow up on those and any other questions you have in that area.

That's really all that I have to say. I think we can get into the business at hand, which is to start on Chapter 4, unless you have any general questions about what we're doing on the System 80+ at this time, and I'd be certainly glad to try to answer those. Are there any questions in a general nature?

[No response.]

MR. MATZIE: Mark, do you want to come up? So we'll do Mark Kantrowitz next on Chapter 4, the reactor.

MR. KANTROWITZ: Good morning. My name is Mark Kantrowitz and I'll be here to speak about Chapter 4 of reactor. System 80+ reactor design is an evolutionary design based on System 80 Plant, which is a licensed operating plant 1283 units. From that, there's been a number of additional design features and improvements that have been made to improve the plan.

Those have been driven by several factors. One of those is the FALWR requirements. Another is changes mandated by the NRC. Those are primarily to address severe accidents. Those are really out of the scope of core design. The third is desired changes by both ABB and the System 80+ Executive Advisory Committee. These are based on plan operating experience, representing both designer and industry observations experience.

MR. WILKINS: May I ask a --

MR. KANTROWITZ: Certainly.

MR. WILKINS: Is it NRC mandated changes? Did you mean mandated or did you mean urged or suggested or hinted at?

MR. KANTROWITZ: I believe there were certain changes that were required by NRC to address severe accident.

MR. MICHELSON: If they're required in the regulations, that's what I mean by mandated and that's what you mean by mandated?

MR. WILKINS: Or they are required by policy, not by regulation.

MR. MICHELSON: Yes, not by regulation. They are required by policy rather than by regulation.

MR. WILKINS: But that has the affect of regulation.

MR. MICHELSON: Yes, there's no difference.

There's no difference.

MR. WILKINS: I think that's theoretically what they're addressing is the policy issues.

MR. KANTROWITZ: Okay. This slide summarizes the impacts and the changes.

MR. SEALE: Excuse me. Are you going to tell us who this Executive Review Committee is that you referred to in your last bullet?

MR. MATZIE: Regis Matzie from ABB. The System 80+ Executive Advisory Committee is a set of utility executives, both domestically and internationally. There's about 12 currently on the committee. It includes utilities in the U.S. such as Duke Power Company, Florida Power and Light, Arizona Public Services. It includes international utilities, including Cree Electric Power Company, Nuclear Electric in United Kingdom, Electricity de France in France, etc. But there's about 12 currently on the committee.

We meet on the order of three to four times a year with that committee and review policy issues, status, etc., of our design and our licensing.

MR. SEALE: Thank you.

MR. KANTROWITZ: Okay. As I mentioned, there were a number of changes made in the -- this slide summarizes the impact of the changes, which I'll get into through the presentation, increased safety, improved performance, improved reliability, improved operability, and reduced costs.

The changes that we made can fall into several classes or two basic ones, one on the reactor core design, another on fuel design. There's also some materials improvements we've made. This slide summarizes the design feature of the System 80+ reactor core.

First, the power. It's an increase relative to System 80. System 80 was 3800 megawatts thermal. The power level of System 80+, core power level. is 3914 megawatts thermal, which is an increase of three percent.

Second, the use of integral erbia burnable absorbers. In System 80, what was used was B4C, or carbide, which were discreet absorbers in nonfuel risers. We've gone to integral absorbers, which are admixed directly with the fuel. The fuel pins consist of erbia rods, erbia pellets admixed with uranium outside, and that gives you improvements in core peaking factors for example.

MR. CARROLL: You said erbia pellets co-mixed with UO2?

MR. KANTROWITZ: The pellets are an admixed -- a mixture of erbium oxide and UO2.

MR. CARROLL: Okay. Okay. I thought, or at least the way I heard it you had erbia pellets and you had UO2 pellets, which seem strange.

MR. KANTROWITZ: Okay. Is that clear now?

MR. CARROLL: Yes.

MR. DAVIS: Excuse me. I noticed your average linear heat flux or power I should say has gone down but the power level has gone up. Have you increased the size of the core?

MR. KANTROWITZ: No. The average has gone down because there are more linear feet of fuel. Before when you have non-power producing pins, those pins don't produce power so you don't count those when you determine the linear heat rate.

MR. DAVIS: So you've replaced those with power producing pins?

MR. KANTROWITZ: Those are the integral pins. They're a combination. That went down by -- the number of pins, power producing pins, goes up by 3.8 percent and then you have a three percent power increase. That leaves you .8 percent decrease in linear heat rate as a result of that.

MR. DAVIS: What is your peak power density now at the beginning of life?

MR. KANTROWITZ: The power density?

MR. DAVIS: Yes, kilowatts per foot. You said that was down from the old design?

MR. KANTROWITZ: That's correct.

MR. DAVIS: Are you like 13 or 12, something like that?

MR. KANTROWITZ: I think it's shown on another slide. I think the number is 10.6.

MR. DAVIS: Oh, okay. Thank you.

MR. KANTROWITZ: Next point is non-positive MTC at all power operating conditions. This is a requirement.

MR. CATTON: What is MTC?

MR. KANTROWITZ: Moderated temperature coefficient. Excuse me. That's a requirement of the FAURD and we've conformed to that.

MR. CARROLL: Do you think that's a good idea? We've run BWRs with positive temperature coefficients for a long time without any real problem.

MR. KANTROWITZ: From a safety point of view, it definitely is beneficial to do that.

MR. WILKINS: But you're paying a price for it. On the whole it's beneficial. The question is, what is that price?

MR. KANTROWITZ: Yes. There is an economic choice there. But on the whole, I think it's beneficial.

MR. WILKINS: Okay.

MR. MATZIE: I guess I could say -- Regis Matzie. It really isn't a penalty with respect to the economics because what you're doing is displacing soluble boron by your fixed burnable poisons early in life to achieve this result and that's not in our mind an economic penalty as long as the residual at the end of cycle of burnable poison has been consumed or is a low value.

With erbium we get a very good burn down and the residual is low. So we get the safety benefit of a negative and moderator temperature coefficient through all operating conditions without any real economic penalty.

MR. CARROLL: But it isn't really much of a safety benefit.

MR. MATZIE: Well, for the ATWS, anticipated transunit without scram, which is calculated at the worst or the most positive MTC, you have much less a significant consequences with a negative moderator temperature coefficient. So we do get a benefit for that postulated event.

MR. SEALE: Well, the price you're paying is essentially the incorporating the mixed oxide burnable integral pin into the reactor in order to get that poison in there, isn't it

MR. MATZIE: We get other benefits by doing that. So it is not viewed as a negative.

MR. SEALE: That's the reason you're able to get rid of the high energy boron.

MR. MATZIE: That's correct.

MR. SEALE: Yes.

MR. KANTROWITZ: Okay. The next point is thermal margin. This plant has thermal margin of at least 15 percent over and above regulatory requirements again --

MR. CATTON: Would you define thermal margin?

MR. KANTROWITZ: Every URD.

MR. CATTON: Would you define thermal margin?

MR. KANTROWITZ: Thermal margin is --

MR. CATTON: I mean you've quantified it by 15 percent.

MR. KANTROWITZ: That's right. That's the --

MR. CATTON: The NBR or something?

MR. KANTROWITZ: That's how much the power level you can run over your plant limit, taking into account required over power margins for safety and instrumentation uncertainties. What's left over is your operating margin and that could be quantified in terms of percent power.

MR. WILKINS: Let me see if I can do that then. You're have 3900 megawatts thermal and 15 percent would add almost 600 more. Let's say -- you're saying you could operate 4500 megawatts, at least for a while, without damaging any of the plant or without pushing the instrumentation beyond its limits, so on and so on.

MR. CARROLL: And not exceeding regulatory requirements.

MR. WILKINS: Yes, and not violating any

regulations. Is that what you mean?

MR. MATZIE: Regis Matzie again. Typically, the reactor cores are limited by, in terms of this parameter, linear heat generation rate or DNBR. ABB Combustion Engineering plants are traditionally and System 80+ also is limited by DNBR. So in reality, this is a DNBR over power margin when you look at the most limiting of the parameters. But I think you're right, Mr. Wilkins, the way you postulated how you could measure that over power.

MR. CATTON: It's the only way that the 15 percent makes sense.

MR. KANTROWITZ: Yes.

MR. CATTON: There was a lot of discussion of other elements that relate to I guess thermal hydraulics in the SER. At some point, are we going to discuss those or is this a good point right here? I looked ahead in your view graphs and then you're off to materials in other areas. Would this be a good place to ask questions?

MR. KANTROWITZ: Well, if you want to get on easier thermal margins..

MR. CATTON: Well, it's not just thermal margins, but things like cooling temperatures and a number of other things that were in the SER, but I don't see any mention of them in your view graphs. Are you going to come back to the subject of thermal hydraulics? If you are, I'll wait. Or is this the last I'm going to see of it?

MR. CARROLL: What do you mean by thermal hydraulics?

MR. CATTON: Anything that has to do with fluid, heat transfer.

MR. DAVIS: Steady state or accident?

MR. CARROLL: But the emphasis today is what's going on in the core.

MR. CATTON: I understand.

MR. CARROLL: Not in the reactor coolant systems.

MR. CATTON: I understand.

MR. CARROLL: Is that a fair statement?

MR. MICHELSON: Well, reactors is more than just a core. I assume it's Chapter 4 today.

MR. CATTON: It's Chapter 4. These were things that came up that are in the SER, discussion in the SER, on Chapter 4. Is this a good place or should I wait? I don't want to screw up your presentation.

MR. KANTROWITZ: Okay. Why don't we continue on and --

MR. CATTON: If you get to the end, and you --

MR. KANTROWITZ: And I haven't addressed your question, we can do it then.

MR. MICHELSON: Along the same line, are we going to discuss core vibration later, too?

MR. CATTON: That's what I was getting at.

MR. MICHELSON: Oh, you're going to get at that one? Okay. Then we'll get to it.

MR. KANTROWITZ: Okay. Another feature is the reduced reactor cooling temperatures as indicated in this RDR and as the table later -- the inlet temperature is reduced from 565 to 556 and the outlet temperature is reduced from 621 to 615, relative to System 80.

MR. CARROLL: What does the fact that OHOFRE is reduced to power to protect steam generators mean in this context? They're, apparently from our bulletin board that we get a status of plant reports, in the last month or so they've dropped back to 98 percent and the stated reason is to prolong the life of steam generators.

MR. KANTROWITZ: Well, one of the changes we've made here is that the steam generator tubes will be Inconel 690 as opposed to Inconel 600, which is much more resistant.

MR. CARROLL: I knew you were going to say that.

MR. CATTON: Is the basic geometry of the steam generator the same as you have at Sentinel for your Palo Verde?

MR. KANTROWITZ: I don't believe so.

MR. MATZIE: Regis Matzie. No, the basic design of the steam generators is very similar to Palo Verde. The System 80, which is an economizer steam generator, we have made a number of improvements in some of the details of the generator because of the start up experience at Palo Verda, and we have already incorporated those into the units we're building in Korea. But the basi : design is very similar to Palo Verde.

MR. CATTON: What about things like the mass flow rates, recirculation ratio --

MR. MATZIE: The recirculation ratio has been increased. So it has better internal thermal hydraulics in the steam generator.

MR. CATTON: So it has higher velocities in the tubal link then?

MR. MATZIE: It has -- I think the answer is probably has some higher velocities from recirculation ratio standpoint. The typical higher velocities in terms of those that have produced problems tended to be across the tubes due flow inlet --

MR. CATTON: And that's exactly what increasing recirculation ratio increases is the cross flow. Have you done anything special to insure that you're keeping your distance from the critical velocity? If you have, I'd like to take a look at it. If you haven't, I suggest that maybe you ought to. I don't hear anything.

MR. RITTERBUSCH: Dr. Catton, this is Stan Ritterbusch. We can check into the record. I believe we had quite a detailed presentation I believe with most of the members of this subcommittee sometime ago on exactly what we've done to the steam generators and how we've addressed these problems, and it got quite detailed with respect to the thermal hydraulics and the analyses for that. So it may be appropriate to -- maybe we can try and get out those transcripts and the information presented at that meeting and that may help understand --

MR. CARROLL: Since that time, however, we've had the Palo Verde problem.

MR. CATTON: I think we're going to need -- most often when we've had such discussions, I have been led down the path where the bottom line is some code that has been written by EPRI. EPRI considers that particular computer code propriety. So I don't know what it is and I would like to see it. Did you use the EPRI code -- I think it's called ATHOS or something -- in your analysis?

MR. MATZIE: We use ATHOS as one of the design codes for steam generators.

MR. CATTON: Could you get me the manual or ATHOS so I can take a look at it?

MR. RITTERBUSCH: We're going to have to check. We believe we are provided at least a summary of the ATHOS code. I think we'll take an action item to find out what we transmitted and to whom.

MR. CATTON: I don't want a summary. I would like something that tells me something about the internals of the code.

MR. CARROLL: You'd be willing to go to Palo Alto and sit there and read it?

MR. CATTON: Certainly. But they have told me that it's proprietary. So if I'm going to go there to take a look at it, it has to be initiated by CE or whoever is using the ATHOS code and then EPRI has to call me and say that I can come and see it. I have been told no.

MR. WILKINS: By EPRI?

MR. CATTON. By EPRI.

MR. MICHELSON: What makes you think CE can change their mind?

MR. WILKINS: They're using it.

MR. CATTON: They're using the code. I think the Staff has to know what's in the code and so do we.

MR. WILKINS: We clearly don't.

MR. CATTON: Does the Staff know anything about the internals of the code called ATHOS that's used to evaluate steam generator behavior? In particular, how they come to the critical cross flow velocity that is directly related to the recirculation ratio that has been increased over past experience?

MR. WAMBACH: I believe for this presentation we don't have the right personnel to know if they would have reviewed it or know about it or not.

MR. CATTON: Could you check and see what the status is on this?

MR. CARROLL: Steam generators are not on the agenda today by the way.

MR. CATTON: I thought that was part thermal hydraulic.

MR. CARROLL: That's why I was trying to pin you down as to what you meant by thermal hydraulics.

MR. RITTERBUSCH: But that's okay.

MR. CATTON: I take a hint whenever I can.

MR. RITTERBUSCH: Thank you for the alert, Dr. Catton. We're check into it from our side.

MR. SEALE: In that regard --

MR. CATTON: What chapter are steam generators?

MR. RITTERBUSCH: Ten.

MR. SEALE: In that regard, though, Palo Verde has also in the process of reducing power, and I understand that it's even a two stage reduction because they wish to increase steam flow in order to try to recoup some of the power loss that they get from that. Apparently, it's within the capability.

But the point is that they're dropping below 600 then I guess ultimately when they get all of these changes made and clearly those are later than the kind of input that had influence on the design of what you're presenting here, and yet it seems to me that's the kind of thing we ought to be concerned with in terms of what the impact of that kind of thing would be on this design and the other things that are recent alterations, if you will, since this particular steam generator got frozen in place. You're nodding your head?

MR. RITTERBUSCH: I was nodding my head because I agreed that we understand the problem, the scope that you're defining. It is a complicated issue. It depends on plant water chemistry, plant operation. We'll try and address that.

MR. SEALE: Fine.

MS. CZARSKI: Maybe it's time we -- you know EPRI has had a steam generator owners group for a long, long time.

MR. CARROLL: I used to be on it.

MR. CATTON: Maybe it's time that we heard from them.

MR. SEALE: Yes, but the problem is that most of the other people are preoccupied with other things. If you look at the tube cracking problems and so forth, the kinds of things that have been observed up in the butterfly of a Palo Verde are almost a no never mind in terms of what most of the people are worrying about when they talk about the cracking thing. So you may get lead off into another set of the woods rather than this particular problem.

MR. CATTON: Somehow I don't know what you're talking about.

MR. SEALE: Well, in looking at the materials problem, the Materials Subcommittee, the problems that most of their efforts are directed towards happen to be the cracks down near the tube sheet rather than up in the butterfly. We have to be very careful we focus what we want to hear from it seems to me.

MR. CARROLL: Again, for a future meeting. But I do have one other point. I know it's nice to say, oh, we've solved this because we're going to use Inconel 690 and much more corrosion resistant. But I bet you if you have dry out up in the top of that steam generator like apparently you have at Palo Verde, 690 isn't going to do all that well.

MR. CATTON: Do you form stuff in the tube sheets so that it clamps the tubes?

MR. CARROLL: You know you get a very concentrated mixture of whatever the impurities are where you have dry out that chemically attacks the tube.

MR. SEALE: Microchemistry. It's very different.

MR. CARROLL: Okay. Back to Chapter 4.

MR. KANTROWITZ: Maneuvering control without changing RTSI for boron concentration. The idea here is that we have changed the control rod design that you could do plant maneuvering on rods alone, which is a benefit as far as wastewater generation and processing.

MR. CARROLL: What is your maneuvering capability?

MR. KANTROWITZ: Step changes, 10 percent. RAM changes 5 percent per minute. Daily log cycles is a common one down to 50 percent --

MR. CARROLL: Down to what?

MR. KANTROWITZ: When you reduce to 60 percent overnight and then come back up, those are the type of maneuvering --

MR. CARROLL: That's without any processing of boracic water?

MR. KANTROWITZ: That's correct

MR. CARROLL: And if you're willing to process borated, you can make bigger daily changes?

MR. KANTROWITZ: The flexibility is there to maneuver in a variety of ways.

MR. CARROLL: Okay.

MR. KANTROWITZ: Also, as I show later extended the CEA lifetime, the change in material, absorbent material going from fluorine carbide to silver in the cavity.

MR. SEALE: CEA.

MR. KANTROWITZ: Okay, we've also made -- talk about some features of the fuel design. As I mentioned, I mentioned already about the integral burnable absorbent erbia. Some of these things are just common state of the art features used in fuel management.

We have a -- the design as presented as natural or low enrichment uranium oxide axial blankets top and bottom of reactant core. We also have erbia absorber cutback regions, in which those pins that have erbia, the erbia is put in the central 120 inches and in the top and bottom 15 inches there's no erbia at all. This improves the axial power distribution, which gives you a benefit in terms of core margin.

MR. WILKINS: Do I infer from that then that you have at least two or three different kinds of pins, some with erbia all the way to the top and bottom and others with erbia only in the central region?

MR. KANTROWITZ: All the pins that have erbia are cutback.

MR. WILKINS: All of them are cutback?

MR. KANTROWITZ: That's right.

MR. WILKINS: But there's also some things that don't have erbia?

MR. KANTROWITZ: That's correct.

MR. WILKINS: So you have at least two different kinds of pins?

MR. KANTROWITZ: Correct.

MR. WILKINS: And I presume you've got some procedures that keep them from getting mixed up?

MR. KANTROWITZ: Yes.

MR. WILKINS: So that you don't put one in the wrong spot?

MR. KANTROWITZ: That's correct.

MR. SEALE: Both within pins and between pins, so to speak, that is to keep the erbia -- the loaded ones separate from the unloaded but also when you're assembling the loaded ones to make sure that indeed you don't wind up scrambling the pellets within there.

MR. CARROLL: From what you have learned about what happened to Seamanns, were there any lessons in your fabrication facility to be learned?

MR. KANTROWITZ: I guess I'm not familiar with that. I don't know if I can answer that question.

MR. CARROLL: They mixed up some enrichments or some burnable poison. I can't remember which and when -- what was the plant? Yes, Clinefield or Robinson, and when they started up they got some very squirrelly looking power distributions at about 30 percent and finally traced it back to the fact that there was mixed up fuel rods.

MR. MATZIE: Regis Matzie. I could make some comment on this. I'm not really familiar -- that familiar with what happened in the Seamann's situation. But we have for many years had fuel assemblies with multiple enrichments in them and we've been controlling that process and to my knowledge have not have any problems in that. But it's a very standard situation with -- our fuel assemblies have multiple enrichments in them.

MR. CARROLL: So had Seamann's and its precursor companies up in Richwood, though.

MR. WILKINS: I guess the problem boils down to are these administrative controls so that there's administrative procedure that you follow that are intended to prevent this sort of situation or are they engineer controls so that no matter how you try you cannot put the wrong pin in the wrong slot?

MR. MATZIE: Regis Matzie again. I believe there administrative controls, both from inspection and from tagging the individual rods correctly and then observing how you're loading them.

MR. CATTON: The down side to making mistakes. It's probably not all that bad. It's just nothing.

MR. WILKINS: It's probably not a significant safety issue.

MR. CARROLL: It'd make the newspapers I bet you.

MR. CATTON: That's a separate issue.

MR. WILKINS: That's probably why it won't happen.

MR. KANTROWITZ: Okay. We've also made some changes in the pellet design in addition and chamfering and, basically, what that does for you is it gives you an increased affect of fuel pellet density, which improves fuel utilization.

We've also increased the maximum fuel rod burn up. One of the ways we've done this is we've -- the cladding is a more highly resistant cladding. And also we've implemented a debris resistant bottom grid. The lower grid in the fuel assembly is designed to more efficiently block the debris that might come up through the flow passage.

MR. CARROLL: What sort of debris is it optimized for? Beer cans or flood and erosion products or what?

MR. CATTON: Bolts that have unscrewed themselves?

MR. KANTROWITZ: I know it has -- the design has smaller flow holes than in the successive grids designed to trap things that might normally progress up the channel.

MR. WILKINS: I think the gist of Jay's question is how large are those holes?

MR. CARROLL: And was there some experience that you had that you made you decide that you needed smaller holes?

MR. MATZIE: Regis Matzie. I believe that our experience over the last -- and I'm not saying how many years -- but 10 years whatever is that the major cause of fuel perforations in operating reactors is because of debris which can collect in the upper grid regions and then vibrate. It's relatively small pieces of materials, but it then wears the cladding and it causes a perforation. So based on all that experience, we have implemented debris resistant lower end fitting, and that we believe will reduce the propensity for that failure mechanism.

MR. CARROLL: The way it's doing it is it's sort of filtering it out there by increasing the pressure drop across the end fitting.

MR. CATTON: And potential for blockage.

MR. MATZIE: The analysis of the design accommodates that potential. This is, basically, all of the features that are being discussed up here have been developed and licensed for reloads for operating reactors and that has all been done with the review of the Staff from the standpoint of topical reports. So we're not introducing any new feature from the standpoint of the current practice. It's just these are the most recent practices and we've taken advantage of incorporating those into the System 80+ design.

MR. CATTON: Doesn't necessarily make them good. How do you decide on the part? Did you size the hole based on some analysis of the flow that will get the particles out of the core? Sort of Stoke's flow or something?

MR. MATZIE: I'm not sure of that, Dr. Catton. We can find out more about what the criteria was for sizing that lower grid.

MR. CATTON: Okay. Thank you.

MR. CARROLL: Did you get that down as a follow up question, Doug?

MR. CATTON: I guess about the same safety significance as Ernest's question but I am interested in how they sized the holes.

MR. KANTROWITZ: Okay. They're also some material -- reactor material features I wanted to mention briefly. These were in response to questions from the Staff. Just summarizing them, we've gone -- the materials for the flow skirt and the seat of motor housing was Inconel 600. We've changed that to Inconel 690, and there was also a question about the right content for welds and we reduced that in the castings and the weld filler material.

MR. CARROLL: In the Staff's FSER, page 4-31, they say, "The applicant states that cobalt based alloys will be avoided except in cases where no proven alternative exist," and I suspect that what's you really did say.

However, when we get off to Chapter 12 later on today, we'll find statements to the effect that there are no cobalt alloys in contact with primary coolant. So I guess while we're at this point is what I just read a correct statement, that you're going to use -- where was I reading?

MR. SEALE: Cobalt 3.

MR. CARROLL: "Applicant states that cobalt based alloys will be avoided except in cases where no proven alternative exist."

MR. KANTROWITZ: The components at issue were CEDM pins and latches and hard facing materials core supports and internal, and the design calls for a cobalt based alloy, such as stellite or a functional equivalent. Right now it's not clear if there are functionally equivalent materials so the option is left open.

MR. CARROLL: Okay.

MR. SEALE: Chapter 12 is the problem.

MR. RITTERBUSCH: This is Stan Ritterbusch. When our speakers from Duke Engineering and Services get here, who will be addressing Chapter 12, we'll try and answer that.

MR. MICHELSON: Yes. Was that same statement intended to include bell trim annulus as well or just reactor components? Anybody want to answer it? Do you understand the question?

MR. RITTERBUSCH: We understand the question. We'll make a -- we'll find an answer.

MR. MICHELSON: Okay, when they come on 12, they may bring it then.

MR. CARROLL: This was specifically limited to reactor components in Chapter 4.

MR. MICHELSON: Yes, but in 12 it sounded like --

MR. CARROLL: It's more general.

MR. MICHELSON: More general. Right.

MR. KANTROWITZ: On page 139 question, absorber type, discreet versus integral, B4C versus erbia. The nominal cycling is the same 18 months. The System 80+ can accommodate 24 months cycle but what we've shown is this 18 month cycling design. The average enrichment weight percent per cycle is about the same. The equilibrium feed batch is smaller. for 96 down to 80 is able to improve fuel cycle and economics, increase burn ups as well, enables us to do that.

We mentioned about reactor coolant temperatures. This is a comparison. 565 in the inlet for the System 80 down to 556 and 621 for the outlet down to 615.

MR. CARROLL: What does the asterisk statement mean?

MR. KANTROWITZ: That's the maximum. That assumes the --

MR. CARROLL: 10 percent. Floodgate allowance?

MR. KANTROWITZ: Thermal design flow rate, which gives you allowance for steam generate too pluggy and crude build up. The best estimate flow rate is higher than the thermal design flow rate, which will reduce the core -- the reactor outlet temperature.

MR. CARROLL: How much higher?

MR. KANTROWITZ: Pardon?

MR. CARROLL: How much higher or how much reduction?

MR. KANTROWITZ: About 609.

MR. CARROLL: From 615 to 609?

MR. KANTROWITZ: That's correct.

MR. MICHELSON: What do the utility requirements document call for in that --

MR. CARROLL: 600.

MR. MICHELSON: Yes, that's what I was recollecting. It was around 600.

MR. CARROLL: But it was not based on Inconel 690 I don't believe.

MR. MICHELSON: I don't know if that's the whole problem or not.

MR. KANTROWITZ: It also mentions the -- one of the items in the EPRI document is core thermal margin and it achieves a 15 percent core thermal margin even with this temperature.

MR. MICHELSON: How are you going to adjust the new RD? Is that going to be a separate discussion somewhere in the SSAR?

MR. RITTERBUSCH: This is Stan Ritterbusch.

Addressing the issue of 600 degrees is a discussion. It has been ongoing between EPRI and ourselves. It is not addressed in CR's DC.

MR. CARROLL: But Carl, they did send out in the package all of the combustions exceptions to the utility requirements document, including this one.

MR. MICHELSON: Yes, but I was wondering how is it going to finally be addressed? Is it going to be a separate section of SSAR or how do we know what they found inside?

MR. CARROLL: I don't know. GE doesn't even do one as you recall.

MR. MICHELSON: Well, that was a different problem for them.

MR. CARROLL: No, I mean a comparison.

MR. MICHELSON: Okay. All right.

MR. RITTERBUSCH: This is Stan Ritterbusch again. It's our understanding that our evaluation of our compliance with the URD will be referenced in the final safety evaluation report. But URD compliance was not a requirement imposed on us by the Staff.

MR. MICHELSON: Are you going to somehow tell us each time that you don't meet the URD requirements so we can discuss them if we think it's important? I mean how do I know when I see a number whether its -- I can't remember everything in the URD. I· there going to be an identifier?

There was a sort of an identifier here in a way. There was an asterisk by the item. But how do we know on other items whether they meet the URD?

MR. CARROLL: Well, if you look at what Doug sent you on January 31st --

MR. MICHELSON: I don't have it in front of me.

MR. CARROLL: Page 15.

MR. MICHELSON: Okay.

MR. CARROLL: You'll find the hot light temperature issue.

MR. MICHELSON: No. My question was in general how do we know whether they meet them or not as we come to various items? Are they going to flag them somehow as not meeting URD?

MR. CARROLL: I don't know what their plan is?

MR. MICHELSON: That was the question.

MR. CARROLL: You can certainly know what the exceptions are by reading this combustion document. It isn't that many.

MR. MICHELSON: Okay.

MR. CARROLL: They've got --

MR. MICHELSON: No, that document doesn't pertain to all parts of the plant? If I understand --

MR. CARROLL: They've got 22 exceptions.

MR. MICHELSON: That's the total for the whole plant? Okay. No other exceptions?

MR. RITTERBUSCH: That bears some discussion. This is Stan Ritterbusch again. The issue of compliance with the URD is what we call a living process. It's an evaluation that's ongoing. As we develop the design end, we'll continue to develop further design detail.

We are aware that there are a number of issues where we have not finalized our design and, therefore, there's a question as to whether we will have a design that complies precisely with URD. Surely, we are going to be talking with EPRI and they have agreed to talk with us and possibly consider changing the URD to address that.

But the point I wanted to bring out is that we will continue to evaluate compliance with the URD and address details. So what I would like to say with respect to the list of I believe it was 21 items that you have before you, that is a list of items where we have made a decision to have a deviation in documented that decision in CR's DC.

Of course, we are continuing to discuss the list of 21.

MR. CARROLL: Two.

MR. RITTERBUSCH: Okay, 22. We are continuing to discuss that list with EPRI, but that represents a status as to where -- a current status as to where we have made a significant design decision.

MR. MICHELSON: Let me ask, Jay, in the case of the ABWR we've agreed that the EPRI requirements just didn't keep up with the review so it was done differently. For the case of System 80+, are we to have seen the EPRI -- look at the EPRI requirements first, then look at the design second, and asks if it meets it?

MR. CARROLL: No. I think it's closer to the ABWR situation.

MR. MICHELSON: It wasn't until later on the advanced reactors that we went otherwise.

MR. CARROLL: And also keep in mind that combustion was a big player in the development of the URD. I mean it just didn't happen off in a vacuum someplace. They were very much interfacing with EPRI. Okay, Mark, you want to go ahead?

MR. CATTON: Before he removes that, what is the -- could you back up just a little bit so I can read your table? You have a mass flow rate and you show it increasing slightly?

MR. KANTROWITZ: Right.

MR. CATTON: Is the core of the 80+ and System 80 geometrically similar, the same?

MR. KANTROWITZ: Geometrically it's the same.

MR. CATTON: Exactly the same?

MR. KANTROWITZ: That's correct. The difference in that flow rate is because of the density --

MR. CATTON: Well, I'm not worry about just that small difference. It's really the velocity that matters when it comes to flow induced vibration. Where is it that you have addressed this or have you or do you assume that based on geometry similarity you don't have to?

MR. MATZIE: Regis Matzie. Let me address that. This fuel is essentially identical to what's being used today in System 80 plants. The reactor internals geometry flow area or etc. are essentially identical and the lead System 80 plant had a full comprehensive vibration program on it. So that was all done.

We see no reason that there would be any change relative to System 80 because we're retaining the geometry and the flow rates, etc.

MR. CATTON: Remember, your System 80 the detailed evaluation sort of came after the fact.

MR. MATZIE: And we've folded in all that experience into this plan. We fed back the experience from start up of those plants.

MR. CATTON: So the subchannel velocities are the same?

MR. MATZIE: That is correct.

MR. CATTON: And your upper internals are the same?

MR. MATZIE: That's correct.

MR. CATTON: Okay. What about the pumps or is that outside this chapter?

MR. CARROLL: Outside.

MR. CATTON: Outside?

MR. MATZIE: The pumps are identical KSB pumps.

MR. CATTON: Including the fixed?

MR. KANTROWITZ: Okay. The last item here is that I mentioned the peak fuel rod burn out has been increased. This is a result, as I said, of several improvements, including the resistant cladding.

A comparison of some derived parameters, moderator temperature coefficient. There was some allowance in the technical specifications for Palo Verde to be slightly positive beginning of the first cycle. System 80+ in conformance with every UDR is not positive at all power operating conditions.

Critical foreign concentrations, 660 for System 80 versus 1000 for System 80+. This was addressed before and represents the difference D4C erbia.

Equal rinse cycle discharge burn up has gone up. It's a batch average, slightly longer cycles in effect for full power days and three percent more power. The average linear heat rate, as I mentioned before, goes down because it's more linear feet of fueling in 80+.

MR. CARROLL: Does this higher boron concentration introduce some new problems in terms of heat tracing or --

MR. KANTROWITZ: No. None at all. It's still relatively low. We've had experience for these levels of boron concentration.

MR. CARROLL: Okay.

MR. KANTROWITZ: The shutdown margin as a result of this CEA changes goes up to two and a half to three percent. I'll discuss that in a minute.

MR. CATTON: Before you get too far away from that slide that I commented on before, I just looked -- you're moving off into other areas. In the chapter for SER they talked about hydraulic instability, in core hydraulic instability. What's meant by a hydraulic in the core? Why do you worry about it? It was 4.4.1.2 in the SER.

MR. CARROLL: If I remember right, it says that they don't worry about. PWR core --

MR. CATTON: I mean I wouldn't have expected them to worry about it at all, yet apparently an analysis was done and then the argument was made that cross flow from subchannel to subchannel sort of took care of it. Well, you don't get much cross flow. I mean I can't understand why it would be looked at all.

But in that it was, I think the reasons for doing away with it were a little bit weak.

MR. CARROLL: 4.4.2.3 on the FSER?

MR. CATTON: That's where they discuss it.

MR. CARROLL: Page 20.

MR. CATTON: And I'm not sure why the SER is written that way. They've raised the question one place and they give the answer somewhere else.

MR. CARROLL: Because I think we've been asked or putting that in FSER since --

MR. CATTON: In those places?

MR. CARROLL: Yes.

MR. CATTON: You've raised the question under one set of numbers and you answer it under another? Okay. And under the DNVR, there's something called a "statistical convolution method." On the surface, those words sound kind of funny. What is a statistical convolution method? Oxymoron?

MR. KANTROWITZ: The method being referred to is a statistical combination of uncertainties, and what that does is instead of assuming that each parameter is its most wounding condition, you would assume a combination and you - - there's some statistical combining of uncertainties rather than a normal worst case stack up.

MR. CATTON: Is there something written on this? I'd like to take a look at it.b

MR. KANTROWITZ: I believe so. I don't know the reference, but this method --

MR. CATTON: I'd really like to take a look at it.

MR. KANTROWITZ: Has been approved by the Staff.

MR. CATTON: Could you get that to Mr. Schultz?

MR. RITTERBUSCH: Yes. And there are two things I think discussed and let's clarify what you're question was on. There's something called statistical combination of uncertainties, which Mark just addressed, and then there's the DNB convolution technique for --

MR. CATTON: Under DNBR, reference is made a statistical convolution method to bring it all together, and that's where you demonstrate that you didn't exceed the DNBR -- what 1.25?

MR. RITTERBUSCH: Okay. Yes.

MR. CATTON: And it says in demonstrating 1.25 is the number that you use in the statistical convolution method.

MR. CARROLL: Actually, what the FSER says on page 4-18 is "The Staff's evaluation of the statistical convolution approach is discussed in Section 15.1 of this report."

MR. CATTON: Oh, so I should go read 15.1?

MR. CARROLL: You haven't got it yet.

MR. CATTON: It's actually CE. I'd like to read to read what CE says, not what --

MR. CARROLL: It's actually referenced, I think, in here.

MR. RITTERBUSCH: I'd like to clarify we're talking two items. One is the statistical combination of uncertainties in order to calculate the compliance with the limit of 1.24. The other is DNB convolution technique. It's a method of evaluating the number of fuel failures and the number of fuel rods that go below 1.24 and what the probability is.

That is what is discussed in -- further in Chapter 15.

MR. CARROLL: That's what Ivan wants to see.

MR. CATTON: Well, there's two parts to it I guess, from what I'm hearing. First, it's the thermal part, and that's where you use this statistical convolution method to handle the uncertainties in your estimate of the DNBR? And then once you have that, you go through some other kind of a convolution method to get the number of leakers? Is that what I heard?

MR. RITTERBUSCH: Yes. I'm not familiar with the FSER so I'm not familiar with the term as you stated it.

MR. CATTON: Oh, you don't use those words?

MR. WILKINS: He didn't use those words. I was noticing very carefully. He didn't use those words.

MR. CATTON: Just clarify. Okay. If he could kind of give me something that would clarify this, whichever words you want to use.

MR. WILKINS: I would like to say this is an area in which a little knowledge is a dangerous thing because I think I know what they're talking about. But I could be badly wrong. So I guess it would be very useful to have Ivan's question answered.

MR. CATTON: It might be something as simple as its square root of the sum of the squares or something.

MR. WILKINS: No, I think it's more like -- the word convolution has a certain bad --

MR. CATTON: Connotation.

MR. WILKINS: Context, the connotation, which Lewis could talk to about ad nauseam if he were here.

MR. CATTON: Another aspect, another question is there is a large table of computer codes referenced in Chapter 4. If this will give you an idea, there's something called torque. There's a digital core protection calculator, C top B, CEA calculator, CE in depth. Have they all been reviewed by the Staff?

MR. MATZIE: Regis Matzie. All of these codes have topical reports, have all been reviewed and approved.

MR. CATTON: And is SERs available on all of them and you've written something?

MR. WAMBACH: Yes.

MR. CATTON: Are there SERs on topicals included?

MR. WAMBACH: Yes, there are SERs on the codes and the topicals in it.

MR. CATTON: Could you put a package together and get it to Mr. Coe?

MR. WAMBACH: Yes.

MR. CARROLL: Of all 23?

MR. CATTON: No. 1-2-3-4-5. Five codes are mentioned and if it's simple, it's a few pages recap.

MR. WILKINS: You want it if it's 500 pages each?

MR. CATTON: Not as badly. I guess I'd like to see the summaries.

MR. CARROLL: Which ones do you actually want?

MR. CATTON: Well, I'd like something that tells me what they are and then from that I could --

MR. WILKINS: Tell them which ones. Is it 1-2-3-4 and 5 on some list?

MR. CATTON: Is there a list here?

MR. CARROLL: Yes. That's the starting of the list on the bottom of the page.

MR. CATTON: I'd like the torque code.

MR. CARROLL: That's one.

MR. CATTON: I don't want C top, and this statistical combination of uncertainties, CEN139AP? I know about the critical heat flux correlations. I guess that's it then. Just the C top and torque. Just the two.

I just have one more question. The heat adjunction thermal couples, what's the time constant? You mentioned, at least in the SER, there were a number of temperature measurements made -- the core exit flame. The heat adjunction thermal couples are used for level.

MR. KANTROWITZ: That's correct.

MR. CATTON: What's the time constant?

MR. KANTROWITZ: I don't recall that. We can get that information if you need it. But I don't recall time constant.

MR. CATTON: Now, my recollection is that experiences [illegible]h the heat adjunction thermal couples haven't been on level, at least they weren't early on because by the time you crank the power through an up and up to give you a good small enough time constant, you can cook them. What's happened in this arena? Can I get a history of the effectiveness of the heat adjunction thermal couples for use as a level device?

MR. RITTERBUSCH: Stan Ritterbusch again. the answer is yes. When the HJTCs were first designed and used and tested there were some problems with the thermal couples. We did change the design and we believe the problems are solved and that was done before the System 80+

design came in. So I think the final product that we have is the one that we believe is adequate.

MR. CATTON: Would it be possible for me to get some information? I'm interested in the time constant and also in the failure rate history.

MR. RITTERBUSCH: Some of that is in the SER, but we will check on it and get something to you.

MR. CATTON: Okay. Thank you.

MR. CARROLL: One DNBR question that I have. What are your capabilities in terms of reduced frequency operation? Can you go down to 55 Hertz without getting into DNBR problems? 58 or what's the design basis? Pump slow down. Oh, okay.

MR. CATTON: I was having a little problem relating Hertz to thermal hydraulics.

MR. CARROLL: It is an electrical coupling.

MR. RITTERBUSCH: I'll take a try at that. We can handle a few percent. We don't have the people here to give a precise answer to that. So it's something that we handle in the accident analysis. But we monitor pump speed and we can handle a few percent drop.

MR. KANTROWITZ: There is a small range that we can cover. I know that.

MR. CARROLL: Well, it's technically been a trip at 58 Hertz, at least on Westinghouse plants that I'm more familiar with. But it turns out you can probably go quite a bit lower.

MR. CATTON: The Westinghouse plants run on a lot tighter DNBR.

MR. CARROLL: Yes, that's true.

MR. CATTON: I haven't seen the CE data since the 70's actually. But typically the type of data they use to get to DNBR is kind of -- has a lot of uncertainty then they put a curve over the top of it. Westinghouse has done a good job of tightening it up. I don't think CE's done anything in the past 20 years.

MR. MATZIE: Regis Matzie. You know we on line calculate DNBRs as part of our core particular calculators.

MR. CATTON: I understand that. But really it's all based on the heat transfer measurements you made a long time ago. Is that -- that's the number you're looking for, the departure from the boiling.

MR. MATZIE: Right. I'm not familiar with how -- what the vintage of all our DNBR correlations. I know we have done testing over the last years --

MR. CATTON: I suspect it ended in about 1976 or 7.

MR. MATZIE: We have done testing with different grids, so I'm not sure if we've retained only that older data. As you change the grids over the course of time, making improvements, you're redoing DNBR correlation tests.

MR. CATTON: But the reference I found was 1976. So I'm just operating under the assumption you haven't done much since.

MR. RITTERBUSCH: That's a correct assumption.

MR. CATTON: And you're living with 1.24 as a result.

MR. RITTERBUSCH: That's correct.

MR. CATTON: I think there's lot of margin.

MR. KANTROWITZ: At this point, the minimum DNB at nominal conditions is 2.0 to give you an idea where you are relative to the 1.24 limit.

MR. CARROLL: Okay. Moving on.

MR. KANTROWITZ: Okay. I was about to show a comparison of the CEAs System 80 versus System 80+. We have three types of CA that full strength with 12 fingers, full strength with four fingers, and part strength with four fingers. That's in System 80+.

The full strength are used for shut down primarily. Those are B4C. Those obviously don't go in the core very much. The full strength four fingers used to be B4Cs and now we've changed the absorbent material to silver and indium cadmium, which has better or the swelling problem associated with B4C has been reduced or eliminated. So that enables us to extend the life of the CAEs.

The four finger pulsating CAs are what are in the regulating banks and we would use those for plant maneuvering.

The part strength rods are Inconel rods. Those are independent banks that you use for axial power distribution control, and those are used in lieu of the part wind rods that were present in the System 80 design.

The feature of part strength enables you to do this maneuvering without using soluble ore, which you couldn't do before.

MR. WILKINS: Is there a difference between strength and length on your chart?

MR. KANTROWITZ: Yes, there is.

MR. WILKINS: Then, will you clarify that then for me?

MR. KANTROWITZ: Certainly.

MR. WILKINS: Part length and part strength.

MR. KANTROWITZ: Okay. The full length -- let me just say full length first.

MR. WILKINS: You don't have any full length up there.

MR. KANTROWITZ: Let me clarify then.

MR. CARROLL: They're all full length.

MR. KANTROWITZ: In System 80+ they're all 150 -- they're all the full length of the active core. There are two different types. There are part full strength and part strength. Okay. The full strength is either B4C or silver indium cadmium as the absorbing material. Those are strong absorbers.

The part strength are also full length but they have a weaker absorbing material, Inconel. That's System 80+. Okay? In System 80, the one that I left out, part length -- there was absorber material, B4C, only in 50 percent of the CEA.

MR. WILKINS: That's a very lucid explanation. Thank you.

MR. KANTROWITZ: I wanted to touch on the issue of reactor vessel fluence. Okay, there's some features that we've implemented in System 80+ reactor vessel to improve its life and the resistance to embrittlement. One of those is ring forged fabrication, which eliminates belt line welds. That's -- the System 8 vessel was plate weld.

We reduced the copper content, which improves resistance to radiation down by about 50 percent or so as an impurity, and we've reduced the initial RT NDT from 40 to 10, which increases the margin for brittle fracture. And we've also implemented a low liquid fuel management scheme. This is something that we do not only in System 80+ but this is typical for our operating plants, which reducing the fluence at the reactor vessel

MR. CATTON: Before you leave that, at the SMERT Conference in August, there was a paper that the copper content was not all as important as it was once thought to be. Are you familiar with that work?

MR. KANTROWITZ: No, I'm not.

MR. CATTON: Second, there was some work done -- and I believe it's from Oakridge. Matter of fact, Oakridge practically ran the sessions at the SMERT Conference. They are arguing that the three dimensional temperature field that results when you get into the -- when natural circulation stops and your ejection is on and the cold water runs into the funnel into your analyst, the three dimensional temperature field is very important in determining what the local stresses are.

So that the kinds of analysis that has been done in the past is not conservative as you once thought it to be. Are you familiar with any of this?

MR. KANTROWITZ: No.

MR. CATTON: It's the Staff. Staff supports the work. So maybe I shouldn't even -- are you familiar with this?

MR. WAMBACH: Yes, our materials reviewer is not available for the meeting today.

MR. CATTON: Could you have him take a look at this?

MR. WAMBACH: Yes, I will

MR. CATTON: This is based on the Oakridge work. They found that the three dimensional affects because, you know the cold flume runs down the wall of the tank and that's not a one dimensional problem. You have circumferential temperature variation as well as axial, and it's really a three dimensional problem. And apparently they've looked at it and they've also done some experiments.

MR. WAMBACH: And you think that is -- oh, go ahead.

MR. CATTON: I think that should be brought to bear at this stage.

MR. WILKINS: Is the implication that there's a decrease in the margin to failure --

MR. CATTON: Yes. One, reducing the copper content may not do what they think it is doing. That's based on one paper that was at the meeting, and second, there may be something that pushes it in the other direction, particularly if the worst case is when they have the cold water just running down into the annulus when there's no natural circulation.

MR. KANTROWITZ: On the next slide, I will show the kind of margin that we do have and I don't know the impact of the issues that you're raising is.

MR. CARROLL: Speaking of the SMERT Conference, Ivan, I found your paper very interesting for your group report but not very timely. How is it that you went to the conference in what?

MR. CATTON: August.

MR. CARROLL: Wrote the report in October and I didn't get it until last week?

MR. CATTON: Well, because the -- is this the place to discuss this?

MR. CARROLL: No.

[Laughter.]

MR. WILKINS: I was going to raise that issue myself. That's a ministerial question for the committee perhaps.

MR. CATTON: I think that's a question for our chairman to look into and has nothing to do with the committee because the data that's on it was the date that it arrived to this building. But an offer was made to do some editing for me and I'm sure the editing made the reading much better. But I don't think it changed the principle part of it.

MR. CARROLL: Yes, the next thing I was going to do was commend you on improving your writing.

[Laughter.]

MR. CATTON: Well, you see, it's been on -- the report has been available via the bulletin board since the

27th of October, particularly in this area.

MR. KANTROWITZ: Continuing, this slide shows -- or this summary of the lifetime fluence prediction with the reactor vessel and the bases for that is based on low fuel management to these calculations showing 1.5 -- 1-5 actual peaking factor, which is an enveloping of a long term operation.

Uncertainty factor of 30 percent, etc. You can see what they are here. 60 of plant life times an 80 percent capacity factor, and the lifetime fluence prediction is predicted to be less than or equal to -- that little bar is missing -- 6.2 times 10 to the 19.

MR. CARROLL: I remember the Staff coming in a year ago maybe and talking to us about a new reg guide or something or other that was going to standardize how one goes about calculating vessel fluids. Is this done with the latest and greatest Staff improved techniques?

MR. KANTROWITZ: Staff has approved our methods of calculating the fluence. It's been fully explained.

MR. WILKINS: That's a very nice non-response to the question asked. But I suspect you have to ask the Staff rather than this gentleman.

MR. CARROLL: Yes, I'm looking.

MR. WAMBACH: Well, the calculation was reviewed by our reviewer that is probably involved with the reg guide development. But I've been told that the reg guide has not been issued. But the reviewer that's involved with it did the review of the fluence calculation for System 80+.

MR. CARROLL: Okay. That's a good answer. Thank you.

MR. KANTROWITZ: Okay. Then the last one shows that the maximum predicted RT NDT is 89 degrees up, which is in compliance with the screening criteria of 10 CFR 50.61 with ample margin.

I also wanted to raise the -- just briefly discuss issue of nuclear fuel system ITAAC. There's a -- ITAAC is Inspection Tests Analysis and Acceptance Criteria. I assume people are familiar with that.

MR. CARROLL: We know that. We've been there.

MR. KANTROWITZ: There's a single ITAAC in the nuclear fuel system and that's preserved by basic configurations. That's in agreement with the Staff position. In addition, a number of limited selected fuel initial for design changes have been permitted. Those are composed of both design features and evaluated parameters, and we've also specified acceptance criteria for those, what the bounds are on those. The Staff has agreed with the procedure and the acceptance criteria.

So in conclusion, you can say that we have a core design which has been approved by the NRC with no open items in the FSER. This concludes my presentation and I'll be happy answer any questions.

MR. CARROLL: I'm looking at page 4-5 of the FSER, and I come across a statement that's talking about the absorber pellets and it says, "The B4C pellets are 74 percent theoretical density with the exception of the lower portion of the element, which contains reduced diameter B4C pellets wrapped in a sleeve of Type 347 stainless steel (felt metal)." What is felt metal? The Staff wrote it. Maybe they have to answer the question. F-e-l-t.

MR. KANTROWITZ: It's a combination of -- well, go ahead, John.

MR. CATTON: It's sort of like the -- remember in -- oh, you weren't with us when we visited KFK. They have filters made of stainless steel felt. It's like cloth.

MR. CARROLL: Okay.

MR. CATTON: It's the strangest material you've ever held in your hand.

MR. CARROLL: I'm not sure about that.

[Laughter.]

MR. CARROLL: Okay. Now we know what felt metal is.

MR. KANTROWITZ: Thank you very much.

MR. CARROLL: I'm just looking for some other pages where we haven't covered things. Okay. Got that one.

Okay, I've been through all mine. Anyone else have any questions of Mark?

[No response.]

MR. CARROLL: I guess it's midmorning and we ought to take our midmorning break. So let's be back by 10:30 by that clock.

[Recess.]

MR. CARROLL: Let's reconvene. Okay. We're going to now take up Chapter 14, "The Initial Test Program"

MR. REC: Yes, will move the initial test program which was scheduled for later on today. We move it up the second presentation here. I'm John Rec from Combustion Engineering, ABB Combustion Engineering, and I'll go over the Chapter 14 aspects of the SER.

MR. CARROLL: What's your background, John, that makes you smart enough to tell us about initial test programs?

MR. REC: I have a -- I've been with Combustion about 20 years. I've been part of the design group for originally the core design reactor physics design group for about nine years and have been in the start up department for about 11 years at Combustion.

MR. CARROLL: So you've seen a start up?

MR. REC: Seen a few, yes. Participated in the start up of the three Palo Verde units. I am now involved to some extent in the Korean units and their start up and also with the -- well, I light the reloads on other plants.

MR. CARROLL: Okay.

MR. REC: Just to introduce it again, Chapter 14, "Initial Test Program." The -- actually Chapter 14 now has three sections. 14.1, which is the PSAR doesn't apply here. What I'll be addressing is 14.2, which is the initial test program description, and 14.3 is a new section, which is the certified design material, and we won't be covering that today.

MR. CARROLL: Now, 14.1 is what, something that existed in Part 50 licensing --

MR. REC: Exactly.

MR. CARROLL: And you just don't have it for a Part 52 applications?

MR. REC: Well, it's the preliminary safety annulus report where we're going directly to the final safety analyst report.

MR. CARROLL: Got you.

MR. REC: The basis for the program, initial start up program, is Regulatory Guide 1.68, Revision 2, which contains the requirements, regulatory requirements, for a start up program for the water cooler reactors. This is supplemented by the Standard Review Plan for Chapter 14, and in addition, there are supplementary reg guides. For example, 168.2, which is shut down outside the control room, and there are a number of these that are typically referenced out of 168 Rev 2.

We also include requirements for system designer that performance data, etc, which are incorporated in the test program and it's supplemented also by industry standards, IEEE standards, ANSI standards, ASME code requirements, etc. So that's the basis for the initial test program that we've described in Chapter 14.

This slide sort of summarizes where we are. The basis for the program is the experience that we've had for all our NSSS systems, Nuclear Steam Supply Systems. We've expanded that to include the balance of plant for the System 80+ plant, which is an essentially complete plant design. So we've expanded it with additional test requirements for systems which are typically balance of plant systems.

In this program, we've included the start up experience from the Palo Verde Unit 1, which is a first-of-a-kind plant -- went through extensive testing -- followed by Units 2 and 3, which are the follow-on units, Palo Verde being the System 80+, which is sort of the precursor for the System 80+ design, and we've supplemented that with the experience of Duke Engineering and Services and Stone and Webster in the balance of plant area.

We've also included testing of unique System 80+

features. I'll give you an example: rapid depressurization system. In addition to that, we've incorporated wording which supports the Tier 1 ITAAC test commitments. This did not introduce new testing into the program but just introduced wording which clarified a little better the relationship between Tier 1, the ITAAC test commitments and what we're doing in Chapter 14, the initial test program.

MR. CARROLL: Now, your example of rapid depressurization system, is it intended that you're going to fire that thing off of --

MR. REC: No.

MR. CARROLL: What does that mean then?

MR. REC: It means that we're going to verify the flow paths, verify the capability to depressurize but not actually fire it off under a -- this program is transferred to the utility or the COL applicant through vendor provided test guidelines, which we provide and the AE provides to the utility, who then transfer those into detailed test procedures, and this is a commitment in the Chapter 14. The overall program has been reviewed and approved by the Staff and we have no issues at this point.

MR. CARROLL: I think I found some contradictory statements in the Staff's FSCR. Maybe you can help me out. On page 14-3, second to bottom paragraph, it talks about testing plateaus of 20, 50, 80, and 100 percent. Then later on on page something or other here, 14-8, the Staff describes the arguments that Combustion made that since this is a follow-on plant, 50 and 100 percent is all that 's required and they conclude that that's acceptable, which isn't.

MR. REC: I think -- I'll let Frank address that -- but I think we do testing at 20, 50, 80, and 100 percent and we have various plateaus, and we do -- typically tests are identified for each of those plateaus. But on a follow-on plant certain tests can be eliminated at certain plateaus because of the experience that we've had in a first-of-a-kind plant, and that's really what I think they're addressing there.

But that's not generally true. There are testing that's done at every plateau for certain tests.

MR. TALBOT: The Staff --

MR. CARROLL: Wait a minute. I guess I'm misreading something. On 14-8 it's talking about reactivity coefficient testing, not testing in general.

MR. TALBOT: The Staff has that same interpretation between first-of-a-kind and follow-on plants. First-of-a-kind do have more testing plateaus and then with the follow-on, you do at it 50 and 100 percent.

MR. CARROLL: I was misreading this. Page 14-7, Section 14.2.6 talks about test records. I'm curious about what the regulatory basis is that requires that test records be retained for the life of the plant. Where do I go to find that information?

MR. TALBOT: QA Requirements, Part 50, Appendix B I believe.

MR. CARROLL: They don't explicitly say that, do they?

MR. ARCHITZEL: This is Ralph Architzel from Projects. But there is -- in QA I, two requirements have daughter standards. It used to be 4529 but they've transgressed into other daughter standards.

They have record retention requirements in them and they'll be required of the COL applicants Quality Assurance Program.

MR. CARROLL: Okay. That's where. Sure. What kind of air system testing requirements does Reg Guide 1.68 now require? Are you going to have to do a total loss of instrument kind of test in this plant?

MR. REC: Yes. We're planning to check the response of valves, etc., to a loss of instrument air. That's a commitment in the test abstract, and maybe a -- in other words, the response of a particular valve to a loss of instrument air will be tested as part of the test of that system.

MR. CARROLL: Okay. But I'm worrying more about some of the strange things that happen as the total air system bleeds down as a result of a broken line or something happening. You can -- the sequence to which things go to their failed position can cause some interesting things to happen in a power plant.

MR. REC: Exactly. Well, we're -- I guess I should say, and please correct me, the instrument air system is not a safety related system here for the System 80+. But in general, the testing would include a loss of instrument air.

Now, the specific details of how you would implement that in a test program would be --

MR. CARROLL: There's a big difference between taking instrument air off of a valve and bleeding the whole system down.

MR. REC: Yes.

MR. CARROLL: Your guidance is that you're going to leave that up to the COL holder?

MR. TALBOT: Well, the requirements for instrument air are stated in Reg Guide 168.3, which is a replacement for an earlier reg guide, and in conformance with that I think we'd have to follow those regulatory requirements.

MR. CARROLL: Okay. I think that one does require the bleed down test I'm talking about.

MR. TALBOT: Yes.

MR. CARROLL: Okay. I'm on page 14-21 of the FSCR, and I'm looking at an Item 1.0(1), titled, "Reactor Component Equipment Operability at 100 Percent Load," and this thing then begins talking about a containment polar crane test. I guess -- okay. This is 100 percent load test on the crane. All right.

I guess I was reading this very quickly and -- why don't you say what it is? It almost sounded to me like at 100 percent electrical load and was going to tell me something about reactor components, and what it really is talking about is a crane test. Why do you call it a crane test?

MR. TALBOT: We can modify the SAR or the FSCR to specifically state that.

MR. CARROLL: I'm on page 14-33 and I guess in response to some Staff comments, Combustion put in a requirement that one needs to verify the security radio system functions properly at all locations throughout the plant. I've never found a radio system that would meet that requirement.

MR. TALBOT: Specifically, where in the FSCR are you reading?

MR. CARROLL: I'm on page 14-33, last page. Normally, you'll find some places in the plant that are so surrounded by concrete and whatever that radios just simply won't work or maybe I'm out of date on my radios but at least that was my experience ten years ago.

MR. TALBOT: Reg 2 of the reg guide does have this specific requirement that this be tested.

MR. CARROLL: At all locations throughout the plant? That's what bothering me.

MR. TALBOT: With respect to what the Reg Guide 168 Rev 2 says, it does -- I'll go back and reverify that, but I believe that's with respect to Reg Guide 168 regulatory position that CE had to address.

MR. CARROLL: Okay. And all I'm saying is I don't think physically you're going to be able -- anybody is going to be able to do that. So maybe the reg guide needs changing or interpreting.

MR. TALBOT: It is a 1978 version.

MR. CARROLL: Well, those are all the comments I had. Any of the other members have things they want to bring up with regard to the initial test programs?

MR. SEALE: We've had situations where in the past certain kinds of -- particularly one challenge in the lifetime kinds of equipment -- isolation valves, things like that -- were tested but not under the conditions it would actually pertain if you had a bona fide accident.

Have you gone through and identified any such equipment that you have where you're concerned that the test envelop that you traditionally used is really insufficient to the let's say the 1.0 type assurance that you might like to have, and have you modified any of the test environments to try to address some of those issues?

MR. REC: We have made a specific commitment and let me just give you the background of this. That was a heavy emphasis on the part of the Staff when we were going through not only the Chapter 14 but also the ITAAC commitments.

I think it was concluded that the combination of type testing that you would do for a valve under the conditions that it's supposed to operate, for instance, and the conditions that you can attain during pre-operational conditions, is about as far as you can go in terms of testing the valve or whatever component you're talking for its expected conditions.

I think to answer your question, yes, we have looked at that very carefully. But I don't know whether there is a testing solution to that. There is a -- we have a very comprehensive Section 11 ASME testing, etc, that tries to adjust that. But you cannot in all cases --

MR. SEALE: Sort of re-rationalize it, so to speak?

MR. REC: Right. We made sure we covered it to the extent that we possibly could with frequency of testing, conditions for testing that are achievable, etc. So I mean we've done the best we can on that without --

MR. SEALE: Well, let me turn the coin over and ask you a slightly different question then. You've been careful that you have not committed the COL applicant to tests that right now you don't know how one would actually go through and do those tests. You haven't, if you will, over committed your COL applicant to do the impossible?

MR. REC: That's -- I believe that's true, yes. We've made a very conscious effort not to do that and I think in conjunction with the Staff with the realization that you cannot over commit in some of these cases.

MR. MICHELSON: I guess, though, you did commit to requirements of generic letter 8910 on the valves?

MR. REC: Yes.

MR. MICHELSON: Which will require prototypical testing of certain of the valves, but not necessarily the one you actually have installed in the plant?

MR. REC: Right.

MR. MICHELSON: But the one that you've installed in the plant, of course, must be essentially identical. It just doesn't have had its blowdown tests. All of that's i there already so I think they've covered as far as you can go, at least in the case of valves. In pumps it's a little different kind of an issue, but it doesn't at least have these extreme conditions that the valves might see in some cases.

The key, though, is making sure that the FSCR really identifies the extreme conditions that the component may have to face so you can properly adjust the motor operators and things of that sort. I haven't had time to look at your SSAR, but I assume all those extreme conditions are identified in there. You don't have so many as ABWR has to begin with.

MR. CARROLL: It's more than adjusting the operators. It's sizing them right in the first place.

MR. MICHELSON: Oh, yes, that you make sure of, of course, because you do have to do the prototypical test, which has -- and you change the operator then you haven't got a valid test any more. You go back and do another one with a new operator. You can't fine tune these things after the fact too well.

But with proper commitment to that, should be no question I guess. So far I think everybody is together on that. What cases have you found that have a need to isolate under extreme blowdown condition other than auxiliary feedwater? Are there any others?

MR. REC: Conceivably, rapid depressurizations system would probably have to --

MR. MICHELSON: Yes, that's all inside a

containment.

MR. REC: Are you saying outside?

MR. MICHELSON: Outside a containment. That's where you get in trouble if you don't isolate. Inside you've already -- can't isolate a lot of breaks. But outside you do have to --

MR. CARROLL: But if you have some spurious actuation, for example, of the rapid depressurization system, you darn well want to be able to isolate it.

MR. MICHELSON: You'd like to intercept it?

MR. CARROLL: Oh, yes.

MR. MICHELSON: But you already not to intercept, though. You're ECCS will handle it even if they aren't intercepted.

MR. CARROLL: You'd have to assign that way because that's why it's in there, to do it, rapid depressurization when the need exists. But the rest of the time, you're trying to protect the plant. But it isn't a disaster if you don't. Just cost money.

Any more questions on the start up program?

MR. REC: Thank you very much.

MR. CARROLL: Let's see. We didn't have any pending questions, did we, Doug, on Chapter 14?

MR. MICHELSON: Are you going to do the ITAAC later? Is that the idea? Are you going to do the ITAAC portion later?

MR. CARROLL: I actually looked at it and it seemed to me that it reflected what was presented today and reflected what's in the SSAR so I guess I think it's done.

MR. SIEGMANN: Good morning. My name is Dr. Siegmann. I'm with ABB Combustion Engineering and I will be talking about Chapter 17, "Quality Assurance," and more particularly Chapter 17 contains the D-RAP.

I've been with Combustion Engineering over 20 years and have spent the last 14 years in the reliability analysis group. I came out of safety analysis before that.

Just briefly summarize, Combustion Engineering has a quality assurance program that meets the objectives of the all the current standards. It is described not in CESSAR but is described in the topical report, CENPD-210A, and that has been approved by the NRC.

Our QA Program is currently in use on new construction projects. We have -- we are building four reactors in Korea and negotiating on another two and we have an active real reactor design and construction program. Currently, there are no open items currently on our QA Program.

MR. CARROLL: In reading the Staff FSER, they're talking about Combustion's organization or four organizations that are involved in nuclear systems or comprise nuclear systems. What is Newington Operations?

MR. SIEGMANN: Our manufacturing facility up in Newington, New Hampshire. They construct a lot of our reactor internals and other components.

MR. CARROLL: Okay. Thank you. Let's see, before we get to that, I also noticed on page 17-2 of the Staff FSER, about the middle of the page, the Staff says that, "The applicant is committed with the applicable portions of NQAI" dated such and such and then QAII, "with an exception as noted in the topical report." That lead me to ask the question, what is the exception?

MR. SIEGMANN: I'm afraid that I cannot answer that.

MR. CARROLL: You see where I'm reading.

MR. ALLENSPACH: We'll see if we can get you an answer for that?

MR. CARROLL: Okay.

MR. WAMBACH: We'll have to check with the topical report reviewer, who's no longer with NRR.

MR. CARROLL: On the next page, on 17-3, the Staff says, "The QA Program provides the system design control." But the certification is much more than just design. Shouldn't you broaden that a bit to include the other things that are included in certification, like start up testing or construction or procurement? I'm on the paragraph in the middle of page 17-3.

[No audible response.]

MR. CARROLL: It may be just in the context that I'm reading it, but it is talking about procedures and instructions and --

MR. ALLENSPACH: Well, I think the procedures and instructions, to the extent they were applicable, because in -- but in a case like this, when you're looking at procurement, you're really only looking at that procurement that would relate to the design items that they might go out unprocured.

MR. CARROLL: Okay. Well, it just jumped out when I was reading it. Maybe it's okay as it is.

MR. MICHELSON: By procured design item did you have in mind the consulting service or something they might have used in preparing the SSAR?

MR. ALLENSPACH: Yes, that's correct.

MR. CARROLL: Why is it okay for hydrogen igniters to be Quality Class II? I'm on page 17-5.

MR. SIEGMANN: The hydrogen igniters are designed for severe accidents and as far as quality assurance goes they're Class II because they're not to fall on anything else that's Class I.

MR. RITTERBUSCH: This is Stan Ritterbusch. I would like to add to that. I think Eric gave at least --

what he said was correct. It's a judgment on the part of Staff and ABB Combustion Engineering at to how important the igniters are to the safety of the plant and there are specific criteria as to how to identify and put items in the Quality Class I.

Simply put, it would be those instrumentations and equipment required to meet the historic design basis accident analysis, and when we address severe accidents we recognize that this equipment required solely and only for severe accidents is important to plant safety but it is not, shall we say, evaluated on the same ground rules that the design basis equipment is and, therefore, we have recognized there is a category of equipment somewhat below Quality Class I and we've called that Quality Class II.

MR. CATTON: What about the hydrogen rule?

MR. SIEGMANN: I'm sorry. I didn't hear that.

MR. CATTON: What about the hydrogen rule? Doesn't that sort of take, even though hydrogen is the result of severe accident, doesn't it take it out of the same --

MR. RITTERBUSCH: We meet the hydrogen rule, and we've been through that and some --

MR. CATTON: Let me pursue that a little further. If igniters are necessary to meet the hydrogen rule, does that put it back into Category I?

MR. RITTERBUSCH: WE believe not. The Commission --

MR. MCCRACKEN: If you recall SECY 90016, we treated everything for severe accidents as something that did not have to meet the redundancy, the QA requirements that you had for difficult DBA. We said you had to provide -- and I'll use the word reasonable but I know that wasn't the right word. You have to provide some level assurance that it will operate.

MR. CATTON: But 90016, if I recall, the hydrogen just refers to the rule.

MR. MCCRACKEN: But the rule doesn't talk about the quality classification of the components you have to have. That's an interpretation of what we've done for the rule. We've done that at operating reactors also.

MR. CATTON: Okay. I don't understand it, but okay. I mean if you have to meet the rule, it seems to me that you ought to have First Class things in there to do the job. If you -- it's a different kind of rule than the other rules.

MR. ARCHITZEL: This is Ralph Architzel from the Staff. I guess I'd like to say that the safety related, the classical safety related definitions are out of Part 100 and don't include necessarily all the rules but includes the subset of equipment in Part 100 design basis specific accident analysis regarding the event -- it still comes out of Part 100. We haven't changed the definition of safety related in that context. So I think that's what we're talking about here, what is safety related and not things like for a rule, important to safety or severe accident type of features.

MR. MICHELSON: According to safety and safety related are something you fellows have never really finally defined for sure because you been using it inconsistently and I think still use it inconsistently. So it never helps me much to say this is important to safety versus safety related because I can't go back and find the set of rules that go with important to safety and another set of rules that go with safety related because you've been inconsistent.

Maybe you'll try to straighten it out eventually and may get there but --

MR. CATTON: It always works as an answer because you don't know what to say when they say it.

MR. MICHELSON: Yes, yes. But it is an answer that's unacceptable in that sense, that we don't know what important to safety requirements are. Can you give me a set of requirements when you call something important to safety and here's the thing you need to meet?

MR. ARCHITZEL: I guess what I was trying to imply is that this particular equipment is not safety related. I don't want to get into important to safety. But we don't consider this equipment safety related. In that regard --

MR. CARROLL: So it has quote marks around it?

MR. ARCHITZEL: Right. It's not safety related. I don't want to get into what you need for important -- I think Conrad was trying to get into.

MR. MICHELSON: But you put into that in your answer and that's what threw me a little bit. At least I thought I heard you talk about important to safety.

MR. ARCHITZEL: Because we consider this in that set of important to safety.

MR. MICHELSON: Yes, but there isn't a prescription on what the requirements are.

MR. ARCHITZEL: 90016 gave us direction.

MR. MICHELSON: No, it didn't give you the prescription. It did for one particular case.

MR. ARCHITZEL: It said it was not safety related. It did say that much, and then it said the other things like reasonable assurance and those type of features.

MR. MICHELSON: Could I go back to the QA Program for just a moment? There's is this CENPD-210, which is apparently the CE's internal QA Program. This is a question for CE actually. Was that internal program used now to control all aspects of the development of the SSAR?

MR. SIEGMANN: No. The QA Program really covers safety related SSCs. Not everything is included in QA Program.

MR. MICHELSON: Now, when you're writing up your SSAR, which I guess that's what you call it as well, if there was a safety related item, then it was under the full QA Program and the process of developing the design requirements, the design basis, the whole thing? In other words, you used competent people to do it and you had somebody independently check it and all the other good things. Was that the case when you wrote your SSAR?

MR. SIEGMANN: Yes, for most of it.

MR. MICHELSON: Well, that's not a good enough answer. Either you are under the program or you aren't. There's nothing in the program says that it's optional. If you're under the program, you do what a program requires. If you're not, then you do whatever you want.

MR RITTERBUSCH: This is Stan Ritterbusch. I'd like to correct Eric's response. The answer is yes. We follow the program for CR's DC.

MR. MICHELSON: Now, and I think the other part that I've wondered about, in the cases of what's in the SSAR that is not safety related and there's a fair number of things that aren't, were those under any kind of a QA control or what do you do for this lower grade of safety significants and how do you handle them?

MR. RITTERBUSCH: All of the material in this SAR is under an internal program for control of SAR packages and that involves level of review and so on and so forth. The report that we reference here is the program description. In addition to the topical report that Eric referenced, we have detailed internal procedures.

MR. MICHELSON: Well, I'm sure you have a number of those. But in the case where it is safety related, I am assured that's under a full QA control?

MR. SIEGMANN: Yes.

MR. MICHELSON: Okay. That's the main thing. Thank you.

MR. SIEGMANN: I'd like now to discuss the D-RAP Program. The program plan is in CSAR, Section 17.3. D-RAP stands for Designer Reliability Assurance Program. It's objectives is to basically provide guidance to the designers on the risk importance of certain systems, structures and components, gives some guidance to the COL applicant, and provide some reasonable assurance that the design and the PRA are consistent.

MR. CARROLL: How do you do that?

MR. SIEGMANN: Well, we do it numerous ways and it's an ongoing program. One of the things we've been doing is the PRA and the D-RAP Project Manager are intimately involved with the design. We attend every design meeting, which are every week. The other thing we are doing is we've generated -- well, let me just -- we'll go into that.

MR. CARROLL: Well, let me tell you where I'm coming from. In reading the Staff's FSER, they seem to think that you go and do a PRA and you conclude, for example, that a train of auxiliary feedwater has to be ten to the minus 3, and given that information a designer can say, oh, the system's got to be that reliable. So I'll pull out my catalog and I'll find a pump and a valve and a circuit breaker that all fit together to do that, and that's nonsense.

MR. SIEGMANN: That's nonsense.

MR. CARROLL: Furthermore, it seems to imply that once this plant is built the operator is then going to be able by some magic to look at his operating experience and say, oh, hey, that's great. This train of auxiliary feedwater is doing better than ten to the minus third. There ain't no way he's going to do that.

MR. SIEGMANN: I agree. I agree.

MR. CARROLL: So what is this nonsense called RAP?

MR. SIEGMANN: Okay. It's very -- my interpretation of it it's very simply this. We, based on a combination of engineering insight and the PRA, have identified some systems, structures, and components that we believe are important to either prevent or mitigate accidents and we have basically wish to tell the designers of our findings and hope -- tell the designers of our findings, make sure the designers are aware that this component, for instance the CBSC System, has been identified as being important, and that's the extent of it.

Now, we give them a little more information than that. We're actually giving them from the PRA the dominant failure mechanisms, that is our findings of how we think it will fail. So that the designer is aware of this as the designer continues to work on the design.

Well, we do not envision the designer getting involved at all in the qualitative assessments of reliability.

MR. CARROLL: Quantitative.

MR. SIEGMANN: I'm sorry. Quantitative assessments of reliability. It's not their job.

MR. CARROLL: Well, you also need to make sure that he's not overreacting to what you tell him because he may say, well, these guys know a lot more about reliability than I do and yet you haven't really gone down to the piece part level in a lot of cases and he could be very badly mislead by that.

MR. SIEGMANN: In general, our fall trees are down to the components. But also, we meet with the supervisors of the design groups on a weekly basis and they know us and our capabilities and the respect we should get in terms of detailed design. So I'm not concerned about the designer drifting off.

MR. CARROLL: Okay. What do you make of a statement that says what you're going to provide the COL applicant to be a lot of information so that he's going to be able to track equipment reliability to demonstrate -- that means to me to quantitatively demonstrate -- that the plant is being operated and maintained with an acceptably low risk consistent with PRA assumptions? You believe he's going to be able to do that? I'm reading on page 17-9 of --

MR. CORREIA: This is Rich Correia of the Staff. Since subsequent discussion on RAP, we have revised the language in the FSER, DECE, and SECY papers to state that the reliability of the equipment should be tracked to provide reasonable assurances that its performance or condition is consistent with the assumptions in the PRA.

MR. MICHELSON: What's that mean, reasonable assurance?

MR. CORREIA: For example, if the PRA assumes a certain unavailability of a train of aux feedwater that the performance monitoring tracking of actual unavailability would be compared against what was assumed in the PRA.

MR. MICHELSON: Well, what are you going to do in a case of valves, which, of course, behave quite differently when you nominally cycle them for an in service test as opposed to you have a demand and now the close are quite different, the conditions are quite different, and you don't have any statistical data on how those valves behave under demand necessarily.

Most of what you've accumulated is under the nominal in service inspection, which is usually a no loaded condition and valves behave altogether different under no load than they do under load. It may not even work under load, and you find that out when you have something happen and lo and behold valve hangs up, doesn't close.

I don't know what this Reliability Assurance Program really means. But in the PRA the numbers you're using are supposed to be under the conditions that postulated for that particular event, and that might be an isolating of pipe break, which is a pretty heavy demand, and you have very little data. We have a handful of numbers in the whole world right now on how they behave under blowdowns as opposed to thousands or tens of thousands.

MR. CATTON: And they don't do any good.

MR. MICHELSON: And they don't work very well, but yet we keep putting these number in PRAs, ten to the minus three, ten to the minus four for the probability of failure under demand and the whole thing is fictitious and now we're further perpetuating that by saying that now we got a program that makes sure that what's said in the PRA is really happening in the plant. That's more fiction.

MR. CORREIA: I think what's important is the PRA will identify relatively speaking what is more risk significant or more important than others so that both the designer, the operator and Staff can focus on those to assure that equipment performance and condition is being monitored more closely to those, that the testing is adequate, they are identifying problems when they appear, and that you take appropriate corrective actions.

MR. MICHELSON: I'm sorry. I have to disagree with you.

MR. CATTON: Let's just pursue that for a moment. What is CE using for the unreliability of a valve on demand, for closure for isolation?

MR. MICHELSON: Auxiliary feedwater would be one case.

MR. CATTON: Oh, aux feed or whatever. What are you using? Are you using the 1150 numbers or are you using something different?

MR. SIEGMANN: We are using the EPRI URD numbers in general for the component rates.

MR. CARROLL: Which are the ten to the minus four.

MR. CATTON: Well, the problem there is that, if I remember right, the unavailability is like four-tenths of a percent, whereas the unreliability that has been demonstrated under closure conditions is like 8 percent. So it's a factor of 20 different. Have you gone back -- I'm sure you haven't. But I think before you can come to the conclusions that you're reaching, they ought to do that. They ought to take and come in and all isolation valves increase the unreliability to eight percent on demand because that number has been demonstrated.

Let's assume --

MR. CARROLL: For certain conditions, for certain MOBs.

MR. CATTON: When you have to stop full flow.

MR. CARROLL: Now, for certain cases where you have to stop full flow.

MR. CATTON: Against the full pressure. But at least they ought to take a look at it.

MR. CARROLL: Oh, yes. I agree with you.

MR. CATTON: And the conclusion reached by Crawford Union was that the existing valve designs, that's about the best you're going to get if you're electrical side is perfect, and this is for closure against full system pressure, which is the qualification you're looking for. I think you ought to do that before you come to these kinds of conclusions.

MR. CORREIA: The actual industry experience and whatever testing information they may have is an important part of reliability assurances. This is a feed back process, back to the assumptions that were made to actually do that comparison, and if warranted, to make the changes in the analysis to determine what the affects may be.But

MR. MICHELSON: But we haven't got much experience.

MR. CATTON: I guess what you're hearing from us is we haven't seen this information in the PRAs. PRA people seem to just not use it.

MR. CORREIA: I can't speak for the PRA people.

MR. MICHELSON: We haven't broken many pipes in plant. So we don't have much experience on how valves behave after you break the pipe and you now try to close it up. So we went to a laboratory and did it and sit you in the laboratory and we began to understand the problem.

But that's just a handful of numbers and you can't use those statistically. You can use those as test individual points. But you cannot talk about the reliability even with that handful of tests. We don't know what the reliability is. You don't have enough information. You've got to do a few thousands of these.

Now you begin to get some information. We haven't done a few thousands of these and we haven't even done 100 of them. I suspect to date we've done less than 100. Not too long ago it was a half a dozen was all we had done.

So you can't talk PRA and talk about individual testing and so forth. They're two different animals and the data banks you accumulate are for all possible kinds of reasons why the valves doesn't work, most of which are never related to the differential pressure or the extreme flows or whatever.

But the PRA has to reflect that if the postulated event is the break of the pipe, and that's where we missed it completely on reactor water clean up. Now, GE has gone back and tried to figure out what guesstimates even to put in and we start finding interesting problems when you start doing it right.

MR. CATTON: Carl, I thought Crawford Union made a good case for the eight percent.

MR. MICHELSON: I don't recall that.

MR. CATTON: It was a presentation here and you might want to --

MR. MICHELSON: Oh, that one. Okay.

MR. CATTON: You might want to get the transcript and the view graphs that went with it. They made a very good case for the eight percent with existing valves.

MR. MICHELSON: That was with their type of existing valve.

MR. CATTON: Well, but I think if you don't have anything else maybe that's what you ought to use. If you don't like it, maybe you ought to reproduce -- redo some of the kind of analysis that they did for your own valves. Furthermore, I don't think the valves are all that different.

MR. CARROLL: No, there not that different. But the operators are --

MR. CATTON: Gate valves are gate valves.

MR. CARROLL: No.

MR. CATTON: Well, you can put different --

MR. CARROLL: Some are stouter. The whole trick is --

MR. CATTON: That's the point they made.

MR. CARROLL: Whether you're going to goal that --

MR. CATTON: Yes, and it's how much twist you're going to get into the gate and they did a full NASTN type analysis of their gate valves to determine how much twist they were going to get, and that's how they arrived at the eight percent. We've done none of that and yet we continue to use the four-tenths of a percent unreliability, which is the databases. I don't think that's proper.

MR. MICHELSON: It isn't proper.

MR. CATTON: Then somebody ought to do something about it.

MR. MICHELSON: Well, we've presented that to the valve people and Staff people several times and I'm sure they're going to try to do something. EPRI eventually will be the one to address it.

MR. CARROLL: I have a letter for the Committee's consideration on the subject of issues relating to advanced reactors. I have three of them in there. Maybe you want to add a fourth.

MR. CATTON: I bet Carl could write the paragraph and I'll edit it.

MR. CARROLL: In the FSER, it says that SECY 8913 the Staff informed the Commission that RAP would be required for a final design approval for design certification. Did the Commission ever respond to that? Did they ever see this is a good idea? Keep going guys? I know Remick asked you some questions about it. Was that the extent of it?

MR. CORREIA: That was the extent of it. Yes.

MR. CARROLL: Thank you.

MR. MICHELSON: I assume it's correct to believe that these items will not be procured to reliability assurance requirement. I mean I should say that it won't be a reliability number associated with the procurement?

MR. SIEGMANN: That's correct.

MR. MICHELSON: In other words, it's going to be a program in principle but no specification as to what the numbers have to be or that they have even need to be specified because that's where we really get tough.

MR. CARROLL: You're not going to put in your spec to the Crain Valve Company that this motor operated valve shall --

MR. SIEGMANN: We tried that once on some military work and we got zero back. No, we can't.

MR. MICHELSON: So this is all nice words and nice ideas but in carrying it out in reality is not easy if is possible at all.

MR. CORREIA: I believe that what is important is the focus on those risk significant equipment systems and trains versus treating everything on the plant equal.

MR. MICHELSON: Which means you better go back to your PRA people and ask them are they doing it right to begin with.

MR. CATTON: It would be interesting to see a PRA where you've gone in and put the eight percent in there and see what the bottom line is, and if it doesn't change very much then you can answer us by saying it's not a problem.

MR. CORREIA: I will serve that question to our PRA problem.

MR. CATTON: Good.

MR. SIEGMANN: If you have measure of that in the PRA group, in the PRA itself, that is in the PRA you have a risk achievement worth which says that if the failure rate of the component is put equal to one what happens? Okay. That can give you some feeling for the importance of the failure rate of that particular component.

MR. MICHELSON: You have to be real careful. When two valves are in series, you've got to put one on both of them, not one on just one of the two of them. I've seen that trick, too. People go ahead and put one on one valve at a time. It doesn't necessarily give you the right answer.

If two are in series and they both see the same conditions, they both stall out, the probability payer is equal on both of them.

MR. MATZIE: We're going to start on Chapter 11 with Joe Barron.

MR. WAMBACH: Mr. Chairman, I believe our reviewer went back and was told to return at 1:00.

MR. CARROLL: Okay. What can we substitute for Joe.

MR. WAMBACH: We've got 12. We've got reviewer for Chapter --

MR. MATZIE: We could shift to going over some of the subjects -- we can either do Chapter 10 or we could over the subjects that were responded to from the last ACRS meeting, either one of those two.

MR. CARROLL: Are you okay for 10, Tom? All right. Let's throw 10 in. We'll get to you after lunch. We've got a full stomach, Joe.

MR. MATZIE: Mr. Laird Bruster, from Stone and Webster Engineering, will make the presentation for Chapter 10.

MR. BRUSTER: Good morning. My name is Laird Bruster and I'm the Assistant Project Engineer for Stone and Webster's effort on the System 80+ design, and I'm going to discuss with you today the Chapter 10 of CSAR.

Chapter 10 contains mainly nonsafety related systems. There are a few portions of some of the systems in the design which are safety related, and what I intend to try to do this morning is to emphasize some of those systems and then get into some of the others in a little lesser detail.

MR. CARROLL: Or perhaps not at all?

MR. BRUSTER: Whatever you would like to do.

MR. CARROLL: Why don't you tell us what you think we ought to hear about from a safety related point of view now and maybe we can make some decisions about whether we even want to hear some of these other things.

MR. BRUSTER: Okay. What I have done here is I've organized the systems and those that are (a) first of all, safety related or have portions that are safety related and (b) those that I think need to have a reasonable level of reliability to minimize challenges to safety systems.

Obviously, the advanced light water reactor design has changed somewhat from past reactor designs and past balance of plant designs. However, for the most part, the designs are fairly similar. What I'll try to do in order of time here is I'll try to highlight those things that are different in the safety related system where we think important aspects that you guys should be aware of.

First of all, just to kind of give you the frame of reference, although this is not part of the safety related aspect, a little summary on the thermal cycle. The design is based around the upper URD document. There are six stages of feedwater heating. Four low pressure heaters, all of which are located in the condenser neck. There is a deaerator for oxygen and chemistry control.

MR. CARROLL: Did EPRI recommend the deaerator?

MR. BRUSTER: Yes, they did. Yes, they did.

MR. CARROLL: Good for them.

MR. BRUSTER: There are three 50 percent condensate pumps and three 50 percent feedwater pumps. The condensate pumps are two out of three operating. In other words, if one fails you have the second in standby. Because of reliability in feedwater -- loss of feedwater accidents, we have -- and it's another EPRI URD requirement -- have three operating feedwater pumps. Even though they're 50 percent, they're all there. So if one drops off, two pumps can make full power.

MR. MICHELSON: Do you know whether they're electrical or steam?

MR. BRUSTER: They are electrical and that is again an EPRI requirement. There are no pump forward heater drains.

MR. CARROLL: What you said about them, about three pumps is true, provided the control systems work.

MR. BRUSTER: Yes, that's true. There are no pu p forward heater drains. That's been a reliability problems in the past. They have been eliminated in the PWR designs. Chemistry is there to minimize corrosion transport to the steam generators, minimize erosion/corrosion -- again, historical problems.

In your package there is a brief slide, which I'm not even going to get into other than to throw it up here, of the heat balance cycle. It just sort of gives you a little flavor of how the system is set up. We have three condenser shelves, the feedwater heaters, the deaerator, a booster feed pump, and then two high pressure heaters into the steam generator and then the turbine side of the house on the way back.

First probably important system in terms of safety aspects is the main steam system. Again, only portions of this system are safety related. It has all of the typical design basis of past PWR designs. I've listed them here for you. I don't think it's really important to get into them in any great detail.

They are safe. The system is safety related from the steam generators out to the MSIVs. That aspect of the design I think is best shown in a sketch which I will get into in a second, but there's important design differences that we need to bring up to you folks.

We have a two loop plant. There are two steam generators and two steam lines per steam generator. Each steam line has five safety valves. On the line, there is atmospheric dump valve on each line. Associated with that atmospheric dump valve is block valve, which is cross powered to an electrical division different from its respective mechanical division that it is in. In that way, we can assure -- have assurance that we can isolate.

The main steam water -- the main steam isolation valves, again, there is one per steam line and that valve has a separate bypass around it for start up situations. As a result of steam generator tube rupture considerations, we have installed N-16 monitors on one steam line from each steam generator and that is on the line that the emergency feedwater turbine is off of.

MR. CARROLL: How about the non-return function that I'm used to on steam lines at the Westinghouse plant.

MR. BRUSTER: In terms of a reverse flow and a break?

MR. CARROLL: Yes.

MR. BRUSTER: The EPRI URD document recommends a single valve, which is designed to do both aspects. That is a EPRI requirement.

Again, the next slide you have is a little more summary of some of the --

MR. CARROLL: That's not true say at Palo Verde? Does Palo Verde have two valves or just one?

MR. CARROLL: I can't answer to Palo Verde on that. Maybe you'll have to ask Stan or one of the other ABB folks.

MR. CARROLL: So you've been doing this for some time

MR. BRUSTER: Again, some more of the design summary. I've already hit on some of the important design differences between past PWRs and this one. I think for purposes of illustration what I'd like to show you is the Tier 1 ITAAC figure, and we have put this in the package as one of presentation. The actual fluid diagrams and pin IDs that are in seesaw are kind of busy, if you will, for presentation purposes so we have those available if you need to get any specifics, but this is the ITAAC figure.

There are, again, two nozzles on the steam generators. The five safety relief valves, the ADV with is associated block, the MSIV with its associated bypass, and the N-16 monitor located on the line that has the emergency feedwater turbine feed to it.

Also in your package -- and again I don't intend to get into them in the interest of time -- we have highlighted --

MR. CARROLL: Where do the turbine bypass valves come out of it?

MR. BRUSTER: Where do the turbine bypass valves come in?

MR. CARROLL: It's not on this.

MR. BRUSTER: They are further down here, past the equalization header. In terms of Tier 1 and ITAAC, we've highlighted some of the ITAAC issues, the things that were brought into Tier 1 on this last slide. I don't think it's important to get into any of them unless you have any specific questions. They're in your package. If you see something that tickles your fancy and you'd like to discuss it, I'd be happy to try to get into it with you.

MR. MICHELSON: I was trying to figure out your previous figure yet. If you've got inside and outside a container interpose there or is I'm having a problem?

MR. BRUSTER: It is interpose. You've got them mislabeled. The stuff you say is inside is really outside.

MR. BRUSTER: He's correct. You're right.

MR. MICHELSON: Thank you. Now you do have some isolation valves inside of containment, too. You just didn't show them because of the nature of this sketch, I guess?

MR. BRUSTER: No, there are no isolation valves inside of containment.

MR. MICHELSON: There's just one main steam line isolation valve?

MR. BRUSTER: Just one main steam line isolation valve, and again, that is the design of other ADB plants apparently, and it is also the EPRI URD recommendation to have one --

MR. MICHELSON: So primary containment, in this case, does not have inside and inboard and outboard isolation valves? I thought that was a regulatory requirement for primary containment irrespective of what it's attached to. Now, sometimes a check valves permissible, things like that because you can't put check valves in this case.

The main steam does not require dual isolation valves on primary containment?

MR. MCCRACKEN: For the PWRs, we rely on the steam generator, too, because that's the boundary.

MR. MICHELSON: Because that's considered one of them but, of course, that boundary doesn't exist if it's a tube rupture you're dealing with to begin with. Then you've got only one valve to prevent the release.

MR. MCCRACKEN: That's correct. Yes.

MR. MICHELSON: I guess I just haven't thought PWRs for long. I'll think about it.

MR. BRUSTER: Okay. I've included -- the next system is the condensate and feedwater system. Again, it's design basis. It's basically similar to other PWRs. Portions of the feedwater system that are required to mitigate accidents are safety related. I will highlight the issues that are different than past PWR designs.

Again, as I already mentioned, we have two out of three operating condensate pumps, seven stages of feedwater heating, and three operating feed pumps. Again, it's a matter of reliability and a matter of minimizing challenges to the safety systems.

We also have a start up feedwater pump. The start up feedwater pump is used during, obviously, start up situations and it has been used in some of the PRA severe accident assumptions.

MR. MICHELSON: I might pursue your steam line again for just a moment. Are the main steam isolation valves now going to be tested to close under blowdown, under pipe steam line break conditions then to verify there good even though there's only one? See, the problem is if you break a steam line the disruption you see in the steam generator if the tubes are already weak, they might very well lead to a tube rupture as well and now you got -- you haven't isolated the blowdown and you in turn haven't isolated the steam generator either. Then it get real sticky.

MR. BRUSTER: I can respond to that it you'd like. In Tier 1, in ITAAC, we have committed to do type testing of the MSIVs at flow and then any calculations that are required to --

MR. MICHELSON: By at flow meaning what flow?

MR. BRUSTER: Excuse me?

MR. MICHELSON: Full power or blowdown flow?

MR. BRUSTER: No. It'd basically be at a test flow that we would achieve and then calculations performed to correlate those to higher flows, and it would again depend on what was required based on the design.

MR. MICHELSON: We haven't been doing MSIVs closure. It's a tough problem having a big enough facility in the world to do it. Germans have come closest, but even there they are a little shy on that. You're going to do a blowdown test of a smaller size and then extrapolate the data. Is that what you have in mind?

MR. BRUSTER: Right. That is the general heading in the Tier 1 in term of --

MR. MICHELSON: We get to all of this when we get to chapter what, 9? See, the valve testing. What chapter are you going to treat the valve testing on?

MR. BRUSTER: I believe there's some stuff in Chapter 14 on valve testing?

MR. MICHELSON: It's probably spread around in various places, but the design requirements I don't think are in 14. That's just the programmatic requirements.

MR. BRUSTER: There are some --

MR. MICHELSON: I'll look for it. We'll get to it.

MR. BRUSTER: There is a section in Chapter 10 which describes some of this, some of the testing and how it's performed.

MR. CATTON: Where will I find the extrapolation process?

MR. BRUSTER: That, other than some words that are in ITAAC, has not been described in terms of any great detail. It talks about meeting the parameters that you need to, about 5-second isolation --

MR. CATTON: Some respects it's kind of tough. If you take a small valve, it's going to have a lot of structural rigidity and it's internals aren't going to move relative to -- one piece relative to another. If you get the full size valve, you're going to have some strain that goes on in the valve that can lead to difficulties.

So you've got two kinds of extrapolation you have to make. One is the loads due to the flow and the second is the response of the valve has to be extrapolated as well, and if you're going to do that, that leads you to a very complicated structural model of a pump, of the valve. What's the Staff going to require?

MR. RITTERBUSCH: This is Stan Ritterbusch. I think there may have been a slight wording problem in an early part of Laird's response. We test the full size MSIV. The test is performed at the maximum conditions expected during normal operation and the extrapolation has to do from normal conditions to accident conditions.

MR. CATTON: What's different about accident conditions and normal conditions?

MR. MICHELSON: Line breaks.

MR. CATTON: Oh, you break the line. You suddenly have a delta piece of the flow is very high.

MR. MICHELSON: It's extremely high.

MR. CATTON: So what you're really doing is you have to by analysis extrapolate both the flow rate the response of the valve to the increased flow. So do you plan to build a structural model of your valve? Because my recollection about what the Germans did is that a lot of the problems come from the change and shape of the valve due to the differing loads. What do you plant to do? What does the Staff plan to require?

MR. MICHELSON: These are different kinds of valves of course. Hopefully, they don't use gate felts for main steam isolation --

MR. CARROLL: What are these valves?

MR. BRUSTER: Right now they're a process flow medium type of valve. They're is a similar valve section. There's a similar valve installed right now at Mill Stone that we intend to use.

MR. CATTON: I guess the question is still there. I don't know what these valves look like, but it would be interesting to hear your response as to what you're going to do.

MR. MICHELSON: The only thing I was trying to emphasize is that much of the valve work so far has been focusing on the gate valves and some on the grove valves and some on butterflies. But main steam isolation valves are unique valves. They probably are best suited for what they have to do because in general the flow and everything seems to assist the closure.

But there's still complications you can get into in terms of bent stems and things of this sort, but I haven't seen anybody really proposing to date what to do about main steam line isolation valve testing, and the Staff to my knowledge hasn't pushed this testing either. But I'd like to know for future plants how it will be handled and that's what I will expect to find somewhere in the SSAR or ask later again.

MR. CATTON: Probably we'd find that under the ITAAC.

MR. BRUSTER: We have, again, an ITAAC test that basically goes through the testing premise and I have in my package a section -- some of the ITAACS.

MR. RITTERBUSCH: It may be best for us to simply prepare a response to address your concerns on what the valves is, how we'll test it, and under what conditions, and --

MR. CATTON: And how we will get to the accident conditions where the valve has to operate.

MR. RITTERBUSCH: Yes.

MR. CATTON: It seems to me that should be part of the ITAAC. You can't just describe the task. Somewhere you need to describe the rest of the problem.

MR. RITTERBUSCH: We agree.

MR. MICHELSON: Now, is the main steam line going to have any flow restriction built into it or will the break be the restriction?

MR. BRUSTER: Steam generator nozzles have flow restrictors in them.

MR. MICHELSON: What "X" are they?

MR. BRUSTER: I'm sorry.

MR. MICHELSON: How many -- is that a 3X restriction, 4X?

MR. BRUSTER: I'm not really 100 percent sure. I'd have to ask one of the -- but I think it's twice, two times.

MR. MICHELSON: 2X. That's pretty big for a main steam.

MR. BRUSTER: Again, I'd have to ask the ABD folks.

MR. MICHELSON: You loss a lot of money in that restriction.

MR. CARROLL: On a broken line you get double --

MR. MICHELSON: Double normal flow. It's a Venturis, but it's very expensive because you lose a lot of energy in it. You can't recover it. I'm surprised it's 2X but that's great.

MR. BRUSTER: 2X has been my experience on past designs. Whatever the flow rate restriction, that's what's been assumed in Chapter 15. To respond, just again, we'll give you a formal response but my experience again has been that the problem with MSIVs has been one of failure to close more than it has been structural integrity, and we'll address those for you.

MR. CATTON: I understand. But there is a whole picture that need to be painted.

MR. BRUSTER: Yes, there is and --

MR. MICHELSON: Well, structural integrity has a relationship to failure to close. It's sometimes the reason for failure to close and to what's going on.

MR. BRUSTER: Again, included in your package is some of the ITAAC commitments. I don't, again, intend to get into those. If you see something as we're going through here that you'd like to ask me about, I'd be happy to get into them for you.

Emergency feedwater system --

MR. CATTON: Wait a minute. Before you leave ITAAC. There's one question which I'd like to have answered, and that is there anything now in your ITAACs that is in any way an additional requirement as opposed to the SSAR requirement. Is everything in the ITAACS already found in the SSAR? I don't even need to look at ITAACs and I can judge the safety of your plant?

MR. BRUSTER: Yes, sir.

MR. CARROLL: Your asking that question globally, right?

MR. MICHELSON: Globally, yes.

MR. BRUSTER: The answer to that is yes, sir.

MR. MICHELSON: That is clearly intention. So a person doesn't need to review ITAACs to determine the safety of the plant?

MR. BRUSTER: That's correct.

MR. MICHELSON: Because all it is is supposed to be some verification tests to verify that you really end up functioning like you thought it was in the SSAR. Okay. Thank you.

MR. CATTON: On your containment penetration pressure test, is this for the LOCA conditions and so forth?

MR. BRUSTER: The pressure test is covered in another chapter and, to be honest with you, I'm not 100 percent sure of what their requirement is right now. I know it was gotten into detail --

MR. CATTON: Where is containment penetration pressure testing described?

MR. BRUSTER: Chapter 3 I believe it is. Is that correct, Stan?

MR. CATTON: When are we going to hear about Chapter 3?

MR. MICHELSON: Next month.

MR. CATTON: Next month.

MR. MICHELSON: We better spend a lot of time on Chapter 3 because that's big chapter and that's where --

MR. CATTON: Do you happen -- you know Chapter 19 can be big too.

MR. MICHELSON: I believe that will be next to Chapter 6.

MR. CATTON: There will be one hour discussion time for Chapters 2 and 3.

MR. MAGRUDER: This is Stu Magruder from the --

MR. MICHELSON: Excuse me. Are you going to do the flooding in Chapter 3 also? The pipe breaks are in there already. But how about the plant site floods as well as internal floods? Is that part of what your analysis is?

MR. RITTERBUSCH: This is Stan Ritterbusch. The -- we have criteria on site selection for flooding.

MR. MICHELSON: No, I'm looking for your flooding analysis.

MR. RITTERBUSCH: Yes, that's in Chapter 3. Correct. And I believe the containment isolation testing program is in Chapter 6.

MR. BRUSTER: Emergency feedwater system, that's another systems that's obviously very important. The aspects of this design that are different than perhaps some of you maybe seen in the past is we have two completely independent mechanical divisions, one first team generator.

In each one of those divisions we have an emergency feedwater storage tank. We have 100 percent capacity motor driven emergency feedwater pump, and we have 100 percent capacity turbine driven feedwater pump. Another aspect of the design that is different than perhaps some of the past is the steam admission valves. In the past we've had problems with the locations of the steam admission valves. These, the ABB System 80+ design, again in compliance to I think the URD document, those admission valves are located at the turbines. There is a small bypass line, admission bypass line, that is used during a start up trend. It opens to pre-spin the turbines so that you don't potentially have over speed conditions.

We have cavitating Venturis to limit mass energy input to the containment. I think those are the highlights of that particular system. I have another ITAAC here, one sketch for you if you'd like to take a look at that.

MR. CARROLL: This pre-spinning bypass takes it up to speed?

MR. BRUSTER: Tom what's the --

MR. CROM: This is Tom Crom from Duke Engineering. I just happen to just got here on my plane and I'm just catching up here. You were asking the question on over speed of the turbine?

MR. CARROLL: Yes.

MR. CROM: There's both an electronic and a mechanical over speed trigger.

MR. CARROLL: No, what I asked was what speed does the pre-spin bypass admission valve take the turbine to?

MR. CROM: That is not determined now because based -- you'd need to know the as procured information and what your hydraulic governor would need to be -- get it pressurized for control.

MR. MICHELSON: Have you specified even the type of turbine it's to be?

MR. CROM: Yes, we've specified, basically, it's a -- it's going to be a turbine, probably most likely with an electronic or electrohydraulic governor.

MR. MICHELSON: Yes, but that's the whole set. Is this going to be a Terry type or a Worthington type or --

MR. CROM: No, that would be -- it was not specified to that type of detail.

MR. MICHELSON: There's a world of difference between those two.

MR. CROM: That's true.

MR. BRUSTER: The emergency feedwater system, having two emergency feedwater storage tanks and two independent trains and pumps, pipes and whatnot, to get it to the lines that feed the steam generator.

MR. CATTON: In this system do you have any cross-connects? For example, on the top you are taking main steam from steam generator one to run the pump, and on the bottom one you take main steam from steam generator two. Do you have cross-connects, where you can switch that?

MR. BRUSTER: No.

MR. CATTON: No, is that the answer?

MR. CROM: That's correct. Yes, there is only one steam from each steam generator. There is not a cross-connect.

MR. CARROLL: But there is a cross-connect on the discharge of the pumps.

MR. CROM: That's correct.

MR. CARROLL: That helps you some, Ivan.

MR. CATTON: I was just remembering what they did at that plant that's in Manheim. You can take the steam from any steam generator and run any pump. You also can take water from the steam generator, from one steam generator, and feed the other. There is cross-connects in all the different directions.

MR. CROM: If we would do that, then we would violate our strict divisional separation that we are trying to maintain in the plant.

MR. CATTON: Have you taken a look at this from the point of view of PRA?

MR. CROM: Yes.

MR. CATTON: I guess they have, and have come to a different conclusior than you have.

MR. CROM: This has been strictly looked at in a PRA, and the PRA's reliability is in Chapter 10.49.

MR. CATTON: That's what you do with the Beta factor.

MR. MICHELSON: They don't --

MR. BRUSTER: Tom, correct me if I am wrong. Isn't another one of the key differences here though, that we have two sets of turbine pumps?

MR. CROM: I am not sure what Manheim has. Current plants only have one turbine driven pump, where we have two 100 percent pumps here.

MR. CATTON: I know you won't do it, but I will suggest it anyway. I think the Manheim plant, they made these changes when they looked at their plant from the point of view of accident management. They came to a lot of interesting conclusions about what to do. When I asked how much did it all cost, it was under one million dollars.

MR. CROM: In order to do this in our design, in order to do just what you recommended, we would have to run high energy piping through the nuclear annex all the way from side to side. Right currently we have the steam lines going down into the turbine driven pump rooms in a chase, so that if there is a steam line break it will pressurize that room and then vent back up into the main steam valve house without going anywhere into nuclear annex.

One of the other things that we have done to significantly improve the reliability on here and the reason that we put this chase in is, we have the emission valve that opens right down at the turbine. A lot of current plants have them up close to the main steam lines and they trip on over speed. We have these valves located right down in the turbine, and there's also a pre-warm line to keep that line warm so you don't trip on over speed.

MR. MICHELSON: Why do you need cavitating venturies in this case?

MR. CROM: The cavitating venturies is to eliminate the automatic isolation logic that some of the current plants have and have had problems with. It's basically so that you restrict the flow to prevent over cooling or restrict the flow if you have a main steam line break.

MR. MICHELSON: You are saying you don't need a break detector then to know which area is --

MR. CROM: That's correct. You have 30 minutes for the operator to take action.

MR. MICHELSON: How much experience do we have now with cavitating venturies under the conditions for which they would be operating with a busted steam generator?

MR. CROM: The problem with current plants on cavitating venturies is, it's difficult to backfit. In order to get a good cavitating venturi and get good performance with it you need a lot of straight runs, both front and after, to get good flow recovery. Some plants have attempted to put them in, and basically found that the problem was that they didn't have the straight run as a backfit.

MR. MICHELSON: I guess really what I am asking is, do you know enough about them now? They do vibrate severely when they are feeding a broken system. Do we know enough to know that that's not going to reflect back into the sources, particularly when you are cross-tying the sources? You are confident that the --

MR. CROM: We are not cross-tying the sources.

MR. MICHELSON: I thought you were cross-tying these two pump sides?

MR. CROM: That cross-connect is only there for one scenario.

MR. MICHELSON: Ordinarily, you will never have that open.

MR. CROM: That's correct. That is only there for the LOCA scenario, where you refill the steam generators as a containment isolation function. Since you have no steam to run the steam driven pumps you put it in there for the single failure with the two motor driven pumps.

MR. MICHELSON: You won't have steam if you bust the generator.

MR. CROM: That's correct.

MR. MICHELSON: Cavitating venturi's have not -- you don't have a good operating history on them under accident conditions since we haven't broken the pipes yet. When you do, this will be -- we will find out. The tests that have been done on them have been a mixed bag, at least in the past.

MR. CROM: Yes. The most experience has been the poor performance has been because they haven't had good flow recovery.

MR. MICHELSON: Yes, that's part of it.

MR. BRUSTER: The next system I would like to talk to you about is turbine generator system. There has been a lot of discussion about turbines and low pressure loaders and the like. I think the ABB design that we have has a lot of that licked.

MR. CARROLL: Let me ask a question. As I read your CSAR I assumed you are talking about a Brown Bravery turbine.

MR. BRUSTER: That's correct.

MR. CARROLL: Then, when I read the staff's FSER I find reference to things like interference fits and disks -- you have disks on a Brown Bravery turbine -- disks, in the sense of shrunk on disks and how they are going to be inspected and so forth. I think whoever did the turbine write up needs to understand how a Brown Bravery turbine is built.

MR. BRUSTER: Right.

MR. CHANDRASEKARAN: We are revising that for plant design. The SER written for the original CSAR was in 1989, and there are some revisions.

MR. CARROLL: The turbine section is going to be extensively revised.

MR. BRUSTER: Initially it was a generic turbine section in CSAR, and in the last two or three amendments we have revised it to show the ABB aspects with some material comments.

MR. MICHELSON: Does the URD permit that type of turbine? I thought they required an integral rotor.

MR. CARROLL: In the sense that, it is an integral rotor when you get done welding the pieces together.

MR. MICHELSON: When it's all done, but that's the principle upon which the term was originally posed.

MR. CARROLL: From a single forging.

MR. MICHELSON: Yes.

MR. MCCRACKEN: If you recall my comment earlier this morning, I said the one big difference was that we are now going with the ABB turbine as opposed to generic. That's a big change in Chapter 10, to address what they have as opposed to turbine.

MR. MICHELSON: They may have to take exception into the URD on their turbine unless I read the thing incorrectly. I thought it had to be an integral rotor.

MR. STAMM: I think there is some confusion. Our turbine -- there's nothing in the URD that we don't meet with the turbine to the extent that the design is developed. It is a forged rotor with the ABB turbine. It does not have shrunk on disks. That is an older design. I don't believe that anybody today is going with that because of the problems that have occurred.

MR. CARROLL: The ABB turbine is forged disks that are welded together, right?

MR. BRUSTER: That is correct.

MR. STAMM: The disks are integral with the rotor. In other words, there's no separate disk. It's a single forging.

MR. BRUSTER: Steve, I have a slide that might demonstrate that.

MR. MICHELSON: There's no problem.

MR. STAMM: When we say disk we are talking about the ring around the rotor that was previously shrunk on.

MR. CARROLL: What I am talking about is a big forging -- here we go.

MR. BRUSTER: The ABB design comprises basically -- this would be a section of forging. This would be a forging right here, so on and so forth. These are welded together, machined, so on and so forth, and inspected at each stage. That is the difference. Whereas, there is nothing that I have seen in the URD document -- I was in fact looking at it last week -- that I saw that physically excluded this.

There was a few things in wordmanship that may make you believe that this kind of rotor would not be acceptable. I don't think this is an issue.

MR. CARROLL: By contrast, the present day GE and Westinghouse designs are a great, humongous forging.

MR. BRUSTER: Right.

MR. CARROLL: All of this is machined onto that forging. There's none of the welding that we are talking about here.

MR. BRUSTER: The benefit of the ABB -- has our ABB turbine guy arrived. He was coming. He flew in from Switzerland.

MR. STAMM: He got stuck in Boston, unfortunately.

MR. BRUSTER: In any event, I have looked at this a little bit and will try to do it justice. If he was here, I am sure he would be able to do a lot better job.

The benefit of this design is the fact that each one of these rotor sections -- this section is a smaller forging. They are inspected after they are welded together. The welds are inspected.

MR. CARROLL: And, can be a higher quality forging because it's smaller.

MR. BRUSTER: Exactly. The interesting thing is that there has not been any disk failures in an ABB turbine to date, where there has been in other designs. This design we think is a real benefit. It's a benefit even after you have installed it in terms of operation and maintenance due to its inspectability.

MR. CARROLL: For the benefit of the Committee, this is not a new design. ABB has been doing this for years. GE and Westinghouse for years and years, they don't understand how these guys do it because they don't understand how to weld these kind of alloys together in a reliable weld. They figured it out eventually, after a few utilities started threatening to change out their GE and Westinghouse rotors with Brown Bravery's.

MR. CATTON: Swiss welder.

MR. BRUSTER: It's like a Swiss watch.

MR. CARROLL: Actually, they did screw up some rotors for me up at the geysers, where they claimed they could weld on them and it didn't work very well.

MR. BRUSTER: I was reading an article on the plane in this morning. In fact, ABB has been using this type of design, I believe -- and I am not sure of this -- since the 1920's.

MR. CARROLL: That's correct.

MR. BRUSTER: So, it has been around for quite a while. It's been perfected and so on, and enhanced. That is in essence the design. By doing this I guess the big point is that you have better control with the forgings, you have better control with the inspections, the weldability at each stage, so on and so forth. After you get it completed and installed it's easier to inspect.

The other thing is that from an SCC standpoint all areas that have an inert gas in terms that are exposed to steam on the inside, whereas you have problems in the past you have had areas where steam would be in there and that would precipitate SCC.

MR. MICHELSON: Does EPRI agree then, that this is an integral rotor?

MR. BRUSTER: I am kind of listening to what you said earlier. I looked at the URD section, and I didn't see any problem with this design. Listening to what you said I am now a little skeptical, that I want to go back and see if there's a deviation.

MR. MICHELSON: I just wondered if you had asked EPRI if this meets the interpretation of the URD. I guess EPRI is the spokesman for the document.

MR. MATSIE: We have discussed this with EPRI at length and made presentations to them, and they agree that this meets what they were trying to achieve with the utility requirements document.

MR. CARROLL: If I want to buy one of these plants and my company has a buy American policy, I guess I would rule out the Combustion System 80-Plus because I want an American turbine.

MR. BRUSTER: I will let Regis answer that.

MR. MATSIE: You would probably get one of these from Richmond, Virginia. Almost every turbine now in the world is, you buy parts and pieces from various places and put them together at some factory localized. We have brought in a number of manufacturing facilities into the U.S. and we now make large turbines in Richmond, Virginia.

MR. CARROLL: Not very many, I will bet.

MR. MATSIE: I wish we had more of a market right now.

MR. BRUSTER: Just one other thing that I think is important. We have a mechanical and electronic over speed trip at 100, 112 percent, respectively on the turbine.

MR. CARROLL: I got a little confused about that in reading the staff's presentation. I assume that what you are going to end up with is whatever ABB provides.

MR. MCCRACKEN: That section is totally re-written.

MR. BRUSTER: The turbine bypass system. The turbine bypass system basically on this plant, in conjunction with the reactor cutback system, can take a full load rejection which is unusual based on past PWR designs. That is the important aspect of these. The rest of the design bases are similar to past PWR's. Either that, or they support this reactor cutback feature.

MR. CARROLL: Have you looked at the impact of full load rejection on funny things that are going to happen in your feedwater heaters?

MR. BRUSTER: In terms of loss of steam flow and stuff? That will be a design consideration. That will be a design consideration.

MR. MATSIE: The full load rejection capability with the reactor power cutback system is operational at System 80 plants in Arizona.

MR. CARROLL: It is, okay. They have been able to take the load rejections?

MR. MATSIE: Yes, they have.

MR. BRUSTER: The system, to meet minimum --

MR. CARROLL: Diablo Canyon was a full load rejection plant. After a couple of tries at demonstrating it one of them at least worked. We decided we didn't want to do those tests anymore. They beat up the equipment pretty good.

MR. BRUSTER: We have turbine bypass valves that will accomplish a 55 percent of full main steam load rejection. The 100 percent, again, comes with the reactor cutback. The valves themselves will take a 55 percent flow. We are using eight valves to do that.

That is the important aspect of that system.

MR. CARROLL: This is all to the condenser.

MR. BRUSTER: Yes, it is all to the condenser.

MR. CATTON: Doesn't this impact on the pressurizer design as well?

MR. BRUSTER: I am sorry?

MR. CATTON: Doesn't full load rejection impact on the pressurizer design as well?

MR. BRUSTER: The pressurizer, as in the RCS?

MR. CATTON: Yes.

MR. CARROLL: Not really. It doesn't know it's happening.

MR. CATTON: It doesn't know it's happening.

[Slides.]

MR. BRUSTER: Steam generator blowdown system.

This system is partially safety related to the extent that we have containment isolation valves for it. It is, again, part of the advanced plant's design to maintain chemistry. The big aspect is the flow capability. We have a .02 percent, which is basically the normal -- when we have normal chemistry limits we have .01 percent. When you have slightly off normal we have a ten percent high rate capability that is used periodically for two or three minutes at a time to basically assist with sludge removal in the generator.

All of this has heat recovery through a flash tank in a heat exchanger, and there's full ion exchange capability right now in the blowdown system. Those, I think are the important aspects. Again, a part of that was safety related only because of the containment isolation system. You will find an ITAAC figure in your package. I don't think it's needed to get into.

The main condenser. The main condenser is a three zone, multi- pressure condenser. Basically, there are two circ water flow paths, independent water boxes, tube passes. As such, we have the ability to isolate a pass of the condenser. There is interface requirements within CSAR that basically you try to maintain certain power levels.

The design is there to minimize chemistry hot well excursions. We have a welded tube sheet. We have corrosion resistant tube materials with tube sheets that are compatible with those. Under each tube sheet we have a leakage collection tray. Within the hot well itself we have conductivity cells to isolate or try to locate leaks. Again, all trying to maintain chemistry to maintain the generators, the feed system, et cetera.

[Slides.]

MR. BRUSTER: The condenser circulating water system, part of it is in design certification scope and part of it is not. Those portions within the turbine building have been deemed to be in the certification scope. It's a site specific interface system. The flooding effects are limited to the turbine building based on an expansion joint failure or any other failure in the piping in that area.

MR. MICHELSON: That statement is based on some flooding studies that have been done, I guess, and written up somewhere?

MR. BRUSTER: There are two or three statements within CSAR that discuss it, some within Chapter 10. I think there's a part in severe accident that also discusses it. Basically it's more on design. Right now there are no pipes that penetrate the nuclear annex directly to the turbine building. There are some --

MR. MICHELSON: No doors, nothing.

MR. BRUSTER: There are some doorways, but they are up at the upper elevations, above the mezzanine level, if I can recall.

MR. MICHELSON: Above the mezzanine.

MR. BRUSTER: Above the mezzanine. They are like 30 or 40 feet above the basement level, if you will, of the turbine building.

MR. MICHELSON: You have done some kind of an analysis of ruptures of steam lines and feedwater lines in the turbine building, and you have done enough of an analysis to know the pressure challenge to those doors and that sort of thing.

MR. BRUSTER: I think the way that it would be easiest to describe that to you is to show you why, by the separation that we have in System 80, that it's not a problem. The nuclear annex and the reactor building structure, the valve houses are located on either side. The steam lines, the feed lines enter into the valve houses, and then are outdoors into the turbine building with no interface here, with the exception of those doors.

MR. MICHELSON: That's what I was asking about. Those steam lines are in the turbine building. If they rupture they create localized pressures. The question is, have you done enough of a look at it to make sure those localized pressures don't blow the doors out going back into the control area and so forth.

MR. BRUSTER: Tom, could you cite some place in CSAR where that has been addressed additionally?

MR. CROM: I am not sure I recall anything on it. You are talking about the doors leading in from the nuclear annex?

MR. MICHELSON: Let me ask a simpler question. Have you calculated what the pressure rise in the turbine building is when you bust the main steam line.

MR. STAMM: No, we haven't done that calculation. What we have done is indicate that from a flooding standpoint, that we would design the building panels such that before the flooding got anywhere near the doors they would relieve the flooding.

MR. MICHELSON: I wasn't asking about doors.

MR. STAMM: I understand. The connection that I wanted to make was that that, in our mind, would cover the buildup from the steam pressure as well.

MR. MICHELSON: You have to do a pressurization analysis because doors don't take much pressure before they blow open, unless you put in special requirements on the doors. You are talking about a pound pressure. Localized pressures of that magnitude even in a big volume can happen if the line is in a small chase or compartment nearby, just depending on where the break is relative to where the doors are.

You have to design for the possibility of a steam line break that might get back into the safety related areas. You are declaring there is no connection. I am saying fine, if there were no doors then I would believe you, as long as you check the walls to make sure you don't have a weak wall somewhere, which is not too likely in this case but depending on how it's designed. Doors are weak. You have to make sure that the area around the break is well vented, well enough to prevent the doors seeing enough differential to blow open. Otherwise the steam will start blowing in that direction too.

MR. STAMM: We understand the question. We have not done the analysis, so we will have to get back.

MR. MICHELSON: When we do Chapter 3 where the pipe break postulations are and where the floods ought to be and all the other things -- that's why we need lots of time on Chapter 3, a lot more than an hour. Realistically, that's the biggest thing in the SSAR are Chapter 3 and 9, in terms of unusual things that are unique to a particular design.

MR. BRUSTER: The last system within Chapter 10 that we have not discussed yet is the condensate clean up system. We have a full flow side stream polisher. The basic key aspect that I would like to emphasize here is, because it is a side stream it basically hydraulically isolates feedwater transients.

If the polishers were to drop off the line for some reason the feed system doesn't even know they are there, and they just keep going. Basically, there are ten lead cat ion beds and ten mixed beds. Any regeneration of resin waste that are required would be processed as radioactive waste, as required.

MR. MICHELSON: What is the percentage side stream?

MR. BRUSTER: It's full flow. It's about a ten percent bypass, if that's what you are asking.

MR. MICHELSON: Side stream is not full flow, the bypass is ten percent.

MR. BRUSTER: That's right. The bypass is ten percent, if that is your question.

MR. MICHELSON: That is it. Thank you.

MR. BRUSTER: There are two other systems. The condenser evacuation system we have vacuum pumps. That's not in your package. It's a totally non-safety system.

MR. CARROLL: What has been the experience with the sort of vacuum pumps that you are talking about?

MR. BRUSTER: My understanding is that one of the reasons -- they are in EPRI URD requirement, as a matter of fact. I think they put them in there because they are more reliable than past air ejector designs, with steam and all the other stuff that you have to do with an air ejector. That is in compliance with the URD.

MR. CARROLL: Okay.

MR. BRUSTER: That concludes what I have, unless you gentlemen have any other questions.

MR. CARROLL: We do have mentioned on page 10-26 about the steam jet air ejector discharge is continuously monitored. Ain't got one.

MR. BRUSTER: In the original CSAR that was changed, I would say, about an amendment or two ago. I think it's just a question of update.

MR. CARROLL: You are going to pick up all those things in the course of --

MR. RAVAL: Initially, we were describing open item. We have closed that.

MR. ARCHITZEL: The following page clarifies that page being closed, and notes that they don't use steam air ejector. That write up will stay the same.

MR. CARROLL: The following page.

MR. SAGALA: The same page, 10-26, the second paragraph.

MR. CARROLL: You are right. Peace.

MR. MICHELSON: Are they just using mechanical pumps then?

MR. CARROLL: Yes. Except, I have never seen one of these. It's apparently a combination vacuum pump. It's optimized for auging in one mode of operation and optimized for maintaining vacuum in another mode. I don't know what the --

MR. MICHELSON: The auging pump won't get down into low enough numbers to do this job. They must go into a different mode then?

MR. CARROLL: I guess

MR. SAGALA: Two modes. One is auging -- 200 CFM capacity and holding is 50 CFM.

MR. MICHELSON: Is this a vein p ?

MR. CARROLL: Like a nash pump?

MR. BRUSTER: It's a nash vacuum pump. They have a water seal.

MR. MICHELSON: Normally, it's hard. Unless it's mechanical veining that somehow is chang positions, it's hard to see how it does them both. I won't worry about it. They say it does both, that's great.

MR. CARROLL: Anymore questions?

MR. RITTERBUSCH: Dr. Carroll, I wanted to provide some additional information on one item that we found out about as soon as Tom Crom from Duke Engineering and Services arrived. That has to do with the testing of the main steam isolation valves. That test program is described in Section 3.9 of CSARDC. We describe the test and the process for extrapolation to conditions higher than the test.

MR. MICHELSON: We will discuss it when we get to Chapter 3?

MR. RITTERBUSCH: Okay.

MR. MICHELSON: I guess.

MR. CARROLL: Thank you. Anything else?

[No response.]

MR. CARROLL: Let's recess for lunch and get back at 1:25.

[Whereupon, at 12:23 p.m. the Subcommittee recessed, to reconvene at 1:25 p.m., this same day.]

AFTERNOON SESSION

[1:30 p.m.]

MR. CARROLL: Let's reconvene. I guess we now have all the staff people and all the Combustion people to get back on doing this thing in order. I guess we are going to start with Chapter 11.

Before we do that though, I guess there are some Combustion people that are here specifically to respond to any questions we may have regarding the responses they provided to our questions on the 8th of December. Can we quickly skim through these questions and answers. Have people seen these, or am I the only one that has them.

MR. DAVIS: They were sent before.

MR. CARROLL: Are we happy with the response to 01? I think that was yours, Carl, 931208-01.

MR. MICHELSON: Why don't you go on. I will read this now.

MR. CARROLL: How about 02? That was mine. I guess I understand the response, but I am not sure I am happy with it. That's okay. Then 03, whose was that, Carl.

MR. MICHELSON: I didn't read that yet.

MR. CARROLL: Was 04 Dr. Catton's? Let's ask him about 04. Then 05, that's Lewis. Lewis still doesn't have all of the material that he needs that is referenced in here. You are going to give that to him tomorrow. Then 06 was Lewis, and 07 was Catton. Pete, was 08 you?

MR. DAVIS: No. I wasn't at this meeting.

MR. MICHELSON: It's Michelson, and 09 must be Charlie. Ten and 11 are Charlie.

MR. SEALE: Twelve was mine.

MR. CARROLL: Are you happy with that, Bob?

MR. SEALE: Yes.

MR. CARROLL: Who was 13? It's Wylie, again. Maybe while Carl is reading and when Ivan gets back he can read his, and we will go ahead with the presentation and interrupt it to get the feedback from people when they are ready to say something. There are some people that could get out of here if we don't need them. Given the weather, it might not be a bad idea.

On that subject, what are your travel plans?

MR. RITTERBUSCH: Washington National Airport may have more to say about that than we do. We will stay until whenever the Subcommittee requests.

MR. CARROLL: All right.

[Slides.]

MR. BARON: Good afternoon, gentlemen. My name is Joseph Baron. I am attached to Stone and Webster. I am principal engineer, and function as a consultant within our nuclear technology division. In terms of experience, I have been involved in terms of system rad waste design since

1971. I have been an active member in the ANS working group that developed the 55.04 and 55.06 standards, which are the design standards for the radioactive liquid and gaseous waste systems for LWR's. I have been involved, in terms of developing the EPRI URD for the rad waste system design.

MR. CARROLL: Have you ever designed a rad waste system, where the operators told you that you finally found the optimum way of treating nuclear power plant rad waste?

MR. BARON: Actually, I have designed them, where they have told me that I have done not such a hot job, especially on the evaporators.

MR. CARROLL: Okay.

MR. BARON: We get a fair amount of feedback. Unfortunately, you don't get too much feedback when it's positive. You get an awful lot of feedback when it's negative.

In terms of the system design, I will be talking about the areas in terms of common design functions for the rad waste system, the philosophy that we followed, and about the individual systems, liquid and solid and gaseous rad waste systems and design parameters, and the impact that they will have on the respective building designs that house them.

My associate, Carol Naugle, will talk about her evaluation of our design and its conformance to 10 CFR 20, and how it meets the design objectives of 10 CFR 50 and Appendix I. She will then deal with the process and effluent monitoring systems in the plant.

[Slides.]

MR. BARON: In terms of the principal functions, this is fairly straightforward. We separately collect and segregate the waste. We provide adequate storage capacity to accommodate delays in processing or disposal. We process the waste for safe discharge. We sample and monitor it as it is being discharged. We basically provide a design that does not permit uncontrolled releases to the environment.

The philosophy section is just about as equally short. In terms of the process design, it primarily had a very strong input in terms of reducing operator exposure. This was primarily done through the reduction, of looking back into the plant and reducing the amount of inputs of liquids and waste that are produced, both in terms of liquid, gaseous and solid. It has been mentioned in previous talks this morning, for example, the boron recovery system, the system that handles the effluent from the reactor cooling system. Now, the reactor handles most of its load following generation of these wastes through its control rods. This is the direct reduction in terms of the amount of waste that enters into that particular system.

We have a separation of cooler drains such as the containment cooler drains, where they normally go through an industrial discharge path that they are not radioactive and are processed in the rad waste system if they are.

We also do it though the selection and design of equipment to reduce maintenance. We utilize equipment such as liquid badge filters rather than cartridge filters, which allow us to extend the time between changeouts. We use ion exchangers versus evaporators. That allows us to reduce an awful lot of maintenance, both in terms of the reboiler design and in terms of the pumps. We use charcoal absorbers, in terms of delaying gases through chromatographic type of decay process rather than compressors or recombiners, for the storage of gases in hydrogenated systems.

We select the unit operations to reduce operator requirements, in terms that ion exchange systems are basically very forgiving in terms of the chemical input conditions, where the flow rates that are being put through them still produce an acceptable product.

MR. CARROLL: As long as you keep the oil out of them.

MR. BARON: Actually, we have oil separators in the beginning. One of the beds, as I will go into a little later, are carbon absorbers. We physically do handle that.

The unit operations are selected --

MR. CARROLL: Let me ask a question, a general question, at this point. The Subcommittee is talking about a possible trip to Palo Verde sometime in the next couple of months. We will, of course, make all of the appropriate arrangements with Arizona Public Service and the Region and whatever. Would we see a similar rad waste system at Palo Verde to what you are describing here?

MR. BARON: I don't believe so. I believe that the system is evaporator-based.

MR. CARROLL: It was a Bechtel system?

MR. BARON: I couldn't tell you that, to be honest with you.

MR. SEALE: No liquid waste --

MR. CARROLL: They have a different situation, nominally zero.

MR. SEALE: Nominally.

MR. BARON: We basically used unit operations to reduce the amount of solid waste generated within the liquid waste system or within the systems itself. This is primarily because we use materials which delay the radioactive species such as ion exchangers or charcoal absorbers, and do not get involved in terms of taking or collecting the bulk constituents which are non-radioactive.

We have a flexibility of design to accommodate operational upsets or unusual inputs. We do it either through having cross-connects to different processing subsystems for the liquid waste systems, or we have the capability of handling leased or vendor controlled equipment to augment the installed equipment design.

[Slides.]

MR. BARON: In terms of talking about the liquid rad waste system in terms of its design basis, the releases are controlled and monitored to meet the requirements and system design release requirements of 10 CFR 20 and 10 CFR 50. It's basically a non-nuclear safety related system with one potential exception, and that is that one of the subsystems is the containment cooler drains. That has a containment penetration, so those valves in that portion of the penetration are safety related.

The rad waste building itself is evaluated for the SSE loads in terms of remaining non-collapsible and things remain standing within it. It's not intended so that things necessarily remain functional after the SSE. We have sufficient redundancy within the processing capabilities through cross-connects or through parallel arrangements that, we can handle any single process failure within the rad waste system portion of the plant. The system is designed to prevent uncontrolled or unmonitored releases, and this is primarily through the areas like the siphon breaks, trip valves, et cetera.

The rad waste building itself primarily stores its liquid below grade. Therefore, in a sense by design, it is actually large enough to store everything that can fall down within the building itself below the grade itself. The only exception to what is stored below grade is, it's the surge tanks to the resin slew system. Those are stored at the grade level. This is done primarily because they have to be at a similar elevation as the ion exchangers within the plant, just for hydraulic purposes.

[Slides.]

MR. BARON: In terms of continuing on with its design basis, it is designed in accordance with the ANSI standard and Reg Guide 1.143. Our waste segregation is based upon source and chemical characterization. The processing is just basically collection, filtration, ion exchange, sampling, and controlled release.

We have provisions for mobile equipment for infrequent or unusual conditions, to augment our installed design. As I sort of mentioned before, the only ones we really expect to see in this is in terms of planned operations, as if we use large amounts of chelating agents or decon agents were present or that we had some major component replacement that would basically overload the system capacity. In either case this would give us adequate time to provide for this type of system.

MR. CARROLL: Is this liquid system designed for a zero release site?

MR. BARON: No.

MR. CARROLL: How would you deal with that, if somebody wanted to put an 80-plus at Palo Verde, for example?

MR. BARON: Our recommendation would not be to a zero release. That actually is against -- it's not recommended in the EPRI URD also. If it had to be done you would have to use -- and you wanted to keep ion exchange versus not having a solid waste or solidification system which would be required if you went into evaporators -- we would have to operate them into a demineralizer mode. Then basically what would have to be done is, we would have to put in vaporizers for the tritium release.

MR. CARROLL: Does that get you into any problems in terms of what's being certified?

MR. BARON: It doesn't get us into any problems in terms of what's being certified, nor does it get us into problems in terms of building storage capacity for the wastes. It would require additional analysis in terms to show that now that we are changing our discharge paths, that we are meeting it. It shouldn't present any problems, per se. We would definitely be violating the URD requirement in terms of, the solid waste generation would go up tremendously.

MR. CARROLL: Yes, but there are utilities in Arizona and --

MR. CROM: This is Tom Crom, from Duke Engineering. That is one of the things of certification is, we know that we had to pick a site. Even when you look at the seismic spectra we don't envelope every site in the U.S. We envelope 90 percent of them. What we selected and what was in the EPRI URD for the design of the rad waste system is a cooling tower site, both on thee ultimate heat sink and on the main condenser heat sink.

When we did our design -- also as you will see in the analysis -- we looked at what would be the dilution flow for a cooling tower site which is more typical, because I know of only two dry sites in the country and that's Palo Verde and Rancho Seco.

MR. CARROLL: In this instance it doesn't seem to me like it would be very difficult to right around that situation so that you could envelope those kinds of sites.

MR. CROM: I believe, the way I understand the certification rules, that tier one does not specify. We could do, under 50.59 process, do a dry site.

MR. CARROLL: That was what I was really trying to get at.

MR. BARON: I will comment on that. In terms of some of the violation it would require an exception to the URD.

MR. CARROLL: Yes, but so what.

[Laughter.]

MR. BARON: I hate to say that some people take that very seriously.

MR. CARROLL: As Bob put it, it's a druthers rather than a got you.

MR. BARON: That's right.

[Slides.]

MR. BARON: In terms of the building layout -- which I have a suspicion isn't showing up very well but I plan on showing this only for a few seconds -- literally, if I cut through this essentially everything is below grade which is liquid bearing. There are two tanks that are located roughly about here and farther back in terms of the picture, and they are in terms of the surge tank. They physically have to be there for just basically for -- we didn't have drain problems when we were sluing over resins.

[Slides.]

MR. BARON: I have more detailed drawings if anybody is interested. I am utilizing what is known as our ITAAC drawings. Functionally, they present the essentials of the system. I can go into greater detail in terms of what's physically incorporated within each of these little black boxes and I intend to do so. When I put up the figure drawing of it and basically looked at it, I couldn't tell what was happening within the system. This actually presents what I want to say.

MR. CARROLL: The good news is, you got inside and outside of containment right this time.

MR. BARON: Right.

[Laughter.]

MR. BARON: That's definitely a strong point. Literally, we have four subsystems which can basically be defined in terms of our higher activity/high purity waste streams, our low purity/low activity floor drain type waste, our laundry/hot shower drain systems and our containment coolers, which normally are discharged out of the plant and on termination of high activity are automatically terminated and bypassed into the rad waste system for further processing.

Each subsystem is essentially identical to every other one in that, its storage capacity is between five to 20 times the normal expected flow because the tank sizing is based upon the ability to collect the maximum design input out of the ANSI standards that we followed.

We used two equally sized collection tanks, and this is primarily to allow collection in one tank while processing in the other, sampling and processing in the other. We use slope bottom tanks to make the removal of sludge easier, both during normal operations and during cleaning operations.

Our pumps are normally sized for a processing flow of about 20 GPM. The system can handle up through 60 GPM, and that's what the design of the filters and demineralizers is based on. When the system is on recirc or sampling it can go up to 120 GPM. The filters themselves are the large bag type for large capacity or infrequent changeouts, and we operate ion exchangers in a series of five. They can be operated in any combination thereof. Usually what we have is, the first one is a charcoal absorber to take care of organics. We then use a selective ion exchanger for the removal of some particular isotopes. The ones that we have been concerned about in the past have been cesium or the cobalt. Cesium is the one that shows up in our current analysis, and that's the one that we are selecting now.

We have a cat ion bed, followed by a cat ion bed and then by two mixed beds. The two mixed beds have the capability of being rotated such that the newest bed that's placed in service is placed last in the series. It's then followed by two equally sized monitor tanks for sampling and discharge purposes.

[Slides.]

MR. BARON: The ITAAC scope for this particular system is basically in terms of its containment pressure test which is just the containment cooler, penetration and isolation valves, the analysis for the collection and storage tanks, and then in terms of the discharge valve for the system, that it can be monitored and controlled from the main control room so that the liquid waste system can be terminated. The discharge valve fails closed when its motor force fails. It can be terminated in terms of high radioactivity.

MR. CARROLL: I'm looking at the staff's table 11-1 which maybe you don't have.

MR. BARON: I actually have not seen it.

MR. CARROLL: For various systems they have a line called "DF" for halogens, cesium and others, with numbers like 1E-3 or different for different systems.

MR. BARON: Right.

MR. CARROLL: What are others?

MR. BARON: Primarily there are other cat ions in the system. If I had to look up in terms of -- let's say telerium, some would be more in terms of the complex. Those would be the other ions that would be taken out in terms of mixed beds themselves rather than selected ions or in terms of the cat ion removal beds.

MR. CARROLL: I guess my problem is that --

MR. BARON: It's everything else.

MR. CARROLL: I wanted to see others defined a little more exactly. It isn't the noble gases that are dissolving.

MR. BARON: The noble gases is just one, straight through.

MR. CARROLL: That's another.

MS. NAUGLE: This is Carol Naugle, Duke Engineering Services. In the effluent analysis the others are everything other than the iodine and the bromides and cesium or cat ions, and everything else is the actinide and things like that. Those would constitute others.

MR. CARROLL: But not dissolve noble gases.

MS. NAUGLE: No. Noble gases, there is no decontamination efficiency for that. They are not removed in the carbon absorbers or ion exchangers. They are released, unmitigated from the systems.

MR. CARROLL: I know the problem --

MS. NAUGLE: He will talk about the gaseous waste system. There are carbon absorbers in that. There is just simply a delay based on those designs, and he will go into that further.

MR. LYONS: This is Jim Lyons. There is a footnote on that "others".

MR. CARROLL: Where?

MR. LYONS: It says that it excludes the noble gases.

MR. CARROLL: You are right, and tritium. I missed that. Maybe you are right.

MR. BARON: The next system would be the solid waste system. The packaged waste in that will conform to the applicable regulations. It's designed in accordance with Reg Guide 1.143. It is entirely a non-nuclear safety related system and it's housed in the rad waste building, which was designed and evaluated for SSE loads.

We provide sufficient storage for one year of expected waste generation. In actuality it will probably be more than that, because the original allocations were set up for anticipated waste deference such as large scale resin movements from the condensate polishing system.

The space provided in the rad waste building for leased equipment, for infrequent or unusual waste, this would be if we picked up, as I said before in terms of the liquid large scale, in terms of chelating agents or in terms of large volume flows. For the specialized chemical inputs, we would potentially use evaporators, these would require solidification systems to be attached. These would be essentially on skids or housed in trucks if there's adequate space in terms of our truck space for that.

There's also space for installation of a solidification system located within the facility if it would be required at a later date.

[Slides.]

MR. BARON: In terms of the process itself, the wet waste which is primarily filters, bag filters, cartridge filters and the resins themselves, are collected and stored for decay, dewatered and packaged for shipment for storage. The dry waste is just collected, sorted, compacted and then packaged for shipment. Resin from the condensate polishers, if it is radioactive, will be put into HICs in the turbine building and transported to the rad waste building for final packaging and shipment. The containers are stored at grade near the truck access. These would be boxes, drums or HICs.

[Slides.]

MR. BARON: As I put on for the liquid rad waste system, the ITAAC drawing describing what the solid waste system looks like in terms of its functional requirements is, resins that are basically low activity would go into these low activity spent resins subsystem. This has adequate capacity for handling about 500 cubic feet of resin through two low spent resin hold tanks.

The high activity spent resin system would handle the high activity resins from the holdup ion exchangers and the CVCS system, purification exchanger system and the fuel pool ones. That would go into that particular subsystem. From there it would be transported either into HICs or onto a shielded container, onto a truck.

Dry solid waste spent filter assemblies that are primarily ventilation system assemblies would go into the low level waste handling system, and would be either packaged in boxes or drums, depending upon what their characteristics are and then stored and shipped off site.

[Slides.]

MR. BARON: The requirement in terms of the ITAAC scope it's basically the analysis, that we have adequate space for spent resin collection and storage of the waste product.

MR. CARROLL: Before you move on to the gas waste systems, can I ask Carl and Ivan if they have finished looking at the answers to the questions?

MR. MICHELSON: Do you want to do that now?

MR. CARROLL: Well, because some people may want to leave, depending on what you tell them.

MR. MICHELSON: On 01, I didn't have any problems with number one, I believe. And, 02 was somebody else's.

MR. CARROLL: That was mine, and I said that's okay.

MR. MICHELSON: I had one question. On the concluding line of the reply it says that the retention time of the optical disk is a utility function, and there is no technical limit. I wanted to ask the staff, is that the position of the staff, that operating data accumulated at a plant can be kept for whatever length of time the utility wishes?

MR. WAMBACH: We have criteria which is Reg Guide 1.28 and NQA1.

MR. MICHELSON: There is some technical requirement on the retention.

MR. WAMBACH: Right. It's used to back up the GDC, and we use Reg Guide 1.28 and NQA1 to establish the criteria that we used.

MR. MICHELSON: Do you know what that might require for something like these optical disks, which is essentially the operating data from routine operation or from accident operation.

MR. WAMBACH: I don't think it intended to change, whether you have optical disk or --

MR. MICHELSON: How long do you keep it, the life of the plant?

MR. ARCHITZEL: Some records are life of the plant.

MR. WAMBACH: Some are.

MR. ARCHITZEL: Rad waste release records are life of the plant, as an example.

MR. MICHELSON: How about operating records. A lot of this on optical disks will readouts of all the various instruments as the plant runs along. How long is that normally kept for, do you know?

MR. WAMBACH: I didn't bring along the Reg Guide.

MR. MICHELSON: Maybe ABB has the replies, as to why they don't think there's any technical limit on it.

MR. SCAROLA: I think I can answer this. The intention in the response is to say that there is no technology limit in how long the optical disk will retain the data. It is not intended to say that there is no administrative requirement imposed upon the owner as to how long he needs to retain the data.

MR. MICHELSON: That's a very poorly written sentence. I will read it. The retention time of the optical disks -- the retention time -- as a utility function, they decide. The disk doesn't decide, the utility decides, how long it's to be kept.

MR. SCAROLA: Right.

MR. MICHELSON: There is no technical limit. I guess you are saying that the technical limits statement meant that the disk will last forever.

MR. SCAROLA: Yes. I agree, it really could have been worded better.

MR. MICHELSON: It's not a utility function, it's a regulatory function, as to how long they are kept. I just wanted to make sure. Most of the question that day was, do you have to keep this stuff. That's the answer I was looking for. This answer isn't quite right. It isn't a utility function.

MR. SCAROLA: I think it would help if we said there is no technical limit on the optical disk technology.

MR. CARROLL: I think that's right.

MR. MICHELSON: I knew that.

MR. CARROLL: This morning somebody mentioned one of the QA daughter standards that deals with the collection and maintenance of records. I think that's what we need to look at.

MR. MICHELSON: That was the crux of the discussion in December.

MR. CARROLL: I don't remember that being a very good standard. I think it was pretty vague, in terms of what it required you to do.

MR. MICHELSON: I would think that if there are regulations already covering this, how does that get into the certification process, all these things that the utility has to do anyway.

MR. ARCHITZEL: NQA1 and 2, there were very specific record retention requirements. I said 45.29 this morning and it might be 45.25. They have been translated into NQA1 and 2. One of the specifics that I remember is the rad waste release records are lifetime of the plant, as a specific example.

The strip chart recorder on certain temperature, there are tables that have retention times in them. A utility has to commit to those standards and implement that for record retention. I don't know all the specifics. We could get that to you.

MR. MICHELSON: The question that came up in December was, do they have to keep these --

MR. ARCHITZEL: They have to keep them for this NQA standard, and it has record retention requirements in it. I guess CE had to design the system to provide certain readouts. Hopefully, there's not a disjoint between those readouts and the record storage requirements.

MR. MICHELSON: The other question we had in December which they did answer very well is, how many of these disks are we accumulating in a year's time. That is in this answer and it looks like a reasonable number. It's certainly not non-manageable.

MR. ARCHITZEL: The point I am aware of is, the optical storage was an approved medium for storage on the NQA.

MR. MICHELSON: It was?

MR. ARCHITZEL: That we have approved that as a storage medium. The lifetime aspects of it are acceptable. It's just versus strip charts.

MR. MICHELSON: That's reasonable. I just didn't quite buy that bottom line on the reply. I think it is now correct.

MR. CARROLL: The next one is yours, Ivan, 04.

MR. CATTON: They sort of finessed the question. I guess I have no problem with it, if the PRA results demonstrate that this is indeed the case. I asked what would happen, and they said it won't happen because we have two of them. I will let others decide whether that's an adequate answer.

I asked them what would happen to their multiplexing units if they had a loss of all HVAC. They are saying loss of all HVAC is considered highly unlikely, we have two of them.

MR. DAVIS: We will have to see.

MR. CATTON: If the PRA backs them up, then I am happy with the answer.

MR. MICHELSON: This is an important one from the viewpoint of ABWR, where I worried about it quite a bit. They don't have redundant HVAC.

MR. CATTON: I don't think we should --

MR. MICHELSON: They addressed the question by saying they will shut the equipment down if it starts getting too warm after they have lost HVAC, because they can shut down one division at a time. That's a good answer. In some areas I would rather see the redundant HVAC, myself.

That's something that the staff should keep thinking about. For these more sensitive areas are we going to require redundant HVAC on one division of electronics. Right now, there apparently is not a requirement. That was what this whole discussion was addressed to.

MR. CARROLL: In fairness though, Ivan, the third paragraph does acknowledge that both systems can fail.

MR. CATTON: Yes. They are saying that if it heats up that's what's going to happen.

MR. DAVIS: It's a problem.

MR. MICHELSON: They will know about it.

MR. CARROLL: They will know about it, and they will take the equipment out of service.

MR. MICHELSON: Yes. I think the fact that they have redundant HVAC on all divisions of all trains of electronics, if that is indeed the way I read this, that's a good step in the right direction. I guess that's my understanding. I would like to see others do the same.

MR. CARROLL: And, 05 is Hal Lewis'. Unfortunately he's not here today, but we will make sure he gets this response and tells us if he's happy or not. The same was true of 06. How about 07, Ivan.

MR. CATTON: Actually, this isn't what I had in mind. I had something more in mind. Input to output testing should include possible off normal or spray transducer output as well as line noise. All they are talking about is line noise. A filter can easily take care of line noise. It's more the former that I am interested in than the line noise.

You really didn't address the question. Maybe I didn't phrase it right. I don't remember. It got reduced to system testing.

MR. SCAROLA: Excuse me, I am not really sure I know what you are talking about.

MR. CATTON: One of the problems with embedded systems, where you go from an input to an output and you have in the middle of it software and on either side hardware, somewhere you ought to be testing the whole thing and putting the kinds of input signals you expect and looking at the output signals of the actual system.

One of the things that you worry about when you do that is that if one of the transducer's fails high or fails low or does something spurious -- and we know what spurious things transducers do -- what does your integrated embedded system do.

MR. SCAROLA: Full system integration tests are part of what we call validation testing. That is identified in this answer --

MR. CATTON: Where?

MR. SCAROLA: In the program manual, as the integrated hardware and software test. That's Section 4.4.4 and 4.4.4.1. There, we do full system simulation on input. In other words, simulated plant process variables --

MR. CATTON: Are you reading from the answer somewhere?

MR. SCAROLA: Right, right in the middle. In addition to system validation testing, Section 4.4.4 and 4.4.4.1 provide requirements for verifying that the integrated hardware and software meet system requirements.

MR. CATTON: I guess if one of the bullets would have used the kind of words that I used, I wouldn't have thought about it. Here, to me, adequacy of functional features for meeting system objectives can be done by just looking at it. What does the word "adequacy" mean? Do you do testing of the full system, port to port?

MR. SCAROLA: Port to port, on a system by system basis, and then we do full testing on a complete integrated control complex basis.

MR. CATTON: You do full testing on the full system.

MR. SCAROLA: Full system.

MR. CATTON: Input to output of the system, whatever it is.

MR. SCAROLA: One hundred percent simulated inputs. We do it for normal inputs as well as off-normal inputs, for a set of predefined input space. In other words, it is not every permutation and every combination.

MR. CATTON: Is there somewhere that I can see what this set of input states are?

MR. SCAROLA: No, not today. The set of input states get defined as a part of the process. That set of input states then is reviewed by the independent verification and validation team.

MR. CATTON: I think what I should do then is accept the answer as it is, and wait to see the input.

MR. CARROLL: That, of course, occurs after FDA.

MR. SCAROLA: After certification.

MR. CARROLL: It's described in the -- I will use the dirty word -- DAC process.

MR. CATTON: I would be interested in seeing the piece of the DAC process that has those words, particularly the words that define input sets.

MR. SCAROLA: The ITAAC references this document by name, not by number. It says there is a software program plan. In this plan it references or discusses the need to define input test cases. It identifies that those test cases must be independently verified by the verification team.

There are requirements for test plans in this document as well as detailed test procedures in this document.

MR. CATTON: These are, as yet, undefined.

MR. SCAROLA: The procedures are undefined, but the requirement for the procedure is well defined.

MR. CATTON: I guess I am still losing it somewhere.

MR. SCAROLA: In other words, if I take a specific system, the actual tests -- and you may run 50,000 test cases -- the actual test cases are not defined to date. The need to define them in the future is documented.

MR. CATTON: Are there any requirements documented for how they will be established.

MR. SCAROLA: In this document it does identify that an engineering evaluation must be made of the appropriate test space. It is largely done by engineering judgment. It's done by the designer who builds up the test cases, and then it's independently verified or independently evaluated and judged by the verification team.

It is certainly a subset of some possible total number of test cases you could run. I don't know that we have any intelligent technology that would lead us to what is an appropriate cookbook method of defining the appropriate test cases. There are words in here that state that the test cases must encompass all of the branches in the software. As a minimum every branch must be tested, via one of the input combinations. Those words are in this document.

I think that's the extent of the intelligence that we have today, as to how to establish test cases.

MR. CATTON: Does the final set of input parameters for these different sets get reviewed by the NRC?

MR. SCAROLA: The NRC certainly has the opportunity to audit as part of the ITAAC process. But, is there a formal review, I don't know that the NRC --

MR. CATTON: If they don't like an input set is there anything that they can do about it. Do they plan a role in the process that late in the game. I see a yes over here and a nod over here. I think that's good enough.

MR. CARROLL: Ivan, you will find in your mail, a draft of how the NRC intends to implement and audit and inspect the ITAAC. I just read it the morning I left for the airport. I am not suggesting it goes into this detail but they describe it.

MR. CATTON: I understand where you are coming from, in not being able to really lay it out. This is an area that perplexes not only the process that you are trying to implement, the aerospace business has the same problem. Embedded systems is an active area of research, and in particular trying to figure out how to test them so that you know what their reliability is, whatever it is.

The hardware/software interface is a difficult one to deal with. I have no problem with it. If some of the words were used from here I would have felt better. It's on the record, and I will wait to see how you do it when it comes time to fish or cut bait. Thank you.

MR. CARROLL: What's the next one?

MR. MICHELSON: Number eight. I had 08. I have a couple of clarifications, and then I can tell if the answer is acceptable. First of all, partly into the reply you said you were going to use dry header systems. Is that going to be all spray systems will be dry header including the diesel compartment for instance?

MR. CROM: That's correct. All automatic actuated systems will be dry headers.

MR. MICHELSON: You are going to fight the fuel oil fire, one spray nozzle at a time.

MR. CROM: The fuel oil fire one spray, no. I don't think that's the case. The actual pre-action --

MR. MICHELSON: The pre-action system --

MR. CROM: The pre-action valve would be at the seismic --

MR. MICHELSON: No. The pre-action requires two things, the pre-action valves and sprinkler fusible links on every head.

MR. CROM: That's correct.

MR. MICHELSON: Which means that the only heads that open up and spray are those where the fire is.

MR. CROM: That's correct.

MR. MICHELSON: Is that for diesel fuel fire, you are going to put it that way?

MR. CROM: That's correct.

MR. MICHELSON: Your fire experts say that's an acceptable way.

MR. CROM: That's what they have in their design currently.

MR. MICHELSON: We will deal with that one later, not today.

MR. CATTON: I already forewarned them about the report.

MR. MICHELSON: I didn't realize they were going to use pre-action on the diesel.

MR. CARROLL: Yes.

MR. MICHELSON: I thought they were going to use water spray all right, but I didn't know they were going to do one nozzle at the time. You will get a lot of argument from the experts on that, as to whether that's effective or not. Most of them want to deluge the area when they get the fuel oil fire.

MR. CARROLL: If you really want to put it out you use foam, but they are convinced --

MR. MICHELSON: That's another whole problem.

MR. CATTON: We have a report coming from our fire science consultant in about two weeks that addresses just this issue, water on diesel oil fires. He has concluded that it won't put it out. I have already forewarned CE that when they get to Chapter 19 and we talk about fires that the report will be on the table, and that they could probably get a copy of it from us in about two weeks.

MR. MICHELSON: I want to ask a couple of more questions. The next to the last paragraph in that first page of the reply talks about the EFW pump room. It says that there's nothing in there that can be affected directly by the spray. I was wondering, using electronic governors and so forth, are they located in another room or something?

MS. SIEGMANN: They have drip covers on them, so that they --

MR. MICHELSON: This is going to lead to the next question right away, which you are claiming that drip proof is all that you need. I would like the electrical experts to tell me if they have changed drip proof from what it used to be. Drip proof is normally not any good for a spray nozzle next to a piece of equipment. It's all right for dripping pipes or whatever or for vertical but it's not any good for horizontal like you get out of a spray nozzle.

MR. CROM: I am not sure I can answer that. I am definitely not a fire protection expert.

MR. MICHELSON: I think I liked your last paragraph, if you just dropped out "drip proof" and just used that sentence that says they are protected from sprays such that the actuation of spray will not directly result in a failure of the equipment. If that's the way you are going to buy it -- and don't talk drip proof because that may or may not be right.

MR. CROM: You are correct in what you said.

MR. MICHELSON: The previous paragraph you didn't say drip proof, so I wasn't sure. It said there wasn't anything that could be affected by spray, and I was pretty sure that you did have something that could be affected by spray. The reply is less than sterling.

MR. SCAROLA: I would like to throw in my two cents. The intention here is that we will have electronic cabinets in those rooms, and we will have the electronics fully enclosed in what you would call historical drip proof enclosures.

MR. MICHELSON: Water tight enclosures, historically.

MR. SCAROLA: No, these are not water tight enclosures.

MR. CARROLL: He said weather tight.

MR. MICHELSON: I said water tight.

MR. SCAROLA: No, I would not consider that they are weather tight either. The thinking here was that the spray nozzles are sufficiently above the equipment, that the equipment will not see horizontal spray.

MR. MICHELSON: If you spec it that way, that would also be acceptable. When you go to the diesel compartment, if I understand the system you are going to use there, I thought you were going to get your nozzles down near the engines which wouldn't be at the ceiling then. Maybe you are going to put the nozzles all at the ceiling to fight that fuel oil fire.

MR. SCAROLA: It sounds like that may need to be an interface requirement, one way or another.

MR. MICHELSON: You can't judge the safety of what you are proposing unless there is either a good spec on it or a very good interface requirement. I didn't find either.

MR. CATTON: If you are going to use sprays and you want to spray enough water to put out the fire you are going to have a lot of lateral motion, mainly because the sprays cause a lot of convection patterns in the room. I know that you don't put as much in as you do when you spray down the containment.

If you have ever seen the Zion containment when they tested one set of the sprays, it literally turned the well upside down. You create a lot of air currents so there is a lot of lateral convection of spray unless you really put the spray on it gently, and if you do that you probably can't put out the fire. I think you need to take another look at this.

MR. CROM: I would like to address this. I can bring in the experts. In the paper that you talk about, the people that we had working on that are all graduates of the University of Maryland, and have worked directly with the professor that you are talking about.

MR. MICHELSON: When they come prepared -- one other thing that I am not certain about is how to properly protect the generator in the diesel compartment. Now, we are talking inadvertant actuation of fire protection and talking about continuing wanting to use the equipment. It's that generator with the induced fans inside of it and whatever, that is literally going to pull the water through it.

I don't know what kind of spec you have to put on the generator now so it doesn't make it --

MR. CARROLL: I think you concede, you will lose the generator.

MR. MICHELSON: This is on all diesel compartments, are going to get the inadvertant actuations at the same time because there are non-seismic detectors and whatever. All of them turn on at once but we don't want to lose all the diesels.

MR. CATTON: I might mention that in the UCLA engineering building most of the damage came from the fire systems, after this last earthquake.

MR. MICHELSON: I will leave it this way, we will talk about it later. This answer is not quite acceptable.

MR. DAVIS: I have a question on that issue, Mr. Chairman. The pre-action valves, what is the power source for those valves?

MR. CROM: I don't think I can answer that right now.

MR. DAVIS: I notice that it says that they fail as is, on loss of power. If they are on normal offsite power and --

MR. CARROLL: Which means, they won't open.

MR. DAVIS: They won't open. You won't have a problem if you lose power to them.

MR. CROM: I am pretty sure they are DC battery backed at the power source.

MR. DAVIS: That's seismic?

MR. CROM: No, that would not be seismic. The problem with the pre-action valve i[illegible]t could fail to open its position just from the sei[illegible]ent itself.

MR. DAVIS: If you lose DC power to it, it fails closed. If you have a fire after that, it will not actuate.

MR. CROM: It doesn't specifically fail closed. They are like a clapper device, and the seismic event, once this opened it remains opened could actually cause it to open, the seismic event itself.

What we are saying is, even if the valve opens you still have to have the spray -- the nozzle itself then has to open and spray. Even though it's not seismic category one, in past PRA's they take anything as welded piping as being seismically rugged.

MR. DAVIS: I am interested in the opposite problem, where the seismic event causes loss of power to the valves so that they fail as is, which is shut. Then you have a fire caused from the seismic event, and then they won't work.

MR. CROM: You don't use the pre-action sprinklers at that time, you use your hose stations from your seismic category one standpipes, manually.

MR. CARROLL: Manually.

MR. DAVIS: You hope the people can get there after a major seismic event, I guess.

MR. MICHELSON: You hope that you don't have fuel oil under those conditions, too. That gets a little tougher.

MR. CROM: One thing I wanted to tough on is, you said the fans on the diesels. We do not have air cooled diesels, we have water cooled diesels.

MR. MICHELSON: No, not the diesels, the generators.

MR. CROM: The generators, okay.

MR. MICHELSON: You have to circulate air through them.

MR. CARROLL: That's an air cooled generator.

MR. MICHELSON: Most of the heat in the room -- you could have insulation for that generator and everything that would handle it. I haven't seen that as a requirement.

MR. CARROLL: You could have a liquid cooled -- a generator with coolers in it.

MR. MICHELSON: It's not quite that. They can use that, so that water isn't going to bother the terminals and whatever. Unless you spec it, it won't --

MR. CARROLL: You have brushes and --

MR. MICHELSON: No. It could be protected. You have to tell them to protect it from that water spray. The answer suggests no concern, no requirement to protect it.

MR. CARROLL: Now, we are on 09, and that's Charlie. Ten is Charlie. Eleven, this is for the NRC staff. Combustion has no comments on that one?

MR. RITTERBUSCH: ABB wrote the response.

MR. CARROLL: You did, okay.

MR. RITTERBUSCH: Right.

MR. CATTON: Another interesting thing that happened in the UCLA building is that the earthquake caused drains to screw up. As a result there was flooding.

MR. MICHELSON: What did it do to the drains?

MR. CATTON: That had to do with equipment. People had running and stuff that was going into the drains, and then the drain broke.

MR. MICHELSON: The drain line broke.

MR. CATTON: The drain line broke.

MR. MICHELSON: Sure.

MR. CATTON: In some cases stuff fell off and plugged the drain.

MR. MICHELSON: That is the nuclear plant, those drain lines are right over the electrical. When they break they are non-seismic floor drains.

MR. CARROLL: Did you look at 11, Carl?

MR. MICHELSON: No, I didn't. Was it one of mine?

MR. CATTON: That's aging.

MR. MICHELSON: No, I didn't read it.

MR. CARROLL: That looks like one that we can --

MR. MICHELSON: I thought that was --

MR. CARROLL: We can let Charlie deal with that. Twelve is Seale. Are you happy, Robert?

MR. SEALE: Yes, I guess so.

MR. CARROLL: This proposed letter that I have this is one of the three topics, the issue of what tech specs are going to say. Thirteen was Charlie.

MR. SEALE: Electrical drawings.

MR. CARROLL: We know which ones we have killed off and which ones we still have to do.

MR. CATTON: There's an awful lot getting loaded into our next meeting.

MR. CARROLL: We may end up with a two day meeting one of these days.

MR. MICHELSON: Chapter 3 is going to take some time, because that's some of the most important stuff outside of containment. It's the compartment pressurizations, the flooding, pipe breaks and things of that sort are all in there. The construction of the buildings, the flooding capabilities of buildings, I was going to ask that on this building.

Is this going to be a water tight building from up to grade?

MR. BARON: Not water tight. It does not have a liner, per se.

MR. MICHELSON: The question then is, does the site flood. You would like to keep these tanks tied down during the site flood and not have them floating away. The more important thing is, you have to keep all the penetrations over to your auxillary building tied down to keep from losing the penetrations, and then the flood goes right in the auxillary building unless you can flood it too.

Is it the auxillary building, or do you call it something else?

MR. CARROLL: Nuclear annex.

MR. MICHELSON: Nuclear annex. Is it water tight to grade?

MR. BARON: I couldn't tell you that answer.

MR. MICHELSON: That will be the kind of question we are going to come up with is site floods. I guess we have a flood on this site up to grade, unless we specify otherwise. That eliminates a lot of sites in a hurry if you don't let that be the case.

Those are the kind of questions that will come up on Chapter 3 when we get to it, and it will take more than the alloted time.

MR. CARROLL: The alloted time was not to cover the entirety of Chapter 3, as I understood it.

MR. MICHELSON: It says approximately one hour for one and two, I guess.

MR. CARROLL: For the seismic and structural, isn't that what you wanted us to cover?

MR. RITTERBUSCH: We were prepared to do all of Chapter 2 and 3 in an hour, but I guess we have to have some feedback.

MR. CARROLL: The consideration was that you have a seismic and structural consultant that --

MR. RITTERBUSCH: That's correct. It was the seismic and structural which caused us to ask for consideration at that time.

MR. CARROLL: What the hour was about was just to deal with those two aspects of Chapter 3. Tom and Pete have asked that we get on with the review of PRA and severe accidents. We were trying to use next month's meeting principally for that, but to also accommodate the seismic structural consultant. I think we can deal with that limited part of --

MR. MICHELSON: Just the seismic.

MR. CARROLL: Chapter 2 and 3.

MR. MICHELSON: Just the seismic part only, yes. When are you going to do the rest of it, the next time after that?

MR. CARROLL: Whatever the schedule is.

MR. MICHELSON: It's the only time it's on the schedule.

MR. CARROLL: It will probably be in April.

MR. MICHELSON: All right. The timing isn't critical. I got a little excited for one hour for Chapter 2 and 3 together.

MR. CATTON: Three is not mentioned in the April meeting at all.

MR. MICHELSON: No.

MR. CARROLL: It should be. We will put it down there. Ken, have we done things, that you and others can leave? On to gaseous rad waste.

[Slides.]

MR. BARON: This is actually a fairly trivial system, in that it meets the requirements in terms of its releases, it meets the requirements in terms of its effluents, it's basically a non-safety related system but it's housed in the nuclear annex. This was done primarily because of not wanting to transport hydrogenated gases any distance around the facility.

The components within the system are supported to the SSE loads. The component pressure boundary is designed to maintain system integrity following a hydrogen explosion. The nominal that is required in terms of the ANSI standard Appendix C is the 20 times normal operating pressure. What we do is, we look at the individual piping and supports in addition, to see whether there are any larger pressure boundaries that have to be identified.

We detect that --

MR. CARROLL: Why is 20 times okay?

MR. BARON: Twenty times is the nominal that has been -- in terms of the analyses that have been done on past plants. ANSI standard 55.4 identifies that as a starting point in terms of the nominal design. Most gas waste systems that are charcoal based are designed for the 20 times the normal operating pressure. If you are operating at one pound gage that would be something like a 300 pound system.

MR. MICHELSON: What hydrogen explosion are you modeling? Somehow you got hydrogen and oxygen together in the pipe or something?

MR. BARON: No. Normally the system is totally hydrogenated, because what we are receiving is hydrogenated fluids. The concern is that you inadvertently start pulling in air from a leak or in terms of one of the potential failures on one of the sources, and start getting a bleed through in terms of oxygen. While there is both hydrogen and oxygen monitors, the real concern is on the oxygen monitoring.

MR. MICHELSON: To make this valid what kind of mixture are you postulating, that 20 times will handle it.

MR. BARON: Stoichiometric.

MR. MICHELSON: You are saying you will detonate inside the pipe and if you have a pipe designed for 20 times operating, operating is probably near atmosphere on a lot of this stuff.

MR. BARON: Right. That's why I said --

MR. MICHELSON: It's not very much design pressure then.

MR. BARON: It's 20 times the absolute. That's why I said it's about 300 pounds.

MR. MICHELSON: Okay. It ends up about 300 pounds gage -- absolute.

MR. BARON: Right.

MR. MICHELSON: These things don't behave that way.

MR. BARON: No. That's why I said the ANSI standard in Appendix C requires you to look at the actual piping configurations. As a starting point the 20 times is the requirement.

MR. MICHELSON: If you do the 20 times you don't have to do any analysis.

MR. BARON: No. What they say is that you have to look at it. Twenty times is your starting point, and if you have unusual configurations you have to go back and do the actual analysis.

MR. MICHELSON: Okay. The minimum is 300 pounds.

MR. BARON: Right.

MR. CARROLL: On the bottom of page 1118 of the FSER it makes it sound like all you have to do is design it for 20 times.

MR. BARON: That's really what in terms of what the requirement is, how the NRC has reviewed it. That has been the most common response and most common found type of thing. We do not get a real detonation within the pipe because the pipe is really below the minimum velocity and run length. In terms of the vessels themselves you only have a limited volume in terms of above and below the charcoal bed that it supports, so you cannot really get the reflection. The charcoal bed themselves act as a diffusion barrier and break up the shock wave.

MR. MICHELSON: How about liquid tanks.

MR. BARON: These are only the gas waste systems.

MR. MICHELSON: You are not talking about the gas that might be in the upper space of a liquid tank.

MR. BARON: Which liquid tank?

MR. MICHELSON: I don't know enough about your rad waste to know which ones are partly full and what can come diffusing out of the liquid.

MR. BARON: There are no tanks in the liquid rad waste system per se, that are hydrogenated. They are all aerated tanks, and they have ventilation flow within them.

MR. MICHELSON: That won't be a problem, okay.

MR. BARON: The one component which has water in this particular system is the cooler in front of it, and that is also designed for the 20 times operating pressure.

We have the capacity to process under the design conditions the 1 SCFM flow on a continuing basis and provide for 30 day decay for xenon and three day krypton decay. This is done at the maximum temperature that we can expect to see within the building, which is about 104 degrees. The normal operation will be at about a third SCFM, so that we get more than the 30 days during expected operation.

We are designed in accordance with the applicable ANSI standard and Reg Guide 1.43. The noble gas holdup and decay are provided by the ambient charcoal. Hydrogenated systems, the incoming gas streams, because charcoal absorbtion is very sensitive in terms of the water content, we cool the system down or cool the incoming gas down to 45 degree dew point. That provides our humidity control, such that we could adequately compensate for the humidity by increasing the amount of charcoal that is within the system.

We provide all filtration on all process streams except for -- whether they are aerated or hydrogenated -- except for the condenser evacuation system.

[Slides.]

MR. BARON: In terms of the function and how it looks, we receive gas from a variety of sources into the gas waste system, stripper, equipment drain tank which is volumetric displacement, reactor drain is also volumetric displacement. The volume control tank, which can either be a control release when you are shipping over from one gas to another or in terms of volumetric displacement. This is also a controlled release path.

It goes through the gas waste system which consists of a cooler which cools the gas down to 45 degrees, and the drains to the low level equipment drain tank in the rad waste system. It then passes through a charcoal guard bed which is in case we get a breakthrough in terms of moisture, but there's one bed which is basically a sacrificial bed. They are followed by six charcoal beds that can be arranged -- any one cut out of service will rearrange in terms of is service orientation such that if there is a reason to replace the charcoal or replace the charcoal we can pipe nitrogen through it on a separate basis.

That more or less completes it. The gas is then discharged, monitored and discharged, and released to the environment.

MR. MICHELSON: Is this all seismically qualified?

MR. BARON: It's seismically supported. The components are supported. There has been no requirement to be functional after a seismic event but it's supported to the SSE.

MR. MICHELSON: Supporting it seismically is not an assurance of non-rupture, is it? It's just an assurance that if it ruptures it won't fall.

MR. BARON: Let me retract in terms of what I said. The components themselves and their supports are designed to withstand the SSE, such that there will not be a gross rupture or minor rupture of the component pressure boundary following a seismic event.

MR. MICHELSON: The pressure boundary is qualified.

MR. BARON: The pressure boundary is qualified.

MR. CARROLL: I am looking at the top of page 11-23, staff FSER. It indicates that you are designing your system for one percent fail fuel.

MR. BARON: Right.

MR. CARROLL: How does your system hold up in terms of severe accidents, where you have much more than one percent?

MR. BARON: In practice we won't see it, because the system will be isolated. If you could give me a little bit more indication of what you are referring to, I will try and answer it in terms of the design of the system. None of the rad waste systems are designed to handle the accident case.

MR. CARROLL: That's what I was really asking. Your shielding -- you have some shielding that is for severe accident but not around the rad waste system. For example, the pass system obviously has to be shielded for --

MR. BARON: Yes.

MR. CARROLL: All right. On page 11-25, and I am trying to understand what it means when it tells me that dry solid wastes consist of certain kinds of filters and compatible wastes such as rags, contaminated clothing and --

MR. BARON: I think it means compactable.

MR. CARROLL: Ms. Naugle is going to tell us about Reg Guide 1.97, instrumentation. I don't have any more questions. Does anybody else have anything on this particular section?

[No response.]

[Slides.]

MS. NAUGLE: I am Carol Naugle, with Duke Engineering and Services. My background is nuclear engineering. I graduated from the University of Cincinnati in 1988. Prior to graduation I had worked on a number of co-ops which ranged from training I&C mechanical maintenance on up to a short stint with the NRC.

After that, I went to Duke --

MR. CARROLL: Should we hold that against you?

[Laughter.]

MS. NAUGLE: I don't know. The jury is out. That was in Region III. After that I went to work for Duke Power for about a year and one-half, where I worked on some PRA and some 50.59 and effluent analysis. Then, I moved over to Duke Engineering and Services, where I began working on ALWR Chapter 11 and 12 issues.

[Slides.]

MS. NAUGLE: What I am going to talk about today is the effluent analysis that has been done for the liquid and gaseous systems. The basic purpose for doing these effluent analyses was to verify compliance with Federal regulations which included 10 CFR 20 Appendix B, Section 20.1001 through 20.2402 -- that's the new Part 1E requirements -- as well as 10 CFR 50, Appendix I, which basically encompasses ensuring that the general public's exposure has maintained ALARA and NUREG-0800 Branch Technical position, which basically encompasses a failure of the gaseous waste system.

MR. CARROLL: I am sure you are going to tell us but is that Branch Technical Position obsolete, given the design of present day gaseous systems?

MS. NAUGLE: From talking with the staff at the NRC, some of the assumptions that are made for establishing the source term are out of date. With the help of the staff and their insight, we remedied that situation as far as evaluating the gaseous and liquid effluent analysis for one percent fail fuel for meeting Part 20 as well as this Branch

Technical position of 500 millirem.

[Slides.]

MS. NAUGLE: The methodology and the codes that were used to evaluate were LADTAP and GASPAR, which basically utilized Reg Guide 1.109 methodology as far as the evaluation of 10 CFR 50 Appendix I regulation. PWR-GALE, which is discussed in NUREG-0017, Revision 1, which establishes an annual release rate of all the expected isotopes from normal operation. The DAMSAM, a code which calculates the reactor coolant concentration for equilibrium conditions for one percent failed fuel. That helps us to evaluate compliance with Part 20.

[Slides.]

MS. NAUGLE: The results of our analyses for 10 CFR 50 Appendix I are 7.8 millirad per year, which is about 39 percent of the limit established in that regulation for beta dose, and 2.1 for gamma dose which is approximately 21 percent of the ten millirad per year.

MR. CARROLL: That's what, safe boundary dose?

MS. NAUGLE: Yes. This is at site boundary.

MR. CARROLL: This is the guy sitting on the fence post --

MS. NAUGLE: Yes. This is your maximum exposed individual hanging on the fence.

MR. CARROLL: All right.

[Slides.]

MS. NAUGLE: The skin dose is approximately six millirem per year. The total body dose is 1.3 millirem per year, which is about 26 percent of the size millirem per year limit. The maximum organ dose is 13.9 percent, which is approximately 93 percent of the 15 millirem per year dose to the infant thyroid. This is based on all pathways.

MR. CARROLL: It's not just anybody sitting on the fence post, it's a deep breathing child.

MS. NAUGLE: This is an infant that we have strapped to the fence.

MR. DAVIS: With no clothes on.

MR. CARROLL: That's right.

MS. NAUGLE: This evaluates all pathways. The gas bar code utilizes conservative land use survey information as well as typical breathing rates for our maximally exposed individual and so on.

MR. CARROLL: Every time I see Part 20 on one of your viewgraphs I can assume that it's the new --

MS. NAUGLE: The new Part 20, that's correct.

[Slides.]

MS. NAUGLE: The staff was very specific, that they wanted it evaluated for new Part 20.

MR. CARROLL: They are proud of it.

MS. NAUGLE: Yes.

MR. CARROLL: After all the years it took in gestation, they ought to --

MS. NAUGLE: The next issue is the Part 20. What we evaluated was -- we came up with 42.5. This is basically a summation of all the effluent concentrations at the site boundary. We take the actual concentration and the maximum -- it used to be maximum permissible concentration or whatever is established in table two of this standard, Appendix B -- and we ratio those and come up with a total fraction of the effluent concentrations we anticipate. We sum those and we show that they are less than one, which shows that we are in compliance with Part 20.

[Slides.]

MS. NAUGLE: For the component failure, here again as highlighted earlier, we looked at the Branch Technical Position, ETP, ETSB 11-5 which stipulates a 500 millirem limit the whole body dose at EAB. This is based on assuming that at the time of the accident, leak or break of the system, we are processing effluent which is one percent representative of one percent failed fuel which, in all realism, is not what we would be operating at. The effluent would be terminated long before that.

However, we did perform the analysis and we have calculated that it's 49.4 millirem, which is well within the 500 millirem limit.

MR. CARROLL: Days of compressed gas systems the component failure was a failure of one of the tanks.

MS. NAUGLE: It's a catastrophic failure, I believe, of the charcoal absorber.

MR. CARROLL: It's not at a very high pressure, is it?

MS. NAUGLE: No. But what we are assuming is that we are taking the normal operating effluent that has been released up to that point for the year and adding in effluent that assumes there is no delay between the time of the rupture and the release to the atmosphere. We are not taking any credit for any transport time through the components of any kind. We are just assuming that it's released directly to the environment.

What we do is, we use the PWR-GALE code and set a parameter to zero based on the delay time through the absorber. We set that to zero, to come up with the actual annual release if we were to have a system set up where we didn't have any delay.

MR. CARROLL: That seems awfully conservative.

MS. NAUGLE: It is very conservative. It is very conservative. Here again, we are evaluating assuming one percent failed fuel, which is also a conservatism built in. As you can see, we are well within the 500 millirem. In actuality, if we did a realistic analysis, I am sure we would be maybe ten percent of this actual number.

MR. CARROLL: I am more forgiving of saying one percent fail fuel. I know what that means. But when you hide conservatism in your model as you have done in this case, I guess I don't like that very well. It always comes back to haunt you.

MS. NAUGLE: Yes. I think we identify all the conservatism, and it is consistent with the standard review plan.

[Slides.]

MS. NAUGLE: The next system which we are looking at is the liquid waste management system. When we look at it from the standpoint of a component leak or failure what we are assuming is that it is completely contained within the rad waste building. That is, there is minimal release to the environment via the ground pathway.

MR. CARROLL: We jumped, from slide 11 to slide 15, for some reason.

MS. NAUGLE: We are assuming that there is very little release, certainly to the surface water, and ultimately to the groundwater. There is no formal analysis that has been done for a liquid waste management system component failure. We assume it's contained for the most part in the rad waste building.

MR. MICHELSON: How do you approach the problem like a potential site flood which might disrupt certain pieces of equipment if it floods the rad waste building and you might break a pipe or whatever, lifting tanks or however. How do you view that kind of release, since it first of all takes the flood to get the thing going -- takes a building flood. I don't think you have enough sources in that building to do much flooding.

How would you view the release under a site flood condition, what kind of rules do you use then?

MS. NAUGLE: Quite honestly, I haven't looked at it from that aspect. I am more than willing to look into that. That, perhaps, is more of a question in Chapter 3.

MR. CROM: I am not sure that I understand your question. The maximum flood levels is one foot below grade. The idea is that you are not going to exceed the flood in the building. You are talking about an external flood, are you not?

MR. MICHELSON: I asked the question a little earlier today, as to whether you intend to waterproof the building up to grade.

MR. CROM: We didn't answer that. I got talking to you on the side before, that you can't absolutely waterproof a building. All these buildings have sump pumps that handle that leakage.

MR. MICHELSON: Some are intentionally not --

there is no attempt to keep the flood out. That was really the question, is there really any attempt to keep the building dry. I realize that you never keep any building dry without pumps and whatever. They can't be built that type.

I just wondered if it's a dry building, fine. Then, the question doesn't pertain. If it's allowed to flood then the question is, how do you treat these?

MR. CROM: It is a dry building. I thought your question was is it completely dry, and do you get any leakage. The answer is no, you do get leakage. That's handled with the sump.

MR. MICHELSON: What I asked was, is it water tight. You keep a dry building unless it is water tight. Now, when it leaks are the joints and so forth that they are water tight --

MR. CROM: That's correct.

MR. MICHELSON: You have to pump that out separately. It could be either way, it depends on the design. This one is going to be intentionally dry.

MR. CROM: That's correct.

MR. MICHELSON: You are going to anchor the building down and all of that against the site flood so it doesn't flood away.

MR. CROM: I am not sure how they handle that, but that is addressed in Chapter 3.

MR. MICHELSON: When we get to Chapter 3 those will be the questions.

[Slides.]

MS. NAUGLE: The next area is compliance with 10 CFR 50, Appendix I, those fractions. As you can see, our total body dose from all pathways is calculated to be 2.65 which is 88 percent of the three millirem per year limit. The maximum organ dose to the infant thyroid is 6.30 millirem which is approximately 63 percent of the ten millirem per year limit. Here again, this is from all pathways.

[Slides.]

MS. NAUGLE: Next is compliance with Part 20, Appendix B, Table 2. Here, we show that the annual average liquid effluent concentration is approximately 9.1E minus two, or about 9.1 percent of the 10 CFR 20 limits. Here again, we are summing the fractions of the effluent concentrations at the potable water source, and showing that they are less than one.

Are there any questions about the bases of these numbers? I do have slides, if you want to go through that.

MR. CARROLL: There's a bunch of stuff in the FSER that I wanted to comment on that relates to this.

MS. NAUGLE: Certainly.

MR. CARROLL: It relates to page 11-22. .ne middle of that page we have statements like the conversion factor should be zip instead of zap, no hint to what the conversion factor you are talking about.

MS. NAUGLE: I think that's just the unit conversion factor.

MR. CARROLL: The what?

MS. NAUGLE: A unit manipulation that may have been in error in a prior amendment, and that's been corrected. I don't know what context it may be in, it's what I am assuming it is.

MR. CARROLL: The next one is probably all right because it tells me what it is. Number three is a dazzler. The multiplication factor of seven applied to the gaseous effluent value as listed in a certain table --

MS. NAUGLE: I know what that is referring to. That's referring to that Branch Technical Position. In the current revision of that standard review plan branch technical position it suggests that a good estimate for one percent fail fuel for the gaseous system is seven times the normal operating, which is taken from GALE results. That was true of Rev 0 numbers. Since GALE is based on operating data from various plants for normal operations, now in Rev 1 the actual individual isotopic, there may be some that are not exactly .12 percent fail fuel. They may be more or less.

In order to establish a basis for the one percent fail fuel we used the results from DAMSAM computer code, which gave us the effluent concentration for one percent or reactor coolant concentration for one percent fail fuel. Then, we looked at whatever GALE generated force and came up with a new multiplication factor.

MR. CARROLL: That's what this paragraph is telling me here?

MS. NAUGLE: Yes.

MR. CARROLL: The other thing that jumped out at me is, since the subject values of the table do not correspond to 0.14 percent fail fuel for all fission products --

MS. NAUGLE: I believe Dr. Chandr is talking about -- he's the one that wrote this -- he's talking about the current GALE results. Prior to this, in Rev 0, they were indicative of approximately 1.2 percent fail fuel rate. Now, that's not true anymore.

MR. CARROLL: Okay.

MS. NAUGLE: Therefore, that multiplication factor had to be re-established.

MR. CARROLL: Maybe the staff may want to take a look at some of that stuff and make sure it says what they think it does.

MR. CHANDRASEKARAN: What number three here means is that of the BWR GALE code was based on 50,000 microcurie per second for megawatt thermal. That is the GALE code basis. For the boiling water reactor the effluent treatment system branch technical position says that in order to do the off gas system failure you should multiply it by a factor of seven. Seven comes from this fact.

The standard in normal plant will be usually 3,400 megawatt thermal. Therefore, the staff said that in order to analyze the off gas system failure for a standard plant we use approximately 3,400 megawatt thermal. You should talk about 340,000 microcurie per second total noble gas release or you should have release rate corresponding to 100 microcurie per second per megawatt thermal and multiply it by a factor of seven.

What ABB did was, in the original analysis that there's -- in DSER they used this basis to explain that. In the branch technical position for boiling water reactor for analyzing the off gas system failure this basis they used, and they said they would multiply it by seven and give you the results. I pointed out that it's not appropriate because multiplying it by seven, that the GALE code releases are based on .14 percent fail fuel.

Since the revision of the PWR GALE code NUREG-0017 Revision 1, are not based on .14 percent fail fuel but are based on operating plant measurements taken for a large number of nuclear reactors over a period of time. I said it is not appropriate to do that kind of a business, by multiplying it by seven.

ABB provided an acceptable analysis, based on one percent fail fuel.

MR. CARROLL: Thank you. I guess what I am saying is that that doesn't come up through the write up very well, what you just described.

MR. CHANDRASEKARAN: We do not generally -- if you want, we can write one or two sentences that we do not elaborately explain all these things. One can probably write a thesis on that. We are willing to accommodate if you want, a couple of sentences. If you think it will be helpful, we will do that.

MR. CARROLL: I am just saying that I had trouble following what was said here. Since somebody 20 or 30 years from now is going to read these words and wonder what we meant today, I think we ought to try to make them as clear as possible.

You are going to talk about instrumentation next?

[Slides.]

MS. NAUGLE: Yes. Next, is post-accident area and effluent radiation monitors. Their primary purpose is to provide indication of potential breach in the fission product barriers as well as indication of significant releases. That is, to determine the severity of the accident as well as the need to evacuate general public or have them take shelter, or whatever.

Also, the area monitors would help assess the accessibility to vital areas to take mitigative actions, and to ensure compliance with the GDC 13, 19 and 64 and Regulatory Guide 1.97.

MR. CARROLL: The staff is in the process as we speak, of finalizing source terms for advanced plants. What did you use for a source term in doing these things?

MS. NAUGLE: I didn't use a source term. I am simply establishing based on Reg Guide 1.97 guidance, the typical sensitivity ranges nd requirements for 1E power, seismic design and such. I didn't look at the source term. However, the COL applicant in the offsite dose calculation manual and also in the body of the tech spec, will establish the appropriate set points to ensure that the intent of these Federal regulations are met.

MR. DAVIS: I think the one you are talking about Jay, is for design basis accidents. This is just to detect a breach of a barrier.

MR. CARROLL: No, it's more than that.

MS. NAUGLE: It's more than that. This encompasses the LOCA's, the steam generator tube ruptures.

The following slides will indicate which monitors are providing that indication and that capability.

MR. CARROLL: For example, the in containment monitor required by Reg Guide 1.97 are intended to help you analyze a very severe accident.

MR. RITTERBUSCH: NRC staff went through an evaluation of our equipment for survivability in a severe accident using the new radiological source term, and the monitors were part of that evaluation. It came out positive.

MS. NAUGLE: Here again, as part of the radiation protection, we will be looking at the adequacy of shielding and environmental qualification of monitors. That's included in the design of these. We have some bases for at least the current source term of what to expect of the environmental radiological conditions. Certainly, at the time when the source term is established and shielding analysis has been performed, then we can better evaluate how well these things are designed as far as survivability goes.

MR. SEALE: It is your expectation that a mechanistically based source term would be used in severe accidents and so on.

MR. CROM: Let me see if I follow your question. Reg Guide 1.97 says you have a certain range that you have to be able to measure, and we follow that for Reg Guide

1.97. You also have to then do some calculations based on sensitivity of your monitor and things like that.

What Carol is trying to say is that without as procured equipment monitors, you cannot do those calculations. Those are a COL applicant item, and they will be using the new source term when they do those calculations.

MR. CATTON: I heard something about environmental qualifications for instrumentation. How global was it? Did you include things other than radiation, like temperature? What temperatures? I see you nodding yes. At what temperatures did you use?

MR. WAMBACH: That will be covered in Chapter 15 and 19 for all the equipment, whether it be DBA mitigating or severe accident.

MR. CATTON: The SAR Chapter 15?

MR. WAMBACH: You don't -- the SER for Chapter --

MR. ARCHITZEL: That's Chapter 3.

MR. WAMBACH: Chapter 3.11 is the --

MR. CATTON: The reason I ask is, typically in containment temperatures are volume averages. If you have instrumentation on the ceiling instead of on the floor, on the floor you will more than exceed what the core that is on it. On the ceiling you are going to be way off. There will be significant thermal stratification as a result of core on the floor.

You have to include that in your environmental qualification or assume that the instrument doesn't work.

MR. WAMBACH: You will hear about that, because we questioned the placement of some of the equipment in the monitor in particular.

MR. LYONS: To clarify, when you are talking about core on the floor are you talking about severe accidents.

MR. CATTON: Yes.

MR. LYONS: You are not talking equipment qualification anymore. We are now .nto the arena of equipment survivability, which is something that was addressed in SECY 90-016. Normal equipment qualification only handles design basis accidents.

MR. CATTON: I just heard 1.97 instrumentation was qualified in the global way. Is that correct, did I hear that?

MR. WAMBACH: I believe so.

MR. CATTON: If it is, there are certain considerations of temperature that have to be made that go beyond what is normally done. That's namely, you need to include stratification. I don't want to get into equipment or anything else at the moment. There will be another time for that.

MR. CARROLL: I do not think 1.97 reflects what you are talking about.

MR. CATTON: It should, and I heard him say that they are doing a more global qualification. Is that correct?

MR. RITTERBUSCH: We go through two types of qualification programs. One is a design basis qualification program. I believe that's quite straightforward. It's documented in Section 3.11 of CSARDC. The equipment survivability evaluation that I mentioned earlier looked at a severe accident survivability. It was a very detailed evaluation, pressure, temperature and radiation. We looked at all of the equipment required to get through different severe accident scenarios. We evaluated its capability under the expected severe accident conditions.

MR. CATTON: This is Chapter 3?

MR. RITTERBUSCH: That part is documented in Section 19.11.4, I believe. It's in Section 19.11. It's part of Chapter 19.

MR. CATTON: That's going to come up on a future agenda, I guess. Just out of curiosity at this moment, what did you use for temperature in your qualification?

MR. RITTERBUSCH: It was high. I believe it was on the order of 500 degrees. We had quite a debate with staff. I don't remember the exact value.

MR. MICHELSON: Outside of containment now, we are talking about.

MR. CARROLL: No.

MR. MICHELSON: Only inside of containment? I would worry far beyond -- if you are going to worry about monitoring what's going out to the public you better be monitoring outside of containment.

MR. CARROLL: True, and that's required.

MR. MICHELSON: It wouldn't be much good. The step that bothers me a little bit though is, I thought that the radiation monitoring as to what's going out to the public is being done with full qualification of the equipment for whatever it has to monitor. In other words, you look at that radiation instrument out there at the fence post, just like every accident it's a design basis and not a severe.

Otherwise, your qualification may be pretty flimsy. I thought it was fully qualified.

MR. CARROLL: It is.

MS. NAUGLE: There is only --

MR. MICHELSON: We are talking about severe accident qualification now, and that's different. There, you get by with a lot less than you do for --

MR. CARROLL: We are mixing two things up, Carl.

MR. MICHELSON: Okay, we will hear it later.

MR. CARROLL: We are talking about effluent monitors on the plant vent. We are also talking about the Reg Guide 1.97 required monitors up in the top of the containment -- inside the containment.

MR. MICHELSON: We are also talking about the environment, radiation monitoring too. That better be fully qualified for whatever it's going to see when it has to measure that condition.

MS. NAUGLE: There's only a certain number of truly safety related -- if you want to use that word -- type of monitors. We will get into this when we talk about the ITAAC scope. They don't include every monitor in the plant.

MR. MICHELSON: I thought that these were safety related, when you are talking about what's going out to the public.

MS. NAUGLE: Not all of them.

MR. MICHELSON: Maybe not all of them.

MS. NAUGLE: They are not all Category 1 under Reg Guide 1.97.

MR. MICHELSON: Maybe someday you need to look at it then. I thought they were.

MR. CATTON: Where are we?

MR. CARROLL: We are just starting into the monitoring of post-accident.

MR. CATTON: Inside the containment they use the 500 degrees; is that correct?

MR. CARROLL: I guess I --

MR. CROM: That was correct, inside containment.

MR. CATTON: When we hear about Section 1911.4 I would like to hear the basis for the 500.

MR. CROM: I believe that's in there.

MR. CATTON: If it's in there, I certainly can read it.

MR. MICHELSON: I guess the temperature and the pressure are also in that same spec.

MR. CATTON: Most calculations in the past have been volume averages, and that's not what you have to deal with.

MS. NAUGLE: The monitors that we would use to provide indication of fission product barrier breach are the primary coolant loop monitors, the containment area monitors, the main condenser evacuation system monitors, nuclear annex ventilation system monitor, the reactor building subsphere ventilation system monitors, rad waste building, unit vent and the unit vent post-accident monitor.

MR. MICHELSON: It will be clear when I look at the SSAR which one of these are going to be fully qualified and which ones are just severe accident.

MS. NAUGLE: Yes. The tables differentiate what those are. I believe what you will see is that the primary coolant loop monitor and the high range monitors are the safety related type monitors.

[Slides.]

MS. NAUGLE: The next group of monitors provide indication of a LOCA. These include the high range containment monitors.

MR. CARROLL: In the interest of time, why don't you let us read them.

MS. NAUGLE: All right. You can see, the following is all the ventilation system monitors --

MR. CARROLL: That's LOCA.

[Slides.]

MS. NAUGLE: The indication of the steam generator tube rupture are provided by the main steam monitors, nitrogen 16 which is a new monitor.

MR. CARROLL: It's new, because of the sad experience at Palo Verde?

MS. NAUGLE: We have seen from experience at Palo Verde and some use in Europe with the nitrogen 16 monitors as far as being able to trend leakage rate versus the counts that is on the monitor for a specific range -- about 6.2 to seven MEV gamma -- that we can correlate the leakage rate to the counts per minute or second on that monitor and get a feel for how severe the leak is. It gives the operators an opportunity to take some mitigative actions such as isolating that generator that has a leaky tube.

MR. DAVIS: Are all of these monitors annunciated in the control room?

MS. NAUGLE: Yes.

MR. DAVIS: For each indication there is a procedure that the operator goes to, and it tells him what to do about it?

MS. NAUGLE: There will be. The COL applicant will have to develop those procedures. If they wish to sample there are provisions to take grab samples at these monitor locations to confirm that the monitor is working properly, and the COL will develop those procedures to establish sample frequency and such and sensitivity, and so on.

MR. DAVIS: Thank you.

MS. NAUGLE: That will be outlined and committed to in the CSAR.

[Slides.]

MS. NAUGLE: The next type of accident is the fuel handling accident. Here again, we have the fuel building ventilation monitor which normally would be operating in the unfiltered mode. However, when you are handling fuel that would be manually switched to the filtered mode. However, you do have the capability to automatically switch over to that mode, the high and low containment purge monitors and the unit vent monitors.

[Slides.]

MS. NAUGLE: The next area of interest is assuring vital area accessibility.

MR. CARROLL: Vital areas in this context mean vital areas as defined in Part 73 for security?

MS. NAUGLE: No, not security. It's more for the mitigative actions that the operator may need to take per the emergency procedures.

MR. CARROLL: Who was first to use the term vital area?

MS. NAUGLE: I am not aware.

MR. CARROLL: I am. It was the security guys. Now, I notice the rad protection folks have taken this term and are using it.

MR. DAVIS: It doesn't mean the same thing.

MS. NAUGLE: The same terminology, and it's presented --

MR. CARROLL: It means a totally different thing.

MS. NAUGLE: Yes, it does. It is confusing.

MR. CARROLL: I am pushing the idea. In fact, we said it in a recent letter on DAC's I guess for ABWR, that it's going to be confusing.

MS. NAUGLE: I agree.

MR. CARROLL: Unless we find another term.

MS. NAUGLE: I agree. This is mainly for radiological reasons, mitigative actions. These include any monitors along the access routes to the vital areas that have been established and identified in the CSAR. Those include control room remote shutdown rooms, hydrogen recombiner rooms.

MR. CARROLL: Why don't I find the TSC on this list, because it's part of the control room?

MS. NAUGLE: It's adjacent to the control room.

MR. CARROLL: When the bullet that says control room it includes TSC.

MS. NAUGLE: It should. I have to look at the CSAR. It may be identified there, but I can't recall.

MR. CROM: The TSC has its own monitor, separate the control room.

MS. NAUGLE: Yes, it has its own monitor.

MR. CARROLL: How about the OSC, operational support center.

MR. CROM: It also has its own monitor.

MR. CARROLL: Okay.

MS. NAUGLE: For your reference in the future, you can look at Section 12.3 and in the post-accident -- all those area monitor drawings are identified as well as being delineated in the table.

MR. MICHELSON: Why is the hydrogen recombiner there? Is there some manual actions or something?

MS. NAUGLE: They have to go out and install those. They are not currently installed. They would have to be installed. That wouldn't have to occur for 24 hours, I believe.

MR. CROM: You have 72 hours to get the hydrogen -- 72 hours to get them in place.

[Slides.]

MS. NAUGLE: As previously asked there are control room interfaces, and those are taken care of by the data processing system and the discreet indication alarm systems. These systems provide the following design features.

MR. CARROLL: Back to the recombiners for a second. That was all post-TMI stuff and pre-spark or catalytic igniter timeframe. Is there any consideration for getting rid of the hydrogen recombiner connections, given that you are going to have igniters and so forth?

MR. CROM: The thing here is that one, it's required per regulations. I understand that NUMARC had requested that as one thing that the staff look at, revising the regulations. It was dropped, I think, due to funding reasons. Right now, I think you are right in saying you probably have a system that may not be needed. According to regulations right now you still have to have hydrogen recombiners.

MR. CARROLL: It's specifically in Part 50?

MR. CROM: Yes.

MR. CATTON: The Germans have taken the opposite view. They were going to require recombiners, and are looking into the need for igniters. The reason is the recombiners can take hydrogen level down to some very low value, whereas the igniters cannot.

MR. CROM: You are talking about different recombiner, I believe. I think you are talking about the catalytic recombiners that they have inside containment. Those are different.

MR. CATTON: Okay.

MR. CARROLL: Little guys, that are only intended to --

MR. DAVIS: Not severe accident.

MR. CATTON: I am sorry. I should have been paying more attention.

MR. CARROLL: Right.

[Laughter.]

[Slides.]

MS. NAUGLE: Design features that are provided through the DPS and DIAS system are to provide the indications of accident conditions, monitor readings, alarm set points and operability status of the monitors in question, as well as the digital interface between those monitors in the control room itself, and to facilitate the operator's capability to initiate various control module actions as far as check source, actuations, change alarm set points and so on.

[Slides.]

MS. NAUGLE: The ITAAC scope pretty much just looks at the safety related type monitors. Those include having displays and alarms in the control room as we stated previously, having the control room intake monitors be able to have auto selection and closure capabilities to select the most contaminated intake and close that intake, the operation of the safety related portion of the process and effluent monitoring sampling system division, that are manually activated in the control room, and to just evaluate the alarms that we receive from those monitors out in the plant. At a preset limit they would alarm the control room and the operator could assess the accident at that time.

[Slides.]

MS. NAUGLE: Here, we are delineating the actual safety related monitors. There is only four. Those are the control room intake monitors, the high range containment monitors, primary coolant loop monitors and the containment atmosphere. That is the particulate channel only. Reg Guide 1.45 specifies that the particulate channel has to be able to withstand an SSE. That's why it has been listed.

It simply says we will provide those instrumentation, they will be seismic category 1, they will have Class 1E power, and they will be the appropriate physical separation between Class 1E and non-Class 1E divisions and components.

MR. SEALE: Those main steam line indications that didn't have the right settings apparently to give the alarms in the Palo Verde steam generator tube would not be on your safety related --

MS. NAUGLE: They are not safety related. No, they are not. That's all I have, unless you would like to look at specifics of the monitors themselves as far as Reg Guide 1.97.

MR. CARROLL: Are there any further questions?

[No response.]

MR. CARROLL: Can we say we have killed off Chapter 11?

[No response.]

MR. CARROLL: Why don't we take a 15 minute break, until 3:45.

[Brief recess.]

MR. CARROLL: Let's reconvene. I guess we are going to hear about rad protection next.

MS. NAUGLE: We are going to talk about how various lessons have been learned in the industry today, how it has been implemented and incorporated into the System 80 design to reduce dose to the public as well as the personnel, and certainly the ALARA principles that are outlined in Reg. Guide 8.8 and 8.10, i.e., time, distance, shielding, and probably most importantly, source term control.

These design features include general arrangements; equipment design, their reliability; source term and contamination control; obviously, the shielding design of the plant; and certain problem areas where it is hot, transient high radiation areas such as an inspection area for the spent transfer to the in-core instrument chase; and, of course, the DAC.

MR. CARROLL: Why don't we do the let's assume we can read approach to this.

MS. NAUGLE: Okay.

MR. CARROLL: And try to get through it --

MS. NAUGLE: All right.

MR. CARROLL: -- more quickly.

MS. NAUGLE: The general arrangement features basically assume that we will segregate radioactive and non-radioactive systems; we will position interfacing systems in close proximity so we can shorten the pipe route length thereby reducing the potential of having to route it through personnel access corridors; all the pipe chases have been shielded wherever possible, providing adequate spacing; and, certainly, trying to minimize a potential for streaming from high radiation sources.

One drawing that will illustrate the segregation of non-radioactive and radioactive type systems is this drawing here. The nuclear island and nuclear annex and radwaste building are, obviously, radioactive areas, and everything outside the RCA, the control room area, the control complex, the turbine building, are typically non-radioactive areas.

MR. CARROLL: This drawing reminds me of something I wanted to ask on Chapter 11. A statement is made that all radioactive gaseous effluents go up the stack and are monitored.

MS. NAUGLE: Yes.

MR. CARROLL: In the plants I've been around, although that is a nice objective, there are always some little things that done exactly fit that situation.

One we had at Diablo Canyon was the so-called penetration area between the containment -- the penetration area coming out of the containment, but there was a gap in the floor to allow for expansion. And if you got steam leaks down in that penetration area, there is no way to ıssure that, even though that was a ventilated areas -- have you ever looked at all those kinds of things, because they are a real nuisance?

MS. NAUGLE: Yes. It is also not only a problem with monitoring of waste or gaseous effluent, it also presents a problem with streaming from the spent transfer to barrier, if you have a gap between the joints between the reactor building and the nuclear annex.

In this situation they are integrated. There is no joint between the buildings. It is one complete building, so you don't have that gap between building and the streaming up through that and, I would assume, the potential effluents that might be released unmonitored essentially.

MR. CARROLL: That was just one example.

MS. NAUGLE: As much as possible, we try to look at those areas.

MR. CARROLL: Well, that's what we thought we did too, but our rad protection inspector out in Region 5 used to drive us nuts over those kind of things. To the extent you can take care of them --

MS. NAUGLE: Where we have --

MR. CARROLL: -- you're really money in the bank.

MR. CROM: Let me address that just a little bit, Carole. You've had one instance. You know, we have a common base mat so we don't have the shake space. But the other thing when you look at our general arrangement, you will see that almost everything is solid concrete walls. We do not use block walls or some of those things throughout the plant. That, I think, addresses a lot of your concerns there.

MR. MICHELSON: How do you do the seismic design, though? Like, the rad waste building appears to be attached to the remainder of the structure.

MR. CROM: It is actually separate. There is actually a space in the rad waste building.

MR. MICHELSON: Okay. Otherwise, there's differential movement. The same in the turbine end.

MR. CROM: That's correct. There is a space between the turbine building too.

MR. MICHELSON: Where is the monolith then, the common base mat? Just that reactor building?

MR. CROM: It is what we call the nuclear annex, which includes the reactor building and containment, then the nuclear annex, which has all of the control area, the fuel pool, and the maintenance building. That is all on one base mat.

MR. MICHELSON: Okay. That's understandable. Okay. Thank you.

Is there some reason why this is non-symmetrical on the turbine end? It is not on the center line of the containment or anything.

MR. BRUSTER: This is Larry Bruster. There is a heater bay, if you will, on what would be the bottom of the picture.

MR. MICHELSON: So the turbine center line is on the containment center line. Is that the idea?

MR. BRUSTER: That's correct.

MR. MICHELSON: And there is just some stuff off to one side.

MR. BRUSTER: Yes. There are some pumps in the heater bay and stuff like that.

MR. MICHELSON: Okay. That explains it. Good. Thank you.

MS. NAUGLE: We continue with the general arrangement. Basically, we've made sure that we've provided adequate spacing for maintenance, inspections, access for the pool equipment. There is a lay down area provided and a pool area so that you can pull those equipment out and, if necessary, transport it out of the higher radiation area into a lower radiation area to perform maintenance. That will reduce personnel exposure, so you don't have people doing a lot of work in the high radiation areas.

The access to the RCA is a single point access on the elevation 91-9, although there is emergency egress provided on all elevations. That enables the waste protection people to interact easily with the work crews that are going into the RCA.

Here is an illustration that illustrates the floor space on the operating deck that is provided to facilitate maintenance. I believe also you can see in this area platforms around. I believe those are the steam generators. That also facilitates access to doing inspection and maintenance, in-service inspection, in those areas. Those platforms are also provided around the reactor coolant pumps.

MR. CARROLL: The other thing you are showing is a steam generator being --

MS. NAUGLE: In a D-ring type of shield.

MR. SEALE: Supine position.

MR. CARROLL: Yes, supine position. Fine.

MS. NAUGLE: Oh, yes. We are showing how we can pool the stream generator.

MR. CROM: That was only to illustrate how much room we really had in this containment.

MS. NAUGLE: Unfortunately, it is obvious that some steam generators have been replaced by the current generators. We are trying to alleviate that by choosing a Inconel 690 that has little better properties, but we have a design for the capacity to remove those generators as necessary in the future.

MR. MICHELSON: Reactor vessel also?

MS. NAUGLE: I don't believe so. Reactor vessel? I don't think we've --

MR. MATZIE: Regis Matzie. We have not done anything to allow removal of the reactor pressure vessel. We've done the design to ensure plenty of margin for a 60-year life, as we showed earlier this morning.

MR. MICHELSON: Yes. That's what Yankee Rowe thought.

MS. NAUGLE: The next figure show the change rooms. The change rooms that are adjacent to the equipment hatch. That reduces the travel time to the equipment hatch in this large staging area for maintenance crews to congregate prior to going into containment to form maintenance during outages.

We also see the single point access in 91-9 to the RCA. This is considered the potentially contaminated area, and then, obviously, the clean area.

And as you can see, here again, we have the radiation access control area; the dosimetry around that general vicinity.

MR. MICHELSON: What kind of piping or whatever is in between the shield wall and the containment?

MS. NAUGLE: I'm sorry?

MR. MICHELSON: What kind of piping is there between the shield wall and the containment? It is called a pipe chase.

MR. CROM: The pipe chase. That is part of your subsphere, so that would be all your safety ECCS system piping located in there. Of course, all your penetrations also come through there, all of your containment penetrations go into those pipe chases as well.

MR. MICHELSON: But that is a straight through radial penetration. Is that right?

MR. CROM: You are talking about the containment?

MR. MICHELSON: Yes.

MR. CROM: The containment, I don't think she has a cut-away view. When you say "straight through," you asked if it goes straight through the annulus area?

MR. MICHELSON: Yes.

MR. CROM: But since it is a spherical containment, it doesn't go in the horizontal direction.

MR. MICHELSON: That's right.

MR. CROM: It actually comes down at an angle.

MS. NAUGLE: As previously pointed out, we have platforms around the arc, reactor coolant pumps in the steam generators. The steam generator maintenance is also facilitated by proving the reliability by material selection. The increase in the size of the manways, the addition hand holes, better fabrication techniques, and the use of cartridge-type practical and pump seals, which makes it so you can just remove that cartridge and take it out, and it facilitates a quick change out of those seals rather than have them form a lot of maintenance in that high radiation area.

MR. MICHELSON: Now, you do have to break the coupling between the motor and the pump to get the cartridge out?

MS. NAUGLE: I'm not familiar with the actual mechanics of working on that.

MR. CROM: That's correct.

MR. CARROLL: You've got to go see one of these plants, Carl.

MR. MICHELSON: What?

MR. CARROLL: You've got to go see Palo Verde.

MR. MICHELSON: Oh, yes. Yes, I don't know what these things look like.

MR. CARROLL: No, I mean, I was really amazed at the size of that steam generator compared to anything I'd ever seen before.

MR. MICHELSON: I'm use to the four-loop Westinghouse plants. They're not that big though.

MR. CARROLL: No, not hardly.

MR. MICHELSON: No where near.

MS. NAUGLE: This is just another illustration of the platform provided. Additional design characteristics.

We tried to use simple reliable type equipment. For instance, we will try to minimize the use of the evaporators. We would use demineralizers instead, and at least according to many operators around the country, that will reduce a lot of the problems we've have.

MR. MICHELSON: How big are your reactor coolant clients?

MR. MATZIE: This is Regis Matzie. The cold legs, I believe, are 30 inch lines and the hot leg 42.

MR. MICHELSON: 30 and 42?

MR. MATZIE: That's correct.

MR. MICHELSON: Boy, they're big. That's a pretty big rupture, then, if you use the usual rules. You are going to tell us later about your subcompartment pressurization calculation and all that sort of thing? You had better do some good ones inside a containment.

MR. MATZIE: A couple of things about the design of the containment. First of all, it is a very open containment, and second of all, we've got a leak before a break on all the major lines in containment.

MR. MICHELSON: On the major ones. In other words, the 30s and the 42s are going to be leak before break?

MR. MATZIE: All lines, I believe, down to 12 inches.

MR. MICHELSON: That's inside containment.

MR. MATZIE: Inside containment.

MR. MICHELSON: Nothing outside?

MR. MATZIE: That's correct.

MS. NAUGLE: The next area is source term control. From industry experience corrosion product account for half to three quarters of the total personnel exposure. So by using materials that are low in cobalt impurities of less than .02 weight percent, we feel that that eliminates a lot of the exposure due to that.

MR. CARROLL: Okay. That is what it says on page 12-4 of the Staff's SER, about two-thirds the way down the page. This morning when we heard our presentation on Chapter 4, we learned that cobalt was indeed being used in some components that are in contact with the reactor coolant system, the latches in the control rod drives and that sort of thing.

Then when I go to page 12-13, at least the last time I read it -- okay, that is sort of another restatement of this. This is about a quarter of the way down that page.

Then when I go to 12-24, I think it says it right, about two-thirds of the way down. It says cobalt alloys and cobalt-based hard facing materials will be minimized.

But I guess I found an inconsistency between those three statements in Chapter 12 and the statement in

Chapter 4.

MR. HINSON: Charles Hinson, Radiation Protection Branch. I believe on 12-24 it says antimony will be minimized. It quotes the 0.02 weight percent.

MR. CARROLL: No, no. I am reading 12-24, about two-thirds of the way down. "In order to reduce the source of cobalt in the primary system, cobalt alloys and cobalt hard face will be minimized."

MR. HINSON: Okay. Then the next line states the percentage.

MR. CARROLL: No, I think that is a fine statement there.

MR. SEALE: It is just not consistent with the earlier statements.

MR. HINSON: You're talking about the statement in Chapter 4, you said?

MR. CARROLL: Well, and I am talking about the statement on page 12-4, which leads me to believe that nothing in contact with reactor coolant will have more than .02 weight percent cobalt.

MR. HINSON: Okay. Well, the wording in the SSAR states that all material in contact with the reactor coolant will be limited to 0.02 weight percent.

MR. CARROLL: I looked that up. I can't tell you the page number. Yes, it's page 12.3-12. I don't think it said that.

MS. NAUGLE: I believe in Amendment U in Section 12.3.1.3.b.1 it does add the percentage that it will be maintained.

MR. HINSON: Yes, the original text here didn't have the percentage stated. I asked them to put in a specific number which will be Amendment U.

MR. CARROLL: Well, stellate had a hell of a lot more cobalt in it than 0.02? I am saying there is stellate in the control drives, which I guess you would agree is in contact with reactor water.

MS. NAUGLE: There is current research underway trying to develop hard facing materials that are going to be low cobalt purities.

MR. CARROLL: I know about that. You say this is under development.

MS. NAUGLE: It is still currently being developed.

MR. CARROLL: If it comes through, you would use it?

MS. NAUGLE: Yes.

MR. CARROLL: But what I am saying is that this statement on 12.4 is incompatible with what I know about the design. I can tell you where it says that in Chapter 4 if you want.

MR. WAMBACH: We believe that if RSER reflected the number that was in Amendment U, then apparently they will have to correct that and we will can correct RSER.

MR. CARROLL: Okay. Do you understand the problem?

MS. NAUGLE: Yes, sir.

MR. CARROLL: Okay.

MS. NAUGLE: Of course, we will minimize present antimony to alleviate particles that were seen in Palo Verde.

Contamination control. This is pretty straight forward. Adequate ventilation.

MR. CARROLL: We will read it.

MR. MICHELSON: What is this curbing now? Is that one more thing? Are you going to have curbs in certain areas? You know, when you have train or divisional boundaries, will those be curbed? What do you mean by curbing?

MS. NAUGLE: I believe wherever it is required by 1.4.3, we will providing curbing or structures to contain or house components of sufficient capacity to maintain their maximum spillage.

MR. MICHELSON: What is that, Reg Guide 1.4.3?

MS. NAUGLE: It is basically a regulatory guide that stipulates proper design, primarily, I think, for rad waste systems.

MR. CROM: What we're talking here is ensuring that we collect any breakage or leakage from rad waste tanks. We are not talking about flooding.

MR. MICHELSON: You are just cubing the tanks themselves?

MR. CROM: That's correct.

MR. MICHELSON: Oh, okay. Not curbing the whole area?

MS. NAUGLE: No.

MR. CROM: That's correct. We are not talking about flood protection here.

MR. MICHELSON: Okay.

MS. NAUGLE: Okay.

MR. CARROLL: Okay. Let's read this one. Does anyone have any comments?

MS. NAUGLE: Any questions? This should be corrected to be 8.19.

MR. DAVIS: It is person rem rather than man rem.

MS. NAUGLE: Okay. We will be more liberated. We will say person rem.

MR. SEALE: Equal opportunity.

MS. NAUGLE: Yes.

MR. MICHELSON: Whatever.

MS. NAUGLE: Any questions?

MR. CARROLL: Okay. Now you're going to follow the new series of reg guides that go with Part 20; is that correct?

MS. NAUGLE: For shielding?

MR. CARROLL: No, I'm looking at lockable access doors for high radiation areas.

MS. NAUGLE: Well, what we want to do there is ensure that personnel don't have access to high radiation areas without HP.

MR. CARROLL: But there is a new reg guide that has come out on that subject. It is one of a series of reg guides that were intended to help implement the new Part 20.

MS. NAUGLE: 834?

MR. CARROLL: I can't remember the number.

MS. NAUGLE: I haven't seen that reg guide yet, so I can't really comment on it. But the intent there is if that is the current regulatory guide, we will look at that and make sure that we will meet that.

MR. HINSON: This is Charles Hinson. That is referred in the SER, the COL applicant will have to commit to abide by that.

MR. CARROLL: Okay.

MS. NAUGLE: Our radiation zone drawings basically estimate what we anticipate radiation zones to be in various areas of the plant based on the equipment located there and piping, and also locate monitors and vital area access routes.

The zone designations are as follows for the anticipated occupancy.

Any questions?

[No response.]

MS. NAUGLE: The access control features that we talked about prior to this was the access to high radiation areas, 100 R per hour. Those include the inspection area to the spent fuel transfer tube and the in-core instrument chase. We provided lockable access doors in the case of the in-core instrument chase, an electrical interlock between the area monitor and the chase and the actual door lock.

MR. CARROLL: That doesn't deal with the case where somebody has withdrawn an in-core after you've gone through the door.

MS. NAUGLE: There is an area monitor in the room and I believe it will be provided with visual alarm and audible as necessary to alert that person that the in-cores have been moved. There will also be emergency egress provided from that area. So if it locks, it doesn't lock the person in there. It can be crash bar or whatever to get out of there.

I believe you could write in the procedures that the operator would have to go in the room and make sure nobody is in there prior to moving of the in-cores. That's more operational than the alarm.

The spent transfer tube is obviously here. We provided several feet of equivalent thickness of concrete or lead shield or combination of those two to ensure that adjacent access corridors and penetration rooms will be maintained less than 2.5 MR per hour dose rates.

Somebody will do an analysis to verify.

MR. CARROLL: How about a test with a hot fuel assembly in there? Is that a commitment?

MR. SEALE: That would be only after it's built.

MR. CARROLL: Yes, but it isn't a bad idea.

MS. NAUGLE: If they do that and they find that there isn't sufficient shielding, then they can add lead or steel or whatever to make up the difference.

MR. CARROLL: So it's designed so you could add more lead?

MS. NAUGLE: This area underneath is maybe not the best drawing to show, but there is sufficient area under here where I think you could add a couple inches of lead or whatever. The main area that is really in closest proximity is probably the penetration room. I think there are several feet of concrete, or at least a few feet of concrete in between the tube and the access corridors there.

MR. CROM: This is one of the areas that you were talking about where the shake space has always been a problem and putting it on a common base mat. We no longer have the streaming problems.

MS. NAUGLE: This would be just direct radiation, no streaming.

MR. HINSON: I have another slide that has another view of this.

MS. NAUGLE: This shows the radiation zones. What we are anticipating here is that the radiation zone will be a zone 2, and that's zero to 2.5 MR. This area obviously is a zone 5, which is greater than 100 MR, probably more like 100 R per hour. We have tried to design this so that we have several feet of concrete equivalent shielding, either by lead or what have you, to ensure that these areas are a zone 2.

When the COL has to perform the actual shielding analysis for the DAC this is one area that they are going to have to look at to ensure that that is going to be the case based on anticipated activity of the spent fuel assembly going through that area.

Here is another view of it. It shows the access ladder. There will be a caged entrance here and you'll have an area monitor, which isn't shown. There will be an area monitor outside that access area. As needed, based on additional analysis to determine what the scatter radiation is coming up out of there, the COL may have to add a shield plug, but that will have to be determined once they do a formal analysis. At this time we are just showing a wire cage locked door around that.

This is the mechanical penetration room down below.

MR. CARROLL: I'd feel better if you put the plug in from day one and make them pull it out if they have to go in and put more shielding in.

MS. NAUGLE: We discussed this at length with the staff.

MR. CROM: There were a lot of operational problems with that, because you have to do ISI inspection on that tube and you'd have to put in all the rigging and everything permanently in there to pull the plug out. If we can demonstrate that we don't need it we are better off, but we still have the option if we have to put it in.

MR. CARROLL: I wasn't aware of the ISI requirement. Why can't you do ISI from inside the tube?

MS. NAUGLE: I think they are primarily looking for leakage.

MR. CROM: I believe during the time period you'd have to do that the pool would be full of water and the tube would be full of water.

MR. CARROLL: Are there bellows in this thing or is it just a straight shot of pipe?

MR. CROM: This one is just a straight shot of pipe.

MR. CARROLL: I'm not sure what ISI you're doing or what's going to happen to this thing.

MS. NAUGLE: I think you might see some leakage around this collar potentially. It may be one of the things they are looking at. We can look into that.

MR. CROM: This is a containment penetration. Even the welds from the containment vessel have to be ISI inspected.

MR. CARROLL: Okay.

MS. NAUGLE: Our beloved DAC essentially stipulates that in tier 1 the shielding analysis will be performed using industry accepted codes and that for the appropriate federal regulations it will be shown that we are in compliance with those as far as accessibility, post-accident conditions, and minimizing dose during normal operation.

Also, part of that is the provision of airborne radiation monitors and ensuring that they will respond within 10 DAC hours. Let's see. What is it?

MR. CARROLL: Concentration.

MS. NAUGLE: It used to be NBCL.

MR. CARROLL: That's the way I remember them too.

MS. NAUGLE: This should be visual alarms in high noise areas. Obviously audible alarms won't be able to be heard.

We've committed that we will provide enough shielding that will maintain offsite exposure to the public within a small fraction of 40 CFR 190.

Any questions?

MR. CARROLL: Any questions on Chapter 12?

[No response.]

MR. CARROLL: Let's mark that one as one we've disposed of also.

MR. CROM: I'm Tom Crom. I'm the Engineering Manager for Duke Engineering & Services for the System 80+ project. I got a BS in mechanical engineering from Virginia Tech in 1976. I started out with Duke Power right after I graduated and worked on the design, construction and startup of Catawba Nuclear Station until about 1985, and I've been on this project, believe it or not, since 1985. I'm one the old-timers, I guess, on the System 80+ project.

I'm going to discuss Chapter 13, Conduct of Operations.

[Slides shown.]

MR. CROM: Conduct of Operations covers the following areas:

Organization structure.

Training.

Emergency planning.

Review and audit.

Plant procedures.

Industrial security.

What you are going to see in this whole chapter is that almost all these items are COL applicant items.

MR. CARROLL: The good old COL applicant gets one more thing laid on him.

MR. CROM: Yes.

However, in Chapter 13 we provided the following guidance to the COl applicant:

BOP interfaces for emergency operation facility, which is an offsite facility. Also, we gave interface requirements for the laboratory facilities and decontamination facilities. I will point out that those rooms and areas are actually located in the nuclear annex and into the radwaste building. However, we leave it up to the COL applicant to determine what type of chemistry, what type of calibration equipment and that type of thing he wants to put into the lab. That is pretty much traditional in the design of most of these plants. The chemists like to put their own equipment in and we've ensured that there is adequate space that can be adaptable to the COL applicant in doing that.

MR. CARROLL: How about things like hoods in the laboratory, a very important part of such a laboratory? Are you providing appropriate ducting to that room for the hood?

MR. CROM: That would be provided as part of the standard design, the duct work and the HVAC for the removal of the hoods. The same way as in the sample hoods in the sample room.

MR. CARROLL: Okay.

MR. CROM: There is some discussion in Chapter 13 of both the technical support center and operations support center. We spent a lot of the meeting in December talking about technical support center as part of the Nuplex 80+. Both of these are located on site in the nuclear annex and located with the tech support center with the viewing gallery looking down at the control room, and the operational support center is also on the same elevation as the tech support center, right outside of the control room in the assembly area for operational support during emergency conditions.

We also provided emergency operating guidelines. That is not the full emergency plan but is what would be given to the COL applicant to develop their emergency plans. This is traditional information that would be given to them to give the interface of what they need in order to develop their emergency procedures.

We also provide the operating procedures development plan. When this gets down to a COL applicant stage, it would become plan 2 guidelines. What we have got now in Chapter 13 as a plan is an outline of the type of things that would be provided.

We also have in there the standard plant vital equipment list for security and also a sabotage vulnerability analysis, which we will talk about next.

MR. CARROLL: It says vital equipment list.

MR. CROM: We're talking about security in vital areas.

MR. CARROLL: As opposed to rad protection vital areas.

MR. CROM: Correct.

MR. CARROLL: I wonder if our human factors friends from the staff can get to some of the other staff people who want to call -- the situation, Dick, is that historically -- and it's in Part 73 -- we have defined "vital areas" for purposes of security. Here in recent months the rad protection folks have come along and decided they have vital areas these days, a totally different meaning. That's vital areas for purposes of rad protection shielding, for stuff you've got to get to under severe accident conditions.

We commented in a letter we wrote last month to

Taylor or to the Commission. I can't remember which. I guess it was to the Commission, on DACs. We haven't heard back.

I think it's bad practice or bad human factors practice even. So let us enlist your aid to see if you can't give us a hand on that.

MR. SEALE: Behavior modification.

MR. CARROLL: Something like that.

MR. CROM: I want to spend the rest of my time talking about plant security.

As I stated earlier, the security plan and actual site security will be a COL applicant item. What we have provided in the SSAR ensures that the COL applicant must meet 10 CFR Part 73, 73.33, including the other applicable reg guides and regulations with that.

The COL applicant shall also provide the plant specific vital equipment list. All that should really include is the things with ultimate heat sink, service water pump structures and intakes and those type of things that will be site specific, compared to the plant where we did provide the standard vital equipment list in the SSAR.

MR. CARROLL: This is kind of off the subject, but we've been looking at the staff's proposal for a rule dealing with vehicular bombs. Have you looked at that issue in the context of this plant?

MR. CROM: Again, that would be up to the COL. He would have to follow the rule. That would be site specific, depending on what your protected fence and that type of access to the site would be.

MR. CARROLL: The difficulty I'm having with what the security guys are proposing is they seem to have the notion that you drive up an explosive laden truck through the fence and up next to the side of the building and set this bomb off and all of a sudden you have a severe accident and all sorts of offsite releases. I just don't think power plants are built that way.

MR. CROM: We'll talk a little bit here in a minute about some of the features we have on this plant that will improve that situation, where we have a lot of the external tanks and stuff located in the nuclear annex and inside containment.

MR. MICHELSON: How far above grade is the main steam line?

MR. CROM: I don't recall what that is. Do you recall, Larry?

MR. BRUSTER: The steam lines enter the turbine building right at grade. So whatever pipe support you have underneath the pipe to keep it up is the distance.

MR. MICHELSON: That introduces a little more of a truck bomb problem.

MR. CROM: You still have your main steam isolation valves.

MR. BRUSTER: The valve houses are up above that. They are up quite high.

MR. CARROLL: Carl, you're falling into the same trap the staff falls into. Suppose I blow up the main steam line. So what?

MR. MICHELSON: That depends on what the effect of the steam generator blowdown is, and so forth.

MR. CROM: Those portions of the lines that are exposed are not vital lines. The vital lines are only up to the main steam isolation valves.

MR. MICHELSON: I realize that's true. What happens if I rupture both main steam lines on a given steam generator? How fast a depressurization do I get? Or cooldown, really. It's the cooldown you're worried about. It's a very large release of steam; it's a very fast blowdown, a few seconds probably, and that generator is empty. It's a very fast cooldown. I haven't seen the transient analysis for that.

There was a time even on the old Westinghouse that you couldn't blow down more than one at a time or you got too fast a transient. Now this is equivalent to kind of blowing down two at a time, so to speak, because there are only two generators and they are very large.

MR. CROM: You're saying a complete blowdown where we've got the main steam isolation valves that are isolating within five seconds.

MR. MICHELSON: That depends upon what disruption the truck bomb causes in terms of pipe movements and all that. You're not designing for that kind of a situation to begin with.

MR. CROM: The way we have the design of those particular lines with the valves, I think it's beyond three feet of concrete, and those lines are also anchored at that wall with some very extensive anchors. You'll see more of that when we get to Chapter 3. Those anchors are huge.

MR. MICHELSON: All main steam lines are headered together in the turbine building, aren't they?

MR. CROM: Yes.

MR. MICHELSON: So in essence both steam generators will blow down to the two line break until such time as the isolation valves close.

MR. CROM: That's correct.

MR. MICHELSON: I guess if you want to do a true analysis you have to assume single failure of one of the main steam isolation valves to close as the worst case. That's for the staff to worry about.

At any rate, you get into some pretty significant cooldown rates on the reactor when you blow two big main steam lines simultaneously. There are only two steam generators to begin with.

MR. RITTERBUSCH: This is Stan Ritterbusch. Considering the rupture of a single main steam line and a failure of the main steam isolation valve on the other steam generator to close, we do consider the blowdown of two steam generators at once, and that is reported.

MR. MICHELSON: I'm just saying what additional contribution is there to the second steam line on one side. It changes the rate. It's a new calculation. Of course both generators are feeding to that double line break instead of a single line break. There are two lines broken. It's not too hard to break two with one truck.

It is something I think will have to be asked and then show that it's an acceptable consequence, unless they are protected well enough against a truck intruder.

MR. CROM: I think what you are saying is there would have to be more than one intruder; it would have to be two intruders.

MR. MICHELSON: No. I'll only concede one side. He either gets one side or the other side, depending on the convenience, but only one side. But it's a blowdown of both generators for a while, until the isolation valves close, and it's a fast cooldown under the reactor. There are two line breaks instead of one.

MR. CROM: I understand.

Going on, we also let the COL applicant designate the vital area boundaries. However, all vital equipment will be located in the vital area, but how the COL wants to make those boundaries, whether he wants to make the whole nuclear annex one boundary or he wants to subdivide, that is left up to the COL applicant.

The COL applicant also specifies the access control approach that he would use into those vital areas.

MR. MICHELSON: You say it's left up to the COL applicant, but it was my understanding that until such time as there is a COL applicant that this is an open issue, that the security arrangement, the definition of the boundaries, and so forth are all settled after an applicant comes in, and there is no pre-acceptance of anything in terms of boundary definitions or whatever, nor is there a pre-acceptance that the applicant do whatever he wishes.

MR. MATZIE: This is Regis Matzie. We discussed that issue with the staff at the management level. Since a rule was coming out on this issue, it seemed inappropriate for us to be trying to preempt that issue when a rule was being developed. That would apply to all power plants.

MR. MICHELSON: That's not what I'm talking about here.

MR. CARROLL: He's talking about the whole area of security.

MR. MICHELSON: I thought the boundaries would not be defined until a COl applicant appears, and then I thought it had to be a mutually agreed to thing at that point in time; it's not pre-agreed to today.

MR. CROM: That's correct.

MR. MICHELSON: Okay.

MR. CROM: We also specified that the COL applicant shall evaluate the security system design, to do an evaluation on the impact of plant operations to basically ensure that the security system does not restrict nor complicate the operator during normal operation or during emergency actions that he must take throughout the plant.

The security alarm annunciators and security non-portable communications are powered from an uninterruptible power source which includes dedicated batteries and those batteries are then backed up by the alternate AC combustion turbine. Other security loads are powered directly from the combustion turbine itself.

MR. MICHELSON: One other thing. When you look at the malevolent use of a truck bomb, you are going to have to check the control building carefully too, or what you call the annex building, because your control area is right next to the steam lines. I don't have the details in front of me, but it's shown in that general area.

MR. CROM: There are actually several rooms between that and where the electrical equipment control area is.

MR. MICHELSON: Then you should be all right. It will come unless it's a very substantial wall. You've got the whipping of the main steam lines momentarily as well, because those aren't designed for that situation perhaps, unless you design them for double breaks.

MR. CROM: As part of the structural analysis we also had to look at break loads on the building.

MR. MICHELSON: If you rupture the boundary of the building, then the steam could end up in the control area, or at least in that part of the building, and I'm sure there are corridors leading to the control room by that point.

MR. CROM: Yes.

We also have requirements on communications systems that each onsite security officer, watchman and armed response individual be provided with continuous communications with an individual in each continuously manned alarm station and also that communications be provided between the main control room and the central alarm station and the secondary alarm station.

I'll just let you look at these. I've got two slides that list the systems that we looked at or considered parts of the systems as vital systems in the vital equipment list. All these systems are basically the systems in the plant required to bring the plant to safe shutdown.

MR. DAVIS: Why is the subsphere floor drain system on that list?

MR. CROM: The subsphere floor drain system is where all your ECCS pumps are located, and you have to have that system operational to pump out all the leakage coming off your seals on those particular pumps so you don't flood the rooms. Those are class 1E power pumps in those particular sumps.

MR. DAVIS: Thank you.

I'm now going to talk about some of the features we have in the design that make the plant somewhat sabotage resistant or improves sabotage resistance compared to some of the current plants.

The first one is our emergency feedwater system. We have added another turbine driven pump. Essentially we've got four 100 percent turbine driven pumps, and those are also located in four quadrants so that it would require all four pumps to be taken out to take away the decay heat removal from the steam generators.

We also have two 100 percent emergency feedwater storage tanks which Laird talked about. Those are also located on opposite sides of the building where we have the main steam valve houses underneath those so that they are fully separated by a divisional wall. Actually, by the whole containment and reactor building.

MR. MICHELSON: But they are inside the building.

MR. CROM: That's a very important point. They are inside the building, compared to current plants which just have almost a nonsafety condensate storage tank sitting out in the open.

MR. DAVIS: What do you mean by 100 percent? Is that 24 hours? three days?

MR. CROM: One hundred percent is 8 hours at hot standby, a spill for 30 minutes before the operator takes action, from a rupture of a main steam line or a feed line, plus enough water to bring you to the shutdown cooling entry conditions

We also have done several improvements to the safety injection system that allow it to have four high head pumps. Again, a saboteur insider would have to take out all four pumps to take away the boration and makeup type sources.

The refueling water storage tank is another key item. It's located inside containment, where traditional plants have it located out in the yard somewhere.

The shutdown cooling system utilizes two separate letdown paths with RCS isolation provided with two valves in series and powered with different electrical channels.

I will point out that the motor control centers on those are separated also within a division so that he would actually have to go to two different areas in order to open those particular valves to try to get an interfacing system LOCA, for example.

We also have provided in the emergency feedwater system adequate battery capacity to run the EFW pumps for eight hours.

MR. MICHELSON: Before you leave that last point that you were making, both the inboard and the outboard isolation valves are in the same division of power?

MR. CROM: These are the letdown lines that shut down the reactors. There are two valves in series, same division of power, and one will be off, for example, A channel and the other one off of C channel. They are in separate areas as far as the motor control centers are located. If you recall our quadrant separation, they would be in different quadrants.

MR. MICHELSON: Yes, but the A channel and the C channel are channels of instrumentation and not motor power.

MR. CROM: Let me clarify that. If you remember our electrical distribution, we also have four buses that are also quadrant separated. So those motor control centers would be coming off of different buses as well.

MR. MICHELSON: They are off essentially different divisions of motor power.

MR. CROM: No, the same division, because there is only one diesel generator.

MR. MICHELSON: Then there are only two divisions of motor power. Are they on the same division of motor power?

MR. CROM: Yes.

MR. MICHELSON: So there are a number of single failures that would not allow you to utilize that system.

MR. CROM: You've still got two drop lines. So you've got two divisions. From a PRA standpoint, your emergency feedwater is your main defense in depth as far as decay heat removal until you get into shutdown cooling.

MR. MICHELSON: If you are into a flooding situation because you've broken a shutdown cooling system line and then you have single failure, the power will cause you not to be able to operate those valves unless you can get to them manually and use manual power. Is that the plan?

MR. CROM: We would be able to have the combustion turbine as well. You're correct in that statement.

Going on, we provide eight hour battery capacity to the emergency feedwater turbine driven pumps. Also we provide alternate AC combustion turbine.

MR. MICHELSON: The eight hours that you claim on the batteries, do you have environment control of that area for eight hours also if there is heat being generated? You do have electrical controls, and so forth, for the steam driven. In fact, you've got an electronic governor.

MR. CROM: The actual pumps themselves are self-cooled.

MR. MICHELSON: How are the electronics for the steam driven cooled? It's in the room, I suspect, or it has got to be awfully close to the room. How is the electronic governor cooled, or is it?

MR. CROM: To meet the station blackout rule, we take credit for the alternate AC source and HVAC in that particular area.

MR. MICHELSON: You're not even utilizing these for eight hours then. I thought you were. I thought that was part of the answer for the station blackout.

MR. CROM: The actual answer to the station blackout is they credit the alternate AC source to meet the station blackout rule, which would power the HVAC to cool the instrumentation.

MR. MICHELSON: I guess we'll get into that when we get to Chapter 9. Or 6. One or the other.

MR. CROM: Features that were talked about in December during Nuplex 80+ are that Nuplex 80+ incorporates automated on-line testing features for the plant protection system as well as on-line monitoring of fluid and electrical systems.

It also has inoperable and bypass alarms that are provided in the control room for components.

We also have position indication on all the manual valves that are in the main flow paths of any standby systems so that you can see if they are in the control room and actually alarmed if they are out of position for the operating mode.

All these are important for being able to detect that somebody is actually taking something out of position or putting it in the wrong position.

We also talked about the digital based safety/control systems utilizing memory protection features for their processors in which software changes are controlled by key lock or password protection.

Safety related cabinets are locked and alarmed in the control room. We also have alarms on those doors entering into where those cabinets are located.

MR. MICHELSON: Your security plan calls for the possibility of an insider, doesn't it?

MR. CROM: Yes.

MR. MICHELSON: That insider might be the fellow who programs this memory and all that sort of thing and he would have the keys. He'd have to have the keys in order to go in and do the programming. There are probably sophistications here that you have that help to prevent that.

MR. CROM: I'd like to have Ken Scarola answer that question.

MR. SCAROLA: There are four separate I&C equipment rooms in four physical locations. So someone has to enter each of these four rooms. In the event that he reprograms, there is an alarm right away that indicates to the operator that the newly stored program is not the one that is supposed to be there.

The scenario might be that somebody enters the A room; he reprograms; the operator sees an alarm. At that point the A room is basically disabled, or the A equipment. But you would hope that the operators have enough sense at that point to stop the guy before he goes into B, C and D.

MR. MICHELSON: There are many legitimate reasons to go in and reprogram. If it's an insider, unless he's awfully pressed for time he'll chose the time when he is going in to make a legitimate change to also make an illegitimate change.

MR. SCAROLA: Right, and that can happen. However, in the data processing system which is monitoring all of these software changes there is the known memory checksum for the valid software change. If he makes anything else other than the valid software change, there will be an alarm that there is a mismatch.

MR. MICHELSON: But you can make many changes that appear to be valid by the logic system.

MR. SCAROLA: Only if all of those modifications end up with the same memory checksum, which is highly unlikely. We run a continuous memory checksum that is in the protection system and we then compare that on line to a known memory checksum that is in the data processing system. If you make a modification, both have to be updated at the same time.

MR. MICHELSON: The checksum works such that I can't go in there and change the logic from opening to closing under a certain variable, but some day I may want to change the logic legitimately. Then I have to go through some other process, I guess, to do it. Checksums will only work if you are really checking what is already supposed to be there and the logic that is supposed to be there.

MR. SCAROLA: The memory checksum is not going to prevent you from making any change. It's only going to monitor the memory subsequent to the change.

MR. MICHELSON: How does it know what it's supposed to see subsequent to the change?

MR. SCAROLA: That's part of the validation program which basically says when we make a software modification back in the factory, say in Windsor or wherever, the V&V team says at the end of this change you should have the following memory checksum, and that is documented.

MR. MICHELSON: I think I understand that. It will work fine as long as the burn-in occurs back at Windsor. If the burn-in occurs on site, you won't know.

MR. SCAROLA: The assumption is that the program modification made by the site engineering staff gets fully V&V'd. At that point I know what the new memory checksum is supposed to be. I now create a maintenance work order. They make the actual implementation change, and now the system looks for the new memory checksum.

MR. MICHELSON: The real key is that the V&V must be done by somebody other than the fellow who is going out and do the work.

MR. SCAROLA: I think that's a fair assumption.

MR. MICHELSON: A V&V is probably the best and perhaps the only answer to this.

MR. CROM: That might be what we would call as an operating procedure to ensure that you don't have a single person.

MR. MICHELSON: That's right.

MR. CROM: One of the assumptions in our vulnerability analysis is that it is a single insider.

MR. MICHELSON: I think that's all you're required to consider right now. I'm not positive of that, but I thought it was just one.

MR. CROM: The final item on that slide. We also have software memory checks that are continuously verified on line and alarmed if altered.

One thing I should note is that a lot of these things that we talk about in general arrangements are good for sabotage but they are also nice things for flood and fire protection as well. That is the main reason we have them but they do help out considerably in a sabotage scenario.

The first bullet I have is essentially all the front line safety systems are located in the reactor building subsphere which is not only divisionally separated but there is also quadrant separation.

I will also point out that there are doors in the quadrant walls within a division for maintenance and removability of equipment. However, those doors will be locked security doors, and we also say that they are alarmed in the central alarm station in the control room if they are opened.

We have no doors on the bottom elevation in the divisional wall. There are no openings that somebody can pass through on elevation 50.

The first doors we have are on the next elevation, on elevation 70. I think that's a key point not only for fire protection, but also from a security standpoint for somebody to get from one room he has to go from one room in one division to another one and then he has to go up a complete elevation to get into the other division.

We also channelized the equipment, including motor control centers located in separate three hour fire barriers. Access to each channelized equipment room is also controlled. The main control room and remote shutdown room are located in separate vital areas and separate from the equipment room which houses the I&C equipment.

MR. MICHELSON: The description you gave of how you get from one division to another by going up a floor and so forth, have the fire protection people looked at that from the viewpoint of how you're going to get to a fire in a given location and how many directions you can come from, and can you open the doors to get your hoses in, or whatever your philosophy is for fighting it?

MR. CROM: Yes. Of course, you're considering that the fire is only going to be in one division and there is good access from that one division.

MR. MICHELSON: The usual assumption is it's one division and you would rather not open the divisional barriers to fight the fire, but occasionally you might have to. I have to look at that. We'll get to that under fire protection.

MR. CROM: Right. We verify, that there is still good access. However, like you say, there is time to get from one room to the other. There is also separation for flood concerns.

MR. MICHELSON: The real problem is smoke control, and so forth, if you've got to start opening up divisional barriers to get the hoses in to go to the other division to fight the fire.

MR. CROM: We'll talk about that when we talk about fire protection. We have complete divisional separation, including the ventilation systems. They are nonsafety but they do not penetrate the divisional wall.

Also, the transfer switches which we talked about in December for the remote shutdown room are located within the control, so they are in a secured area.

We also have alternate transfer switches for the remote shutdown room located in each of the channel equipment rooms associated with each channel. So essentially there are six switches located in different rooms to transfer.

I will talk a little bit about what we have done as far as the vulnerability analysis. Basically what we have done here is just to look to ensure there aren't some design features or something that we missed in the design. This is not a complete analysis from a security standpoint for an insider. That will be done by the COL applicant, but we have done enough to ensure that we haven't missed something in the design.

We did this by reviewing the sabotage vulnerability to tampering by an insider with authorized access.

We assured that timely means exist to discover and compensate for tampering.

If there was anything that we found, we would incorporate design and procedural changes where practical.

In doing this, we used essentially the PRA. We took the PRA. We looked at what equipment needed to be there for success to mitigate an event, and we reviewed that that equipment had some sort of detection to tampering and then ensured that there was adequate separation between that equipment so that once it is detecting that he is tampering that we can then send someone from the control room in order to stop it.

MR. CARROLL: It sounds like we have got the makings of a new program. We've got reliability assurance flowing from PRA. Now we can have security assurance programs flowing from PRA.

MR. DAVIS: And it will do a lot more.

MR. CROM: Yes.

MR. MICHELSON: It also helps the potential saboteur.

MR. CROM: Yes. Your PRA might be your saboteur's road map.

MR. MICHELSON: You'll have to start guarding the PRAs.

MR. CROM: The following assumptions were used in this vulnerability analysis and all these assumptions aren't something we dreamed up. They came right out of the EPRI requirements document.

The assumptions were that the threat was from a knowledgeable insider without explosives. I think that's a key point. He does not have explosives in this analysis.

The tampering of security detection system is detected in a timely manner.

MR. CARROLL: The truck just brought them in.

MR. CROM: That isn't an insider. That's an external saboteur, which is treated under different rules.

Insider can initiate an event, we assumed, and disable one or more safety systems and disable one or more non-safety systems or a combination of the above if not detected.

We assumed that equipment inside containment is considered inaccessible to an insider for tampering.

We also consider the control room to be protected since there is the presence of several employees at all times.

And sabotage events do not consider single failure or independently initiated events on top of the tampering.

MR. MICHELSON: How do you claim you can detect tampering, like in motor control centers?

MR. CROM: Basically, what we stated on Nuplex 80+ is that all the equipment is monitored not only on an equipment level, but on a system level.

MR. MICHELSON: All kinds of tampering can be done to this that cannot be easily monitored. I can just stick a piece of a Popsicle stick in the contacts on the contactor in the motor control center and you don't know it's there unless you go look. You don't even know if somebody entered it unless you are going to monitor every door, which hasn't been done in the past.

MR. CROM: Like I stated, this was an analysis to determine whether we had any real vulnerabilities in our design. It will be up to the COL applicant to address tampering.

MR. MICHELSON: It's a difficult thing to detect tampering if it's a knowledgeable person doing it. If it isn't a knowledgeable person, he probably won't do any real collective harm anyway. A knowledgeable person can do all kinds of tampering that you can't detect.

MR. CROM: I don't disagree with you.

MR. MICHELSON: Unless you purposely operate the equipment, and then you'll find out it doesn't operate.

MR. CROM: I don't disagree with you. You can always put rubber bands around limit switches or something.

MR. MICHELSON: There are lots of little tricks. You can prohibit Popsicles in the plant, of course, but you'll find something else to stick in there.

MR. CARROLL: Match books work just as well.

MR. MICHELSON: There are a lot of tricks. These are tricks that the people that do the work know, because that's how you fix it up so you can do certain tests without actuating the equipment.

MR. CROM: These are the transients that we considered as potential sabotage events. These are things that we think an insider can initiate from outside the containment without explosives.

He can initiate a loss of feedwater.

He can initiate a small break LOCA by manipulating valves or a medium LOCA by manipulating valves outside containment.

He can also initiate a loss of offsite power by going to switchyards or transforms.

And there is what PRA just calls other transients.

The ones that we felt were not potentials were steam generator tube rupture, that he would have to enter containment.

A large LOCA. Again he would have to enter containment and have explosives.

The same thing with a vessel rupture.

Anticipated transients without scram was not considered because of the assumption that there would have to be an event on top of the tampering for that to occur.

MR. MICHELSON: What event do you think it takes? It doesn't take much when you do it right.

MR. CROM: Ken talked about the alarms and the protection that we have on the protection systems that detect that.

MR. MICHELSON: Some of the more vulnerable things are like the design of the relief valves. They are very simple to gag. Unless you put monitoring on all of them in a certain way you won't even know they've been gagged. You gag them purposely when you do hydros and stuff. You know how to do it. Everybody that does it knows exactly how to gag it. Once you take the safeties out of the picture it doesn't take much to blow the reactor apart. Just the right transient, and you can initiate that from outside of containment.

You don't want to get too complacent.

MR. CROM: I've got loss of HVAC in here. That one is excluded basically because that is a support system. Also there is some time for recovery in a loss of HVAC.

We also excluded the large secondary side break based on the insider not having explosives. It still doesn't address your external insider concern with the truck bomb.

We looked at those and showed that we could detect that equipment in the control room had some sort of indication if it was taken out of service, that we also had essentially four components of all the front line safety systems, and also with the separation that there was adequate time for a control room operator to detect and disperse somebody out for those particular events before he actually initiated the transient.

Our conclusion was that we did have one area that we identified that we needed to change the design, and that is where we added indication on the manual valves. At the time we did this analysis we did not have an indication. That is not only from a sabotage standpoint; we think it's a good safety practice because there have been a number of events, TMI and Davis-Besse, where people had manual valves in the wrong positions.

MR. CARROLL: Are you doing every valve? How about maintenance valves?

MR. CROM: No. All of the valves that are in the main flow paths and are in standby systems. If they are like a component cooling water system that runs all the time, there will be detection of loss of flow, but only on standby systems in the main flow path.

MR. MICHELSON: The same person that closes the valve that you don't want closed can also fix the limit switch real easy.

MR. CARROLL: How many manual valves did that turn up?

MR. CROM: Thirty-two, and which valves those are are listed in Chapter 13.

MR. CARROLL: I would have guessed it would have been a bigger number.

MR. CROM: There are not that many in the front line standby safety system. That even included systems like on the diesel generator some of the standby support systems for that.

MR. MICHELSON: It's a good safety measure. I don't think it's worth a damn for sabotage protection. Anybody that can figure these things out can easily figure the limit switch before he ever moves a valve.

MR. CARROLL: Yes, except the more you have, the longer it takes him to do something.

MR. CROM: Finally, like I said, the COL applicant will have to perform the final sabotage vulnerability analysis for any site specific final design. Also he will use what we have currently in Chapter 13 as a starting point when he does that.

MR. MICHELSON: Is the control room in this plant above or below grade?

MR. CROM: Above grade.

MR. CARROLL: Would anybody be dumb enough, Carl, to put a control room underground?

MR. MICHELSON: Sure. Especially when it can be flooded.

MR. CROM: Any questions?

MR. CARROLL: I've got one for the staff on Chapter 13 that I didn't notice when we were covering it. This on page 13-6 and it's talking about the design certification material for emergency planning. I'm looking right after design certification material: Requirements for the TSC and OSC are covered in the ITAAC. Not true. There is a requirement for the TSC but no mention, that I could find at least, of the OSC in the ITAAC.

MR. WAMBACH: Our reviewer, who said he had to leave, informed me of that as he left and said that if you bring that up --

MR. CARROLL: That Carroll is probably going to find it.

MR. WAMBACH: And we will bring that up with CE.

MR. CARROLL: What else did he tell you?

[Laughter.]

MR. ARCHITZEL: Just a question for Mr. Michelson on blackout. Station blackout was covered in Chapter 8 and you mentioned before about the eight hours. Can you clarify what you want on that?

MR. MICHELSON: The main question was those pieces of equipment that we claim remain functional for that eight hour period have to have support services. In the case of batteries, you look to see that the battery will supply power for eight hours. The question that came up was, do you have to control the environment for eight hours around the equipment? Do you have to keep it cool, in other words?

MR. ARCHITZEL: But you don't need to do an analysis to get AAC.

MR. CROM: It's a two minute coping period. With alternate AC it's a two minute coping period. We provide eight hour batteries, but that's for defense in depth. It's not really to satisfy the station blackout rule.

MR. MICHELSON: Yes, but don't take any comfort at all in the eight hour battery if the room heats up and your off in 20 minutes anyway.

MR. ARCHITZEL: For the station blackout you credit the AAC power source and you have ventilation.

MR. MICHELSON: Now you're going to bring that environmental cooling for the emergency feedwater pumps, loading it on the alternate power source.

MR. ARCHITZEL: Sure.

MR. CARROLL: That takes care of a situation where the seismic event or the hurricane or the tornado took out my non-hardened alternate AC system?

MR. ARCHITZEL: I was just asking if you wanted us to come back and address that. That's the approach that has been reviewed by the staff.

MR. MICHELSON: Somewhere we are going to eventually read about the station blackout capability of the plant, under Chapter 19 probably, on severe accident?

MR. CROM: It was addressed in Chapter 8.

MR. MICHELSON: The arrangement of power supplies came up in that context but it didn't come in the context of a coordinated reply to station blackout.

MR. CROM: One of the responses we gave in that letter was how was alternate AC sourced. It is credited in the station blackout. It is the resolution to our station blackout rule.

MR. WAMBACH: In the section on USI's/GSIs all we do is reference to section 8.5.

MR. MICHELSON: When I look at the heating and vertilating then I'll see that it is indeed is to be loaded that way and it's a viable answer.

MR. CARROLL: It's just fine as long as you give credit for the alternate AC.

MR. MICHELSON: It depends on how big the alternate AC is and how many of these things you start up. It's a perfectly good answer.

MR. CARROLL: It's a big generator in terms of rating.

MR. MICHELSON: I don't know what all is on it.

MR. CARROLL: It will take one whole safety division plus a bunch of other junk.

MR. CROM: We explained that in December. We can go over it again. It can handle two permanent nonsafety buses or a permanent nonsafety bus and one division of class 1E power.

MR. MICHELSON: When you say it handles a safety bus, it handles all the supporting auxiliaries for that?

MR. CROM: That's correct.

MR. MICHELSON: Including heating and ventilating, and so forth?

MR. CROM: That's correct.

MR. CARROLL: It's quite a bit bigger than the individual diesels.

MR. MICHELSON: It would have to be.

MR. CROM: All our essential chillers, essential chilled water pumps for the chilled water system are on the diesels. All our chillers and chilled water pumps for the non-essential chilled water system are on the permanent nonsafety bus and powered from the combustion turbine.

MR. MICHELSON: When we get to the water systems and the chiller systems we will see that. That will be Chapter 9.

MR. CROM: Yes.

MR. CARROLL: If there is no more in Chapter 13, let's try to sum up where we got today.

On Chapter 4, we're going to let Bill Shack look at the materials part of that chapter.

Did we have some questions we wanted answered on that chapter, Doug? You had some thermal hydraulic things.

MR. COE: I'll write them up and pass them around to all the members so that you can verify that we got them right and I'll send them off to CE.

MR. CARROLL: On Chapter 10, I guess I would like to proclaim that one as complete, although just out of curiosity I would like to see what the staff does in their technical editing. This is the one where there was the real mixup between Brown Boveri and other kind of turbines and stuff.

MR. ARCHITZEL: That wasn't a technical editing.

We didn't incorporate some revisions in Amendment T. By the way, the technical editing even in the version you're going to get at the end of this month will not be incorporated yet.

MR. CARROLL: Let's say we've driven a stake through the heart of Chapter 10 except I want to make sure they did a good job.

MR. MICHELSON: This question on technical editing, the version it will be at the end of February, the 28th, is there another version before June when you publish your final FSER? Or do we ever see the technical editing?

MR. ARCHITZEL: We haven't addressed that yet.

MR. MICHELSON: It's not on this schedule showing anything in between. If we don't see the technical editing, then we're never quite sure, so a final letter has to say, well, so far as we saw on February 28, here's our comments, and we don't know what they might have changed after that.

MR. WAMBACH: What you see on the schedule, we thought we would have all the technical editing done. The way it has turned out with the inputs that we have received from the technical branches we have not been able to do that. I will check with my managers when we get back. Those that we issue on February 28 that have not gone through the technical editor, maybe we'll provide you copies after we incorporate the technical editor comments.

MR. MICHELSON: It's up to Jay how he wants to do it, but I would always be concerned in recommending an FDA on a document that we haven't seen yet. Anything after that amendment is free game. If during certification somebody challenges it, then they have to go back and find out what we looked at. It's nice to look at as near the complete document as is physically possible.

MR. CARROLL: I agree.

MR. MICHELSON: Otherwise you get into all kinds of problems later on what did we look at. We'll be very clear on what we looked at.

MR. ARCHITZEL: As we get the chapters done, is it okay if we send you a copy of the technical edited chapters after February 28?

MR. CARROLL: That's the understanding I think I had with Bill.

MR. ARCHITZEL: We'll do that.

MR. CARROLL: Okay. 11, 12, 13 and 14. I guess my recollection is that we have driven a stake through their hearts.

MR. MICHELSON: Except you only looked at 14.2.

MR. CARROLL: Oh, yes. 14.1 doesn't exist. That was a PSAR. We looked at 14.2. The only other part of 14 is 14.3, which was the ITAAC, which I looked at.

MR. MICHELSON: But that doesn't count entirely.

MR. CARROLL: Except you asked the question, do I even have to look at ITAACs?

MR. MICHELSON: That's right. I think there are some of them we'll have to look at, the DAC associated ones, for instance.

MR. CARROLL: Yes, but this is not a DAC associated one.

MR. MATZIE: Jay, 14.3 is going to be a relatively thin description of the ITAAC process. ITAAC is a totally separate document you could look at today. It's about this thick.

MR. CARROLL: That's what I looked at. I looked at the ITAAC on initial test programs in the big, thick book.

MR. MICHELSON: Do you go beyond 14.3? Are there sections in the SSAR beyond 14.3?

MR. MATZIE: No.

MR. CARROLL: Okay. So you're right about 14. All we've done to it is take care of 14.2.

MR. MICHELSON: There is probably nothing left, but we don't know.

MR. CARROLL: We still want to look at 14.3.

MR. WAMBACH: Yes, 14.3 will describe the process similar to what is in the ABW 14.3.

MR. CARROLL: In fact, it's on the schedule for

April.

MR. MICHELSON: There it is. Sure. We have to look at everything in the SSAR but we don't have to look at the CDM at all because that's nothing new.

MR. CARROLL: On 17, the quality assurance part of it, I don't think we had any problems. I think we have a serious generic problem with this RAP program, much more than just Combustion Engineering. We may write a letter on the generic thing this meeting.

On the follow-up questions we killed off all but Lewis and Wylie's.

MR. MICHELSON: We killed them off but we didn't agree on some of the replies. I don't think there was a disagreement on that.

MR. CARROLL: They didn't disagree as to why we disagreed?

MR. MICHELSON: That's right. Therefore we haven't bought off on it.

MR. CARROLL: Let's make sure we understand where we are. I think I heard words like, well, I know what you said and we'll pick this up when we cover Chapter 6, or something.

MR. MICHELSON: If these replies are going to be part of the record they ought to be corrected if we don't agree with them, or at least agree to disagree with them.

Like question 3. I think there is a limit. The staff says yes, there is going to be limits. I still think the last sentence suggests that this is an optional thing the utility decides, and that's not true.

MR. CARROLL: Would you want to change the wording?

MR. MATZIE: Yes.

MR. MICHELSON: I think that will fix that one for me.

The next one was 8. We discussed 8 quite a bit and I think you fellows agreed that drip proof isn't going to necessarily cut it. The last part of that sentence, if that were the only specified requirement, it would be far better. You're going to fix it so the spray will not affect the equipment.

MR. DAVIS: That's what it says now.

MR. MICHELSON: No. It just says it could be drip proof and/or that. It doesn't necessarily have to be that.

MR. DAVIS: It says drip proof and, drip proof or.

MR. MICHELSON: And/or.

MR. DAVIS: I read it as being it's going to be protected from the spray. It may or may not be drip proof.

MR. MICHELSON: That won't even cut it here. Protect from the spray is all that needs to be said. I'd take the "drip proof" out of it.

MR. DAVIS: I think that's what they had in mind.

MR. MICHELSON: In the previous paragraph it didn't say how it was going to be done in the electronic governor and that sort of thing. Yes, you can protect it, but it will take a little more than drip proof to do it.

MR. CARROLL: You would be happy if that first sentence of the last paragraph read "are protected from spray such that . . . ."

MR. MICHELSON: And that same sentence needs to be in the previous paragraph as well for the emergency feedwater. If there is anything vulnerable, you've got to protect it. I think that is what you agreed to do. In the previous paragraph you didn't say how and in the last paragraph you gave two options, drip proof and/or protecting it from the spray.

MR. CARROLL: Does Combustion have a problem with revising that?

MR. MATZIE: Could you reiterate what paragraph?

MR. CARROLL: We are on question 8 and we are in the last paragraph on the first page. The first line gets the words "drip proof and/or " scratched. I guess Carl would like to find that same statement of commitment in the preceding paragraph.

MR. MICHELSON: In some manner.

MR. MATZIE: Take out "and/or".

MR. MICHELSON: Then you're all set. I think you agreed you're going to protect it.

MR. MATZIE: You also want something similar in the previous paragraph.

MR. SEALE: Right.

MR. MICHELSON: I also raised the question on the diesel generators, the generator itself. I think that these words that we just agreed to apply to the generator as well and will take care of the whole thing. I think you'll have to look at the generator carefully.

That took care of that answer, for me at least.

MR. CARROLL: Wait a minute. If that's an air cooled generator, there ain't no way you're going keep water out of it if the sprays go off.

MR. MICHELSON: The spray will not directly result in failure of the equipment however they do it. Right?

MR. MATZIE: Let us look at the answer. We understand what you're looking for.

MR. CARROLL: All right, Carl?

MR. MICHELSON: I think that was the last one I had.

MR. CARROLL: We are going to pin Hal down tomorrow on whether he's satisfied with the responses to his questions. Is somebody from Combustion going to be here tomorrow?

MR. RITTERBUSCH: I will be in the area and I will be in touch with Doug to find out the results of Hal's comments. We will then take care of them as necessary.

MR. CARROLL: Is there anything else we need to discuss today?

MR. WAMBACH: I have a question for clarification, Jay. He made mention of whether these answers were docketed and getting them corrected. These answers were to the ACRS.

MR. CARROLL: "Docketed" was the wrong choice of words.

MR. MICHELSON: They're just to us.

MR. CARROLL: They're informal responses from Combustion to us.

MR. WAMBACH: If you record those in your transcript or something, fine, but we didn't ask for them and we didn't get a response.

MR. CARROLL: Absolutely.

MR. MICHELSON: We don't even want you involved in it, I don't think. As long as you recognize how they replied to us and you don't have a problem that that's not what the documentation shows or something.

MR. CARROLL: Anything else we need to clarify?

MR. DAVIS: What about the meeting at Palo Verde?

MR. CARROLL: We're going to talk about that in future activities.

MR. MICHELSON: Do we think we can finish up with this big meeting in April? The March meeting is almost entirely severe accident and PRA, if I understand it correctly.

MR. CARROLL: I don't know.

MR. MICHELSON: In April two days might do it. By that time we'll get around to reading the documents carefully. So we may have a lot of other questions.

MR. SEALE: You're not planning on meeting with the ABWR, though, are you?

MR. MICHELSON: No. By that time ABWR is all done and we can give this our undivided attention.

MR. CARROLL: Doug has got the April meeting planned for two days already, the 5th and 6th.

MR. MICHELSON: From experience, what we run into is that the first time we hear it it raises some questions and they go back home and come up with some answers. For everything done in April there is no schedule for how they come back with the answers or the explanations, or whatever. That's the only thing. Probably one more date somewhere as a catchall might cover it.

MR. CARROLL: We'll ask all the tough questions on the 5th and they can get the answers overnight to us on the 6th.

MR. WAMBACH: In this regard, Jay, I know there is concern about 2 and 3 and not getting them on the same day if we have a full scope. Is there any possibility of the subcommittee having a two day meeting in March and we can cover 2 and 3 on one day?

MR. MICHELSON: No.

MR. CARROLL: There is a meeting on the 9th.

MR. MICHELSON: ABWR has got a final meeting. That may not take all day, of course. That's what is scheduled for the 9th, the final meeting to hear the staff's SER. We would like to hear how you resolve the final open issues, and they are still doing it for ABWR. Any changes or anything will be page changes on the 9th.

MR. CARROLL: Do you know enough about what you are dealing with there to give us some time on the 9th? Can you say that we could have half the morning or all of the afternoon?

MR. MICHELSON: Let's keep it in our vest pocket as a possibility.

MR. CARROLL: No, because we've got to tell Combustion and the staff.

MR. MICHELSON: But I don't know today. We've got another amendment coming from GE that we haven't even seen yet. Amendment 34 is going to come in.

MR. CARROLL: Anything else?

MR. ARCHITZEL: Can we clarify in 2 and 3 what you are looking for at the next meeting? Was there some thought we could do a little more than just seismic that day? I heard that Combustion only had the guy available for one hour.

MR. CARROLL: Not true. That day.

MR. ARCHITZEL: But you don't want any more than just the seismic aspects of 2 and 3 and you want to put the others off until April?

MR. CARROLL: Correct. The reason for that is that Tom and Pete have been pushing to get PRA and severe accidents moved ahead because that's where they think there are going to be a lot of questions and problems. Probably less so with the remainder of Chapters 2 and 3.

MR. ARCHITZEL: It's not currently a problem but there is some staff resistance to doing all the PRA on that particular day. They're willing to make the presentation. We'll get back if there is any real problem.

MR. CARROLL: We already heard that all you'll be able to support is the level 2. Is that right?

MR. WAMBACH: Yes. We are going to go back and try to do more arm twisting though.

MR. CARROLL: Okay.

MR. MICHELSON: If you do only level 2 it won't take but a small part of the day.

MR. DAVIS: Level 3 will also be included.

MR. MICHELSON: How the heck can you think about a PRA when you do the back end first?

MR. CATTON: I've always wondered about that, but it doesn't seem to bother them at all.

MR. CARROLL: Anything else we need to do today?

[No response.]

MR. CARROLL: We are adjourned.

[Whereupon at 5:30 p.m. the meeting was adjourned.]

REPORTER'S CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

NAME OF PROCEEDING: ACRS ABB-CE Standard Plant Design

DOCKET NUMBER:

PLACE OF PROCEEDING: Bethesda, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Michael Paulus

Official Reporter
Ann Riley & Associates, Ltd.

ABB Combustion Engineering System 80+™ Standard Plant

Chapter 14 - Initial Test Program

John R. Rec

ACRS ABB-CE Standard Plant Designs Subcommittee

February 9, 1994

RAK ACRS1 2/3/94

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System 80+ Standard Plant Initial Test Program

- Section 14.1 PSAR Information (not applicable)
- Section 14.2 Initial Test Program
- Section 14.3 Certified Design Material

System 80+ Standard Plant
Section 14.2 - Initial Test Program

Basis

- **Regulatory Guide 1.68 Revision 2 and Chapter 14 Standard Review Plan**

- **Supplementary regulatory guides**

  For example,

  - R.G. 1.68.2 - Remote shutdown capability demonstration

- **System designer test requirements**

- **Industry standards**

ABB

System 80+ Standard Plant
Section 14.2 - Initial Test Program

- **Based on initial test programs for ABB-CE designed Nuclear Steam Supply Systems**
- **Expanded to include balance of System 80+ plant design and site-specific interfaces**
  - **Includes most recent startup experience from...**
    - Palo Verde, Unit 1 - First-of-a-kind-unit
    - Palo Verde, Units 2,3 - Follow-on-units
    - DE&S and SWEC in Balance of Plant
  - **Includes testing of unique System 80+ safety features**

    For example,
    - Rapid Depressurization System
- **Incorporates specific Tier 1 (ITAAC) test commitments**
- **Provides the bases for the COL Applicant Detailed Test Program through vendor test guidelines**
- **Reviewed and approved by NRC**

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ABB Combustion Engineering System 80+™ Standard Plant

Chapter 17 - Quality Assurance

Dr. Eric R. Siegmann

ACRS ABB-CE Standard Plant Designs
Subcommittee

February 9, 1994

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System 80+ Standard Plant Quality Assurance Program

Objective:

- QA Program to meets applicable standards
  - 10CFR50
  - 10CFR52
  - NQA-1
  - NQA-2
  - Regulatory Guide 1.28
  - ASME Code

- **QA Program described in topical report CENPD-210, Rev. 7A (approved by NRC)**
- **QA Program is currently in use on new nuclear design projects**
- **No open items on QA in Chapter 17**

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System 80+ Standard Plant Design Reliability Assurance Program

Objective:

- Provide guidance to the designers on the risk importance of certain systems, structures, and components (SSCs)
- Provide guidance to the COL Applicant on the risk importance of certain SSCs
- Provide reasonable assurance that design and PRA are consistent

- Design Reliability Assurance Program
  - Plan is summarized in Section 17.3 and has been reviewed by NRC staff
  - Program implementation is ongoing
  - Documented in D-RAP report

ABB

System 80+ Standard Plant Design Reliability Assurance Program

- Program components
  - Identify risk significant SSCs
    - PRA importance measurements
    - Engineering insights
  - Inform designers of risk significant SSCs
    - PRA group participation in design meetings
    - Distribution of PRA assumptions and insights for D-RAP SSCs to responsible design group
  - Feedback from design engineers
    - Design improvements, changes or problems fed back to the PRA group
    - Input to the O-RAP
- Guidance to O-RAP will be prepared for the COL Applicant
- No open items on D-RAP in Chapter 17
- No impact on ITAAC, D-RAP included in Tier 2

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Chapter 4 - Reactor

Dr. Mark L. Kantrowitz

ACRS ABB-CE Standard Plant
Designs Subcommittee

February 9, 1994

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System 80+ Standard Plant Reactor

- Evolutionary reactor core design
  - Based on System 80
  - Incorporates additional design features and improvements
  - EPRI ALWR Requirements
  - NRC mandated changes (severe accidents)
  - ABB-CE and System 80+ Executive Advisory Committee desired changes (operating experience)

ABB

System 80+ Standard Plant Reactor

- Impact of changes
  - Increased safety
  - Improved performance
  - Improved reliability
  - Improved operability
  - Reduced cost

ABB

System 80+ Standard Plant Reactor

- Reactor core design features
  - Increased power level relative to System 80
  - Integral Er_2O_3-UO_2 burnable absorbers
  - Non-positive MTC at all power operating conditions
  - Thermal margin of at least 15% over and above regulatory requirements
  - Reduced reactor coolant temperatures
  - Maneuvering control without changing RCS soluble boron concentration
  - Extended CEA lifetime

ABB

System 80+ Standard Plant Reactor

- Fuel design features
  - Integral Er_2O_3 - UO_2 burnable absorbers
  - Natural or low enrichment UO_2 axial blankets
  - Erbia absorber cutback regions
  - Increased effective fuel pellet density
  - Increased maximum fuel rod burnup
  - Debris resistant bottom grid

ABB

System 80+ Standard Plant Reactor

- Reactor materials features
  - Inconel 690 flow skirt and CEDM motor housing
  - Reduced ferrite content limits for stainless steel
    - Castings
    - Weld filler material

ABB

System 80+ Standard Plant
Comparison of Core Design Input Parameters

	System 80	*System 80+*
Core power, MWth	3800	3914
Burnable absorber type/material	Discrete Al_2O_3-B_4C	Integral Er_2O_3 - UO_2
Nominal Cycle length, months	18	18
Average UO_2 enrichment, wt%	2.6	2.6
Equilibrium cycle feed batch, No.	96	80
Reactor inlet temperature (°F)	565	556
Reactor outlet temperature (°F)	621	615*
Core mass flow rate (10^6 lbm/hr-ft^2)	2.62	2.65
Maximum fuel rod burnup, GWd/MTU	≤52	≤60

*Maximum - assumes thermal design flow rate

ABB

System 80+ Standard Plant
Comparison of Core Design Derived Parameters

	System 80	*System 80+*
Moderator temperature coefficient ($10^{-4}\Delta\rho/{}^{o}F$)	≤ +0.5	Non-positive (at all power operating conditions)
Cycle 1 critical boron concentration, PPM (BOC, HFP, equilibrium xenon)	660	1000
Equilibrium cycle discharge burnup, GWd/MTU	~ 42	~ 48
Average LHR, kW/ft	5.41	5.36
Shutdown margin (N-1), %$\Delta\rho$	2.5	3.0

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System 80+ Standard Plant Reactor

- CEA design objectives
  - Maneuvering control without changing RCS soluble boron concentration
  - Extended CEA lifetime
  - Increased shutdown margin

ABB

System 80+ Standard Plant

Comparison of Control Element Assembly Design

	System 80		System 80+	
CEA Type	Number	Absorber	Number	Absorber
Full-strength (12-finger)	48	B_4C	48	B_4C
Full-strength (4-finger)	28	B_4C	20	Ag-In-Cd
Part-length (4-finger)	13	B_4C	--	--
Part-strength (4-finger)	--	--	25	Inconel
Total	89		93	
Lifetime	10 years		20 years	

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System 80+ Standard Plant
Reactor Vessel Fluence

- Reactor vessel features
  - Ring forged fabrication
    - Eliminates belt-line welds
  - Reduced copper content
    - Improves resistance to radiation
  - Reduced initial RT_{NDT}
    - Increases margin to brittle factor
- Low-leakage fuel management scheme
  - Reduced fluence at reactor vessel

ABB

System 80+ Standard Plant Reactor Vessel Fluence

- Lifetime fluence prediction based on the following:
  - Low-leakage fuel management scheme
  - 2-dimensional DOT calculational model
  - 1.15 axial peaking factor
  - 30% uncertainty factor
  - 0.80 calculation/measurement bias
  - 60 year plant lifetime
  - 80% plant lifetime capacity factor

- Lifetime fluence predicted to be $< 6.2 * 10^{19}$ n/cm^2 (E>1 MeV)

- Maximum predicted RT_{NDT} is 89 °F (<< 10CFR50.61 PTS screening criterion of 270°F)

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System 80+ Standard Plant Nuclear Fuel System ITAAC

- Single Nuclear Fuel System ITAAC
  - Verify basic configuration of the fuel assemblies, the CEAs and the Nuclear Fuel System arrangement
- Selected fuel and initial core design changes permitted
  - Selected fuel and initial core design features
  - Selected fuel and initial core design evaluated parameters
- Acceptance criteria for selected design changes approved by NRC

ABB

System 80+ Standard Plant Reactor

- Conclusion
  - Design approved by NRC
  - No open items in FSER

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ABB Combustion Engineering System 80+™ Standard Plant

ACRS ABB-CE Standard Plant Designs Subcommittee

February 9, 1994

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System 80+ Standard Plant Meeting Agenda

• Chapter 4	Reactor	M. Kantrowitz
• Chapter 10	Steam & Power Conv. Sys.	L. Bruster
• Chapter 12	Radiation Protection	C. Naugle
• Chapter 11	Radioactive Waste Mgmt.	J. Baron/C. Naugle
• Chapter 17	Quality Assurance Program (including Design Reliability Assurance Program)	E. Siegmann
• Chapter 13	Conduct of Operations	T. Crom
• Chapter 14	Initial Test Program	J. Rec

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System 80+™ Standard Plant
Chapter 11 - Radioactive Waste Management Systems

Joseph S. Baron
Stone & Webster Engineering Corporation

ACRS ABB-CE Standard Plant Designs Subcommittee
February 9, 1994

System 80+™ Standard Plant
Radioactive Waste Management Systems

Topics	Presenter
• System Design	J.S. Baron
• Effluent Analysis	C. Naugle
• Radiation Monitoring	C. Naugle

System 80+™ Standard Plant
Radwaste System Design

Principal Functions:

- To separately collect and segregate gaseous,liquid, and solid radioactive wastes
- To provide adequate storage capacity to accommodate delays in processing or disposal of wastes
- To process the wastes to permit safe discharge or disposal
- To adequately sample waste streams for process and effluent control
- To monitor discharges in compliance with state and federal regulations
- To assure high integrity boundaries for radioactive fluids to preclude their uncontrolled release to the environment

System 80+™ Standard Plant
Radwaste System Design

<u>Design Philosophy:</u>

- Process design to reduce operator exposure
- Selection and design of equipment to reduce maintenance
- Operator actions reduced by selection of unit operations
- Unit operations selected to minimize solid waste generation
- Flexibility of design to accommodate operational upsets or unusual inputs

System 80+™ Standard Plant
Liquid Waste Management System

Design Bases

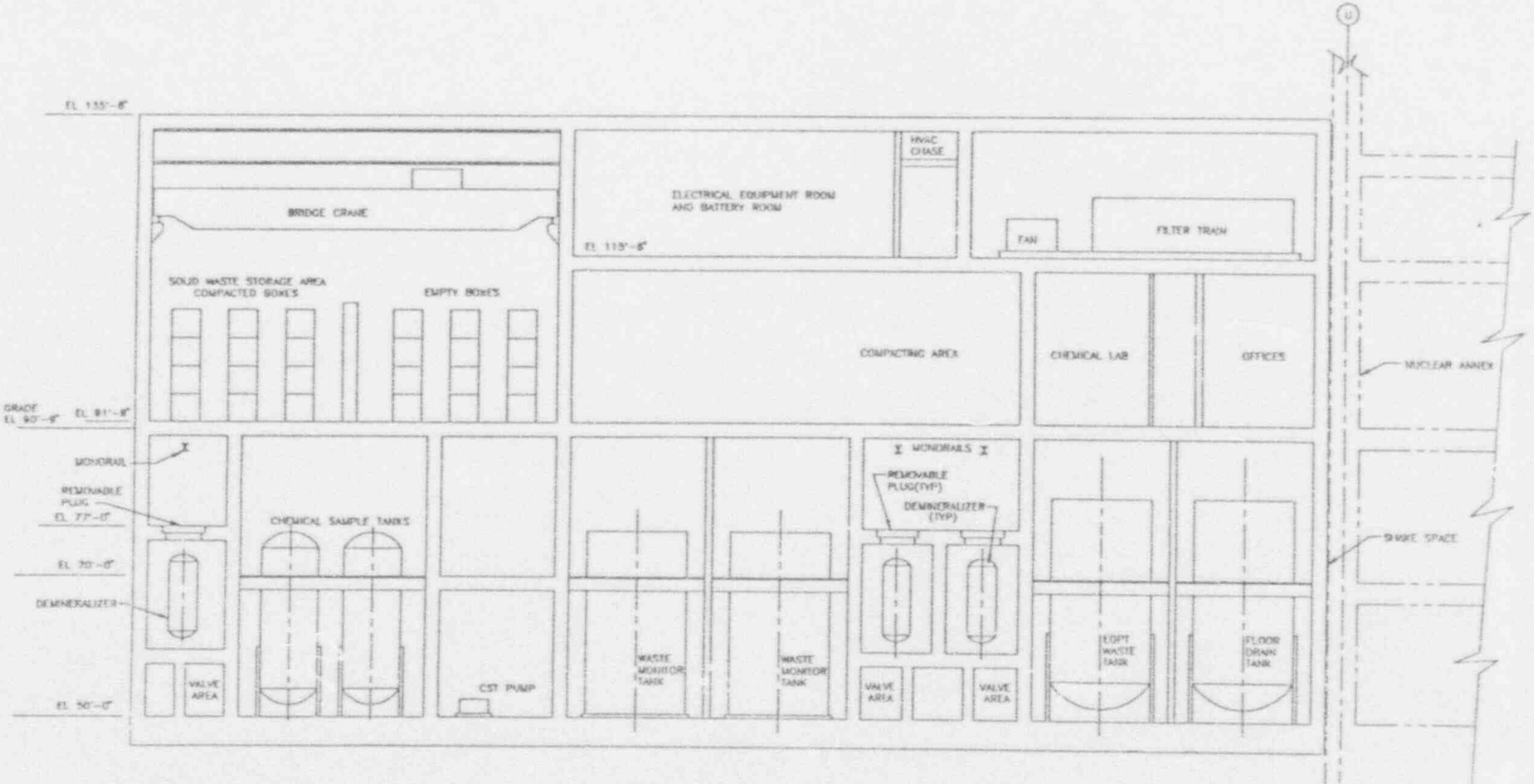
- Releases controlled and monitored in accordance with 10CFR50, Appendix A (GDC 60, 61, 64)
- System design meets the requirements of 10CFR20 and objectives of 10CFR50, Appendix I for effluents
- Non-Nuclear-Safety Related System
  - RW Building evaluated for SSE loads
  - Redundancy to tolerate single process component functional failure during maximum anticipated waste volume generation period.
  - System designed to prevent uncontrolled/unmonitored releases
  - RW Building below grade volume sufficient to contain maximum liquid inventory

System 80+™ Standard Plant
Liquid Waste Management System

Design Bases

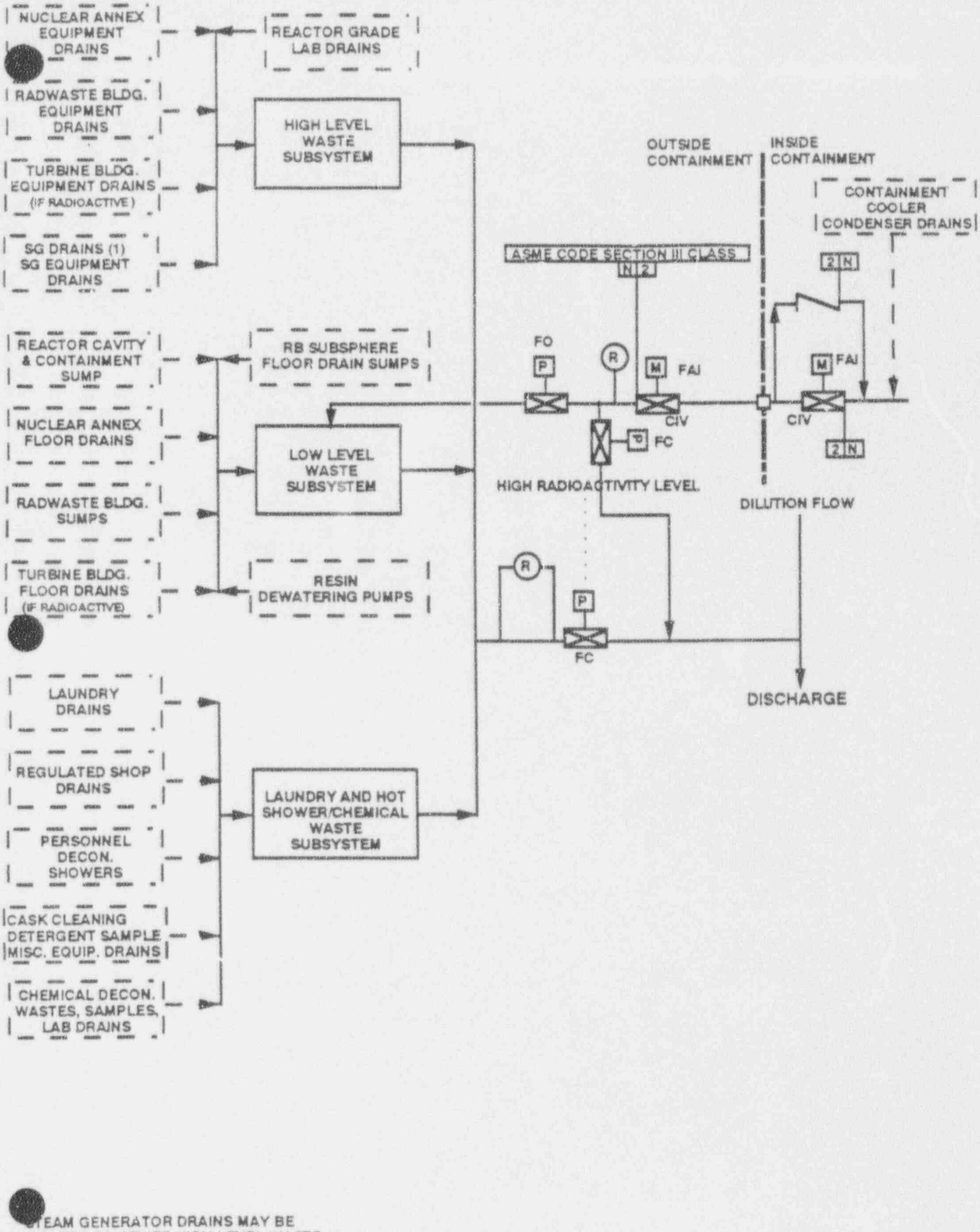
- Designed in accordance with ANSI/ANS 55.6 & R.G. 1.143
- Waste segregation based on source and chemical characterization
- Waste processing based on collection, filtration, ion exchange, sampling, and controlled release
- Provisions for mobile equipment for infrequent or unusual conditions to augment installed equipment

System 80+™ Standard Plant Radwaste Building Layout



SECTION 2–2

SYSTEM 80 + ™



(1) STEAM GENERATOR DRAINS MAY BE ROUTED TO EITHER HIGH LEVEL WASTE OR LOW LEVEL WASTE DEPENDING ON SAMPLE ANALYSIS

FIGURE 2.9.1-1
LIQUID WASTE MANAGEMENT SYSTEM

12-31-93

System 80+^{TM} Standard Plant
Liquid Waste Management System

ITAAC Scope

- Containment penetration pressure test
- Collection and storage capacity
- Controls to terminate LWMS discharge
- The discharge valve fails closed
- Discharge terminated on high radioactivity

System 80+™ Standard Plant
Solid Waste Management System

Design Bases

- Packaged waste will conform to 10CFR61, 10CFR71, & DOT Requirements
- SWMS designed in accordance with R.G. 1.143
- Non-Nuclear-Safety Related System
  - RW Building evaluated for SSE loads
  - RW Building provides sufficient shielded storage for 1 year expected waste generation
  - Space provided in RW Building for leased equipment to process infrequent or unusual wastes

System 80+™ Standard Plant
Solid Waste Management System

Design Bases

- Process:
  - Wet Waste: collection, storage for decay, dewatering/stabilization, packaging for shipment or storage
  - Dry Waste: collection, sorting, compaction, packaging for shipment or storage
- Resins from condensate polishers, if radioactive, placed in HICs in the turbine building and transported to the RW building for final packaging for shipment or storage
- Filled shipping containers stored at grade near truck access

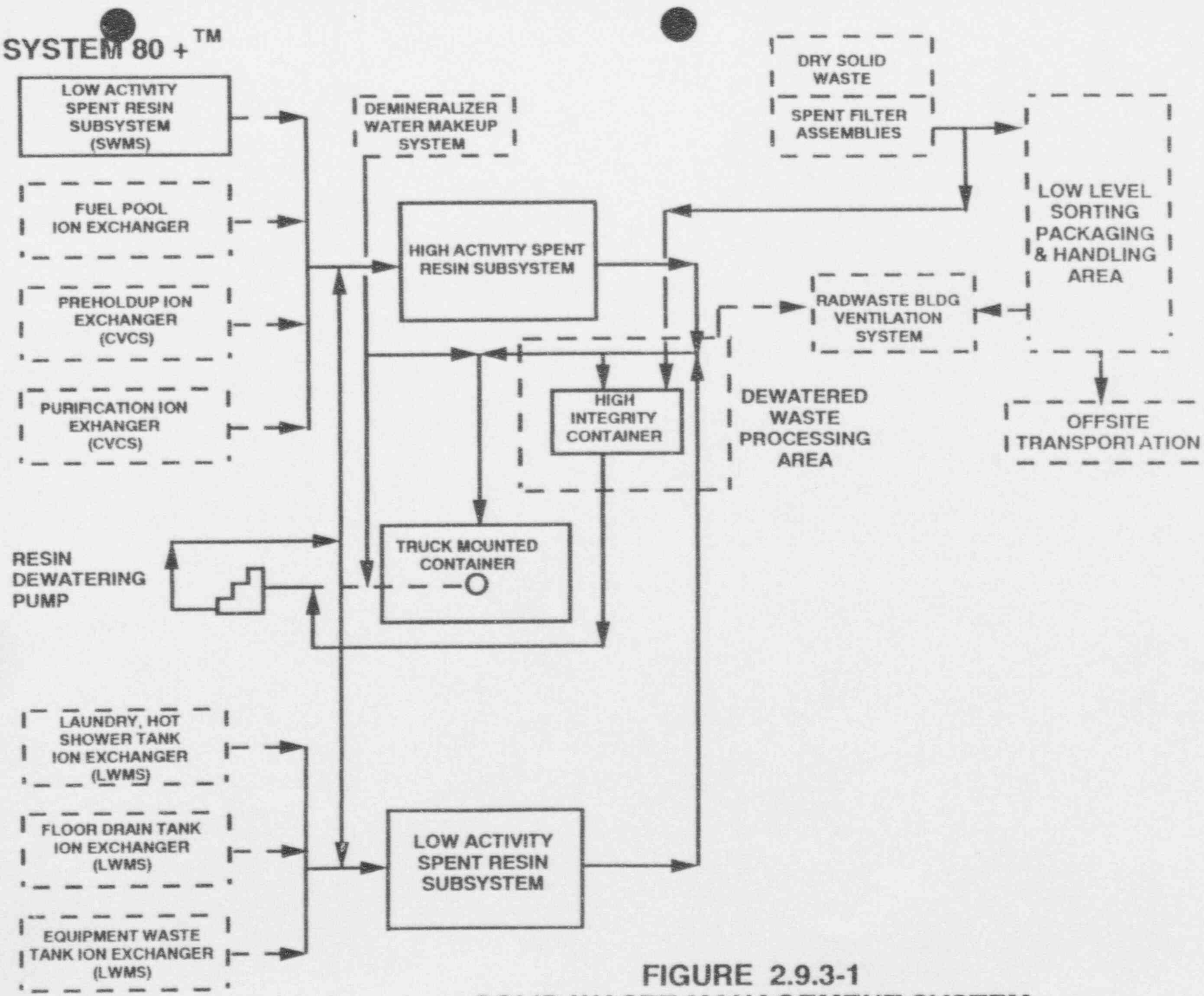


FIGURE 2.9.3-1
SOLID WASTE MANAGEMENT SYSTEM

12-31-93

System 80+™ Standard Plant
Solid Waste Management System

ITAAC Scope

- Spent resin collection and storage capacity

System 80+™ Standard Plant
Gaseous Waste Management System

Design Bases

- Releases controlled and monitored in accordance with 10CFR50, Appendix A (GDC 60, 61, 64)
- System design meets the requirements of 10CFR20 and objectives of 10CFR50, Appendix I for effluents
- Non-Nuclear-Safety Related System
  - Housed in Nuclear Annex; supported for SSE loads
  - Component pressure boundary designed to maintain system integrity and withstand hydrogen explosion (20 times operating pressure)
  - Detection of oxygen intrusion for prevention of flammable/explosive mixtures
  - Capacity to process 1 SCFM on a continuous basis and provide 30 day decay for Xenon and 3 day decay for Krypton

System 80+™ Standard Plant
Gaseous Waste Management System

Design Bases

- Designed in accordance with ANSI/ANS 55.4, R.G. 1.140, and R.G. 1.143
- Noble gas holdup and decay provided by ambient charcoal adsorption for hydrogenated streams. Incoming gas streams cooled to 45° F for moisture removal and humidity control
- Filtration provided for all process vent streams - aerated or hydrogenated (except condenser evacuation system)

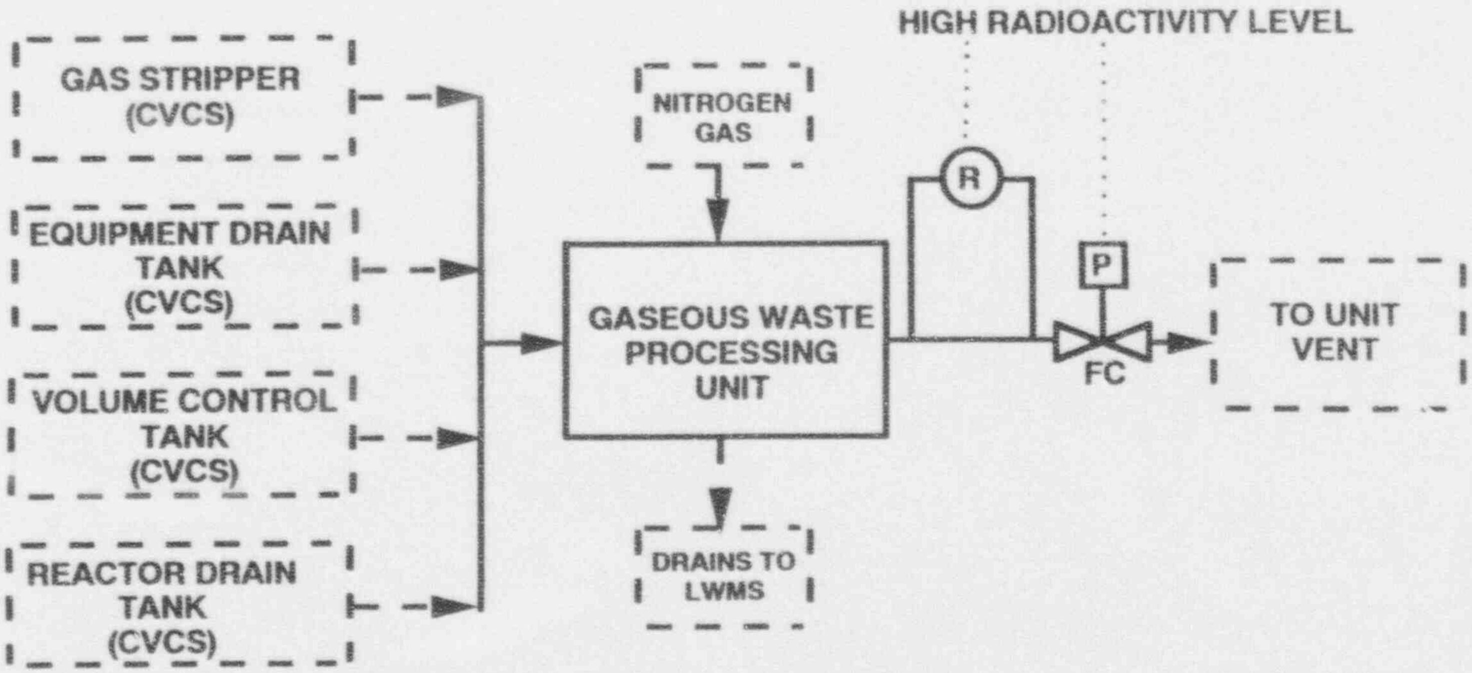


FIGURE 2.9.2-1
GASEOUS WASTE MANAGEMENT SYSTEM

12-31-93

System 80+^{TM} Standard Plant
Gaseous Waste Management System

ITAAC Scope

- Support of GWMS to SSE
- Pressure boundary to withstand H_2 explosion
- Controls to terminate GWMS discharge
- Discharge valve fails closed
- Discharge terminated on high radioactivity

System 80+™ Standard Plant

Post-Accident Area and Effluent Radiation Monitors

- Purpose
  - Provide indication of a potential breach of fission product barriers
  - Indication of significant releases
    - Determine severity of accident
    - Need to initiate action to protect the general public
  - Determine accessibility to vital areas by operators to take mitigative actions
  - Ensure compliance with federal regulations:
    - 10CFR50, App. A, GDC 13, 19, and 64
    - Regulatory Guide 1.97

System 80+™ Standard Plant

Indication of a Breach of Fission Product Barriers

- Primary coolant loop monitors
- Containment area monitors
- Main condenser evacuation system monitor
- Nuclear annex ventilation system monitor
- Reactor building subsphere ventilation system monitor
- Radwaste building ventilation system monitor
- Unit vent monitor
- Unit vent post-accident monitor

System 80+™ Standard Plant

Indication of a LOCA

- High range containment area radiation monitors
- Containment low and high purge monitors
- Nuclear annex ventilation system monitor
- Reactor building subsphere ventilation system monitor
- Radwaste building ventilation system monitor
- Unit vent monitor
- Unit vent post-accident monitor

System 80+™ Standard Plant

Indication of a SGTR

- Main steam line monitors
- Nitrogen 16 monitors
- Main condenser evacuation system monitor
- SG blowdown sample monitor

System 80+^{TM} Standard Plant

Indication of a Fuel Handling Accident

- Fuel building ventilation system monitor
- Containment low and high purge monitors
- Unit vent monitor
- Unit vent post-accident monitor

System 80+™ Standard Plant

Vital Area Accessibility

- Nuclear annex post-accident
- Post-accident sampling room
- Primary chemistry lab and counting room
- Control room
- Remote shutdown room
- Hydrogen recombiner rooms
- Access routes to vital areas

System 80+™ Standard Plant

Control Room Interfaces

- Data Processing System (DPS)
- Discrete Indication and Alarm System (DIAS)

System 80+™ Standard Plant

DPS and DIAS Design Features

- Provide primary indications for post-accident and non-post-accident radiation monitors
  - Monitor readings
  - Alarm setpoints
  - Operating status
- Digital communication network to interface DPS and DIAS systems with each monitor microprocessor
- Dedicated operator control modules
  - Change microprocessor data items
  - Initiate monitor control functions (e.g., sample pump actuation)
  - Change alarm setpoints

System 80+™ Standard Plant

Process and Effluent Radiological Monitoring and Sampling System

- ITAAC Scope
  - Displays and alarms of safety-related instrumentation exists in the main control room (MCR) or can be retrieved there
  - Control room intake radiation monitors have the capability of auto selection and closure of the most contaminated intake
  - Operation of the safety-related PERMSS division can be manually activated from the MCR
  - Main control room and local alarms are initiated when the radiation level exceeds a preset limit

System 80+™ Standard Plant

Process and Effluent Radiological Monitoring and Sampling System

- ITAAC Scope (cont'd)
  - PERMSS is non-safety related with the exception of:
    - Control room intake (2/intake)
    - High range containment (2)
    - Primary coolant loop (2)
    - Containment atmosphere (particulate channel only)
  - The above safety-related instrumentation will be provided.
  - PERMSS safety-related instrumentation are classified as Seismic Category I
  - Physical separation exists between Class IE divisions of the PERMSS and between Class IE and non-Class 1E divisions of the PERMSS.

ABB Combustion Engineering

System 80+™ Standard Plant
Chapter 11 - Radwaste Management Systems Effluent Analyses

Carole L. Naugle
Duke Engineering & Services, Inc.

ACRS ABB-CE Standard Plant Designs Subcommittee
February 9, 1994

System 80+^{TM} Standard Plant

Radwaste Management System Effluent Analyses

PURPOSE:

- Verify compliance with Federal Regulations:
  - 10CFR20, Appendix B of Sections 20.1001 through 20.2402, Table 2, Columns 1 and 2
  - 10CFR50, Appendix I
  - NUREG-800, Section 11.3, Branch Technical Position ETSB-11.5-1

System 80+™ Standard Plant

Radwaste Management System Effluent Analyses

Methodology/Codes Used:

- LADTAP AND GASPAR (Oak Ridge National Lab Codes) utilize Regulatory Guide 1.109 methodology to verify compliance with 10CFR50, Appendix I during normal operating conditions
- PWR-GALE (NUREG-0017, Rev. 1) utilizes plant operational data to estimate typical gaseous and liquid release rates (Ci/yr) from System 80+ Standard Plant
- DAMSAM (ABB-CE Code) utilized to calculate the RCS equilibrium concentration (uCi/gm) for 1% failed fuel fraction to evaluate compliance with 10CFR20, Appendix B of Sections 20.1001 - 20.2402, Table 2 - Columns 1 and 2

System 80+^{TM} Standard Plant

Gaseous Waste Management System Effluent Analyses

Results:

10CFR50, Appendix I Analysis Dose Fraction

Maximum Air Annual Dose (mrad/yr)

Beta	7.8 = 39% of 20 mrad/yr
Gamma	2.1 = 21% of 10 mrad/yr

System 80+^{TM} Standard Plant

Gaseous Waste Management System Effluent Analyses

Results (Continued):

10CFR50, Appendix I Analysis Dose Fraction

Maximum Individual Annual Dose (mrem/yr)

Skin Dose	6.0 = 40% of 15 mrem/yr
Total Body Dose	1.3 = 26% of 5 mrem/yr
Maximum Organ Dose (Infant - Thyroid)	13.9% = 93% of 15 mrem/yr (All Pathways)

System 80+™ Standard Plant

Gaseous Waste Management System Effluent Analyses

Results (Continued):

10CFR20, Appendix B of Sections 20.1001 - 20.2402, Table 2 Release Fraction

- **Design basis annual average gaseous effluent concentration = 4.25E-01 sum [EC(i)], or <42.5% of 10CFR20, Appendix B of Sections 20.1001 - 20.2402, Table 2, Column 1 Effluent Concentrations**

System 80+™ Standard Plant

Gaseous Waste Management System Effluent Analyses

Results (Continued):

Component Failure or Break Dose Fraction

- **Whole body dose at EAB = 49.4 mrem or 10% of SRP Section 11.3, ETP ETSB 11-5 (500 mrem)**

System 80+™ Standard Plant

Liquid Waste Management System Effluent Analyses

Results:

10CFR50, Appendix I Analysis Dose Fraction

Maximum Individual Annual Dose (mrem/yr)

Total Body Dose (All Pathways)	2.65 = 88% of 3 mrem/yr
Maximum Organ Dose (Infant - Thyroid)	6.30 = 63% of 10 mrem/yr (All Pathways)

System 80+™ Standard Plant

Liquid Waste Management System Effluent Analyses

Results (Continued):

10CFR20, Appendix B of Sections 20.1001 - 20.2402, Table 2 Release Fraction

- **Design basis annual average liquid effluent concentration = 9.1E-02 sum [EC(i)], or <9.1% of 10CFR20, Appendix B of Sections 20.1001 - 20.2402, Table 2, Column 2 Effluent Concentrations**

ABB Combustion Engineering

System 80+™ Standard Plant
Chapter 12 - Radiation Protection

Carole L. Naugle
Duke Engineering & Services, Inc.

ACRS ABB-CE Standard Plant Designs Subcommittee
February 9, 1994

System 80+™ Standard Plant

Radiation Protection Features

- **Principles incorporated in System 80+™ Design**
  - **Lessons learned from current generation of nuclear plants**
  - **ALARA principles (e.g., time, distance, shielding, and source term control)**

System 80+™ Standard Plant

Radiation Protection Features (Continued)

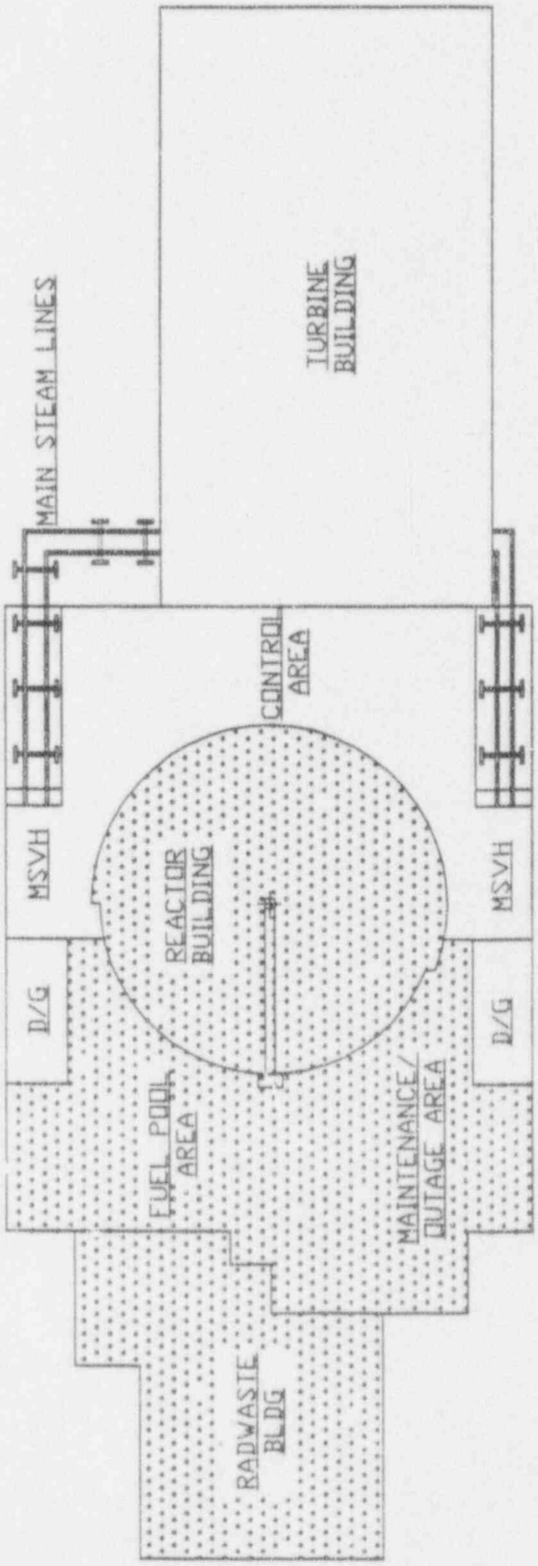
- System 80+™ Design Features
  - General arrangements
  - Equipment design and selection
  - Source term and contamination control
  - Shielding design
  - Radiation zone drawings and designations
  - Access control to transient high radiation areas (>100 R/hr)
  - Radiation protection design acceptance criteria

System 80+™ Standard Plant

General Arrangement Features

- Radioactive equipment separated into compartments such as:
  - Valves
  - Ion exchangers
- Segregation of non-radioactive from radioactive systems
- Chemical and volume control and fuel pool cleanup systems in close proximity to radwaste systems
- Shielded pipe chases provided
- Penetrations located to minimize streaming
- Adequate rigging and lifting equipment provided

FIGURE 1

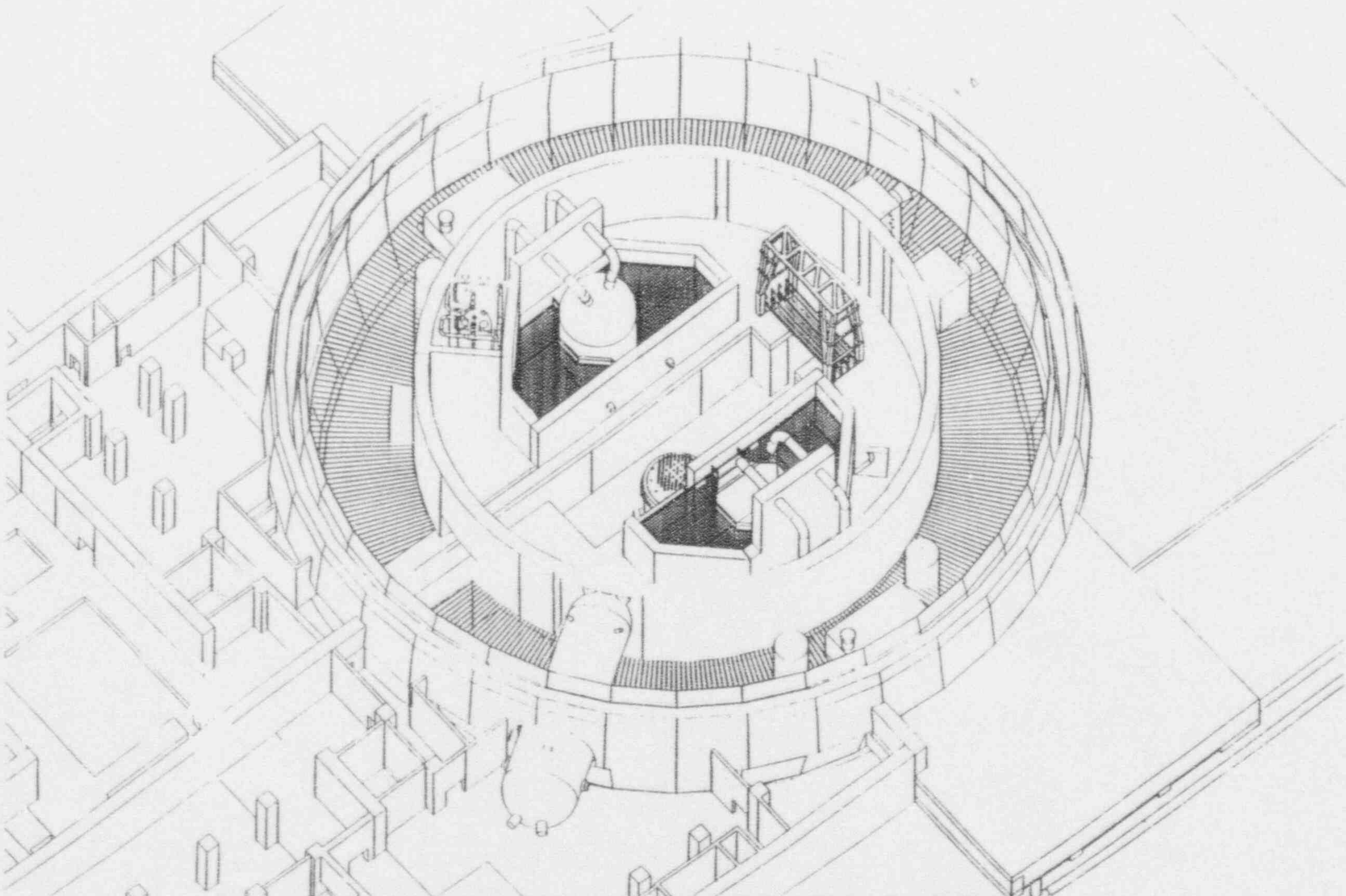


SEPARATION OF RADIOACTIVE SYSTEMS
FROM NON-RADIOACTIVE SYSTEMS

System 80+™ Standard Plant

General Arrangement Features (Continued)

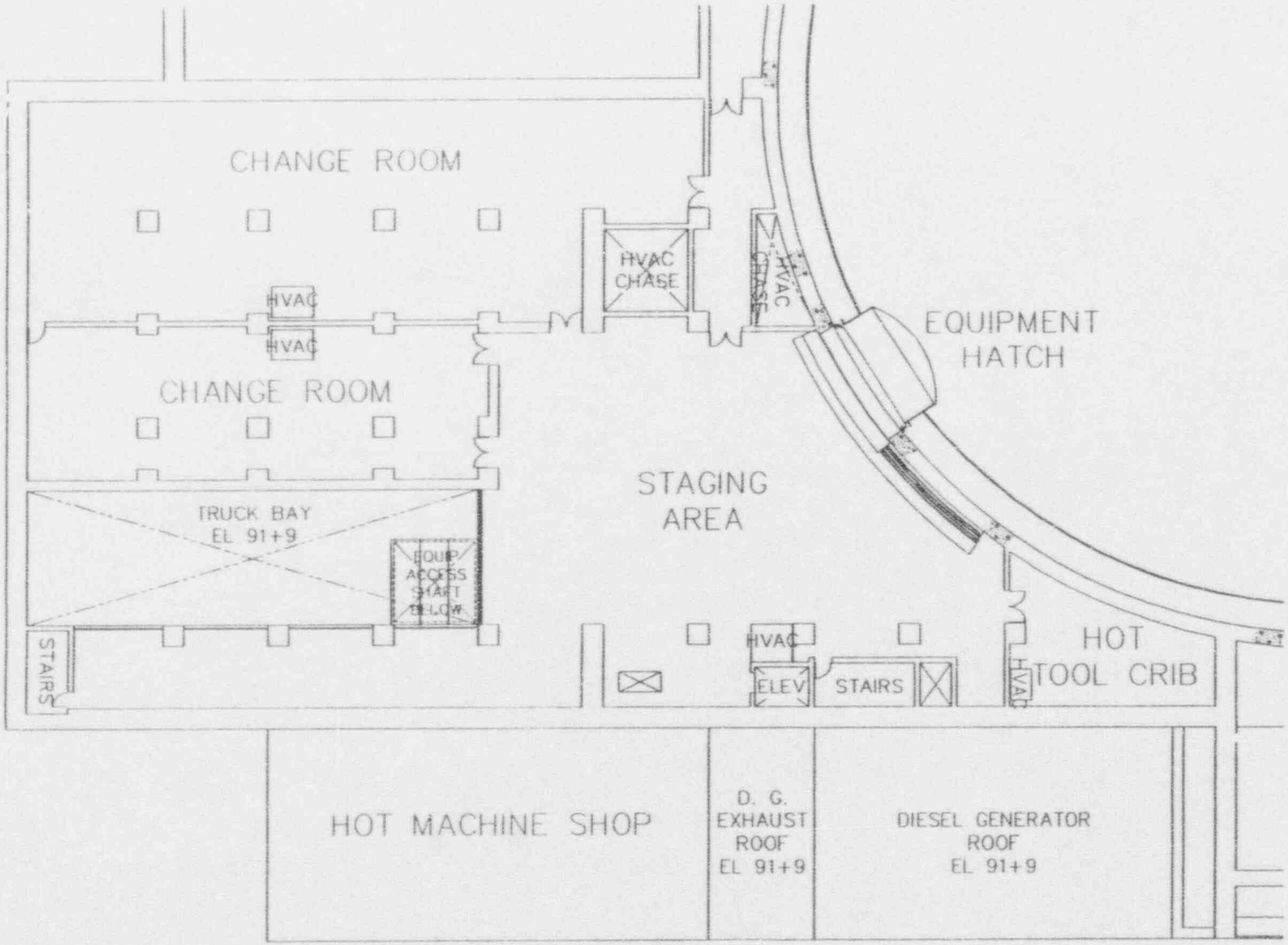
- Adequate space for maintenance and inspection activities
- Hot machine shops and hot tool cribs located in low radiation areas adjacent to maintenance areas
- Large staging areas inside and outside equipment hatch
- Access area to RCA provides:
  - Single point access and egress to RCA
  - Immediate interaction with radiation protection personnel
  - Large area (40'x100') for maintenance crews
- Change areas located near airlocks



FLOOR SPACE AT OPERATING DECK
ALLOWS ROOM FOR MAINTENANCE

FIGURE 2

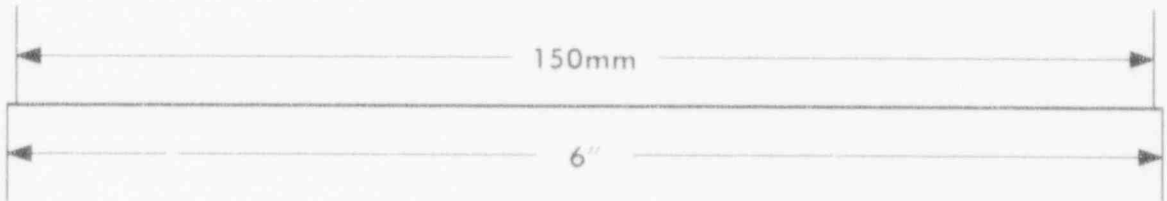
FIGURE 3



SYSTEM 80+ CONTAINMENT EQUIPMENT HATCH
STAGING AND MAINTENANCE AREA

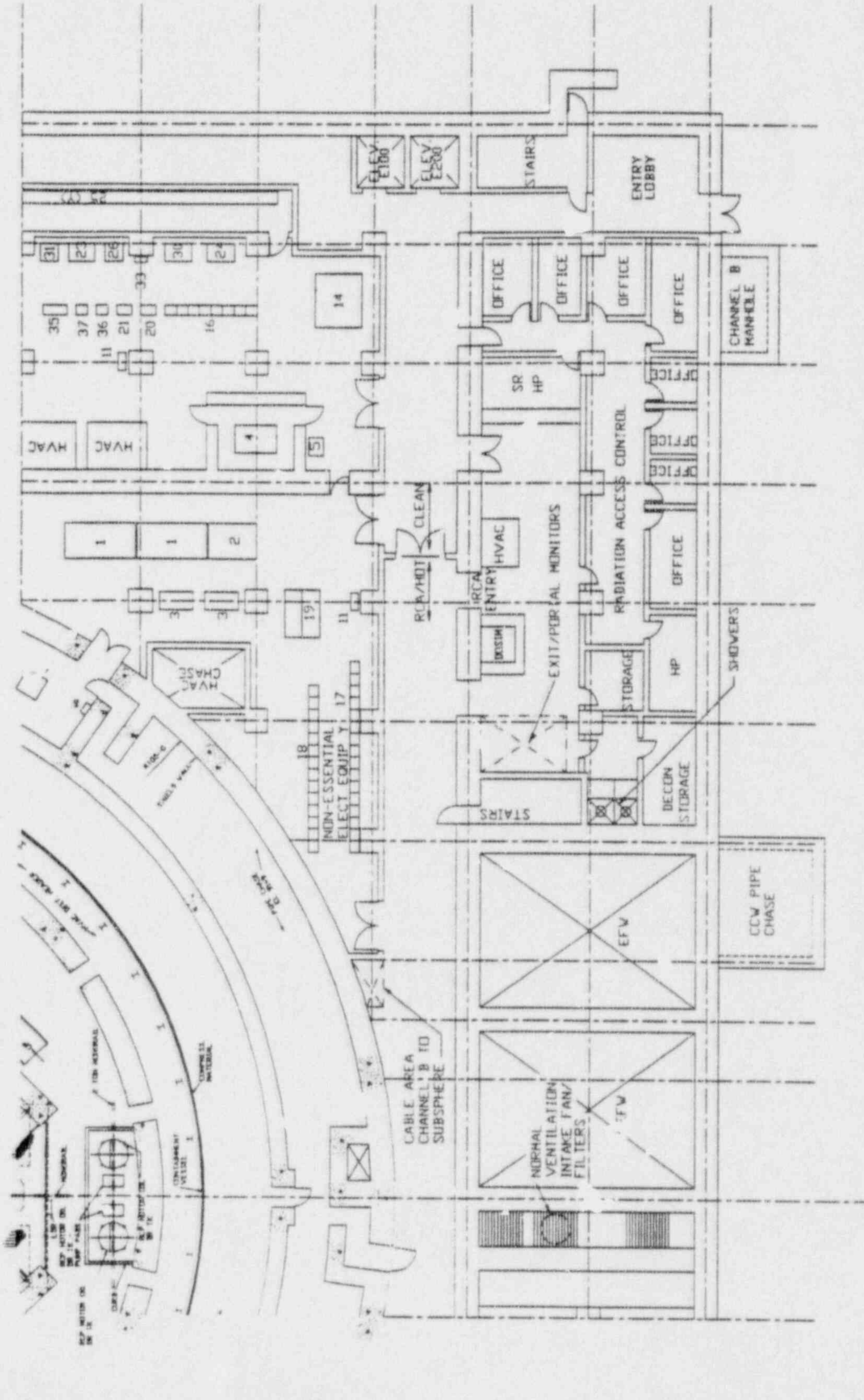
2

IMAGE EVALUATION TEST TARGET (MT-3)



PHOTOGRAPHIC SCIENCES CORPORATION
770 BASKET ROAD
P.O. BOX 338
WEBSTER, NEW YORK 14580
(716) 265-1600

FIGURE 4



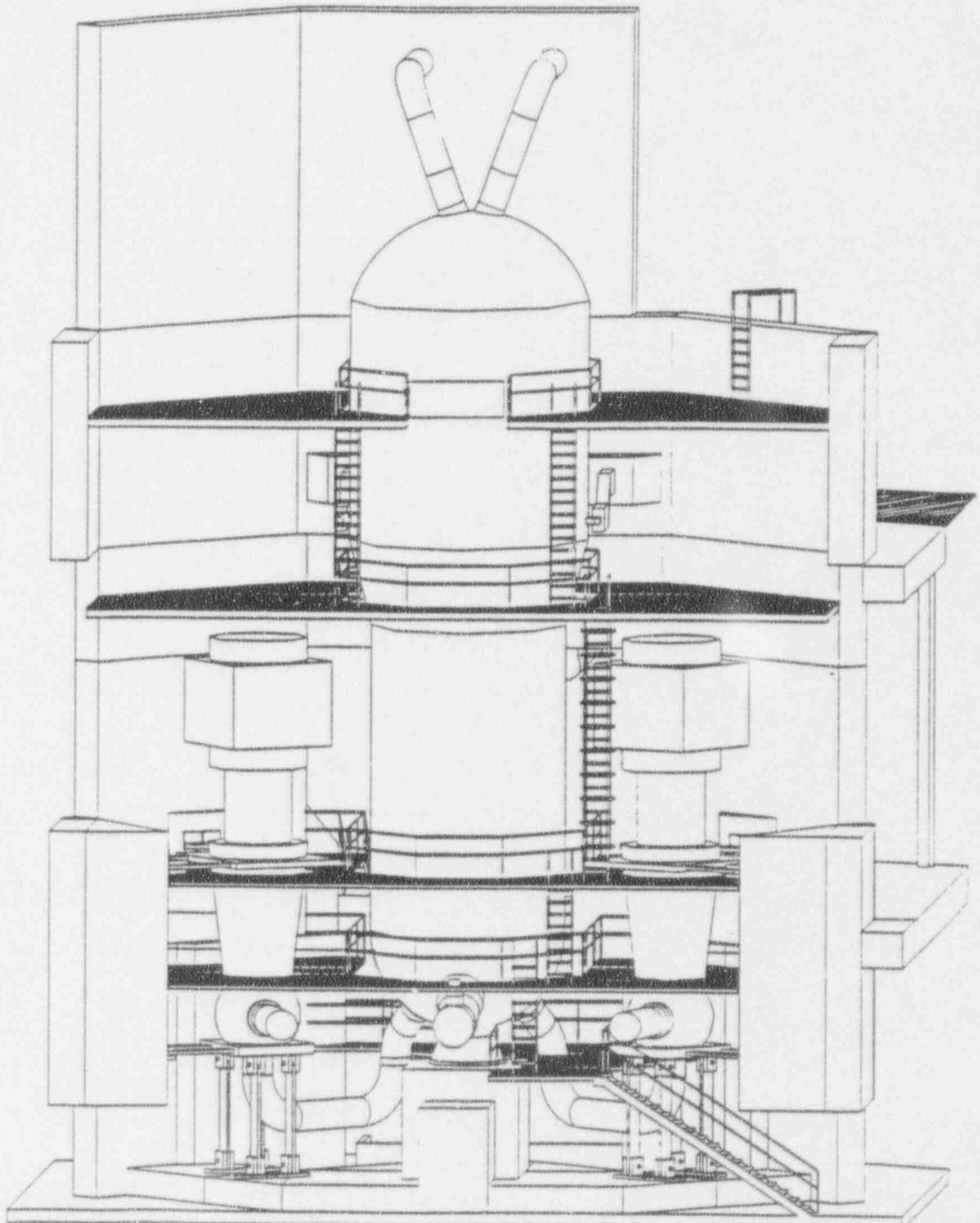
RADIATION ACCESS CONTROL AREA

System 80+™ Standard Plant

Equipment Design Features

- Reactor coolant pump seal replacement
  - Use of cartridge type RCP seals
- Steam generator maintenance, tube inspection, and plugging
  - Location and size of manways adjusted
  - Addition of hand holes
  - Use of removable insulation
  - Improved material selection, Inconnel 690
  - Improved fabrication techniques of S/G tubing to minimize residual stresses
- Provision for platforms around major equipment (e.g., S/G, RCPs)

FIGURE 5



PLATFORMS FOR REACTOR COOLANT PUMP AND STEAM GENERATOR MAINTENANCE

System 80+^{TM} Standard Plant

Equipment Selection Considerations

- Use of reliable and simplistic equipment (e.g., minimization of use of evaporators for decontamination)

System 80+ ^{TM} Standard Plant

Source Term Control

- **Corrosion product control**
  - Primary chemistry control (increase pH 6.9 to 7.4)
  - Material selection of components in contact with the reactor coolant with low cobalt impurities (<.020 w/o cobalt)
  - Provision for flushing capability for slurry or resin transfer lines
  - Minimization of stagnant legs
- **Improved fuel performance**
- **Minimize presence of antimony in RCP bearings**

System 80+^{TM} Standard Plant

Contamination Control

- Ventilation systems designed to provide air flow from areas of lower contamination to areas of higher contamination
- Containment of spills
  - Curbing
  - Sumps

System 80+™ Standard Plant

Shielding Design Features

- **Adequate shielding to ensure:**
  - Personnel exposures are ALARA (i.e., total estimated annual occupational exposure = 79 man-rem/yr)
    - COL applicant will perform a detailed dose assessment in accordance with Regulatory Guide 1.97 guidelines
  - Radiation levels are less than or equal to radiation zone designations
    - Evaluated in accordance with radiation protection design acceptance criteria
- **Shielding between redundant radioactive components**
- **Controlled access to high radiation areas:**
  - Lockable access doors
  - Labyrinth entrances
- **Use of portable shielding during maintenance (e.g., lead blankets)**

System 80+^{TM} Standard Plant

Radiation Zone Drawings

- Locating components
- Pipe routing
- Equipment qualification activities
- Harsh environment identifications
- Radiation monitor locations
- Identify additional shielding requirements

System 80+^{TM} Standard Plant

Radiation Zone Designations

ZONE NO.	ALLOWED CAPACITY
I	Uncontrolled, Unlimited Access
II	Controlled, Limited Access, 40 Hr/Wk to Unlimited
III	Controlled, Limited Access, 6 to 40 Hr/Wk
IV	Controlled, Limited Access, 1 to 6 Hr/Wk
V	Normally Inaccessible, Access Only as Permitted by Radiation Protection Personnel 1 Hr/Wk

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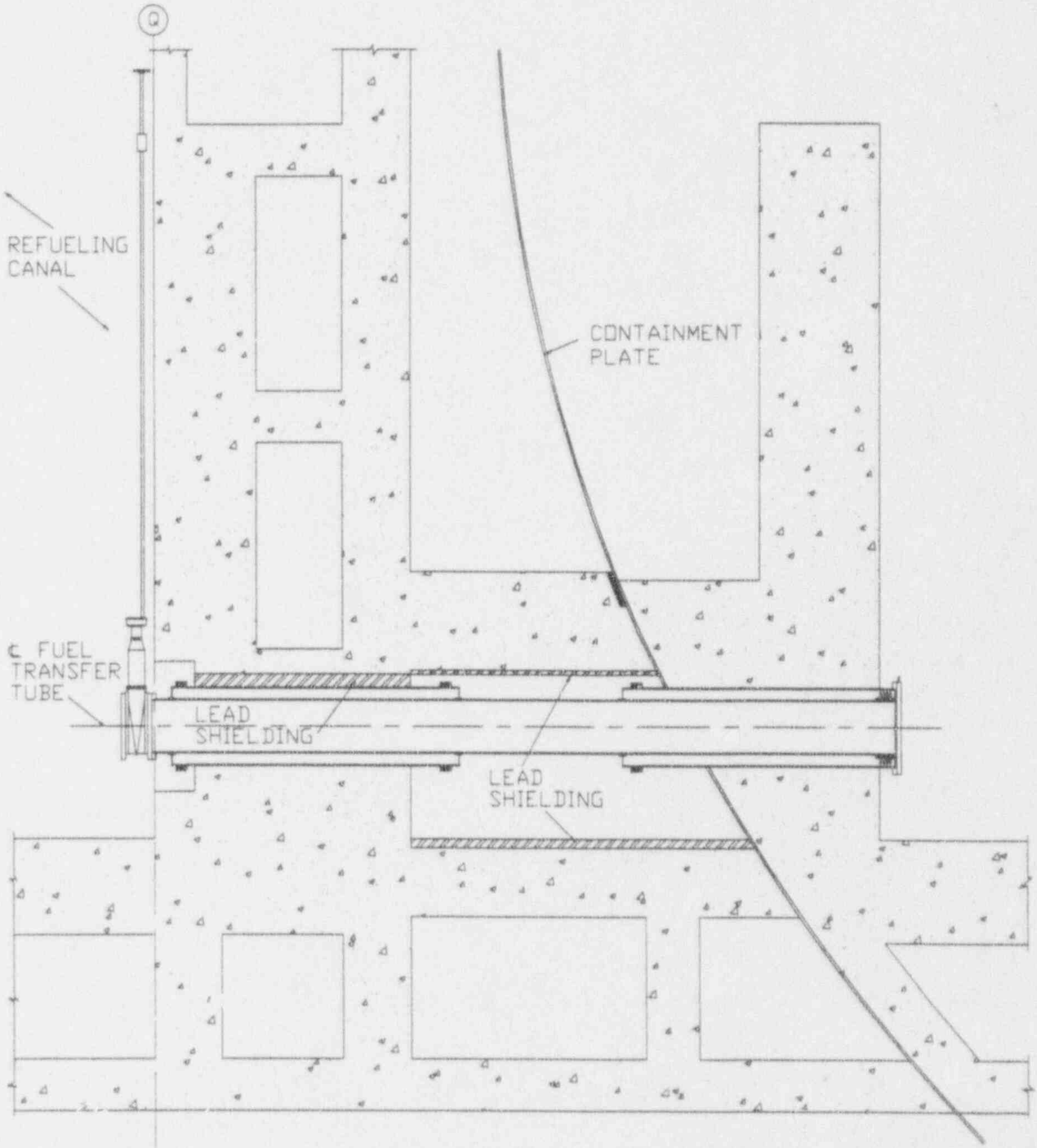
System 80+ ^{TM} Standard Plant

Access Control Features

- **Access control features added to protect against transient sources >100 R/h (i.e., fuel transfer tube inspection area and incore instrumentation chase):**
  - Area radiation monitors located at entrance to fuel transfer tube inspection area and inside incore instrumentation chase
  - Lockable access doors
  - Electrical interlock between area radiation monitor and access door to incore instrumentation chase

FIGURE 6



FUEL TRANSFER TUBE

System 80+^{TM} Standard Plant

Radiation Protection Design Acceptance Criteria

- Design acceptance criteria scope
  - Maximum radiation levels less than or equal to radiation zone designations
  - Predicted individual occupational doses during post-accident conditions:
    - $\leq$5 Rem (whole body) during period access required
    - $\leq$15 mrem/hr (whole body) averaged over 30 days
  - Airborne concentrations are maintained
    - Small fraction of Derived Air Concentrations (DAC) for normally occupied areas
    - Within the DAC for areas requiring infrequent access

Radiation Protection Design Acceptance Criteria (Continued)

- Design acceptance criteria scope (Continued)
  - Provision of features to reduce spread of airborne contamination from areas seldom accessed to areas of lower contamination
  - Airborne monitoring provided with capability:
    - To alarm within 10 DAC-hours
    - For calibrated response
    - For local and audible alarms in high noise areas
  - Dose to general public is a small fraction of federal regulations from direct and scattered radiation

ABB Combustion Engineering

System 80+™ Standard Plant
Chapter 10 - Steam and Power Conversion Systems

Laird H. Bruster
Stone & Webster Engineering Corporation

ACRS ABB-CE Standard Plant Designs Subcommittee
February 9, 1994

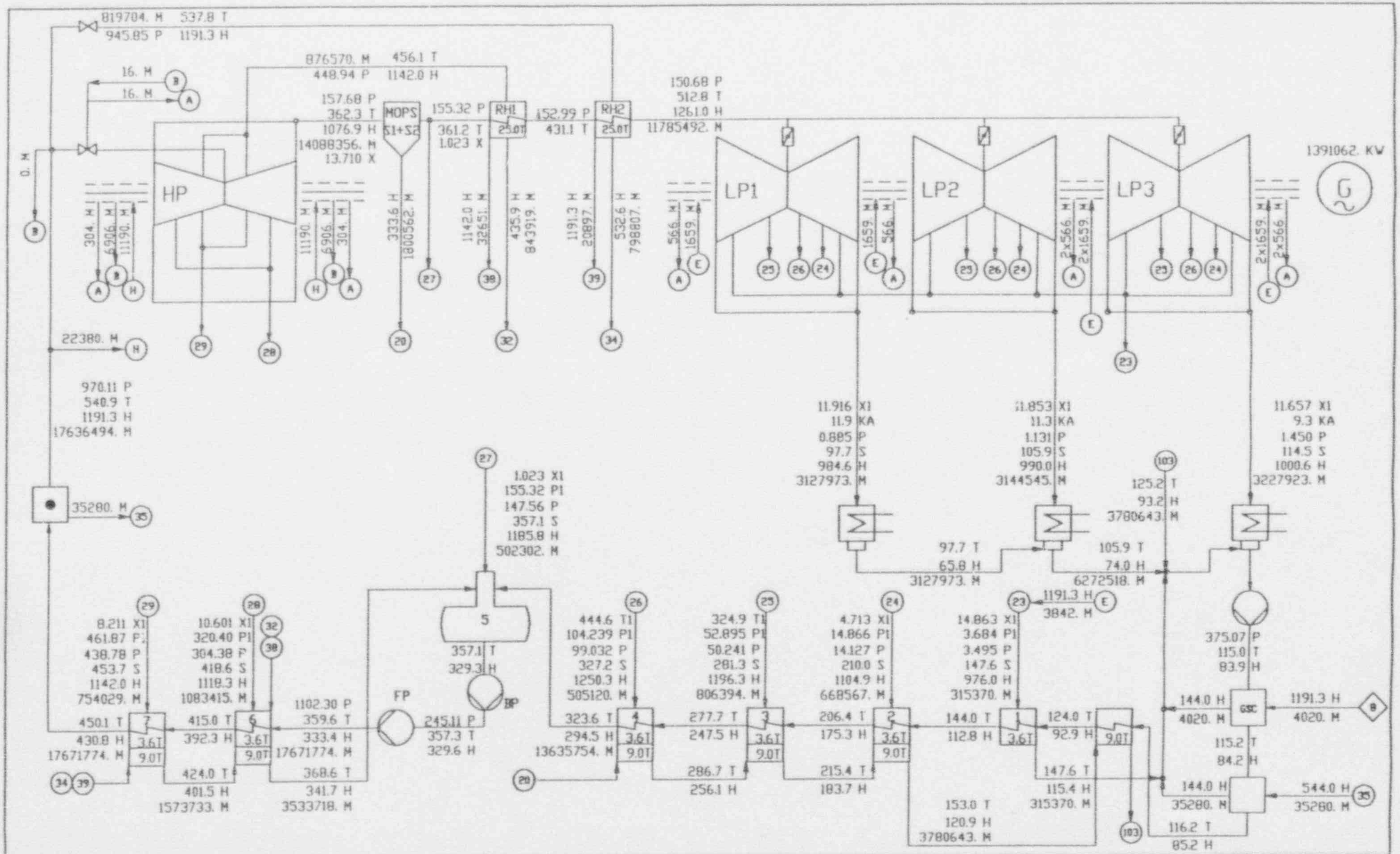
System 80+™ Standard Plant
Steam and Power Conversion Systems

<u>Systems</u>

- Main Steam Supply System
- Condensate and Feedwater Systems
- Emergency Feedwater System
- Turbine Generator
- Turbine Bypass System
- Steam Generator Blowdown System
- Main Condenser
- Condenser Circulating Water System
- Condensate Clean-up System

System 80+™ Standard Plant Thermal Cycle Summary

- 6 Stages of closed feedwater heating
- All LP heaters in condenser neck
- Deaerator
- 2 out of 3 operating condensate pumps
- 3 out of 3 operating feedwater pumps
- No pumped heater drains
- Water chemistry, design, and materials selected to minimize corrosion products/transport and erosion-corrosion



P = PRESSURE	PSIA	
T = TEMPERATURE	°F	
H = ENTHALPY	BTU/LB	
M = MASS FLOW	LB/H	
S = SATURATION TEMPERATURE	°F	
X = MOISTURE CONTENT	%	

INDEX 1: CONDITION AT TURBINE FLANGE

KA = EXHAUST LOSS		BTU/LB
MECHANICAL LOSSES (TURBINE)	= 2820.0	KW
GENERATOR EFFICIENCY	= 98.759	%
THERMAL EFFICIENCY	= 35.388	%

HR = (17636494. (1191.3- 430.8)

/1391062. = 9642.0 BTU/KWH

AEND:
GEPR: 93-03-10
FREI: 93-03-10

ABB
ASEA BROWN BOVERI

HEAT BALANCE DIAGRAM 100%
NUCLEAR PROJECT PWR 3931 MWTH
970.1 PSIA 540.9 °F 1800 RPM
1.60/2.30/2.95 IN HGA

ALEKS al
KWDV42
HT005
HTGD 583404

System 80+™ Standard Plant
Main Steam Supply System

Design Bases

- Removes heat
  - Normal power operation
  - Initial phase of Plant cooldown
  - Following turbine and/or reactor trip
  - When Main Condenser not available
- Safety Related from SG to MSIVs
- Isolates NSSS from non-safety portion of Main Steam System including containment isolation post-LOCA
- Provides over-pressure protection for secondary side of NSSS

System 80+™ Standard Plant
Main Steam Supply System

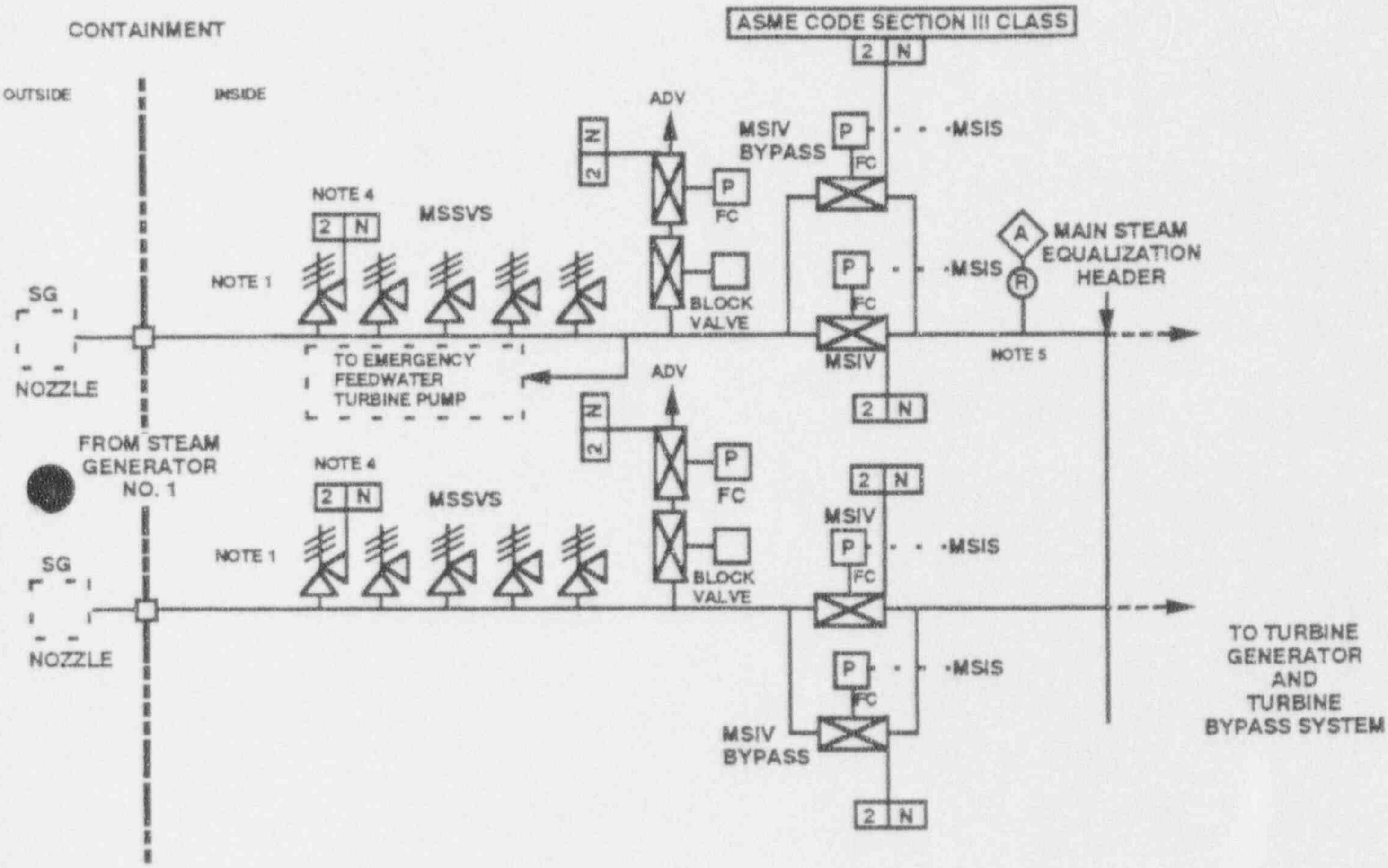
Design Summary

- 2 steam generators, 2 steam lines / generator
- 5 safety valves per steam line
- 1 atmospheric dump valve (ADV) per steam line
  - Each ADV equipped with block valve powered from Class 1-E Division different from its respective mechanical division
- 1 main steam isolation valves (MSIVs) per steam line
  - Air operated bypass valve provided for each MSIV
- N-16 monitor installed on one steam line from each steam generator

System 80+™ Standard Plant
Main Steam Supply System

Design Summary (cont.)

- Maximum steam flow from un-isolated path - 10% of Rated Steam Flow
- Safety related portions of MS system designed as LBB (Chapter 3)
- Failure of MS line or malfunction of valve will not:
  - Reduce EFW flow capability below the minimum required
  - Prohibit function of an Engineered Safety Feature
  - Initiate LOCA
  - Cause uncontrolled flow from more than one SG
  - Jeopardize containment integrity
- Safety related portions of the MS Lines are designed and located such that protection is provided from internal and external hazards



NOTE:

1. NOT LESS THAN 5 MSSV WILL BE INSTALLED FOR EACH STEAMLINE.
2. ASME CODE SECTION III CLASS COMPONENTS SHOWN ON THE FIGURE ARE SAFETY-RELATED.
3. SAFETY-RELATED ELECTRICAL COMPONENTS AND EQUIPMENT SHOWN IN THIS FIGURE ARE CLASS 1E.
4. THE ASME CODE SECTION III CLASS BREAK OCCURS AT THE DISCHARGE OF EACH MSSV.
5. PRIMARY TO SECONDARY LEAKAGE MONITOR IS NOT SAFETY- RELATED

FIGURE 2.8.2-1
MAIN STEAM SUPPLY SYSTEM
(ARRANGEMENT SHOWN FOR ONE STEAM GENERATOR)

12-31-93

System 80+^{TM} Standard Plant
Main Steam Supply System

ITAAC Scope

- Containment penetration pressure test
- Controls for [safety-related] power-operated valves
- Overpressure protection via MSSVs
- 1E power sources
- Independence between 1E, and 1E to non-1E
- Physical separation between mechanical Divisions
- Valve failure response on motive power loss
- MSIV, MSIV bypass valves close on MSIS
- Steamline radiation monitors for primary-to-secondary leakage

System 80+^{TM} Standard Plant
Condensate and Feedwater Systems

Design Bases

- Portions of the Feedwater System required to mitigate accidents & allow safe shutdown are safety related

Design Summary

- 2 out of 3 operating condensate pumps
- 7 stages of regenerative feedwater heating including deaerator
- 3 out of 3 operating feedwater pumps
  - Full load capability with trip of one fw pump
- No pumped heater drains
- Startup feedwater pump

System 80+™ Standard Plant
Condensate and Feedwater Systems

ITAAC Scope

- Containment penetration pressure test
- 1E power sources
- Independence between 1E, and 1E to non-1E
- Physical separation between mechanical Divisions
- Controls to start & stop pumps; open & close valves
- MFIVs close on receipt of MSIS
- MOVs, CVs function under fluid conditions
- Valve failure response on motive power loss

System 80+^{TM} Standard Plant
Emergency Feedwater System

Design Bases

- Safety related feedwater heat removal during emergency phases
  - Two independent mechanical divisions (one per SG) :
    - One EFW storage tank
    - 100% capacity motor-driven EFW pumps
    - 100% capacity turbine-driven EFW pumps
- Automatically intitiated (with manual back-up) for events that result in loss of feedwater (including loss of normal onsite and offsite AC Power)
- Cooldown functions
  - Maintains hot-standby (up to 8 hours)
  - Facilitates cooldown to shutdown cooling system initiation
  - Provides water inventory margin to cover 30 minute break flow prior to operator action
- Maintains SG tubes covered post-LOCA minimizing containment bypass leakage

System 80+™ Standard Plant
Emergency Feedwater System

Design Summary

- Design bases conditions can be met under all required conditions including:
  - Secondary pipe break as initiating event
  - Failure of any one EFW pump subdivision to deliver flow
  - No operator action taken for up to 30 minutes

- Redundancy provided through use of
  - Two full-capacity motor-driven pumps &
  - Two full-capacity turbine-driven pumps &
  - Two 100 % capacity EFW storage tanks (350,000 gal each)

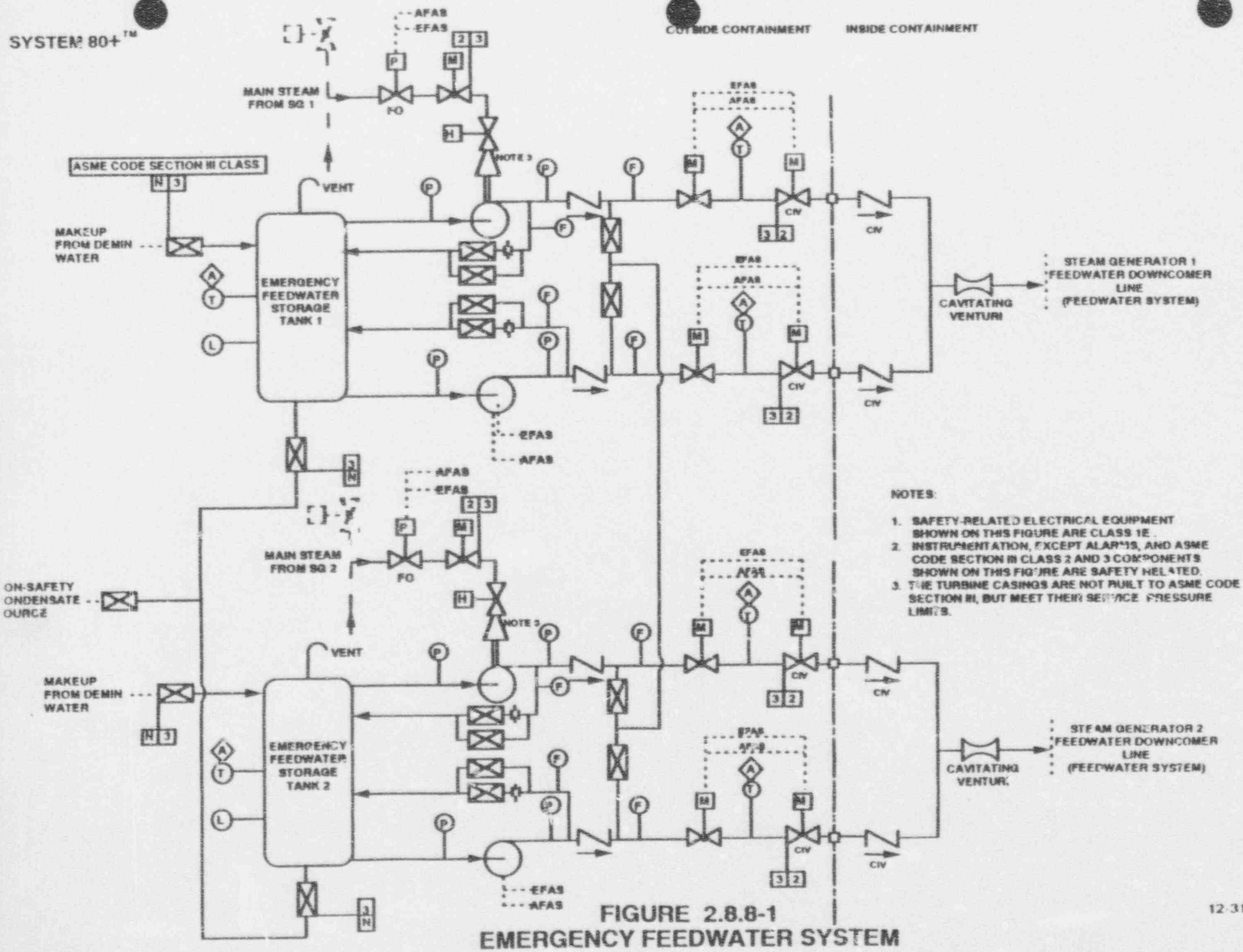
- Steam admission valve located at EFW pump turbine
  - Constant warm up line
  - Bypass admission valve to pre-spin turbine and avoid governor problem

- Cavitating Venturis to minimize mass-energy input to containment under postulated breaks, overfill of SG, excessive cooldown rates

System 80+™ Standard Plant
Emergency Feedwater System

Design Summary

- Diversity provided through use of
  - Two types Of pump drivers
  - AC & DC emergency electrical sources
    - EFW during station blackout coincident with single failure
- Separation precludes interaction between divisions and sub-divisions
  - Components protected from internal and external hazards
- Piping arrangement/design minimizes potential for water hammer
- Steam binding of EFW pumps minimized
  - Temperature sensors between EFW control valve and isolation valve
  - Continuous system venting
  - Normally closed isolation valves @ interface to Main Feedwater System



NOTES:

1. SAFETY-RELATED ELECTRICAL EQUIPMENT SHOWN ON THIS FIGURE ARE CLASS 1E.
2. INSTRUMENTATION, EXCEPT ALARMS, AND ASME CODE SECTION III CLASS 2 AND 3 COMPONENTS SHOWN ON THIS FIGURE ARE SAFETY RELATED.
3. THE TURBINE CASINGS ARE NOT BUILT TO ASME CODE SECTION III, BUT MEET THEIR SERVICE PRESSURE LIMITS.

FIGURE 2.8.8-1
EMERGENCY FEEDWATER SYSTEM

12-31-93

System 80+™ Standard Plant
Emergency Feedwater System

ITAAC Scope

- Gravity source of condensate makeup
- Minimum pump recirculation flow test
- Delivered system flow and pressure
- Maximum flow to broken steam generator line
- Minimum available EFWST volume
- Containment penetration pressure test
- Displays of instrumentation exist
- Controls to start & stop pumps; open & close valves

System 80+™ Standard Plant
Emergency Feedwater System

<u>ITAAC Scope</u>

- System alarms actuate in the main control room
- Pump available NPSH exceeds required pump NPSH
- 1E test signals exist only in Division under test
- Independence between 1E, and 1E to non-1E
- Physical separation between mechanical Divisions
- Flow to steam generator within 60 seconds of EFAS or AFAS
- MOVs, CVs, function under fluid conditions
- Valve failure response on motive power loss

System 80+™ Standard Plant
Turbine Generator

Design Bases

- 30% step load change followed by 2%/min load gradient (Loading)
- 15% step load change followed by 1%/min load gradient (Un-loading)
- Redundant mechanical and electrical trip devices
- T-G orientation to Category I structures precludes turbine missile impact
- COL Applicant verifies turbine valve closure meets overspeed criteria

System 80+™ Standard Plant
Turbine Generator

Design Summary

- ABB-PG: Double-Flow HP Turbine / 3 Double-Flow LP Turbines
- Two vertical - 2 stage reheaters
- Turbine rotor/blade design & material - proven design
  - Traditional industry rotor failures not expected
  - Design of rotors makes material less susceptible to SCC
  - Reduced outages & inspection duration due to LP rotor design/ inspectability
- Mechanical/electronic overspeed trip @ 110%/112% respectively

System 80+™ Standard Plant
Turbine Generator

ITAAC Scope

- Trip in response to reactor trip
- Manual trip from main control room
- Electronic and mechanical overspeed trips

System 80+™ Standard Plant
Turbine Bypass System

Design Bases

In conjunction with the Reactor Cutback System, the Turbine Bypass System

- Accomodates load rejections down to auxiliary loads without reactor trip or lifting primary or secondary safety valves
- Maintains the NSSS at hot zero power conditions
- Provides CEA automatic motion inhibit (AMI) signal when turbine and reactor fall below selected thresholds
- Provide means for manual control of RCS during NSSS heat-up and cooldown
- Include redundancy such that no single active failure or operator error results in excess steam releases
- Provide an interlock blocking turbine bypass flow when condenser pressure exceeds a preset limit

System 80+™ Standard Plant
Turbine Bypass System

Design Summary

- 8 Turbine Bypass Valves - total capacity for 55% full load main steam flow
- Turbine bypass valves/system designed to
  - Fail closed to prevent uncontrolled/excess steam bypass to condenser
  - Minimize valve wear and maintain controllability
  - Sequence/adjustment which limits the flow imbalance between condenser shells

System 80+™ Standard Plant
Turbine Bypass System

<u>ITAAC Scope</u>

- Controls open & close power-operated valves
- Turbine Bypass Valves open on turbine bypass signal
- Valve failure response on motive power loss

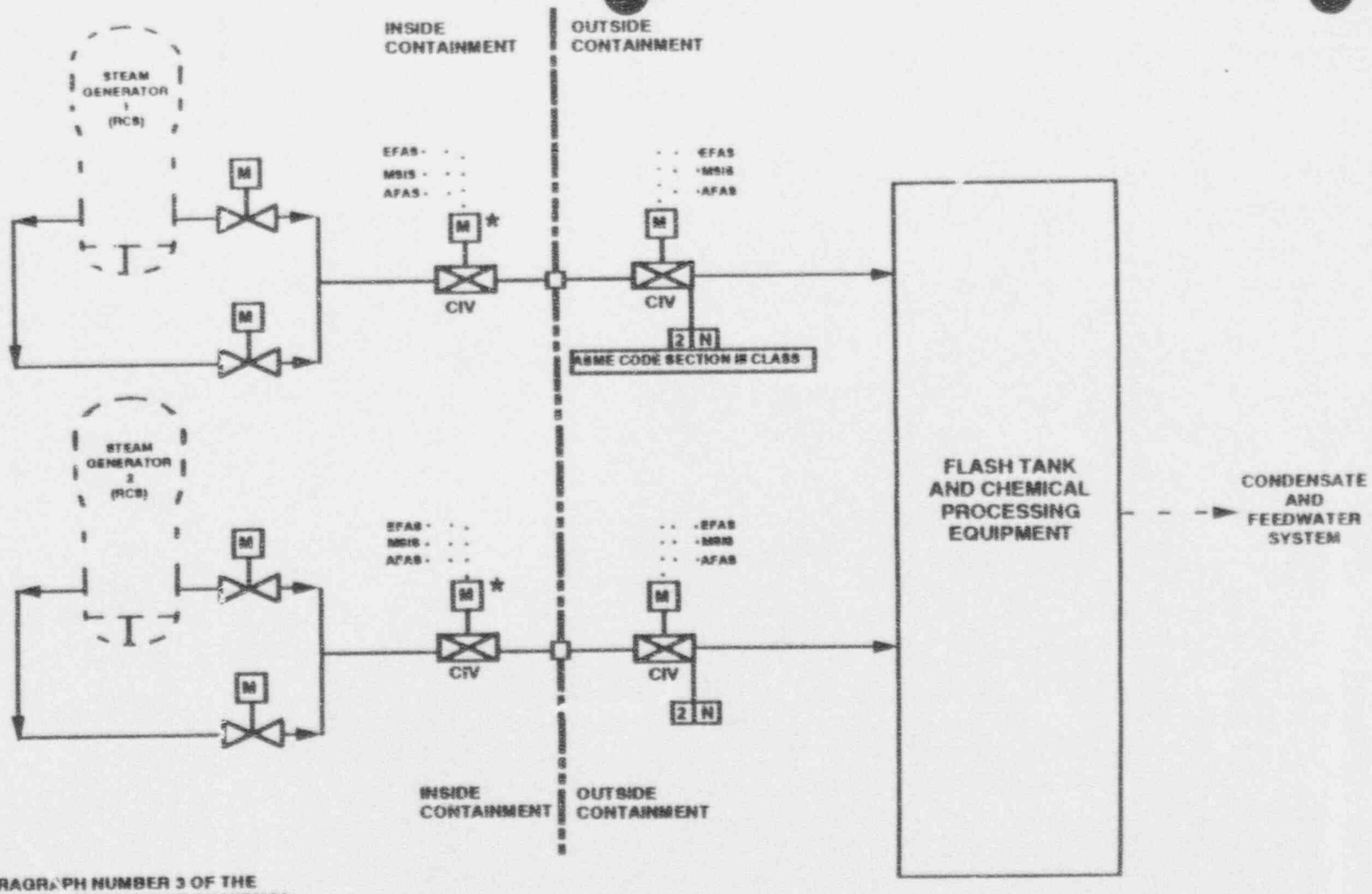
System 80+™ Standard Plant
Steam Generator Blowdown System

Design Bases

- Maintain SG shell side chemistry
- Process SG blowdown for reuse as condensate
- Enable blowdown concurrent with SG tube leak
- Continuously sample for radioactivity
- Provide for containment isolation

Design Summary

- Maintain/control solids content at SG tube sheet
- Heat recovery thru flash tank & HX cooled by condensate system
- Full flow ion exchange capability
- Blowdown rate (% of steam generator's maximum steam rate)
    - 0.2% full power & SG chemistry within normal limits
    - 1% full power & SG chemistry not within normal limits
    - ≈10% high rate (2 minutes) for steam generator sludge removal



NOTE:

★ EQUIPMENT FOR WHICH PARAGRAPH NUMBER 3 OF THE "VERIFICATION FOR BASIC CONFIGURATION FOR SYSTEMS" SECTION OF THE GENERAL PROVISIONS (SECTION 1.2) APPLIES.

FIGURE 2.8.7-1
STEAM GENERATOR BLOWDOWN SYSTEM

12-31-93

System 80+™ Standard Plant
Steam Generator Blowdown System

<u>ITAAC Scope</u>

- Containment penetration pressure test
- Controls to open & close power-operated valves
- Containment penetration valves close on MSIS, EFAS, or AFAS

System 80+™ Standard Plant
Main Condenser

<u>Design Summary</u>

- Three Zone, multi-pressure (3 Shell) condenser
- Vacuum pumps for hogging and holding air evacuation
- Design minimizes hotwell chemistry excursions
  - Welded tubesheet
  - Corrosion resistant tube material selected for site conditions
  - Leakage collection trays below each tube sheet
  - Hotwell conductivity cells
- Isolatable water box for each tube pass
- Non-Safety heat removal
  - Initial phases of cooldown through turbine bypass system
  - Sudden load rejection through Turbine Bypass System
    - Up to 55 % of full main steam flow
- Flooding effects limited to the turbine building which does not contain any safety related equipment

System 80+™ Standard Plant
Condenser Circulating Water System

<u>Design Summary</u>

- System portions within turbine building included in Design Certification Scope
- Site specific interface system
- Three zone, multi-pressure 3-shell condenser
- Flooding effects limited to the Turbine Building which does not contain any safety related equipment

System 80+™ Standard Plant
Condensate Clean-up System

Design Bases

- Removes dissolved and suspended impurities
- Removes radioisotopes from SG primary to secondary leak
- Removes impurities from circulating water leak

Design Summary

- Side stream - full flow polishers
  - Reduces feedwater transients
- 10 lead cation beds - 1 spare
- 10 mixed beds - 1 spare
- Regeneration & resin wastes - process/disposal as radioactive waste as required

ABB Combustion Engineering

System 80+™ Standard Plant
Chapter 13 - Conduct of Operations

Thomas D. Crom
Duke Engineering & Services, Inc.

ACRS ABB-CE Standard Plant Designs Subcommittee
February 9, 1994

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System 80+™ Standard Plant

Conduct Of Operations

- **Chapter 13 covers the following items:**
  - Organizational structure of site
  - Training
  - Emergency planning
  - Review and audit
  - Plant procedures
  - Industrial security

- **These items are to be provided by the COL applicant**

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Conduct Of Operations

- **Items provided to COL applicant for guidance:**
  - BOP Interfaces for Emergency Operation Facility, Laboratory Facilities and Decontamination Facility
  - Technical Support Center and Operational Support Center within standard design scope
  - Emergency Operating Guidelines
  - Operating Procedures Development Plan
  - Standard Plant Vital Equipment List
  - Sabotage Protection Vulnerability Analysis

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Industrial Security

- **Interface requirements and design criteria to be met by the COL applicant**
  - Security system in conformance with 10 CFR Part 73, 73.55 Including:

Part 73 Appendices B and C	10CFR50, 50.70 (B) (3)
10CFR25 and 10CFR95	Regulatory Guide 5.12
Regulatory Guide 5.44	Regulatory Guide 5.20
NUREG-0674	Regulatory Guide 5.65
10CFR73.56	Regulatory Guide 5.66

  - COL applicant provides plant specific vital equipment list

Industrial Security

- **Interface items (Continued)**
  - The COL applicant designates vital area boundaries
  - COL applicant specifies access control approach
  - Security system design includes an evaluation of impact on plant operations to assure security restrictions are compatible with operator actions during normal and emergency conditions
  - Security alarm annunciators and security non-portable communications powered from uninterruptible power source which includes dedicated batteries and alternate AC source (combustion turbine). Other security loads powered from combustion turbine directly.

Industrial Security

- **Interface items (cont.)**
  - Security communication system meets the following:
    - Each on-site security officer, watchman, or armed response individual provided with continuous communications with an individual in each continuously manned alarm station
    - Communications provided between the main control room and CAS and SAS

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Systems Which Have Components Included In Standard Plant Vital Equipment List

- Reactor Coolant System
- Safety Depressurization and Reactor Coolant Gas
- In-containment Water Storage System
- Cavity Flooding System
- Safety Injection System
- Shutdown Cooling System
- Containment Spray System
- Class 1E AC Power System
- Class 1E Vital I&C Power System
- Pool Cooling and Purification System
- Emergency Feedwater System
- Feedwater System
- Mainsteam System
- Component Cooling Water System

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Systems Which Have Components Included In Standard Plant Vital Equipment List (Continued)

- Station Service Water System
- Diesel Generator Engine Fuel Oil System
- Diesel Generator Engine Lube Oil System
- Diesel Generator Engine Cooling Water System
- Diesel Generator Engine Starting Air System
- Diesel Generator Engine Air Intake and Exhaust
- Diesel Generator Building Sump Pump System
- Essential Chilled Water System
- Control Complex Ventilation System
- Diesel Building Ventilation System
- Reactor Building Subsphere Floor Drain System
- Steam Generator Blowdown System
- Steam Generator Wet Layup System

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Design Features for Sabotage Resistance

- **Mechanical Features:**
  - Emergency Feedwater System designed to provide two motor driven pumps and two turbine driven pumps
  - Two 100% EFWST located within the Nuclear Annex and separated by divisional wall
  - Safety Injection System designed to deliver flow at higher RCS pressures, four high head pumps and direct vessel injection
  - Refueling water storage tank located inside containment
  - Shutdown cooling utilizes two separate letdown paths with RCS isolation provided by two valves in series powered from different electrical channels

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Design Features for Sabotage Resistance

- **Electrical and I&C Features:**
  - Adequate battery capacity for running steam driven EFW pumps for eight hours
  - Addition of AAC combustion turbine
  - Nuplex 80+ incorporates automated and on-line testing features for the plant protection system as well as on-line monitoring of fluid and electrical systems
  - Inoperable and bypass alarms are provided in the control room for components and effected systems
  - Position indication and misposition alarm is provided in the control room for manual valves located in the flow paths of standby safety systems
  - Digital based safety/control systems utilize memory protection features of their processors in which software changes are controlled by key lock or password protection
  - Safety related cabinets are locked and alarmed in the control room
  - Software memory checks are continuously verified on-line and alarmed if altered

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Design Features for Sabotage Resistance

- **General Arrangement Features:**
  - Front line safety systems located in Reactor Building Subsphere
  - Divisional and quadrant separation
  - Channelized equipment including motor control centers located in separate rooms separated by 3 hour fire barriers
  - Access to each of the channelized equipment rooms is controlled
  - Main control room and remote shutdown room are located in separate vital areas and separate from the equipment rooms which house the I&C equipment
  - Transfer switches for the remote shutdown room are located within the control room
  - Alternate transfer switches for the remote shutdown room located in the channelized equipment rooms with a switch associated with each channel

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Sabotage Vulnerability Analysis

- Reviewed sabotage vulnerability to tampering by an insider with authorized access
- Assured a timely means exist to discover and compensate for tampering
- Incorporated design and procedural changes, where practical, which minimize opportunities for tampering or ensure ability to compensate for tampering
- Sabotage protection strategies were developed from the PRA insights

Sabotage Vulnerability Analysis

- **The SVA utilized the following assumptions:**
  - Threat from a knowledgeable insider without explosives
  - Tampering of security detection system is detected in a timely manner
  - Insider can initiate event, disable one or more safety systems, disable one or more non-safety systems, or a combination of all the above if not detected
  - Equipment inside containment considered inaccessible to insider tampering
  - Control room protected by presence of employees
  - Sabotage events do not consider single failure or independently initiated event

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Sabotage Vulnerability Analysis

- **Accidents types identified from PRA as potential sabotage events:**
  - Loss of feedwater flow
  - Small LOCA
  - Medium LOCA
  - Loss of off-site power/station blackout
  - Other transients

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Sabotage Vulnerability Analysis

- **Accident types identified from PRA as not potential sabotage events:**
  - Steam generator tube rupture
  - Large LOCA
  - Vessel rupture
  - Anticipated transients without scram
  - Loss of HVAC
  - Large secondary side break

Sabotage Vulnerability Analysis

- **Conclusion**

  - Analysis identified sabotage vulnerabilities and additional design features were added
  - COL applicant will perform a sabotage vulnerability analysis on site specific final design
  - The sabotage vulnerability analysis provided in CESSAR-DC provides the starting point for the site specific sabotage vulnerability analysis