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SUBJECT: Forwards 800508 sys review transcript re Class IE power sys. Review held before Power Sys Review Board in Phoenix,AZ. Pp 1-179.
see Rpts

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June 4, 1980
ANPP-15567 - JMA/DBK

Mr. H. R. Denton
Director of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2 and 3
Docket Nos. STN-50-528/529/530

Dear Mr. Denton:

Attached are two copies of the transcript of the System Review conducted on May 8, 1980 for the PVNGS Class IE D.C. Power System. This transcript is submitted for your use and as a record of the System Review.

A discussion of open items is provided in Pages 170 through 176. These open items consist of unanswered questions and requests for information made by Review Board members and the NRC representative, Faust Rosa. We will provide resolution to the NRC for these items in order to close the record of this System Review. We expect this information to be provided by June 30, 1980.

The attendance of Faust Rosa at this review provided valuable insight into NRC concerns with Class IE D.C. Power Systems. We look forward to additional participation by the NRC staff in the PVNGS A.C. Power System Review (scheduled for mid-July, 1980) and the PVNGS Auxiliary Feedwater System Review (scheduled for mid-September, 1980). We are presently working with our NRC Licensing Project Manager to establish firm dates for these System Reviews.

Respectfully submitted,

ARIZONA PUBLIC SERVICE COMPANY

By: Edwin E. Van Brunt
Edwin E. Van Brunt, Jr.
APS Vice President,
Nuclear Projects
ANPP Project Director

On its own behalf and as agent for all other joint applicants.

State of Arizona)
)ss:
County of Maricopa)

Subscribed and sworn to before me this 4 day of June, 1980.

John M. Allen

My Commission expires:

Jan 23, 1983

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8006110308

SYSTEMS REVIEW

of the

PALO VERDE NUCLEAR GENERATING STATION

CLASS IE DC POWER SYSTEM

Before the

POWER SYSTEMS REVIEW BOARD

Phoenix, Arizona

May 8, 1980

GRUMLEY REPORTERS

PHOENIX, ARIZONA

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The Power System Review Board of the Palo Verde Nuclear Generating Station convened in the Conference Room in the offices of Snell & Wilmer, Attorneys at Law, 3100 Valley National Center, Phoenix, Arizona, on the 8th day of May, 1980, Mr. Edwin E. Van Brunt, Jr., Vice President of Nuclear Projects, Arizona Public Service Company, presiding.

MR. VAN BRUNT: My name is Ed Van Brunt. I am Vice President, Nuclear Projects Management for Arizona Public Service Company. I am the officer responsible for all the engineering design, construction, and quality assurance for the Palo Verde Plant.

The purpose of this meeting today is to perform a system review of the Palo Verde Nuclear Generating Station Class IE dc power system. The concept of performing a system review was discussed in recent meetings with NRC Director for Nuclear Reactor Regulation, Dr. Harold Denton. With this concept, the design of a plant system is thoroughly reviewed and presented to a review board by an expert in the technical disciplines encompassed by that system. This review and presentation would assist NRC in understanding the system design and operation, thereby minimizing the review manhours required for that particular system.

As a result of the discussions with Dr. Denton, APS as the first step in this process has undertaken a system review of the Class IE dc power system. Bechtel Power

Corporation, the architect, engineer, and construction manager for the Palo Verde Plant, was instructed by APS to present the Palo Verde dc power system design to this Review Board. On April 10, 1980, Bechtel met with the Review Board assembled to review that system for the purpose of determining the Board's areas of interest. Using the guidance provided in that meeting, Bill Bingham, the Manager of Palo Verde Project Engineering, has assembled members of his staff to present the Class IE dc power system design to this Review Board.

The Review Board for this system consists of members of the APS staff assigned specifically to the Palo Verde Project. John Allen, sitting here on my left, is Nuclear Engineering Manager, reports directly to me. John is responsible in the areas of electrical engineering instrumentation and control, licensing, health physics. He is also responsible for our records management system. Carter Rogers, sitting here on my right, is another Engineering Manager who reports to me. Carter has responsibilities for mechanical systems, chemical systems, civil engineering matters, and nuclear fuel and nuclear-related items. Don Karner over here is Supervising Licensing Engineer. He reports to John Allen and has responsibility for licensing matters and is our day-to-day interface with the Nuclear Regulatory Commission in such matters. John Barrow is a Supervising Electrical Engineer who

reports to John Allen. He is responsible for electrical systems for the project. Stan Shepard is a Mechanical Engineer for Palo Verde Operations.

Also, we have asked Ron Paul, who is an Electrical Engineering Manager with the Generation Engineering Department, who is an industry expert in electrical systems such as this, to sit as an independent member from APS on this panel. Ron is not directly involved in the project, although from time to time we use him as a consultant in various areas.

Two Review Board Members from Bechtel, while experts in this area of design, are not associated directly with the Palo Verde Project. These representatives are Karl Kreutziger, Chief Electrical Engineer, and Sheldon Freid, from the Bechtel Nuclear Staff.

Here from Combustion Engineering are Mr. Chuck Ferguson, Palo Verde Project Manager, and Mr. Mike Barnoski, Assistant Project Manager.

It should also be noted that Mr. Faust Rosa, from the Nuclear Regulatory Commission, is present to audit these proceedings. We welcome you here and invite you to participate as you see fit.

We also have a Court Reporter, as I am sure you have all noticed, who is taking a transcript of these proceedings, so we will ask the Review Board Members or anybody else who makes a statement to please identify themselves before they ask any questions or make any statements

for the benefit of the Court Reporter.

Bill Bingham, I request that the Review Board and the NRC representative be allowed to ask questions at the close of each section of your presentation as outlined in the review documentation which you have distributed to the Review Board and Court Reporter.

I guess if there are no other questions from the Board or procedural issues anybody wants to raise, we will get on with this review activity. Anybody have any questions or anything they wish to raise at this point?

Okay, Bill, I will turn the meeting over to you.

MR. BINGHAM: My name is William Bingham. I am the Project Engineering Manager for Bechtel. In that capacity, I am responsible for all engineering performed by Bechtel.

I have brought with me today Dennis Keith, who is Assistant Project Engineer. I brought Gerry Kopchinski, Nuclear Group Supervisor, and Fred Tajaddodi, Electrical Engineering Specialist, for the presentation.

As was mentioned today, we are presenting the IE dc power system. We are not talking about the non-IE, which is a completely separate system, but not part of this presentation.

This is an ongoing review of the systems that Bechtel conducts, and I thought it would be interesting to have a little background for the benefit of the panel of the

flow of design of the systems that we have on Palo Verde. I have this exhibit (Figure 1), which shows the design criteria, being the hub of all the work that we do. This design criteria, which now is in the form of about three volumes, this, and the rest are back there, is a document that is reviewed by APS, approved by APS, and forms the basis for the design. In that particular document will be a description of the system, the criteria for it, which you will hear about later, and from that, as you can see from the exhibit, there is input from the utility for the specific requirements. There are input standards from the NSSS manufacturer, from the designer, and then input to the licensing documents. From that is a feedback to the system to ensure that it meets the criteria. We have from that then development of the plant arrangement, the design criteria, the standards, the procurement specs, the system descriptions, and the complete detail design of a particular system.

During this process, which takes generally two or three years, there are many meetings that are held between the engineer and the owner or the applicant. Those include review of the P&ID's, the one-lines in this particular case. We have systems review, multi-discipline analysis in the systems, looking at the final design, safety, how it meets the regulatory guides.

Today what we are going to do is to tie all of these

reviews into a concise presentation for the Board so that we can demonstrate that we have been diligent in the manner in which we have designed this particular system. We also, as Ed mentioned, met informally with the Board and have had some requests to include specific items such as detailed discussion of conformation with the Standard Review Plans, a review of the Safety Evaluations Task Force items that have been prepared by APS, and an expanded discussion of equipment qualifications.

The agenda we intend to follow is shown on the second slide (Figure 2) and we have organized it and would like to make one modification, if the Board will accept it, that we have questions at the end of the first two, at the end of the third section, at the end of the fifth, the seventh, and then thereafter throughout the discussion. Fred Tajaddodi will be making the presentation and I will field the questions and the group from Bechtel will respond as appropriate.

Fred, would you start, please?

MR. TAJADDODI: The purpose for the Class IE dc system is to provide reliable sources of continuous power which are required and to supply the plant in a safe shutdown condition. The dc system is designed to the criteria that we are going to discuss. First of all, it has got to meet the regulatory requirements, which we have shown here (Figure 3). Those regulatory guides are only peripheral in nature. They are not directly

applicable to the dc system description per se, but we touch on them briefly. The major ones that are going to be described are the ones which are left open. We will discuss later on the General Design Criteria and related FSAR sections and all the related licensing requirements.

The design criteria first of all has got to meet certain codes and standards (Figure 4). Those codes and standards are all the pertinent IEEE standards, IEEE Standard 308, Standards 323, and 344, which are related to qualification of equipment, and Seismic Qualification, IEEE 450 plus IEEE 384, and all the other National Electrical Manufacturers Association standards which are applicable to the design of the equipment.

The dc system has got four totally independent systems and each of the systems is capable of distributing power to one of the four channels, which are completely independent.

There is physical independence of the redundant Class IE systems in accordance with IEEE 384 and augmented by the requirements of NRC Reg. Guide 1.75. We don't have any non-Class IE loads connected with the Class IE loads to the Class IE system with the exception of the status panel, which is an instrumentation panel in the control room, and we've got the proper design for the system to meet the requirements of 1.75 to meet that requirement.

Each source has got a battery charger to supply

power under normal conditions, and for each redundant channel, we've got a backup charger to supply power to one of the redundant channels at a time should one of the chargers be out for maintenance.

The battery supply to the Class IE system is designed to meet the requirements of the load for two hours if the chargers are not available (Figure 5), and the battery chargers provide power to the redundant channels A, B, C, D independently.

There are no interconnections among the four Class IE dc buses within each unit. This is a requirement of Reg. Guide 1.75, IEEE 308, and Reg. Guide 1.6.

There shall be no interconnections among the 125-V dc buses of Units 1, 2, and 3. Each unit has got its independent and redundant buses.

The Class IE batteries are sized to meet the requirements of the load for IEEE-485. The sizing of the batteries shall be based upon electrolyte temperature of 60F degrees and has the additional capacity to meet the 25% capacity for the end-of-life requirements, which is dictated by IEEE-450.

The capacity of each Class IE batter charger is also based on the largest combined demand of all the steady state loads plus the charging current required to restore the battery from the design minimum charge state to the fully charged state within 12 hours.

The dc system is ungrounded and receptacles and switches shall not be located within the battery rooms. We've got these located outside the rooms for purposes that are required for the plant.

All the redundant Class IE batteries are located in separate rooms (Figure 6) completely separate by three-hour fire walls and the Class IE batteries and battery racks and dc panels shall be capable of withstanding a safe absolute shutdown earthquake, which is a requirement of IEEE 344.

There is instrumentation both located locally and in the control room. There is going to be a dc bus undervoltage alarm, which we will go into detail later, in the instrumentation; battery current indication; dc voltage indication; and dc ground indication; battery circuit continuity alarm monitor; charger malfunction alarm, including input ac undervoltage, dc undervoltage, dc overvoltage, and output breaker open; charger output current, also at charger; ac and dc breaker position indicated at the charger and in the control room of the charger. We will go into detail of these later on, but we wanted to indicate them briefly here.

The loads on the Class IE batteries are as indicated and in the design criteria. The requirements for field flash of the diesel engine, miscellaneous loads associated with load group 1 and channel A, which are the engineered safety

features requirements, the aggregate of those loads are fed from the inverters, and we've got reactor trip switchgear plus all the related motor operated valves which are required to function during an accident condition. The list (Figure 7) that you are witnessing here in the design criteria is just a summary of some of the loads that we have on the batteries. Those loads are detailed in our FSAR and are described fully in our discussion later on in our presentation.

MR. BINGHAM: That completes the first two items. You heard the design criteria. Are there any questions from anybody at this time?

MR. VAN BRUNT: I have a couple myself, but do any of the other Members of the Board have questions?

MR. BARNOSKI: Could you describe a little bit in detail what the basis is for the two-hour design basis?

MR. TAJADDODI: The two-hour basis has been accepted throughout the industry as being a standard and it has been accepted by the Nuclear Regulatory Commission as being a sufficient time to provide the power to the loads to bring the plant to a safe shutdown condition.

MR. ALLEN: I have a question. You mentioned a while ago that the only non-IE load connected to the IE 125-volt system is the safety status panel. How is that isolated?

MR. TAJADDODI: We've got a breaker and we've got a Class IE inverter which is going to act as an isolation device

and meet the requirements of IEEE Standard 384. The breaker ahead of it is going to meet the requirements of Reg. Guide 1.41, so we've got breakers and an inverter, which the inverter is going to be Class IE. It is going to be inside a panel. It is going to meet the requirements of IEEE 323, 344, and that is going to constitute an isolation device.

MR. ALLEN: That gives you your isolation from ac to dc, but how about dc to dc?

MR. TAJADDODI: Dc to dc has got a breaker inside the panel, so that is going to constitute -- also, the energy levels, we are going to do some additional analysis showing that the energy levels of the status panel is such that there won't be any degradation if there is any fault in the status panel because of the low energy requirement.

MR. BARNOSKI: This isolation, does it take place in the battery room or at the location?

MR. TAJADDODI: No, it will be at the location. We've got the location inside the panel itself.

MR. ROGERS: I notice that this handout that you had here has no professional signatures on it. Can you explain why that is?

MR. BINGHAM: Yes. There was a recent revision to that Regulation Guide which is in circulation. There were some very minor changes made in Revision No. 6, and each time we issue a full revision, it has got to be signed by the

appropriate people. However, for that last revision, that paper work is still in the mill.

MR. ROGERS: You mean for the design criteria, not for the Reg. Guide?

MR. TAJADDODI: For the design criteria, not for the Reg. Guide.

MR. ROGERS: So right now the handout that you have here is a recent revision which is in review at Bechtel now?

MR. TAJADDODI: Right.

MR. ROGERS: Will that be sent to APS for review?

MR. BINGHAM: Carter, if you look at the bottom, you will see the dates, the date of origin, which you can see in the volumes here, and then the dates of revision.

To answer your question, that is ready to come over for review and approval by APS.

MR. ROGERS: Thank you.

MR. ROSA: The isolation device, the inverter, are you going to present an analysis to qualify that as an isolation device, or what?

MR. TAJADDODI: The inverters are current limiting and they are built to the requirements of IEEE 323 [illegible] and 344 and are separated as isolation devices. I understand that NRC has not given its position on that. However, chargers and inverters are considered an isolation device if they are current limiting in nature, and we are taking credit

that that is a basis for isolation.

MR. FREID: Your criterion E says in terms of interconnection between channels of the dc power system requires the inability to simultaneously have breakers open on both channels on the swing bus. We are assuring that there is no way of mechanically connecting both sides of those breakers?

MR. TAJADDODI: Yes. The standby charger or the swing charger, as it is called, has got two output breakers which can swing to either A or C channels (Figure 8). These breakers are mechanically interlocked. They are interlocked such that no two breakers are going to be closed simultaneously. Only one breaker is going to be closed simultaneously. The two breakers are air breakers and isolated with a barrier between them to meet the requirements of Reg. Guide 1.75 and IEEE 384. In addition to that, there are two additional breakers in series with those breakers that are connected to the charger. As can be seen on this chart in here (indicating) the two breakers in series here are normally open with the chargers on standby condition. If the charger is on supplying power, this charger is completely disconnected with these breakers open. So no fault or no failure in the charger can jeopardize the integrity of these dc buses during normal operation. If the charger is out for service and we connect standby battery charger C to the dc bus, only the appropriate breakers which are aligned to the dc distribution center are going to be

closed with the other two open. These two (indicating) are interlocked mechanically. You cannot close these two breakers simultaneously. There is a barrier here (indicating) and they have more than a six-inch separation between the breakers. The switch is such that you maintain complete separation of the wires inside to make sure that you are not violating the requirements of Reg. Guide 1.75 and IEEE 384.

MR. VAN BRUNT: Fred, for the record, would you please identify the charts that you are using?

MR. TAJADDODI: The chart that I am using (Figure 9) is a one-line diagram of the dc system on systems A and C, which is a sample. The same thing is true for channels B and D.

MR. VAN BRUNT: Is it in the handout?

MR. TAJADDODI: It is in the handout, yes. It is right ahead of another drawing (Figure 8) which shows all four channels.

MR. PAUL: I would like to ask a question. Is it necessary to have magnetic trips in the circuit to the dc bus and are they reliable?

MR. TAJADDODI: Well, yes. The air circuit breakers are reliable interrupting devices.

MR. PAUL: Another question. What is the fault interruptible capability of that breaker?

MR. TAJADDODI: This air circuit breaker fault interrupting duty is about 30,000 amperes.

MR. PAUL: Can you buy molded case breakers that will

stand that?

MR. TAJADDODI: The molded case breakers in here (indicating)?

MR. PAUL: Yes.

MR. TAJADDDODI: We thought that an air circuit breaker was more reliable than a molded case breaker to do the job for the IE dc system.

MR. PAUL: Had you ever considered connecting another interlock breaker to test the facilities through a fuse disconnect so that you didn't --

MR. TAJADDODI: In lieu of this breaker here (indicating)?

MR. PAUL: No, interlocked to an additional breaker to the test facilities.

MR. TAJADDODI: What test facilities?

MR. PAUL: You are going to test the battery every 18 months.

MR. TAJADDODI: Right. If you are going to test it, you've got to disconnect it from this system.

MR. PAUL: This is right, you have to disconnect, but if you put in facilities, you wouldn't have to touch it and then you could hook up your test equipment at possibly a junction box. Wouldn't that be better for maintenance?

MR. TAJADDODI: It will be a marginal gain for maintenance, but the design of the system the way it is provides the reliability of the system without encumbering it

with additional equipment and components. We tried to make the system as simple, yet as reliable and redundant to meet all the requirements without encumbering it with a lot of other equipment which might degrade the redundancy and the reliability of the system. You can do the testing of the battery with ease without having those additional breakers or test equipment that you are mentioning. It has been done. All the dc systems have been designed to meet that.

MR. PAUL: It may be something to consider. I think some of the nuclear plants are using this type of system and it makes it a lot easier to maintain systems.

MR. TAJADDODI: As far as the ease of maintenance, it might be true, but we feel that this can meet that requirement just as good.

MR. KREUTZIGER: I just have a general question with respect to the design criteria. Where are we showing the interface between this system and the requirements of the other systems? For example, I see that we have sized it -- we are looking at the area of a 60-degree temperature with respect to battery capacity. Where is the design criterion that would establish the HVAC requirements on electrical equipment as well as potentially any requirements for ventilation exhaust?

MR. BINGHAM: In the Design Criteria Manual, there is a general section that covers all of the basic environmental

parameters. Coupled with that is a general section for each of the disciplines, electrical, mechanical, and civil, so forth. That gives more detailed application of the criteria to specific items. Then the design criteria that you looked at in the exhibits is for the system.. Each of the systems has its designator. You happen to be looking at the IE. In the back of that criteria is a reference to the interacting systems or the interfaces.

MR. KREUTZIGER: So the general load temperature of the station is 60 degrees, is that a general criteria throughout the entire station?

MR. KOPCHINSKI: We have criteria for temperature ranges in each building and you would find that each of the building ventilation systems give criteria for the ranges it has to keep each building at, so that control building HVAC system has criteria on it which may be further broken down, like the control room has a tighter range than some of the other areas of the buildings.

MR. KREUTZIGER: All electrical equipment then has what high temperature range, 40 degrees C?

MR. TAJADDODI: The higher limit of the temperature for that particular area is 40 degrees C. Most of the higher limit temperatures of electrical equipment are at 40 degrees C with the exception of some equipment which are 50 degrees C outside the containment, but most of them are 40 degrees.

MR. KREUTZIGER: Then your control building system description or design criteria for the control building HVAC system would specify a range so that, for example, the low temperature in the capacity would be assured that we would have a battery room temperature no lower than 60 degrees?

MR. BINGHAM: That's correct.

MR. KREUTZIGER: Or no higher in the room than in the areas of the heat sources such as the inverters, chargers, no higher than one hundred and what, 104 degrees?

MR. TAJADDODI: 104 degrees. The reason why we chose the lower limit on the temperature was that was the limiting temperature for the size of battery. As the temperature goes up, the size of the battery is enhanced, so that was for the worst condition to meet the conditions of the batteries.

MR. KARNER: On Page PK-2 of your Detailed Design Criteria [Figure 5], Item H discusses the capacity of the battery. Could you discuss the criteria that you used to determine the battery loading for determining that two-hour capability?

MR. TAJADDODI: Yes. The battery loading is done by two standards. One is the IEEE-485 criteria for sizing the batteries. The other one is IEEE 450 for the maintenance and the life. The 25% margin requirement for the batteries is a requirement of IEEE 450 to meet the end of life of 80% life at the end of its qualified life. On top of that, we had another 15% margin on top of the loads in the beginning of our

design to assure ourselves of any contingencies that may occur later on. So have 25% plus 15% margin when we start the design of the battery system, sizing of the battery. The battery itself is sized, as we said, for IEEE 485. It tells you how to take into consideration the continuous loads, the redundant loads, the random loads, and how to treat each of these per se to make sure that the battery is sufficient and capable to meet its load requirements.

MR. VAN BRUNT: I have some questions. I'll wait until everybody else is finished.

I would like to go back to the design criteria and go back to some basics for a minute.

First off, when were the design criteria established in the whole design process?

MR. BINGHAM: Well, for this particular system, the date of origin was 10/28/74. This was probably not one of the earliest systems. I believe we had systems that affected the NSSS and some of the mechanical side a little bit earlier than that.

MR. VAN BRUNT: What process did you go through -- you described the design criteria and the role it plays in the design of the plants, that sort of thing, but what process did you go through to establish these criteria? Where did the criteria come from? What was their basis? What was the review process that they went through and what sort of a

procedure do you have for updating these criteria to assure that they reflect the latest regulatory requirements, the latest industry occurrences, for example, the recent Crystal River dc power systems? I don't really want to get into the problems, but I want to understand the control process you go through for the design criteria, since it is the underlying basis for the design of this system.

MR. BINGHAM: Fine. Let me take the first question, which was how do we get started, and with the work that Bechtel has been doing with many, many power plants, we don't have to start with a blank page. We have information through our standards, through criteria on other plants that are similar that we start from for a particular project. The project team that is set up, as it has been, for Palo Verde will assemble that information into a preliminary design criteria for a particular system at the beginning of the job. At that time, we will have extensive reviews with the owner's engineers and through our data gathering from our other divisions to come up with a draft that reflects what we believe to be the current requirements for the particular system. From the reviews that we have with the utility, we will put in specific requirements for a particular system. For example, there may be some requirements that tie into off-site power availability or to a particular arrangement or number of units on a site. That particular criterion is reviewed in our house

by our chief to get the inputs from other jobs that are going on simultaneously and is in many cases reviewed in detail by the project engineer on the job through meetings that he might have.

MR. VAN BRUNT: Is this a formalized process with sign offs and all that kind of thing?

MR. BINGHAM: Yes, it is. We have procedures that require that all responsible parties review the particular document and, in particular, the final sign off has the chief engineer of the discipline and the project engineer, the project engineering manager in this particular case on this job. The internal procedures require a documented review, which is in our files. After the sign off, there is a letter that comes to you with the document requiring review and approval from the utility. Once that is done, the criteria then are approved for us on the project.

You also asked, Ed, I believe, how do we keep this as a dynamic or updated document for new things that may be happening that do affect the system. There are several ways that that is done. As you can see, this particular one has been revised five times and is in the process of being revised once more. We have a formal procedure called a Design Criteria Change Request that is required of all disciplines to issue for my review and determination whether it is an acceptable change to the criteria. Once that is accepted, then the

original document is marked up with the change, circulated, as it was before, to the reviewers. Once approved, perhaps with comments which are resolved, it then is issued and follows through the same course. Now, there are other influences other than just internal that might affect this, such as IE bulletins that come to us, either to us directly or through letters that the utility sends to us. The systems are reviewed and the disciplines are required to note whether there is a change to the design criteria that is required.

There is one other form and that is our SAR change notices, which have a block on them to indicate whether there is a requirement to change the design criteria. So we have that feedback to the base document, which is the design criteria, from all the various sources.

MR. VAN BRUNT: Well, you partly answered my next question. I was going to ask you how are you sure that the design criteria, which, as I understand it, are the basis for the engineers and the designers to proceed, coordinate specifically with the commitments of the applicant in their preliminary safety analysis reports or FSAR or whatever other regulatory codes or other documents are involved?

MR. BINGHAM: Well, I did hit on part of it. The other part, on the two documents, the request for change, there is a block to say is an FSAR change required, and on the FSAR change form, there is a block required for a design

criteria change. So we have two ways to assure that we get the proper changes, and once it is noted, it is flagged, it is logged in, and then there is a follow-up system to assure that that is incorporated in a timely manner.

MR. VAN BRUNT: Were any of the design criteria for this particular system the result of criteria established from Combustion Engineering Standards Safety Analysis Report, CESSAR? If so, what kind of a mechanism do you have to assure yourself that you have properly and correctly interpreted those criteria so that the designers then can proceed with that?

MR. BINGHAM: Ed, there weren't any for this particular system from CESSAR. However, generally, the interface criteria that is in CESSAR is responded in the licensing document that the design criteria again is checked to make sure that it does include those interfaces, does address them.

MR. VAN BRUNT: Aren't there some dc loads that come out of CESSAR that form a basis for this battery design?

MR. BINGHAM: That's correct.

MR. VAN BRUNT: How are those handled, then?

MR. TAJADDODI: Those are the loads.

MR. VAN BRUNT: But those are still design critiera.

MR. TAJADDODI: Yes. Those are tabulated in the complete tables that CE requires, and we put them in there as

a requirement of the loads that CE dictates to us.

MR. VAN BRUNT: But does CE then review these design criteria to assure that you have properly interpreted their load requirements as to length of loads or time or whatever the criteria might be?

MR. BINGHAM: The answer to that is yes, they review all our design criteria plus they review our key documents.

MR. VAN BRUNT: Is that a documented review?

MR. BINGHAM: It is a documented review signed off by their project manager.

MR. VAN BRUNT: How are changes to those criteria handled?

MR. BINGHAM: All of the changes are submitted to the affected entities for review and changes. We have an automatic system. If it is a drawing, we have a documentation of every drawing and what reviewer is to see it. Actually, it is part of our logs. When that drawing comes out and is issued again as a revision or if there is a design change noticed, it goes with it. That goes automatically to the particular organization, Combustion Engineering in this case. Their people review it and send back a formal response with either comments or acceptance if it is indicated.

MR. VAN BRUNT: And all of these procedures are subject to that?

MR. BINGHAM: That is correct.

MR. VAN BRUNT: I don't have any more questions. Does anybody on the Board have any more questions?

MR. ALLEN: I've got a couple here. We neglected to say anything about associated circuits. Does someone want to comment on that? Do we have them? If so, how do we handle them?

MR. TAJADDODI: The only place that we have associated circuits in the dc system again is related to the safe shutdown panel. Those circuits are appropriately identified as such and they are treated to meet the requirements of 1.75. They are identified separately, distinctly, and they are routed and separated in accordance with the requirements of IEEE 384 and Reg. Guide 1.75. That is just one standard of the safe shutdown panel. No other circuits that we know of are associated. They are all Class IE and we don't have any non-class IE loads that share those systems.

MR. KEITH: The safety equipment status panel I think is the proper name. Safety shutdown panel is not.

MR. TAJADDODI: Fine.

MR. ALLEN: Just one clarification. We are talking just about unit for unit dc system. Would you clarify if we have any connections at all between the dc systems between units?

MR. TAJADDODI: As we mentioned in the beginning, the dc units, each unit is independent and it is not interconnected

with the other units. We meet the requirements of the appropriate Reg. Guides, as we will go into and see how we are meeting them, but they are all separate. They are not interconnected. Each unit has got its own dc system completely divorced from the other units.

MR. VAN BRUNT: And the two systems within the unit are completely independent as well?

MR. TAJADDODI: As well, right.

MR. ROSA: If NRC wanted to audit a detailed calculation, do you have a package of calculations associated with battery sizing that would be available for audit?

MR. BINGHAM: Yes, it is available. As maybe some of you don't know, NRC is looking at calculations and various systems that we have.

MR. VAN BRUNT: What part of NRC?

MR. BINGHAM: This would be the Compliance Division, Region Four.

MR. VAN BRUNT: Region Four, not Region Five?

MR. BINGHAM: Not Region Five. In fact, they were just in last week looking at the calculations on the pipe whip restraints. About a month and one-half or two months ago, they were in and looked at the calculations on one of the mechanical systems. I think the aux feed water system.

MR. ROGERS: A few minutes ago, I raised a question pertaining to Revision 6 of the design criteria and some of

the discussion has brought up some further thoughts along that line. Let's suppose that we have a Revision 5 that is in effect. Revision 6 is proposed, and that proposal, while it is in review or is getting signed off could make some changes in the systems themselves, physical hardware, how would Bechtel go about putting those changes in the hardware into effect? How would they get that accomplished?

MR. BINGHAM: Well, we wouldn't make the changes until the criteria are approved, but if there was some particular reason because of maybe long lead delivery of some item like that, we would review that with you and would set in motion contact with the particular manufacturers of the equipment to make the proper modifications. I am talking about things that really have to be fixed in order to have an acceptable design.

Any other questions, Ed? Shall we move on?

MR. VAN BRUNT: Anybody on the panel have any other questions?

MR. BINGHAM: Let's move on then to Number 3, FSAR Compliance. [Figure 11]

MR. TAJADDODI: Our FSAR has got to meet the requirements of IEEE standards, the GDC, Section 10 CFR 50, and additional Reg. Guides that pertain to the dc system. For the dc system, the following Reg. Guides are applicable: Reg. Guide 1.6, 1.29, 1.32, 1.41, 1.75, 1.81, and 1.93.

In addition, it has got to meet the General Design Criteria 17 and 18 and meet the requirements of item IEEE 308-1974, 323-1974, 344-1975, 450-1975, and 384-1974.

We will also discuss the Standard Review Plan Acceptance Criteria and how it meets it and any pertinent questions that might be related to those.

GDC 17 (Figure 12) pertains to electric power systems and requires that Class IE dc subsystems, including batteries, chargers, dc switchgear and distribution equipment, be physically separate and independent. In our drawings, we indicate how we are meeting this (Figure 10). As we can see, the battery rooms are completely separate and independent separated by fire walls. They've got the separation independence and the circuits connected to these two also are routed completely independent. The related equipment that is connected to each of these batteries is also separated. The D distribution panels, inverters, and battery chargers are across the room from where the batteries are, and similarly for C, A, and B. We have tried to maintain at A and C channels, which are related to train A, separate, and B and D close in that respect so that we can have the separation and isolation of circuits more reliable.

Another requirement of GDC 17 is sufficient capacity, capability, independence redundancy and testability for Class IE dc systems to ensure that the safety functions meet

the requirements of single failure criteria. If we look at our one-line diagram --

MR. VAN BRUNT: Fred, if you would, as you put up different slides, if you would identify them somehow for the Reporter so that somebody that reads this transcript separately will know which document you are referring to.

MR. TAJADDODI: That's fine. This is a single-line diagram of the dc system (Figure 8). The previous drawing was a physical arrangement of the battery system equipment (Figure 10). Looking at the one-line diagram, we see that the dc system is designed such that no single failure that can happen in any one of the systems can affect the redundancy and the realiability to make the system function properly. If there is a fault in the dc system on channel A, only channel A will be affected. Channels C and D and B are completely separate and isolated. Likewise, if at the time the charger was connected to charger A and battery charger A was for maintenance, only this portion (indicating) is going to be affected. Now, there is a possibility that it might happen that there is a failure into this charger, but whatever failure we might have in here is going to affect only that portion of the charger which is connected to A. The C channel is completely isolated because of the breaker being in an open position. So we have designed the system to meet a single failure criteria as far as failures are concerned, to isolate them and make sure that no two

channels are affected due to a single failure.

MR. VAN BRUNT: Is this a point where you want to let us ask some questions, Bill?

MR. BINGHAM: No, not yet.

MR. VAN BRUNT: You will let me know?

MR. BINGHAM: Yes, I will.

MR. TAJADDODI: The other General Design Criteria of 10 CFR 50 (Figure 13) is the inspection and testing of electrical power systems and requires inspection and testing during equipment shutdown of wiring, insulation and connections to assess the continuity of the subsystem and condition of its components. The system is designed such that we've got isolation devices that we can isolate the system and test each one of them individually. We can test the equipment as far as their wiring to make sure that the insulation is in a good condition, there is no degradation of insulation, and maintain the parameters of the equipment within the design requirements. All the equipments have got isolation devices, breakers, to make sure that we can isolate them without jeopardizing the rest of the system.

Periodic testing during normal plant operation of the operability and functional performance of the subsystem by isolating the subsystem is also provided. You can test equipment periodically by isolating them by the appropriate means and test them for the requirements that are set forth in

the standards and requirements.

Now we will go into details of the design requirements of IEEE 308 (Figure 14), which is the basic standard to meet the requirements, and all the rest of the Reg. Guides we will be documenting, so we decided to go into details of this system from the very beginning. One of the requirements of the IEEE 308 standards is to have redundant loads. They should be separated into two or more redundant load groups. We are meeting that requirement by providing four independent load groups to the loads that are required to shut down the plant, so it meets the redundancy requirements of IEEE 308.

Another requirement of IEEE 308 is to provide safety actions. The safety actions shall be redundant and independent of safety actions by its redundant counterparts. Our design is such that safety actions of each of the four redundant load groups are independent. No two groups are interconnected to jeopardize that requirement.

The power supplies requirement of IEEE 308 requires that each of the redundant load groups shall have access to a power supply that consists of a battery and one or more battery chargers. We are providing a battery and a battery charger plus a spare or standby battery charger as it is required, and the battery charger serves only one channel of an independent load group at a time.

The common power supply requirements of IEEE 308

states that two more load groups may have a common power supply if the consequences of the loss of the common power supply to the load groups under design basis conditions are acceptable. The only place that this is designed into the system is that the two chargers, A and C chargers, are connected to A train Class IE system, so we are not violating any law for that even though they've got a common ac source, 4160 bus source, so they meet the requirements of common power supply that two channels of each of the load groups are connected to that train and those are the redundant channels for that load group.

Common failure mode requirements. The battery should not have a common failure mode for any design basis event. Both the design and the location of the batteries is such that they've got to meet the requirements of IEEE 344 and 323 for qualification to make sure that a nonseismic event is oing to keep the system viable and the connections of the systems are such that it precludes the possibility of a single failure affecting more than one channel at a time.

Distribution system requirements (Figure 15), each system shall be capable of transmitting sufficient energy to start and operate all required loads in that circuit. The design of the distribution system is capable of doing that for safety action.

Independence requirements are provided for the

distribution circuits to redundant equipment by physically and electrically isolating each other for compliance with IEEE 384 and Reg. Guide 1.75. As we witnessed in the physical arrangement drawings, those equipments are arranged and separated.

The auxiliary devices to operate independent equipment shall be supplied from a related bus section. All auxiliary devices such as breakers, relays, and so forth, which are connected to the dc system are independent for each channel. No device shares any two systems at a time, so they are completely independent.

The feeders between the Class IE power systems located in Safety Class Structure and systems located in non-Safety Class Structures shall be provided with automatic circuit interrupting devices. All feeder devices are provided with circuit breakers to interrupt a fault to make sure that they are isolated and they meet the requirements of IEEE 308.

The battery supply requirement is that each battery supply shall consist of the storage cells, connectors and its connections to the distribution system supply circuit breaker. That is where the circuit breaker comes in, and we have designed it such that the battery is connected to the dc distribution system through a circuit breaker.

The capability requirements of 308 are such that batteries are sized for IEEE 485 to start and operate the

required loads for two-hour duration.

The availability, [Figure 16] each battery supply shall be immediately available during normal operations and following the loss of power from the ac system. The batteries are always connected to the breakers and the breakers are always in the closed position so that if the charger loses its function, the batteries immediately take over and supply the power to the distribution system.

The independence requirements are that each battery supply shall be independent of other battery supplies. As we have noticed in our single-line diagram drawing, all those batteries are completely redundant, independent.

The stored energy requirement for the batteries is that they should be maintained in their fully charged condition. Stored energy shall be sufficient to operate all necessary circuit breakers and provide an adequate source of power for all required connected loads during loss of ac power to battery chargers. Now, the batteries, as we mentioned earlier, will be maintained and tested on a periodic basis to assure the availability of stored energy in accordance with IEEE 450-1975.

Battery charger requirements again require that each battery charger supply shall include all equipment from its connection to the ac system to its distribution system supply circuit breaker. That is why the single-line diagram

indicates that all equipment from the ac supply source to the connecting breaker are provided to the distribution system. The function of the charger is to supply electric energy for the steady state operation of the connected loads during normal and possible accident operation while its battery is returned to its fully charged position simultaneously.

We mentioned that the batteries are going to be sized such that they are going to carry the normal load and post-accident loads plus they can restore the batteries when they are completely discharged to their minimum voltage level. The capability requirements for each battery charger (Figure 17) are that the battery charger should be sized and be capable to supply the necessary steady state loads and provide charging to the batteries from their design minimum to fully charged state.

Each battery charger is independent. In addition, a standby charger is provided for each load group. That is a requirement for independence.

The surveillance requirements indicate that you've got to have a capability to monitor the output voltage and output current and a circuit breaker position for the dc system. We have met those requirements and we will go into them in detail later on.

Disconnecting means, we've got disconnecting means for the battery chargers' power supply from the incoming 480-volt ac to make sure you can isolate the charger and the

output breaker is also a means for isolating the charger for the requirements of IEEE 308.

The following requirement for the IEEE 308 is that the charger should be designed so that there is no feedback from the dc to the ac. The chargers are provided with blocking diodes to assure that there is no feedback from the dc system to the charger if there is a malfunctioning of the ac supply.

Now we come to the requirements that are dictated by the Nuclear Regulatory Commission. The first Reg. Guide that is applicable to the dc system is Reg. Guide 1.6, and we have indicated those requirements in your handouts (Figure 18). First, they shouldhave separate redundant load groups, which we have indicated again they are.

They should be energized by a battery and a battery charger, which they are.

There should be no automatic connection to any redundant dc load group. We have seen that the only connection that we have between A and C is through a selector switch. That is a manual selector switch. There is no automatic connection in the A or C or B or D systems. All those connections are manual. We don't have any automatic connections.

Standby source of one load group should not be automatically paralleled with the standby source of another

load group under accident conditions. We don't have that capability. We do not provide the capability to make automatic paralleling with a standby source.

No automatic transfer of loads between redundant power sources. There is no automatic transfer of loads between the redundant dc systems.

If means exist for manual connection of loads, at least one interlock should be provided to prevent parallel operation, and we've got that in our standby battery charger to provide that requirement to preclude to possibility of connection to one more load.

The other Reg. Guide which is applicable to the dc system is the seismic requirement. It states that the Class IE system should be designed as Seismic Category I and should withstand the effects of Safe Shutdown Earthquake and remain functional. All the Class IE systems and equipment that we are purchasing are required to meet the IEEE 344-1975 requirements and to meet the requirements of Safe Shutdown Earthquake during an accident.

The next Reg. Guide which is pertinent to the dc system is Reg. Guide 1.32. It states that a battery charger supply capacity should be based on the largest combined levels of the various steady state loads and charging capacity to restore the battery from the design minimum charge state to fully charged stated irrespective of the status of the plant.

We have mentioned before that the battery charger is sized to do just that. The minimum voltage requirement is 105 and the fully charged stated is 130 volts.

The last requirement of Reg. Guide 1.32 [Figure 19] is that a discharge test should be made per IEEE 450-1975. We are complying with that. We will be complying with that requirement for test for IEEE 450-1975.

The next Reg. Guide applicable to the dc system is Reg. Guide 1.41, and it states that the onsite system should be functionally tested successively with all dc and ac sources disconnected completely for one load group. Now, we've got the means to do that. We've got all the breakers to disconnect and test each of the components in the system by isolating them, opening the breakers, and provide that requirement.

The next requirement is during each test, the dc buses and related loads not under test should be monitored to verify absence of voltage. We've got instruments on the buses and in the control room to monitor the status of the voltage and current status of all the equipment and the operators will be in a position to know whether there is voltage or there is no voltage on the system.

The last requirement here, the first requirement of 1.75, which are pertinent, and we have stated only those areas which are of great importance, is that isolation devices actuated only by fault current are not considered to

isolation devices. We meet that requirement. Isolation devices are actuated by an SIAS signal in addition to fault current for power circuits. The dc systems are pretty much -- most of the loads are from the inverter and those are dictated by that requirement.

Interlocked armored cable should not be construed to be a raceway. We meet that requirement.

Locating redundant circuits and equipment in separate safety class structures, which we have noted in our general arrangement drawing that we are meeting that requirement.

Associated circuits installed should be subject to all requirements placed on Class IE circuits, and we have stated that associated circuits are treated as Class IE up to isolation devices. After the isolation device, they are treated as non-Class IE systems.

The next Reg. Guide applicable to dc systems is Reg. Guide 1.81. It states that dc systems in a multiunit plant should not be shared, and we have stated that there are no shared systems between the units.

A single failure should not preclude the capability to automatically supply minimum ESF loads, and we have seen that having four redundant channels and having a single failure, we still meet the requirements of for more than two out of four, which is required to meet the requirements

and thus preclude the degrading of the system.

The onsite power capacity (Figure 20) should be provided to energize sufficient Seismic Category I equipment. As we have seen, we have supplied four redundant systems, so the capacity of the dc dystem is sufficient to energize the necessary dc loads even if we are faced with one failure in one system.

The interaction between each unit's ESF electric circuits should be limited. There actually is no interaction, because our systems are completely isolated and redundant. There is no interaction existing between units.

The final Reg. Guide applicable is Reg. Guide 1.93, which is the Limiting Conditions of Operation. It states that if only one dc source is not available, power operation may continue for two hours. We have the capability with a standby charger to enhance that requirement. As a matter of fact, we feel that with the standby charger, we can have the continuity of operation even if one charger is not available, and the dc battery is sized for two hours to do the job.

We have compiled the requirements of the Standard Review Plan to see how we are meeting again the intent that NRC looking for. We have tabulated the acceptance requirements for the Standard Review Plan and we have responded as to how we are meeting them and where in their FSAR we are going to discuss these things. (Figure 21)

In the first requirement, system redundancy

requirements, it says that the acceptability of the onsite dc system with regard to redundancy is based on conformance to the same degree of redundancy required of safety-related components and system by GDC 22, 33, 34, 35, 38, 41, and 44. Those are systems which are required for the safety of the plant, and we have the redundancy as dictated by those. We are providing four redundant power supplies to meet that redundancy.

Conformance with single failure criterion. They should meet the requirement of GDC 17, IEEE 308 augmented by Reg. Guide 1.6 and Reg. Guide 1.81 implementing the requirement of GDC 5 "Sharing of Systems, Structures and Components," and Reg. Guide 1.75. These requirements, as we have mentioned before, are compiled in these parts of the FSAR: GDC 17, Paragraph 8.3.2.2.11.

MR. BINGHAM: Let's not read all those things.

MR. TAJADDODI: In the power supplies acceptance criterion, it says that a basis of selection of battery and battery charger should be based on IEEE 308, which we have seen and gone over in some detail.

Sharing of dc power systems between generating units will not be permitted. As we have said, we are meeting the requirements of Reg. Guide 1.81.

Non-saftey related loads connected to safety power supplies should conform to Regulatory Guide 1.75, and we have

said that the only non-safety load connected to safety-related dc power system is the safety equipment status panel.

The thermal overload protection of safety-related valves (Figure 22) should meet Branch Technical Position EICSB 27, which we are meeting by bypassing the thermal overload protection on SIAS per the requirement of Reg. Guide 1.106.

Identification of cables and cable trays. The Standard Review Plan requires that the cables and raceways be identified, and we have said all power cables are color-coded to identify the channels they are associated with. Their respective raceways are identified by tags at specified intervals per IEEE 384 and Reg. Guide 1.75.

The vital supporting systems, the requirement for acceptance criteria states that the instrumentation, controls and electrical equipment for those supporting systems identified as vital to the proper functioning of the safety-related systems and acceptable if the design conforms to the same criteria as the safety-related systems supported. All the instrumentation, controls and equipment meet the redundancy requirement. They are completely isolated, and they are required to meet the safety requirements as imposed by the appropriate Reg. Guides and standards.

The systems testing and surveillance requirement says that they should be preoperational and an initial start-up test per Reg. Guide 1.68 and 1.41.

Periodic testing per IEEE 450 and Reg. Guide 1.22.

Surveillance of the dc power supply should be in accordance with Reg. Guide 1.47 and Branch Technical Position EICSB 21. These two Reg. Guides actually relating to the dc system were covered fully in the control systems section of Section 7 of the FSAR.

The protection system is provided with means to perform testing of protection system actuation functions per requirements of Reg. Guide 1.68, 1.41, 1.22, 1.47 and Branch Technical Position EICSB 21. We will not go into details of these requirements because they are related to FSAR Section 7.

Seismic design requirements states that the electrical and mechanical equipment (Figure 23) should meet the requirements of IEEE 344 and Branch Technical Position 10. We see that systems and components are designed and procured to meet IEEE 344-1975 and Reg. Guide 1.100, which is a substitute for EICSB 10.

Finally, the quality assurance requirement of the Standard Review Plan are met. We do purchase and procure all the equipment and the design is monitored for the requirement of IEEE 336 and Reg. Guide 1.30. Bechtel has got a thorough program to meet that requirement.

MR. BINGHAM: That was a lot of information, but I thought, since there was so much comparing of the SRP's and the Reg. Guides, and so forth, that I wanted to get you through

it, and now we will entertain questions.

MR. VAN BRUNT: I think for the Reporter's benefit and everybody else, why don't we take a ten-minute break until 10:00 and then we will come back with the questions. Otherwise we are likely to drag on, so why don't we break for ten minutes.

MR. BINGHAM: All right, let's do it.

(Thereupon a brief recess was taken, after which proceedings were resumed as follows:)

MR. VAN BRUNT: John Allen.

MR. ALLEN: I have a question. Back to common mode failures, most of this equipment is located down in the bottom of the control building and I wonder exactly how you would go about ensuring that there won't be a common mode failure caused by steam line breaks, water pipe breaks, that could go in and flood out all the room or something like that.

MR. BINGHAM: The equipment is not in the basement, it is up at grade. The steam lines are not anywhere in the vicinity of these particular buildings. They are over in a separate structure called the main steam support structure, and the elevation has been set so any outside environments such as flooding, and so forth, would not enter these particular areas.

MR. ALLEN: Are these sealed doors, Bill?

MR. BINGHAM: They are doors, but I don't believe they

seal to other than just the environment, the normal environment.

MR. VAN BRUNT: I would like to follow that up with another question on the dc battery system. You have gone through all the separation from an electrical viewpoint through this whole system and out through the tray and all the rest of that kind of thing, but dc systems basically provide power to various aspects of mechanical systems. What kind of separation do you provide to assure that a mechanical occurrence, let's say a pipe break or something like that in a train B system, which is being supplied by dc power off of the train B dc power system doesn't affect the train A dc power system? In other words, a cross interaction of that?

MR. BINGHAM: Let me go back to John's question. In the separation reviews that we conduct, we do look at all the hazards, so that has been done and it is documented, Ed.

On the design of the plant, once we get outside the containment, which this is, we really go to compartmentalization and separation, separate the electrical from the piping systems, and we use compartmentalization to separate the trains so that if there was a mechanical failure of some kind in one train, it would have to penetrate several feet of concrete in order to enter the other trains and components.

MR. VAN BRUNT: If I understand that correct, you do not intermix either mechanically or electrically any components

that are associated with the same train, is that correct?

MR. BINGHAM: That is our basic criterion, outside containment, yes.

MR. ALLEN: Bill, carrying that on a little further, maybe I didn't state my question correctly, I know a concern that has been identified by the NRC to another utility of a steam line break not in the same room or something, but very near where it would actually overload the environmental condition and the HVAC system to the point where the temperature rise would come up and exceed the qualified temperature, you might say, of those rooms that you might have your inverters in and your chargers and everything like that. How do we preclude that type of thing? How do we go about reviewing that to ensure that won't happen to us?

MR. KEITH: I think, John, once again, as part of our separation reviews that we look at all credible hazards. The goal is to look at all hazards and list each room, each area, so that the equipment will perform its safety function.

MR. VAN BRUNT: How is that separation review done? Do you do it by analysis or what tools do you use?

MR. KEITH: Well, Ed, most of the time -- well, first, it is a multidiscipline review within Bechtel primarily conducted at our scale model so that we can look at all the equipment which is in a given area. In general, it is not necessary to perform an analysis, because the plant,

particularly the outside containment, is pretty well separated. Many of these kinds of problems are taken care of. We do have some analytic tools such as for a steam line break, we have a subcompartment pressure analysis we can do. We haven't as yet found a need to do that outside of the containment.

MR. VAN BRUNT: Since we are talking about steam line breaks, to follow up on John's question a little bit, are there any interconnections to the HVAC system or any other interconnected mechanical systems between the main steam support structure and the control building where the battery systems are located where you could get this kind of flow of steam which might raise the temperature above the limits for the batteries or whatever?

MR. KEITH: I can't think of any. The distance between the control building and the main steam support structure is so far and there are no interconnecting HVAC systems or anything.

MR. VAN BRUNT: Do you have a separate HVAC system for the main steam support structure?

MR. KEITH: Yes, it is separate.

MR. VAN BRUNT: So the supplies and the exhaust and all the rest of it are separate from that which is servicing the control building?

MR. KEITH: Yes.

MR. KREUTZIGER: I had a follow-on question. Have internal hazards of water which might be in the control building, particularly service water supplies I would imagine to cool in the area of potentially the control room air conditioning system, has your hazard review addressed any internal flooding and defined that it will not affect in a common mode area?

MR. KEITH: Yes. Most of the water is confined to the lower level of the control building. I think somebody asked about watertight doors. As far as where the batteries are, there is nothing, but down below we are separated so that the train A HVAC system is separated from the train B HVAC system to take care of any possible flooding. So that is part of our separations review. To answer your question, yes, we do look at it.

MR. VAN BRUNT: As a follow-up to that question, does the battery room have a floor drain system or a drain system of any sort?

MR. BINGHAM: Yes, it does.

MR. VAN BRUNT: Where does that system go? I realize that is out of the electrical area, but it is an interrelated kind of thing.

MR. BINGHAM: Well, it goes into the equipment drains, and I don't recall without looking at the drawings, Ed, just where it eventually ends up.

MR. KEITH: I was going to say our drainage system, in the design of that, we have looked at potential back-flooding and questions like that.

MR. VAN BRUNT: Well, I wasn't thinking of backflooding so much, but I was thinking of some kind of catastrophic failure in the batteries so that you end up with a lot of sulfuric acid on the floor, where does that go and what impact is that liable to have on whatever drain system it goes into, where does it go. Does it get overboarded or whatever. As a follow-on to that, what kind of floor coatings and stuff have you got in the room and what impacts could a major spill of sulfuric acid or something in that area have on that? Is there any gaseous generation from the interaction of the sulfuric acids and the floor coating? That is a whole series of questions.

MR. BINGHAM: That is a lot of questions. Let's take the first one. As you know, there is a retention basin on site that all chemicals eventually end in so that they can be monitored to assure a safe discharge to the evaporation ponds, so they would go through the system either to the oily water separator or bypass it and end up at the retention basin.

MR. VAN BRUNT: Bill, excuse me, before we leave that point, and I realize that in this area, you may not be prepared to answer right now, because we are talking about electrical systems, but if we have this kind of spill, does

that go directly overboard to the retention basin or does it go through some hold-up system, and if it goes directly overboard, is there some monitoring system to assure that through some other means you could get some radioactivity in the room which then can go out into the retention basin?

MR. BINGHAM: The retention basin is the point of monitoring. It is very difficult to catch things and there is no provision except for oils out of the turbine building.

MR. VAN BRUNT: Does it go directly out or into a sump and is then pumped out?

MR. BINGHAM: It probably goes into a sump, but, Ed, I would have to look at the drawings.

MR. VAN BRUNT: Maybe that is something you could follow up on, if you would.

MR. BINGHAM: We can look at that.

MR. ALLEN: There are some drawings over there.

MR. BINGHAM: Well, I know there are drawings there, but I would need to spend quite a bit of time to perhaps look at it.

MR. VAN BRUNT: Maybe at the break for lunch, if you take a look at it, as a supplementary, you might provide us with a little input on that.

MR. ALLEN: I have another question. To what extent in your review of cable tray isolation and runs and the proximity of pipes and stuff where you could get a break,

flooding or steam line break, how much detail in design review do you do on the model now?

MR. BINGHAM: For this particular system or in general?

MR. ALLEN: However done. Do you go actually down to the cable tray level, to the raceway level, or conduit level, or how far down do you go I guess is my question on model review?

MR. KEITH: We go all the way down to the raceway and conduit level, cable tray and conduit level. You really have to be able to say, for example, in these pipe breaks that you are not wiping out some cabling which you may need to mitigate the consequences of that pipe break.

MR. ALLEN: Then how do you document that you have done that?

MR. KEITH: We have minutes of those meetings which we keep on file.

MR. KREUTZIGER: Can I ask a clarifying question? In your design review right now on the model, all conduit is not shown, is that correct?

MR. KEITH: That is correct. For the conduit review, we have to supplement the model with field generated drawings showing the conduit routing.

MR. KREUTZIGER: Is there a procedure that would identify a zone of influence of a hazard so that in the subsequent routing of the raceway there would be a design

process such that we would not put a raceway in that area.

MR. KEITH: Yes, we are working in that area. In general, just how we work, we have kind of the same problem with instrument tubing as we have with the conduit routing, and the nuclear discipline states where the hazard areas are as far as where the pipe breaks are and the zones of influence and transmit that to the electrical and controls disciplines in an effort so that they will avoid those areas.

MR. FREID: If we go back to the physical drawing that we had [Figure 10], the question is on independence between the trains. You show a door between C channel and D channel, which is a door between two trains. In the design criteria, I haven't seen the general section, but I assume in your general HVAC section, you have criteria for assuring that there is no cross-connection between trains due to the HVAC channel. However, is there a security system that assures that that door is closed?

MR. BINGHAM: You are talking about the particular door over there?

MR. FREID: That is the only interface that I see between train A and train B, not channel but train.

MR. TAJADDODI: That's right. The answer to your question, we don't know exactly what kind of monitoring device we have on this one to make sure that this door is always closed at this moment, but the reason for this door is

accessibility for reasons that the layout of the control room itself, the battery room, is such that there should be access from this side (indicating) to this side (indicating) through some kind of a door. That is the reason for this door here (indicating). But whether or not this is monitored at this time I am not prepared to say.

MR. KEITH: We will have to check. As I recall, that was recently added to the security system, but I will check for sure.

MR. KREUTZIGER: That is a three-hour fire wall?

MR. BINGHAM: Yes.

MR. TAJADDODI: All these walls are three hours.

MR. FREID: Was my supposition correct that compliance with the general criteria for HVAC assures that you don't have any ducting that runs across that wall and connects the two trains?

MR. TAJADDODI: We have looked at the ducting of the four channels. We couldn't get a drawing produced in time, but the drawing shows that the ducts come independently outside to here like that (indicating). They don't come through the doors like this (indicating).

MR. FREID: Are the ducts from separate air handling units to each train?

MR. TAJADDODI: To each train, not to each channel.

MR. FREID: Each train?

MR. TAJADDODI: Each train, but not to each channel. In other words, these two channels (indicating) share one main duct that branches off and comes to these redundant rooms.

MR. KEITH: To clarify, if there are any of the ducts that go through the walls, then those ducts will have three-hour fire dampers and any doors through the three-hour fire wall are rated for three-hour doors.

MR. BARROW: In talking about the ducts, there has been brought up a question of the battery room ventilation ducts for the four battery rooms to ventilate, change the air in the battery rooms enough to keep hydrogen buildup from occurring. If I recall, the recent item we were looking at in regard to the TMI safety evaluation was whether or not we had four redundant ventilation ducts, one for each room. Can you address that?

MR. TAJADDODI: Yes. We've got the main duct serving the battery rooms. There is one damper in the main duct that can fail and close all four, shut down the circulation of these. That is one of the safety evaluation things that we have found that is a design degradation. We've got to look into it. There is a damper outside, and if it inadvertently closes, it is going to shut off the ventilation to all four rooms, and we are cognizant of that fact. We have looked into it and the Safety Evaluation Task Force Four has identified

that it is a design defect and we will be rectifying that design in time.

MR. ROSA: In addition to that, are there design features in those ducts to prevent a hydrogen explosion in one room from precipitating damage into any others?

MR. TAJADDODI: As I say, those ducts are coming independently to the rooms. They don't cross over the rooms. They come from outside. They go into the rooms and they branch off outside the rooms and they go inside the rooms. If there is any hydrogen evolution in here (indicating), the ducts are such that if there is an explosion in the inside of a duct, it is going to affect that train alone. It is not going to affect the redundant trains. In other words, no C and D or A and B battery rooms are going to be affected. They are redundant trains. In other words, they've got one common duct in each train, so that duct, if this is going to be affected, it is going to affect only that train.

MR. BARROW: I think his question was, though, suppose you had a hydrogen buildup in one room or one of the batteries was physically damaged and shorted out and generated a bunch of hydrogen, if that battery room suffered an explosion, could the pressure wave from that explosion be transmitted by the ducts to where they all join to that common damper and then be transmitted to the other rooms?

MR. BINGHAM: No, the two systems are separate. You

could certainly get to the other room that is on the same train, but you couldn't get to the other trains.

MR. BARROW: I thought you just said that there was just one damper for all four channels.

MR. TAJADDODI: There is one main damper outside.

MR. KOPCHINSKI: Is that for the exhaust system?

MR. TAJADDODI: That is for the exhaust. However, that damper location physically I cannot tell you right now.

MR. BINGHAM: Well, in any event, as Fred said, we are looking at that and we are going to fix it so that won't happen. The intent is not to be able to propagate these kinds of environments between trains.

MR. VAN BRUNT: This is an open item that you owe us a response?

MR. BINGHAM: Yes.

MR. TAJADDODI: We are cognizant of the fact that it is one of the items in the task force.

MR. ROSA: I would suggest that you might even consider providing some sort of isolation between the battery rooms in the same train if you can.

MR. TAJADDODI: Isolation of ducts, you mean?

MR. ROSA: Yes, isolation in the ducts.

MR. TAJADDODI: Well, we have the dampers. We've got subsequent dampers as well, but there is one main damper that can cause a failure and shut off the exhaust to all four, but

each one has its own damper. Each one of these ducts coming into the room has got its own damper. We do have isolation for each room, but all four have got one main damper ahead of them that if that closes, it shuts off the circulation for all four, and that is the one that is causing the problem. We do have isolation for each room. Each room has got its damper.

MR. BARROW: The ventilation I assume is forced ventilation, it uses suction. In other words, there are blowers outside the rooms that draw air from the rooms through the ducts?

MR. BINGHAM: It either draws it or pushes it, I don't know which.

MR. BARROW: And those blower assemblies for this ventilation are all seismically qualified?

MR. BINGHAM: Yes.

MR. FREID: One of the other comments I have is in discussion of Standard 308, it discussions a design basis accident or design basis event, and I don't recall in the design criteria the definition of what the design basis event to the system is.

MR. BINGHAM: Well, you have to go back to the general criteria that apply to all the systems. For example, for seismic, depending upon which building you are in, there is an appendix in the general criteria that says use this criteria

for each of the different levels for your design.

MR. FREID: What about an accident for which the loads -- you have a load table. Your design criteria doesn't specify for which accidents you would want to assemble those loads in designing the plant? A main steam line break, several of these things, what has the actual design basis been for which your loads are designed for which you have battery capacity?

MR. TAJADDODI: I can answer that. The design basis for our dc system is the loss of coolant accident. The worst case as far as loading is concerned on the dc system as a whole which taxes the dc system is the LOCA condition. Any lower level accidents definitely can be met, but the limiting condition is LOCA, and that is what the batteries and chargers are sized for.

MR. KREUTZIGER: I have a question. I thought I had understood that the actual loading table was based upon the connected load. In other words, the load on the inverter, you are assuming the entire load of that inverter is operating in a continuous state?

MR. TAJADDODI: Yes.

MR. KREUTZIGER: So there is considerable conservatism. In fact, you have taken the maximum output of that inverter as being the design load that would come from the battery system with respect to continuous supply?

MR. TAJADDODI: Yes. The inverter load is the rated kva loading on the battery. In other words, we have assumed a load on the battery to be equal to the rated value of the inverter. Whatever the rating of that inverter is, that is the loading on the dc battery.

MR. KREUTZIGER: But in your calculations, I had understood Shelly Freid's question and that is my question, do we have a table that shows what the local dc loads are or are we in fact saying that the maximum loads that will occur under the condition are on an output verified to be an output of so many kva on the inverter?

MR. TAJADDODI: That is a typical example of what the loading of the battery is (indicating).

MR. VAN BRUNT: Identify what it is you are looking at.

MR. TAJADDODI: This is the Class IE dc system load drawing in your handout (Figure 24). As an example, this one is described as dc subsystem A and, as you can see here, the inverter load is a continuous load. In other words, when you start the inverter, it's got some energy associated with it, but this 160 amps is the continuous loading of the inverter, and that, as you can see, is a continuous load for two hours. The rest of the loads, as we can see, they are not on the inverters and they've got the appropriate loading for a one-minute interruptible and the continuous as they might be appropriate.

MR. BARROW: Regarding this load profile, this gets back to a question which Ron Paul asked earlier. He was asking a question about the dc breaker installed between the battery and the bus. Although we understand that the breaker is an air circuit breaker with a higher rating than a molded case breaker -- I think the rating you mentioned was 30,000 amps.

MR. TAJADDODI: Something like that.

MR. BARROW: Looking at the profile, I went from this picture over to the next page in our handout (Figure 25), which shows the profile on battery A. It shows a one-minute profile of 912 amps, and then from the one minute to 119 minutes, it shows 340 amps.

MR. TAJADDODI: The breaker is oversized, as you can see.

MR. BARROW: Yes, but my questin is coordination. In other words, how do you size a dc breaker to protect against a fault during the first minute of operation and also to protect against a fault during the next 119 minutes of operation without undergoing the risk of having it falsely trip during the first minute.

MR. TAJADDODI: Well, if you are talking about fault level, the fault level is going to be 30,000 amperes or something in that range.

MR. BARROW: That is only based on a completely solidly

grounded fault.

MR. TAJADDODI: That's right.

MR. BARROW: I mean if you have a high impedence fault, you may have a fault that is maybe just double the zero to one minute rating.

MR. TAJADDODI: For the dc system, we don't have an arcing ground fault as such. The likelihood of having a high impedence ground fault for a dc system -- if that does happen, we've got an alarm. The operator can be aware of that condition. All those instruments and gauges indicating volts and amperes are going to indicate an abnormal condition.

MR. BARROW: So what you are telling me is you are setting this breaker maybe on the order of 5,000 amps or something like that, a very high setting?

MR. TAJADDODI: It will be high. I can't quantify it right now, but it will be high. It is high for two reasons. One of them is to make sure it is not going to trip on the high one-minute rating of the battery, to make sure that that is not going to happen. Number two is that that was the minimum size air circuit breaker in that category that we can find. We cannot find anything less than that. There are two reasons for that and that is the reason.

MR. BARROW: Could we make an action item or something for Bechtel to just check among their different projects to see what the rest of Bechtel's practice is on the use of

dc breakers between the battery and the bus?

MR. BINGHAM: Let me answer that question. If the question is whether we should use a circuit breaker or not -- is that the question?

MR. BARROW: No, the question is what is Bechtel doing on other projects. We understand in the industry that there is some movement to solidly bolt the batteries to the buses rather than use a breaker or fuse because of the dangers of inadvertent trips.

MR. TAJADDODI: Can I answer that question? That is a requirement of 308 to have the breaker. If you go through the requirements of the battery, you will see that 308 requires that the battery be connected to circuit breaker.

MR. BINGHAM: It would be a deviation from the criteria, John, to do that.

MR. TAJADDODI: In the battery system, the description on page 2 on battery supply, that is verbatim from IEEE 308.

MR. PAUL: But does it have to be a tripping breaker?

MR. TAJADDODI: The breaker, yes. The reason for that is for testability. It calls for a circuit breaker. IEEE 308 specifically calls for a circuit breaker.

MR. BINGHAM: Is there any action that the Board would like in that particular area as a carryon?

MR. VAN BRUNT: I imagine Ron has had his question answered or is satisfied. I guess John by default had his

taken care of relative to what the standard says. I guess I would like to see some additional information or interchange between the project and Bechtel to assure that we have adequately handled this. I think we need to look into Ron's concern about testability and be sure that we have taken care of that area, so I guess I would like to hear some more on this subject.

MR. BINGHAM: Let's make sure we understand again Ron's concern on testability.

MR. PAUL: I am questioning the necessity of a tripping breaker in between the battery and the bus. Normally, I have been led to understand that a disconnect switch is sufficient with a means of switching to the testing connection so that you don't have to disturb the dc system whenever you are providing any maintenance on the equipment.

MR. BINGHAM: Ed, if I may, I had understood John Barrow's question and Ron's question to be essentially focusing on the same issue.

MR. ALLEN: Ron's is a little bit more, though, because he goes into the maintenance.

MR. BINGHAM: I understand, but the issue is do you replace the breaker with some other device.

MR. ALLEN: One part of it.

MR. BARROW: Mine was to replace a breaker with a switch. Ron's was replace just the switch with like a

two-position switch that you can switch over to the testing position:

MR. BINGHAM: We would be happy to look at that.

MR. VAN BRUNT: I think you need to evaluate this and come back and provide an explanation that will permit us to assure ourselves that we are satisfied with the design of this particular area.

MR. BINGHAM: All right, fine.

MR. KOPCHINSKI: This is not a safety concern, then, it is a maintenance concern?

MR. BARROW: Well, it is a safety concern in that we are still concerned about the possibility of false trips on that breaker when the battery has to go into emergency operation, the possibility it could false trip during the first minute right when it got to peak.

MR. KREUTZIGER: I thought that I heard that when on the SIAS signal, which is essentially the accident condition, that we were bypassing it.

MR. TAJADDODI: That is not an isolation device. That is not an isolation device under the requirements of 1.75. That is all a Class IE system. The whole thing is IE.

MR. KREUTZIGER: No, is there a tripping -- is there an overcurrent trip on that, a breaker on that, that is set at some value below the fault current level?

MR. TAJADDODI: This breaker, first of all, for

continuous duty purposes is sized such that it can override the one-minute in rushes,. one-minute requirements of the battery. Number two, it is sized such that if there is a fault here (indicating), it can interrupt and protect the battery. Now, I see two different questions. One is saying that we've got to connect this solidly to the distribution system.

MR. BARROW: Well, through a switch.

MR. TAJADDODI: The switch is not going to provide any protection, because it cannot interrupt a fault, so from that point of view, you are not protecting your battery. That is out of the question.

The other question was why don't we have a molded case circuit breaker. A molded case circuit breaker as far as maintenance I don't see is much different than an air circuit breaker. Anything with a fuse, first of all, has to be maintained for test. Number two, it will be in violation of IEEE 308.

MR. BARROW: Well, the thing is taking a protective device out and losing a battery is not really a bad thing, because that can only happen on one train and you have four redundants, but what would be a good thing is if you had a breaker to each one of those positions on each four trains and you had a common mode failure of that breaker. In other words, a common mode, it open circuited inadvertently, when

you had an SIAS signal it open circuited inadvertently and you lost a battery connected to those.

MR. TAJADDODI: These breakers have got no interface with an SIAS signal. They've got no connection to an SIAS system.

MR. BARROW: No, I am saying that they open circuited inadvertently when the batteries picked up the short-term load.

MR. TAJADDODI: Yes, but I told you this is well above its one-minute loading let alone the continuous loading, so it couldn't inadvertently open. Maybe I am misunderstanding your question.

MR. BARROW: I am talking about a common mode failure problem, not normal operation.

MR. BINGHAM: Single failure.

MR. BARROW: Yes. If you had a common mode failure in those breakers, because they are all the exact same breaker --

MR. BINGHAM: You are talking about four failures.

MR. BARROW: Four failures, but the definition of common mode failure is to have identical devices fail the same way.

MR. FREID: I think what he is saying, Bill, is that the thing is rated for 5,000 amps, but it actually trips at 900, because that is what your one-minute in rush is. If

there is an inherent design deficiency in one circuit breaker, that same design deficiency would exist in all the circuit breakers, so when you demanded one of them, none of them would go on, because they all had the same design flaw.

MR. BARROW: That's right.

MR. BINGHAM: Well, that's true for any component in the system.

MR. BARROW: Well, what we are saying is that you could remove that possibility in line with what Ron was saying by removing that active device and replacing it with a passive device.

MR. VAN BRUNT: Without belaboring the point further, do you understand the concern that the Board is raising relative to this matter?

MR. BINGHAM: I am beginning to understand it. One of the things that we have to deal with is it does depart from the established criteria for the system.

MR. VAN BRUNT: Yes, I understand that.

MR. ROSA: From the standpoint of the NRC, the requirement in 308 for a breaker in that position I think is intended to reflect good design practice for equipment protection. We recognize the probability of a spurious trip, say, on this initial high current, but the same thing can be said of every main feeder breaker on all the main buses. The diesel generator breakers, for instance, on the

4160-volt buses, the same analogous position, and they all contain overload features, automatic trip features, and so forth. So before you go down that road of considering just a plain disconnect there, I think you ought to give it a lot of thought.

MR. TAJADDODI: We particularly felt that we enhanced the reliability of the system by having the circuit breaker in it. We realized that you can have a fuse thing in here, but that was unacceptable as far as testability was concerned. Every time you test a fuse, you've got problems with that, but, also, as you mentioned, these things are common to all the electrical systems whether they be dc systems or ac systems. They are all subject to common mode failure. Even a diesel generator is subject to common mode failure.

MR. BINGHAM: Ed, do you want to finish with what the Board would like us to do?

MR. VAN BRUNT: Well, I want to be sure you understand the concern that has been raised and comments of the various people. I think that it is an area, just listening to it, that I think you need to go back and think about. If you understand the concern that is being raised, I would ask that you go back and think about it and come back with a discussion of this particular point and why it is not a problem or what we ought to do about it to be sure that it isn't a problem.

MR. ROSA: There is one other comment that bears on this, I believe. Preoperational testing of the systems includes the actual simultaneous actuation of all ECCS loads which would impose that design load on that particular breaker, and that is repeated every 18 months.

MR. BINGHAM: That's true.

MR. VAN BRUNT: That is partly getting to what I was going to say. I think we ought to think it through to relieve some of the concern about inadvertent operation of that breaker. Because of the testing of those components, as Mr. Rosa has mentioned, that relieves any items that you will have subject to inadvertent operation or maloperation, but you relieve that by continuous testing and proper setting.

Are there any other questions in this area?

MR. KARNER: I would like to get back to separation for a little bit. When you talked about doing your separation reviews, were you doing those reviews for separation of all four channels in the event of pipe whip or some kind of physical phenomenon or were you looking at separation of the two trains?

MR. KEITH: It is primarily separation of the two trains, but what we allow or our criterion is that, for example, a pipe break doesn't wipe out more than one channel of the four. We do not allow a pipe break to wipe out two channels. We do allow it to wipe out one.

MR. ROSA: Even within the same train?

MR. KEITH: A channel would always be in the same train as the pipe break. There are two channels that are kind of associated with each train of the four channels, but we only allow the pipe break to wipe out one channel.

MR. VAN BRUNT: Associated with a train? We've got four channels, A, B, C, and D, and I don't know whether it is right, but A and B say go with the A train and C and D go with the other train, and if you've got some kind of mechanical phenomenon, pipe whip, associated with the A train, it will only take out one of the electrical channels associated with that train. Is that what I heard you say?

MR. KEITH: Well, what I said was we assure that it does not take out more than one channel. If it does take out a channel, the channel almost certainly would be associated with that train just because of the physical location.

MR. VAN BRUNT: But you can't take out both of the channels with that train.

MR. KEITH: No.

MR. ROGERS: I am going to continue on. A little while ago you talked about field generated drawings and you said that in field generated drawings you establish certain hazard zones and you don't permit, say, conduit to be run within those certain hazard zones if I understood you correctly. Is that right, Dennis?

MR. KEITH: That's correct.

MR. ROGERS: What I would like to ask is how do you verify that the drawings that are generated in the field and the actual physical equipment are implemented correctly? How do you go out and verify that they don't impact or get into an area that is incorrect?

MR. BINGHAM: That poses an interesting question. The way that we are proposing to have the ultimate check is to have a walkdown of the systems. At the present time, from time to time, we are finding from various individuals looking at the systems that there are some things that are getting inadvertently through. The installation of conduit happens to be one that we are trying very hard to look at on the model, but there are cases that occur where we may encroach on the particular space or something else. All the piping systems will be walked down as part of our release for the systems to determine and to make sure that all the restraints, supports, and so forth, are in the proper place. Other systems are going to be walked down as well. We are presently thinking about I think throughout all of our companies just how best to accomplish this means, because it is an area that has to be done. So, in answer to your question, we are probably doing 90% of the job now. The other 10% we are going to pick up in some means such as walking the systems down prior to turnover to start-up or actually maybe during the

functional testing of the system.

MR. ROGERS: So I understand then that all of the conduit will not be shown on the model?

MR. BINGHAM: All the conduit will not be shown on the model.

MR. ROGERS: So that means that you will bring engineers familiar with the criteria over to the field and have them walk it down?

MR. BINGHAM: Yes.

MR. ROGERS: When will this be done?

MR. BINGHAM: Well, like I said, probably sometime around functional testing or just prior to the start-up functional testing of the systems.

MR. ROGERS: Have you considered doing that as it goes in with the field-generated drawings themselves?

MR. BINGHAM: We have, and, as I said, we can't assure 100% compliance until everything is there. The idea is to get as far along as you can and make sure you catch major items through all the eyes that are available to look at what is going on in the field.

MR. ROGERS: This does get us back to a question that I raised much earlier, and that was changes to design criteria. I am concerned about the changes in the criteria and how we go back and verify that those changes are implemented properly. I don't think that you ever came to a final discussion on how

the criteria and specifications which evolved from the criteria and the equipment which are produced from the specifications do finally meet the criteria that you have implemented in, say, Revision 6 or Revision 7. What is the review process that ensures us that the criteria indeed are met in the final design product that is in the field?

MR. BINGHAM: Well, it is a multipronged effort. As I indicated, the industry, including Bechtel, is focusing on the best way to come up with that assurance not just in these systems, but all systems. We have our proceduralized setup that I discussed earlier which sets everything in motion. We still are dependent upon people to fulfill their function, their jobs, that we have described. We insist that all the key documents be signed and/or stamped by registered professional engineers in the appropriate states with its associated code of ethics and practices that they must follow as professional engineers. Toward the end of the job, we will have a formal design change control program that will assure proper level of reviews and in fact go to the higher levels of engineering and project management, and then we will follow that up, as I said, with various programs of walking down the systems with engineers that are familiar with the design. There are other agencies that will be helping us review it. For example, the Compliance Division of NRC before an operating license is signed will again review the

work that Bechtel has done, for example, for compliance with the commitments in the licensing document. Again, if you recall, I said there is a one-to-one correlation between the design criteria and the commitments in the licensing document. So we have several levels, plus the utility also is reviewing and assuring themselves that the design that is installed does reflect the criteria that they have approved. So we have Bechtel, we have the utility, we have the regulatory agencies all looking at the same things. Finally, we are developing more comprehensive programs and will be developing them to assure that we have met the criteria and have implemented the design, including changes, properly. You know, of course, that present history of operating plants is that there is a significant amount of changes for various reasons up to the day of loading fuel and even subsequent to that. So it is an ongoing program that is being done. You have these three different agencies and you have the different levels with the group.

MR. ROGERS: Let me take another tack on the same question. Revision 5, January 18, 1980, of the 125-volt dc IE design criteria states that the NSSS IE dc load sizings given in reference one shall be used in sizing the Class IE batteries. Reference one is the CE Balance of Plant Criteria Section 22, Table 22.3. Combustion Engineering Standard Engineering Package Revision 6 refers to references one and two,

so there is another listing for NSSS loads. What assures us that in the final design you used both references.

MR. BINGHAM: Let me talk about that one particularly. Just a while ago, we were advised by Combustion Engineering that the use of the SEP is no longer appropriate and should not be referenced in our design critiera. This was as a result of their review of the later revisions of our design criteria. We since have been going back through revising the criteria to pick up the correct reference and have been assuring ourselves through our own review and the review CE has made of our design that the proper loads have been incorporated in the design. What you are seeing now is making the proper reference to the actual criteria.

MR. ROGERS: Do you go back with the new or revised criteria to the calculations and verify those calculations again to assure you and us that the loads are indeed proper to the new criteria?

MR. BINGHAM: In general, we would do that. This specific case goes the other way around. The loads were already in the calcs and now we are getting the reference right.

MR. ROGERS: So you would go back to each calculation and verify that the numbers are correct and then go to the specifications and verify that we are indeed purchasing the proper equipment?

MR. BINGHAM: That's correct.

MR. SHEPARD: Bill, I think you probably know there have been occurrences in operating plants where the battery charger has been identified to have failed. I mean by that the battery charger has failed to accept load. These failures and the manufacturer of the charger in each case have been identified in the operating report. The manufacturer for our battery chargers is Power Conversion Product, Incorporated. My question is does Bechtel know of failures of battery chargers made by this manufacturer which have occurred at any of Bechtel's plants and/or other operating plants?

MR. BINGHAM: Fred, you looked at this one, didn't you, for us?

MR. TAJADDODI: Yes. We are aware of the problems that can happen to the chargers. We've got also Bechtel's experience and feedback through different divisions as to what kind of problems we can expect on different equipment. As far as the failure of a charger is concerned, as far as safety requirements of the system, we consider that the way it is designed, even if the charger fails, we are not going to violate single failures like the failure of any other component. Now, if we've got a common mode failure of equipment, we will know through our experiences, but so far we have not identified a problem with the chargers to be of the magnitude to require addressing on a major level, but if

there is a failure of such magnitude that needs to be undertaken, Bechtel will take the appropriate measures to rectify the situation.

MR. BINGHAM: Let me add --

MR. SHEPARD: Your response is --

MR. BINGHAM: Are you addressing the manufacturer of our battery chargers?

MR. TAJADDODI: Well, I didn't understand your question specifically. What do you mean?

MR. SHEPARD: In selecting the bidder and subsequently, have you looked at failures of that manufacturer in other operating plants?

MR. BINGHAM: I think I understand the question a little better. I thought you were focusing on that one particular issue. The answer is yes and, as a matter of fact, we have several organizations within our company looking at these particular things. If it were a plant that has not yet procured a particular component, we will through our Procurement Department and through our Engineering Department be looking at whether a vendor is qualified. Let's say that we have already bought something. We then have what we call problem alerts that come from the chief engineers where they have heard that this particular component or manufacturer is not doing a satisfactory job. The project engineer is notified. The group supervisor in charge of this particular

design is notified and is formally requested to respond how this particular issue is being handled. That is reviewed by the chief. Generally it sets up a complete chain of review. Usually the customer or the utility is involved. The vendor is called in immediately to sort out the problem, and in some cases even a vendor's product may be dropped and another used. So there are several checks and balances.

MR. TAJADDODI: Bill, I might also mention the I&E bulletins that are coming from NRC, which have from time to time mentioned the serious problems that other utilities might be experiencing on equipment, and they are circulated throughout the whole industry for information trying to alert problems of a nature that you have described. So NRC also helps us in that manner through the IE bulletins and information.

MR. VAN BRUNT: Bill, before we get off this subject, I would like to ask that you assure the Board -- you don't have to do it right now, but assure the Board that you have talked to our particular manufacturer and that he has identified any problems to you that he is aware of.

MR. BINGHAM: I'll do that, Ed, and, as you probably know, in general, when we get a question that comes in, we send letters out to all the manufacturers of the particular product. Generally it is a product not necessarily a name brand and we get responses in writing from those individual

suppliers. We compile them, review them, and then send them to you for your review, and all of these that have been flagged either have been answered and are documented in the records or they are in the process of being documented.

MR. VAN BRUNT: I understand. I would like you to verify to us that that has in fact happened.

MR. BINGHAM: We'll find out.

MR. ROSA: Bill, has aging been considered in the seismic qualification of batteries?

MR. BINGHAM: Yes, it has. We are going to talk about qualification toward the end of the presentation, Faust, and we can get into that to any depth you would like at that time.

MR. KARNER: I would like to get back again to separation. You indicated that in your separation reviews as far as pipe whip, you only allow one channel to be disrupted by any given pipe whip. What is your criterion for fire protection relative to degradation of one or more channels?

MR. KEITH: Don, in certain selected areas, for example you saw the battery rooms themselves, they are all separated by fire walls, and in the control room, I think the cabinets are pretty well taken care of, but, in generally, I think the conduit and all that is just separated trainwise rather than channelwise as far as meeting the NRC exposure fire criteria. As far as meeting Reg. Guide 1.75, we meet that and we meet

those separation requirements on a channel basis, but as far as the exposure fire, I don't think -- you know, I think we just meet that on a train basis rather than on a per channel.

MR. TAJADDODI: With the exception of the battery rooms. They meet that requirement anyway. We meet the battery room requirements on a channel basis.

MR. FERGUSON: In the fire walls between the battery rooms, are there any penetrations of any kind?

MR. TAJADDODI: We can show you what we have.

MR. KEITH: That doesn't show. I am not sure, Chuck. If there are any, they will be qualified for three hours. In a three-hour wall, all the penetrations are qualified.

MR. FERGUSON: So it covers the whole thing?

MR. KEITH: Yes.

MR. VAN BRUNT: Let me follow up with a question. I gather from the conversation there is a sprinkler system or whatever in the battery room, is that correct?

MR. TAJADDODI: A CO_2 system.

MR. VAN BRUNT: So there is no water in the battery room, so I take it then the drain system is not sized to handle water.

MR. BINGHAM: It would be leakage from the battery runs and such as that.

MR. VAN BRUNT: That is what I was going to ask. What is the sizing basis for the drain system?

MR. TAJADDODI: Let me say we've got a backup. The primary fire protection is CO_2, but the backup is fire sprinklers and hoses. They are primarily CO_2 unless the CO_2 is not available because of malfunction. Then you go to the fire hoses, and those are the basis for the drains.

MR. VAN BRUNT: Then the fire hoses are the basis for the drain system sizing, is that correct?

MR. KEITH: We are going to get back to you on the drain system anyhow.

MR. VAN BRUNT: Would you add that to part of that?

MR. KEITH: Yes.

MR. BINGHAM: Let me indicate, Ed, for the panel's information that there is a design criterion that covers the design and sizing of all the drains throughout, which this is one piece, and we can go into that information and pick out the information.

MR. VAN BRUNT: I realize it is a little out of the basic thrust of this meeting, but it is all related to the adequacy of this system, that the batteries could be flooded out because we didn't have adequate drainage capacity in the rooms or something like that.

MR. BINGHAM: John Allen I believe had a question.

MR. ALLEN: Yes. Let's go back to the failures again. Fred, during your presentation, you indicated that we meet the single failure criteria. However, since TMI, there has

been a lot more emphasis on going beyond meeting the single failure criteria. Maybe it is not quite good enough. What has Bechtel done in their review of this system to maybe take that just one step further and see if the single failure criteria is adequate?

MR. BINGHAM: The answer to your question, John, is that we have been thinking about it, but we have not at this time done any substantial work on this particular system. One of the systems that we will probably be looking at is the auxiliary feedwater system. We have become aware of this particular concern and, should there be some future work that is done in the industry, we will apply it, but right at the present time we do not have any plans to go into detailed analysis on this particular system.

MR. ALLEN: What you are saying then is we look at the auxiliary feedwater system and you take it a step further, the dc 125-volt class system would be a part of that analysis.

MR. BINGHAM: It would be a part of that analysis, that's right.

MR. VAN BRUNT: Bill, I think for the record and for future consideration that you should specifically consider some additional testing of the system, and I don't mean physically testing, I mean other kinds of testing of the system looking at how far the system can go beyond the regulatory design basis, if you like, and share that with us.

MR. BINGHAM: All right.

MR. VAN BRUNT: I have another question along those lines. Early in the presentation, Fred talked about all these codes and standards and Reg. Guides, and so forth, and so on, that apply to the design of this system, or any system, for that matter. In your design of these systems, how do you consider those Reg. Guides? Do you consider them as minimum requirements, do you consider them as the maximum requirements you've got to have, or what?

MR. BINGHAM: Well, Ed, it depends on what particular system you are looking at. Certainly there are requirements that we have or the utility has committed to as part of their construction permit, so they are a mandatory part of the criteria. There are cases where we have put forth arguments with NRC for various reasons, because they do permit that if we believe our system meets the intent of the design requirements. Sometimes we win; sometimes we lose. So to say they are mandatory in some cases, they are imposed necessary criteria as part of doing business. There are other cases where for a particular utility there may be things built into the design that are particular utility concerns -- coatings, maybe some other type of fastener, remover, or a standard sort of thing amongst various components that allows a utility to have better assurance of having high availability of the plant, ease of maintaining, so forth. That may be

built into the criteria. Maybe one could say well, it is above and beyond, but I look at it as being supplemental to the basic criteria that we have.

MR. VAN BRUNT: Well, let me say it a little different way, because you didn't quite get at what I was trying to get at. Do you ever exceed the regulatory requirements in the design?

MR. BINGHAM: Do we ever exceed the regulatory requirement? Can you tell me what you mean by exceed?

MR. VAN BRUNT: Well, if the regulatory requirements say you need two cables for redundancy, would you for reliability purposes, and I am talking about as a basic good design, forgetting the safety aspects of this, would you put in four, let's say.

MR. BINGHAM: We may.

MR. VAN BRUNT: So, coming back, you don't view the regulatory requirements as you are going to go that far and not any further. You might for good and sound reasons go beyond that or whatever as a basic design requirement.

MR. BINGHAM: Absolutely, yes.

MR. KEITH: As an example, in this system, the swing chargers, the two swing chargers which we have, are not required by the regulations.

MR. BINGHAM: And they are put in to allow the plant to stay on line a longer time. That is a good example,

Dennis.

MR. VAN BRUNT: I've got a couple of other questions I want to get in. Does the Board have some other questions?

MR. KRAMER: When we were discussing compliance with Reg. Guide 1.75, the first requirement, you mentioned something about isolation devices associated with the Class IE dc system that were actuated by SIAS. What devices are these?

MR. TAJADDODI: Breakers. Most isolation devices are breakers, which are actuated other than by a fault current. That is the requirement of 1.75. The other requirement besides the fault current is the opening on SIAS. Those are what we consider as qualified isolation devices in accordance with 1.75.

MR. KRAMER: Well, I was just looking for at least an example of one in this system.

MR. TAJADDODI: We don't have isolation devices other than that because it is all Class IE. We don't isolate Class IE from non-Class IE, because we don't have the two associated together. All the system is Class IE. We don't intend to isolate it. We are all within that same system, so we don't have an isolation device per se here with the exception of that panel that we mentioned in the control room, which is for indication purposes, and there is a qualified inverter there and a breaker plus analysis to meet the requirements of 1.75. That is the only place we have an

isolation device.

MR. ROSA: I just want to verify something you said here. 1.75 does not recognize fault current operated devices as isolation.

MR. TAJADDODI: Alone, that's right. It has got to be actuated.

MR. ROSA: By an SIAS signal.

MR. TAJADDODI: By an SIAS signal.

MR. ROSA: Or there should be a qualified isolation device.

MR. TAJADDODI: Right. Absolutely.

MR. BINGHAM: Ed, are there some more questions?

MR. VAN BRUNT: Yes, I have a few more.

MR. BINGHAM: Mr. Allen has one. You might want him to go first.

MR. ALLEN: Awhile ago, we talked about the safety equipment status panel being non-IE, but it being located on the control board next to the IE devices. How do we ensure we have adequate separation between those two on the control board?

MR. TAJADDODI: Physical separation?

MR. ALLEN: Right.

MR. TAJADDODI: Under 1.75, the equipment is purchased to meet the requirements of internal wiring and barriers are installed inside to meet the requirements of 1.75, six-inch

separation between the wiring if not a barrier between the devices, and so forth, to meet the requirements of 1.75. These are part of our equipment procurement procedure that the manufacturer has got to follow and we check those and make sure that the wiring inside meets the requirements of six-inch minimum or qualified barriers, whatever is needed to meet the requirements of separation.

MR. VAN BRUNT: Bill, before I ask a question, and maybe you didn't hear me, because you didn't answer it, this is going back to some kind of spill of sulfuric acid or whatever in the battery room. We have floor coatings of some sort, I don't remember what they are, in that room. What have you done to assure that there aren't any reactions between the acid and the floor coatings that might generate some hazardous gas or explosive mixture or whatever the case might be?

MR. BINGHAM: Yes, you did, that's right. I forgot to answer that question. I think two things are important. First of all, the plant is designed to meet the OSHA requirements, which bring into play all the safety issues for personnel, for example. The second part is the protection of equipment, and the coatings are selected to be compatible with the type of environment that they are going to seal. For example, in these particular rooms, the coating would be compatible with the acid that is being spilled on it to assure

personnel protection and ease of cleanup after the spill.

MR. VAN BRUNT: I guess I would like you to, unless you can right now, verify for the panel that there are no reactions between whatever the coating is in that room and the acid if it was spilled.

The second part of that question, do you happen to know what has been done to assure that the support rack structure for the batteries and things like this will not be corroded or otherwise react to the acid should there be spills?

MR. BINGHAM: There will be some degradation. Again, I guess we are focusing on normal maintenance and not on a particular failure in this case, because we have said that if there is a failure of one channel, which might be a complete spill of a battery or degradation of the racks, that that is acceptable because of the redundancy.

MR. VAN BRUNT: I guess I am going beyond the safety case now.

MR. BINGHAM: For the maintenance, yes. I guess I could mention that the utility and engineer have meetings either once or every other month looking specifically at maintenance concerns on this plant, and those are done with a preestablished agenda looking throughout the whole plant on assuring that we have addressed all of the maintenance operability issues. So from a maintenance viewpoint, there is

quite a program going on that is documented through minutes of meetings that deal with these particular issues. Whether the specific one you have mentioned or not is documented I don't know.

MR. KOPCHINSKI: Yes, it is.

MR. TAJADDODI: Well, we were going to cover these. I think we are slightly ahead of ourselves, because these are covered in the component description which we do mention later on in the presentation. The battery racks are of structural steel with acid-resistant coating.

MR. VAN BRUNT: How about the connection to the floor?

MR. TAJADDODI: The connection is as well. We are going to cover these. We tried to summarize these things as much as possible. There are some connections that may not be, but the racks themselves are coated. The racks are coated, but some of the connections might not be.

MR. VAN BRUNT: What I was really getting at, I am thinking of a battery rack in my car. After while it gets corroded and these connections might get corroded here, and then if they were subject to earthquake or something like that, had they been, we can end over a period of time such that you might get some adverse effect from it. That could be kind of viewed as a common mode kind of situation, because it could happen in both battery racks.

MR. BINGHAM: We will discuss that.

MR. VAN BRUNT: If you are going to discuss it, I will get off that particular kick.

MR. TAJADDODI: Yes, we have that in here.

MR. BINGHAM: Let's take that up at that time. If there are any other areas the Board would desire that we look at in more detail, I am sure we can get the information for you.

MR. VAN BRUNT: I want to go back and follow up on the area that Carter was delving into a little bit. I think Dennis when he was talking about this indicated that conduit runs are generated in the field drawings. I would like to understand a little better how the criteria are communicated to the field people to generate those drawings, what internal controls you have on preparation of those drawings to assure that they are signed off by the appropriately technically qualified people, what are the kinds of people that are doing this work to be sure that these drawings which are generated in the field have the same design review level, if you like, as home office generated drawings.

MR. BINGHAM: You are focusing on the conduit drawings particularly?

MR. VAN BRUNT: Or any field generated drawings. Dennis happened to mention field generated conduit drawings, and I was interested in how you control those particular drawings and changes to them, because you have a 100- or 300-

mile chasm that you have to span between Downey and the Palo Verde site.

MR. BINGHAM: Very difficultly, I guess is the answer. The drawings are generated in the field. They are brought into the home office, where they are reviewed for whether there are congested areas involved or not or interferences. Generally, we have about 20% that fall in that category. The other 80% are being put on the model to assure that things are in order. Once that check is done, then they go back out to the field for installation.

MR. VAN BRUNT: What criteria are the engineers or draftsmen or whoever in the field that are generating these drawings working to?

MR. BINGHAM: Well, generally, they have what are called work plan procedures or instructions that are reviewed by the home office engineer. In fact, every work plan procedure is reviewed by engineering to assure that the technique that is depicted in the procedure reflects approved criteria. Then they will do their work to that particular procedure, which is auditable, and submit the information then to us. We have a proedure, and I believe that it is partly in modification right now, to make sure that we have proper instructions to all the individuals that accomplish that review.

MR. VAN BRUNT: Do these field generated drawings become a part of the final drawing record for the plant?

MR. BINGHAM: Yes. In some cases, they are actually either shown or referenced on our permanent plant drawings. For example, all the underground field generated drawings are shown on the underground drawings or are referenced to a particular field generated drawing number.

MR. VAN BRUNT: Are these units specific drawings or are they a single drawing as we have in most of the other areas?

MR. BINGHAM: Well, in some cases, they are plant specific. In other cases, they will cover the total area outside; in other words, the yard area, so to speak. The other drawings are generally referenced on an as-built listing that we have for each unit. The intent is to have a complete compilation of all the drawings, the design changes, and other related documents such as nonconformance reports, and so forth. If something doesn't get located exactly right, we are not going to rip it up and change it, but we want some documentation of how it looks, so you will either see it on a drawing or you will see it in the as-built records.

MR. VAN BRUNT: In what is left of your presentation, are you going to get into -- we have been talking a lot about the conversion of design criteria and the specific design drawings. We haven't talked very much about specifications and procurement. Are you going to get into that at all?

MR. BINGHAM: Not in detail, Ed. I think if the Board

has some particular questions on those, it would be appropriate now to bring them up, and if we don't have the answers now, we could get them during the break.

MR. VAN BRUNT: What I wanted to get into is really the same kind of discussion that we just had on the field generated drawings. You have a lot of criteria the majority of which for this particular system end up in drawings. However, there are a lot of criteria in the form of loads and other things that end up in the form of specifications to manufacturers who provide us with a piece of equipment. I am interested in what the process is to assure that all of the design criteria get incorporated into those specifications.

Secondly, what is the mechanism to assure you that the manufacturer understands those criteria, how do you go about selecting the manufacturer, the whole procurement process, if you like, and then after the equipment is purchased, what kind of controls are put on interfacing in the exchange of underdrawings and those kind of things to assure that the criteria that come from the specific vendor that provides this pieces of equipment is factored back into the system design that we have been talking about.

MR. BINGHAM: I can answer those questions without further work.

MR. VAN BRUNT: I hope so.

MR. BINGHAM: Let me preface and say, though, that

even though we think we have a very workable system, there are always times when we have some breakdowns that are picked up and we have to go back and reinforce those particular areas. Let's talk about the procurement cycle a minute and particularly from the design viewpoint, which is I think where we are trying to focus anyhow.

MR. VAN BRUNT: You might also relate to the utility's role in that process as well, at least from your perspective.

MR. BINGHAM: All right. From our perspective, the start of the procurement cycle is really the design criteria and the plant application. From that, we take one of our standard specs and modify it to meet the particular plant design. That is reviewed by the disciplines to assure that all of the requirements they have for a particular system or component that is being ordered has been included. That is really not good enough for us, because we find that, while you may get 95%, it is the other 5 that is missing that many times is not desirable, so we have a set of checks and balances in the review of specifications that consists of about three sheets that are attached and are part of the record of the review of the specifications. One of them is a sheet that documents the review of the codes engineer, that all of the codes are appropriate for this particular specification; that is, the right reference, the right year, whatever code cases are involved, and any other pertinent information.

The second sheet is a review of the licensing requirements, that is, the commitments and the licensing documents, and that goes through and assures that all the commitments are being met and gives a reference of where that occurs or, in general, its source. There is a final sheet that is put together by the quality engineer in each discipline, which is a check-off sheet much like when you start up an airplane or anything else. It has several questions, items that they must verify that have been covered in the specifications. Once this is done, then I as a project engineer have assurance that all of the pertinent criteria have been reviewed for incorporation in that document.

I have another level of review, which is the chief's office, to assure that the component is the proper component and reflects all that we have learned throughout industry and represents good practice. That document then is sent to the utility for review, and the utility has a program, and now I am looking from the perspective of our relationship with APS, of review where they will check again all those various components to assure that they have been included in the specification and any requirements that a particular utility might have for maintenance or other reasons and then the questions are sent back to us asking generally for clarification. In some cases, there may be a point that was missed, so we have that level to put the spec together.

That is the specification that essentially is ready to go out to bidders for a request for proposal.

MR. VAN BRUNT: How do you resolve those utility comments in house?

MR. BINGHAM: They are resolved by letter.

MR. VAN BRUNT: I know they come back by letter.

MR. BINGHAM: In house, the comments go to the responsible engineer for that particular specification. That responsible engineer's job is to work with the utility, resolve the comments, and then to respond in writing the resolution of the comments. That is basically the step. Is there any question on that part?

The next part is how do we determine who should we go to bid with, and there are technical reasons that must be considered. There are schedule reasons. There is performance. For example, many vendors may have their shop overloaded and cannot perform in the time frame that we are interested in. All of those specifications that we have written, we have a document that reflects potential bidders for each of those, which is updated and is reviewed by the utility. That document forms the basis to start the list for approved bidders. Then the current environment is viewed looking at shop loading, looking at whether a vendor is commercially on the brink of bankruptcy, looking at such things as overall ability of a particular supplier to meet the requirements of

the particular spec.

MR. VAN BRUNT: What do you do about quality assurance?

MR. BINGHAM: If it is a Q component, the spec is appended to the requirements of the program essentially asking them to submit documentation and their program with the bids, their QA program, for our review to assure it does meet 10 CFR 50, Appendix B. We in addition for certain specs look at the use of local bidders. This is generally not the case with some of the more complex equipment, but for some of our buildings and other things and tanks, for example, or structural steel, we will look at the benefits of the local bidders as well. Once we have done that, then we submit to the utility our recommendation of the proposed bidders for the particular components. Before we go out to bid, we have in writing from the utility their concurrence or suggested modifications to that bidder's list. That gets us to the point where we are ready to go to bid. Your question I think then picked up at the time when we had selected a particular supplier.

MR. VAN BRUNT: Well, even more than that, Bill, you issue the specifications now to this list of selected bidders.

MR. BINGHAM: That's correct.

MR. VAN BRUNT: What vehicle do you use to ensure yourself that the bidder has understood the specification? A typical area that I know is a difficult area has to do with

the equipment qualification. How do we assure ourselves that the vendor understands the specs so that when the bids come in, which is really what I want to get to, that you've got a piece of equipment that meets the specs, or how do you assure yourself of that? How do you communicate to the vendor what you want and then how do you assure yourself that you got what you wanted?

MR. BINGHAM: Of course, many of the vendors see a lot of the same specifications. In other words, there is a lot of equipment that is the same. So, depending on a case-by-case basis, we may spend a lot of time getting our requirements across, for example, on purchasing an NSSS or turbine generator. We may spend substantially more time with the individual groups that are going to bid to explain really what our requirements are. But, in any event, generally there are informal meetings even before the request for proposal goes out where the vendors are very interested in what we are doing and we try to explain to them some of our thoughts a little bit about the particular plant and the applications that we have. I think the area where we assure ourselves most is after we have determined the low bidder or the next bidder, we have them in to assure that we have a common understanding. Now, there is some procurement protocol that goes on during that time that we adhere to to assure fairness to all the vendors.

On this particular project, we have worked very hard to conform our specifications so that there is at least minimal misunderstanding on the part of the vendors of what is really required at the time that the purchase order is signed. I think that has given us a high degree of assurance that there is understanding or at least that the words are very clear of what the requirements are.

MR. VAN BRUNT: For the record, when you go through your evaluation of the bids that you have received, what are the kinds of things that you consider before you make a recommendation as to which manufacturer of equipment ought to be selected?

MR. BINGHAM: We look at both tangible and intangible items. First of all, we do an analysis of the cost and compare it with the estimate to determine whether the bidders costwise are in the same ballpark. Next we look at intangibles such as performance, that is, meeting our schedules, the dates that we have asked for the equipment. We look at the exceptions that they have taken to the procurement document, and we look in detail both at the commercial and the technical side of the proposal. For example, an individual may be an extremely low bidder and say you are going to take my standard terms, which may have little or not conditions or anything else. So we have these three that we balance. We have a meeting about ten days after the bids are received. Bechtel

will then rack up the different vendors, and at that time we will determine whether we can make a preliminary recommendation to the utility or whether more information is required in order to understand the bids that are in. Let's assume that there is sufficient information. We then will do a detailed evaluation of the proposals and we will usually look in more detail at the one or two selected bidders that we see. We send that over to the utility with a recommendation. The utility reviews it, we have a meeting to determine whether the recommendation fits the best interests of the project, and from that point, we will agree mutually how to proceed with consummating the purchase order for that particular piece of equipment.

MR. VAN BRUNT: Do you always go to the low bidder?

MR. BINGHAM: We don't always go to the low bidder.

MR. VAN BRUNT: The other last part of the question I'm interested in is how do you deal with the design criteria. You get feedback. After you have gone to XYZ Manufacturer for a particular piece of equipment, he then submits to you a lot of vendor drawings and other things. How is that particular interface handled and what assurances are provided that there is adequate understanding of that information that goes back and forth?

MR. BINGHAM: There are probably three things to consider. The first one, and let me deal with a Q class

specification where the vendor has a program as required by the spec to assure himself through his management reviews that input that comes in is properly incorporated into the design and that all their internal manufacturing and design procedures are satisfactory and meet the spec and the has a reporting system to us of any deviation that he takes from the specifications. We, also, on the second part do audit these individuals from time to time to assure that they do what they say they are going to do. That is the second point.

The third point is the criteria. Generally, we try to define the interface criteria clearly for a particular vendor, and that information when it comes back in the form of drawings is reviewed by a particular discipline to assure compliance with the overall design. So if a vendor says to us, "I can't meet your specification," he will send in some documentation on an SDDR form and that will be looked at in detail by the home office engineering and either accepted or rejected. Because of the complexities as you get later on the job, there is a separate procedure that has a check-off list, if you will, of all the people that are involved in the decision. It has the responsible engineer, it has his supervisor, the records of the notification to the customer, the records on the cargo in the field if it is a ship short or some other item, and finally the last review of the QA group on the project that everything is in order. That then

documents the changes that are required. It also sets up this procedure through checking the right box of the design criteria changes required or FSAR changes required. It is also signed by the nuclear group supervisor to assure that the licensing impacts are included if it is appropriate for that particular component.

MR. VAN BRUNT: Really as a bottom line, then my understanding is that that whole procurement process is a process that is covered by procedures, it is a process that has checklists, et cetera, and that when all is said and done, it is audited by Bechtel QA, by APS QA, and as appropriate, and maybe I would ask, whether it has been audited by the regulators themselves? Is that correct?

MR. BINGHAM: That is correct and that has happened.

MR. VAN BRUNT: You wore me out, Bill. John has some questions.

MR. ALLEN: Let's go back to common mode failures for a minute. That is my favorite subject. The room above all the battery rooms, that whole dc system, is the lower cable spreading room; right?

MR. BINGHAM: That's correct.

MR. ALLEN: And in that lower cable spreading room is a large amount of water supplies for fire protection. Sprinklers.

MR. BINGHAM: Yes.

MR. ALLEN: I believe we have several penetrations

going through the floor up in there going back down into the room. What is to prevent leakage down through there and sufficient leakage to cause excessive flooding and water being poured over the top of all this equipment and knocking it all out?

MR. BINGHAM: John, there has been a substantial amount of work as far as our fire protection studies with documents and supplements on these particular areas. There are seals. In that particular instance, I know that the drain system is designed, the deluge system, so that we don't have water building up in that particular area. I don't have the ready references, but there has been quite a bit of documentation on that particular issue.

MR. ALLEN: I understand the drains and everything, but my experience has been some of these seals are just foam stuff and actually after several years, there are holes down through it. Do we use multicable transits in that case or do we use foam?

MR. TAJADDODI: Between the cable spreading room and the control -- yes, we use transits only in the cable spreading rooms.

MR. ALLEN: We are using multicable transits to go between the lower cable spreading room and the battery rooms?

MR. TAJADDODI: No, I'm sorry, it is between the floor of the cable spreading room and whatever the rooms are.

Yes, the battery rooms, you're right. We are using cable transits.

MR. ALLEN: No foam?

MR. TAJADDODI: That is the only place we are using them.

MR. ALLEN: And the same in the upper?

MR. TAJADDODI: Yes, for cable spreading rooms only.

MR. VAN BRUNT: Hold on a minute.

MR. BARROW: I think we need that to be verified. I am not sure and I don't have any references, but I believe multicable transits are only used in the floor of the upper cable spreading rooms to protect the control room flooding and I believe that the lower cable spreading room floor only uses foam.

MR. TAJADDODI: That's right. What I said was we are using them in the cable spreading room. They are used to protect the cables, the water from coming into the cable spreading room from the control room. In other words, these transits are located between the cable spreading room and the --

MR. BARROW: Between the upper cable spreading room and the control room?

MR. TAJADDODI: That's right. That is the only place we are using them. We are only using them in the upper cable spreading room between the control room and the --

MR. BINGHAM: I think the question, Fred, as I understand

it, and we will get an answer for it, is are there any penetrations that go from the floor of the lower cable spreading room into the battery rooms --

MR. VAN BRUNT: Which could be subjected to some kind of flooding.

MR. BINGHAM: Which could have some flooding occur. I think the answer is no, but we will confirm that for you.

MR. VAN BRUNT: We would like you to verify that particular situation for us.

MR. ALLEN: If it is and you use foam, I think that is a major concern.

MR. VAN BRUNT: I think we ought to take a look at that.

MR. KRAMER: I have one question. What have we done to assure in our design of the battery rooms that there are no sources of conductors that could either in an earthquake or in normal operation fall on the batteries and cause individual cell shorting.

MR. TAJADDODI: We don't have anything in the battery rooms other than the batteries. There is no other equipment that I know of in the battery rooms other than the batteries per se.

MR. VAN BRUNT: Is your HVAC duct overhead?

MR. TAJADDODI: Yes, they are seismically designed --

MR. BINGHAM: Well, that is the answer to his question if there is a fault, we either seismically design it or look

at the two-over-one concept.

MR. VAN BRUNT: I guess I would request that you verify that we don't have some situation we could get into where for some reason this would occur.

MR. ALLEN: What type of hydrogen monitoring do we have in the room?

MR. TAJADDODI: We don't have any hydrogen monitoring per se, but we've got our ventilation system such that it precludes the possibility of a hydrogen buildup higher than what in our sequence, if there is an explosive situation, is 2%. We have made a calculation showing that if indeed we lose our ventilation system and we have the highest rate of hydrogen evolution, that is, when the batteries are being overcharged, it will take 88 hours for the percentage of hydrogen to build to 2% of the volume, and we have plenty of time for the operator to take remedial action to make sure that we don't exceed that 2%.

MR. VAN BRUNT: A couple other questions along that line come to mind. Is this ventilation system running continuously or is there some actuation that turns it on?

MR. TAJADDODI: No, the normal ventilation system is there all the time.

MR. VAN BRUNT: Is there some indication to the operator that that system is not operating?

MR. TAJADDODI: Yes, every damper position is

annunciated and every HVAC system is annunciated in the control room.

MR. VAN BRUNT: In the unlikely event that that system has got redundancy into it, and I assume it's got a redundant power supply to the motors or something or other so that you have for each train some redundancy, and if that is not true, tell me, do you line in any way the walls of that room for any explosion protection?

MR. BINGHAM: The answer is no.

MR. VAN BRUNT: Did you make some analysis to justify not doing that?

MR. BINGHAM: I think what we have said is or at least the approach we have taken is that, since the likelihood of that occurrence is extremely small because of the long duration before you even get to a point where you might want to think about it. The walls, of course, are rather strong and could be looked at for that particular issue, but they have not been at this time and probably would withstand a hydrogen event of some kind.

MR. TAJADDODI: Let me amplify on that question a little bit. Even though NRC's requirement is to limit it to 2%, the explosive threshold of hydrogen is about 4%, and before that can happen, you've got to have more than 88 hours' duration before it can build up to 4% to be an explosive threshold.

MR. VAN BRUNT: Your answer to John's question was there are no hydrogen monitors in that room, so you don't have any indication of the buildup. You have to get to it by indirect methods, annunciation of the fact that your motors aren't running or you've lost your ventilation system.

MR. TAJADDODI: I was saying it takes a long time, and there is a lot of time for the operator to realize he has lost the air conditioning or ventilation system.

MR. BINGHAM: But, Ed, you're right. If the operator chose to not pay attention to all the various alarms on the system -- there isn't one here that says hey, the hydrogen content is high, but if you were going to assume that, you would assume he wouldn't look at that alarm, also.

MR. VAN BRUNT: Let the record show that I asked Mr. Kramer, from the Operating Department, to be sure that the operational procedures deal with this particular situation.

MR. KRAMER: One more question. In the ventilation system, do we directly measure the air flow at any particular location?

MR. BINGHAM: I don't know.

MR. TAJADDODI: I don't think we do. I am not so sure. We can give you an answer, but I am not so sure that we do measure air flow. We are talking about volume, rate of flow, or things like that?

MR. VAN BRUNT: Well, if you have flow.

MR. TAJADDODI: No, you have the flow, but quantifying the rate of flow, is that what your question is?

MR. VAN BRUNT: Do you want the rate or do you want to know whether we have flow or not?

MR. KRAMER: Basically whether we have flow or not.

MR. TAJADDODI: We have that, yes.

MR. BINGHAM: There is a differential pressure measure.

MR. TAJADDODI: But we don't quantify the rate of flow.

MR. VAN BRUNT: Are there any other questions along this particular line that anybody wants to raise? We kind of got off the subject a little bit, but I think the understanding of the design process and how it is applied to this system will apply as we go on.

MR. ROSA: The blowers that move this air through the battery rooms, they are on safety buses, are they not?

MR. TAJADDODI: Yes, sir. They are Class IE. They are from the Class IE power source.

MR. VAN BRUNT: Any other questions?

(No response.)

MR. VAN BRUNT: How long is your next presentation going to take, Bill?

MR. BINGHAM: Well, the presentation won't take too long.

MR. TAJADDODI: Most of the questions that have been raised were going to be part of the forthcoming presentation, so there is going to be an overlap.

MR. VAN BRUNT: Does anybody on the panel otherwise have any plans say beyond 3:00 or something like that?

MR. BINGHAM: Well, I do, but I can -- I've got a 1:25, but I can stay until the panel is satisfied.

MR. VAN BRUNT: I would suggest, knowing how long it takes to eat around here, that possibly we break for lunch and we get back together at 1:00, and I would anticipate, based on your comments, that we ought to finish by 2:00.

MR. BINGHAM: Or 3:00.

MR. VAN BRUNT: If that is satisfactory for everyone.

(Thereupon the meeting was at recess.)

May 8, 1980
1:15 p.m.

MR. BINGHAM: We had just finished the FSAR compliance and now we would like to go into the systems description and component description and cover those two and then entertain questions at that time.

Fred, if you would, please.

MR. TAJADDODI: The system [Figure 10], as we have mentioned before, is very simply four independent dc systems which are comprised of chargers, batteries, control centers and packages

and the standby charger to supply the power to either channel on the group. In addition, we have shown in this slide here [Figure 25] the battery profile as to how we have calculated the battery size. It gives you an indication of the conservatism that is built in the battery itself in sizing them. We've got the one-minute loads, the steady state loads, the random, and the end-of-the-cycle loads that can happen at the end of the battery profile. It gives you an indication of the conservatism that is built in the battery sizing criteria.

The components of IE dc systems [Figure 27] are the battery chargers, batteries and racks, and the dc control centers. Those comprise all the components that are in the dc systems plus some instrumentation in the control room.

The battery chargers actually are three-phase constant voltage units using solid state circuitry and they are self-supporting, free-standing structures.

The batteries are lead calcium types. They've got plastic containers with leak proof seal covers and they are designed to absorb shocks. The battery racks are acid resistant as far as they've got a coating to have acid-resistant characteristics.

The dc control centers are free-standing structures. The incoming section houses the electrically operated drawout type circuit breakers, and the other breakers are mainly

comprised of manually operated breakers, starters, and distribution panels.

A brief description of the equipment data (Figure 28) is that it tells you who the manufacturer of the batteries is and what are the quantities of the batteries and what type of battery it is. It gives you, also, the indication of the capacity of the batteries and the different short circuit ratings of the four different batteries and the internal resistance and other pertinent data.

The battery charger likewise gives you the manufacturer, which is the Power Conversion Products, Incorporated. There are four battery chargers with two backup battery chargers for a total of six chargers. The characteristics of the chargers is that they are supposed to meet transient voltage of 5,000 volts, the normal charge voltage is 130 volts, the equalizing charge set at 140, the maximum floating voltage is supposed to be about 135 with a plus or minus of ½% and a 2% ripple. The efficiencies of the chargers are 90% and they operate at approximately 75% power factor.

MR. BINGHAM: Are there any questions on the component descriptions? Before we get into that, I would like to indicate that the System Description was a brief summary of what occurs in the system description volumes for each of the systems. It goes through a description and talks about its normal and abnormal operation and the interfaces with the

systems. What you saw here was just a summary and we are prepared to add any additional information the Board might be interested in.

MR. BARROW: I just wanted to point out that it is most likely that those two sets of, well, you show them as EC [Figure 28], actually that should have been EN, and I believe those EN's have now become GN's possibly because of Exide's qualifications on them. I just suggest that these might be changing to GN's. They were EN's.

MR. TAJADDODI: Because of the manufacturer's problem with qualification.

MR. BINGHAM: We will talk about that a little later when we get to qualification.

MR. VAN BRUNT: As I understand it, these are the specification requirements that were given to Exide and Power Conversion Product, Inc., to manufacture these batteries and chargers, is that right?

MR. BINGHAM: That's correct, yes.

MR. VAN BRUNT: What do we do to ensure that this is the battery and charger we got? What kind of a test program or receiving inspection or whatever else do we have that this is what we've got?

MR. BINGHAM: Let's start at the point where we have released the manufacturer, the supplier or manufacturer of the equipment. That means that we have received documents that

describe the design, we have compared them with our criteria, and have assured ourselves that the information on the paper that the vendor has is accurate. The work goes into fabrication or manufacture. We have programs set up that are implemented by people from our Procurement Department through both the expediting and inspection sides of the house. The engineer when he makes an award indicates formally to our Procurement Department whether inspection is required or not on a particular component. Of course, on all the Q components, we require inspection. Along with that inspection requirement is an inspection plan. The inspection plan is a document drawn up by our Procurement Department, which is routed through the responsible engineer and myself for modification to the particular product. What we will do in there is, in addition to our particular requirements, our standard requirements of looking at configuration, general requirements of the spec, there may be some specific requirements that we might ask. For example, we may ask for witnessing of particular tests to assure that the manufacturer has indeed met those requirements.

MR. VAN BRUNT: Is there a specific performance test for the components?

MR. BINGHAM: Components, there may or may not be. For these that you are talking about here, I believe the answer is yes. There were performance tests on the batteries

and I believe there was a performance test on the charger. Is that right?

MR. TAJADDODI: Before the batteries are shipped, they are supposed to have the performance test, and after the shipment, we are going to have the operational test, and after that, we are going to have periodic tests every 18 months, I believe, per the requirements of IEEE 450.

MR. VAN BRUNT: I presume there is documentation that the tests have been performed.

MR. BINGHAM: There is documentation and they are in many cases witnessed by either us or our procurement people.

MR. KARNER: On Page PK-A-1 of your system description (Figure 28), you show the ripple as 2% on the dc output of the battery charger. What kind of fluctuation on the 480-volt ac input can you take and still maintain that 2%?

MR. TAJADDODI: From what I gather, and I am not sure, it is plus or minus 10%. We will have to verify that. It is plus or minus 10% fluctuation.

MR. KARNER: Do you have isolation to the battery charger for switching surges and other peaks that may be on the ac system?

MR. TAJADDODI: The chargers are designed, first of all, with blocking diodes to begin with to make sure that there are no surges from the dc into ac. On top of that, they are supposed to meet the surge requirements of 5,000 volts for

10 miscrosecond duration to make sure that there is no breakdown of equipment, either the solid state equipment or the wiring and related equipment into the charger. The 5,000 volt 10 microsecond test is for NC -- I believe it is C37.9, but we will verify that. The number of that I am not so sure.

MR. FREID: I am trying to reconcile these battery profile numbers (Figure 25) with the FSAR (p. 8.3-93), and the numbers that you end up with don't look like the same numbers you have presented.

MR. TAJADDODI: These are the latest revision of the calculations that are not reflected probably in the FSAR.

MR. FREID: But there are some very, very large differences.

MR. TAJADDODI: The differences are on the conservative side, because we have added a lot more.

MR. FREID: No, you are absolutely wrong. You are not conservative. In that one case, channel C, the one-minute current is 760 amps and you show 315 amps zero to one minute.

MR. TAJADDODI: You are talking about battery C?

MR. FREID: Yes.

MR. TAJADDODI: Battery C has got two -- we've got two one-minute loads where before we did not have those random loads at the end of the cycle.

MR. FREID: Is that the current design?

MR. TAJADDODI: That is the current design.

MR. FREID: But the FSAR says that we need 760 amps for one minute.

MR. TAJADDODI: I can't answer that question as to what the changes have been, but that is the latest design right now and we can verify to see why the changes have been made.

MR. FREID: I would appreciate it.

MR. KOPCHINSKI: I had understood that there was an FSAR change notice initiated to go with this.

MR. TAJADDODI: As I said, the FSAR is not up to date. These are the up-to-date versions.

MR. FREID: What is the battery designed for?

MR. TAJADDODI: The battery is designed for these loads, this one-minute load in the beginning and this one-minute load in the end and all the cycling loads in between and the steady state loads.

MR. KREUTZIGER: I understand from this data sheet, the one-minute rating on that battery, for example, battery C, is 1,210.

MR. TAJADDODI: Yes, that was stated in our purchase order, but the actual loads that we are going to have are these by our latest calculation. We have refined the data on the loads and we have come up with these loads right now. That sheet that you see was before these revisions were made.

MR. KREUTZIGER: I can interpret this to be the actual

battery capacity? For example, that the battery with the EC-21 has a nominal 880 ampere hour rating with a 1,210 one-minute rating and an eight-hour rating which is a standard industry type of rating, although we don't specify that, of 110?

MR. TAJADDODI: This is the battery that has been procured. That is the battery that is being procured. In case we come up with any bigger loads than these, we can always revise the requirements for the batteries, because the batteries are not delivered yet. In case that we find out that the batteries are smaller than what we have, we have the ability to change the batteries, but these loads still are within those capabilities of the values that you see in that description.

MR. ALLEN: C and D now are GN batteries; right?

MR. TAJADDODI: Apparently they will be. They are not right now, but there is a possibility of them being, that's right. That is just what John Barrow was talking about.

MR. BARROW: We understood the main reason that A and B's were GN was because of the high loads on them and they made the others EN's because Exide didn't have to supply these large GN cells, and it is our understanding now that because Exide changes to GN's and there is a limit on how small they can make them that actually the C and D batteries are now going to be approximately the same size as the A and

B's, is that correct?

MR. TAJADDODI: No. The A and B's are the largest that I know of that we are going to procure. The C and D are going to be slightly smaller. I don't know what kind of discussions have been going on as far as quality lately, but the last information I have is that those are going to be actually the sizes of the batteries.

MR. VAN BRUNT: Faust, you had a question.

MR. ROSA: Regardless of what it finally ends up, I assume that 25% oversize plus the 15% contingency will still be in the design?

MR. TAJADDODI: The 25% will be there, but that 15% might have eroded by now. That 15% was in the initial design stage. By now, I think we've got something less than 15%.

MR. ROSA: But the 25 will be there?

MR. TAJADDODI: The 25 will be there irrespective. It will be 25 plus.

MR. VAN BRUNT: I think in the context of this conversation, I would like you to verify and then confirm to the panel exactly the status of which batteries we have and assure us that the design is adequate for the service and that all the necessary SAR change notices and everything else are taken care of.

MR. BINGHAM: We'll do that.

MR. VAN BRUNT: Other questions?

MR. ROGERS: Yes. The batteries, the battery chargers, and the dc control centers I take it are all seismically qualified?

MR. BINGHAM: Yes.

MR. ROGERS: How are they tied to the floor in the rooms that they are in?

MR. TAJADDODI: You are talking about a structure itself?

MR. ROGERS: Yes.

MR. BINGHAM: The batteries are in racks and they are bolted or welded to the floor. The racks are either bolted or welded to embeds in the floor.

MR. TAJADDODI: They are bolted.

MR. BINGHAM: The chargers I believe are the same.

MR. TAJADDODI: They are bolted. They are free standing, but bolted. They are not welded.

MR. BINGHAM: Yes, they are bolted down to the floor.

MR. ROGERS: Now, this bolting, is this in concrete and cores or how --

MR. BINGHAM: Let me think a minute. No, I believe they are on embedded plates in the floor.

MR. KREUTZIGER: I noticed that yesterday at the job site, and they are in embedded plates.

MR. BINGHAM: I believe that our standard design is embedded plates.

MR. ROGERS: In regard to the embedded plates for the battery racks, are those embedded plates made out of a material which won't corrode?

MR. BINGHAM: They are not.

MR. ROGERS: What assurances will we have that we won't get corrosion then at the wells or on the plates throughout the life of the plant.

MR. BINGHAM: There was an earlier question about the coatings on the floor, and I presume you are relating to the battery room.

MR. ROGERS: Yes.

MR. BINGHAM: Dennis has an answer on the coatings. We can either talk about it now or --

MR. ROGERS: Why don't we go ahead and talk about it now since we are actually in that area.

MR. BINGHAM: Do you want to go through that issue?

MR. KEITH: The coating is an epoxy type of coating which is rated as being good with respect to acid spills and that kind of thing. Obviously, it is not used for lining a bucket and carrying acid, but it is suitable for this type service.

MR. ROGERS: For spills of that nature?

MR. KEITH: Yes.

MR. ROGERS: Is this coating placed over the embeds and boltings? Is that what I understand?

MR. KEITH: I would expect it is, Carter. I don't know the details of how the coating is applied or when it is applied.

MR. VAN BRUNT: I guess I would ask that you verify exactly what is the detail and whether it is necessary that the bolting that is embedded over the life of the plant needs some corrosion protection or not or whatever.

MR. BINGHAM: We'll do that. The criteria are to protect it so that it is sound, and, while Dennis doesn't have the details, we will confirm, but I am quite sure that the coating has been applied to meet that criterion.

MR. ROGERS: Bill, as you know, we have gone to great lengths in this job to preclude the use of expansion anchors or at least to control them very carefully, and we don't have expansion anchors to my knowledge in any of the seismic qualified systems. However, I think it would be appropriate to verify that they are not in this, also, because I would be concerned that for sulfuric acid spilling into a concrete floor that there could be some degradation of the concrete and we could get a loosening up of the expansion anchors if there are such inserted.

MR. BINGHAM: We'll do that, Carter. Are there any other questions?

MR. VAN BRUNT: Anybody else got any other questions on this particular aspect?

(No response.)

MR. BINGHAM: I think I would like Dennis to follow up on where the acid goes, which was a question that the Board brought up earlier, since we are on that subject now.

MR. KEITH: We have four-inch drain lines from each of the battery rooms. They go to a neutralizing sump which is right next to the control building sump and there it is treated and then drained into the control building sump and from there to the oily waters separator and then from there to the retention basin.

MR. VAN BRUNT: Is it a pump drain, a gravity drain, or what?

MR. KEITH: It is a gravity drain from the rooms down to the neutralizing sump and from the neutralizing sump to the control room sump. From there, it is pumped.

MR. VAN BRUNT: If you know, what kind of monitoring is on this at its ultimate discharge?

MR. BINGHAM: The purpose of the retention basin is to catch it so that you monitor it there.

MR. VAN BRUNT: I see. Okay, I am with you.

MR. BINGHAM: So there is no monitoring prior to that.

MR. KARNER: There was another open item relating to that and that question was what was the criterion for sizing the drains. You mentioned they are four-inch.

MR. KEITH: That is kind of a standard drain size and

it needs to be that big just so that you can clean it out, but there is no -- well, as Fred said earlier, we don't expect a lot of water in there. The fire protection, the primary one in that room, is CO_2, so the four-inch is more than adequate for washdown purposes.

MR. VAN BRUNT: I think Fred also said that they had a backup water system or hose system that would be used. Is that four-inch drain adequate to carry away the flows from the hose system?

MR. KEITH: Yes.

MR. BINGHAM: Are there any other questions? I think that was the only supplementary information we wanted to provide. If there are no other questions, we will go on with the presentation.

The next subjects we want to cover are Systems Operation and Instrumentation Description, and at that point, we will entertain questions.

MR. TAJADDODI: We have very briefly aummarized the way the system operates (Figure 26). Actually, the system operates from the chargers dedicated to that particular dc system. If those chargers are not available, we've got a standby battery that can provide power instead of the normal charger.

The batteries will supply power if the preferred power is unavailable, and the batteries are sized to carry the loads under accident conditions for two hours. If the

power fails, the chargers will supply power. When the ac power is restored, the chargers will supply all the normal loads and they will charge the batteries and carry the normal loads to the dc system.

Here [Figure 30] we've got a detailed description of what kind of instrumentation we've got locally in the control room to monitor the status of the dc system. I think we can go on one by one, and they are in your handouts.

We have an ammeter at the charger and at the control room to monitor the charger output dc current. We've got a voltmeter at the charger and at the control room for the charger output dc voltage. We have an undervoltage relay both at the charger and in the control room to monitor the ac undervoltage, and we've got another one to monitor the dc undervoltage, both located in the control room. In addition to that, we've got an overvoltage relay at the charger only to monitor the dc overvoltage condition where the operator has got to know if there is an overcharging of the batteries. The position of both the ac and dc breakers at the charger are monitored. If we have an open breaker, there will be an alarm in the control room, and all the conditions of the charger, if there is any malfunction of any nature, it is going to be annunciated in the control room, including all the undervoltage conditions and output breaker open conditions that might happen.

For the battery instrumentation, we've got similar monitoring devices both locally and in the control room with appropriate undervoltage relays at the dc panel and in the control room. In addition, we've got a ground detector relay which provides an indication of the ground conditions, but there is no interruption. It is just an alarm in the control room and the operator will take appropriate actions should he see fit to isolate the system or let it run to suit his purposes.

MR. BINGHAM: Are there any questions on this information?

MR. ROSA: You don't mention a battery high discharge rate alarm. That is being provided on some designs.

MR. TAJADDODI: That is covered by our overvoltage relay. High discharge --

MR. ROSA: High discharge rate, battery high discharge rate.

MR. TAJADDODI: We don't consider that to be a problem for safety as far as if there is a short. If there is a fault condition which is going to cause a rapid discharge of the system, it is going to be indicated in the instruments that are being monitored in the control room. We don't have such a device to have an unusual discharge rate monitoring instrument.

MR. ROSA: Normally, the battery is not supplying any

current. Any kind of a discharge rate except during accident conditions at the beginning or when there is no ac available at the charger input would be an abnormal condition; right?

MR. TAJADDODI: Any current supplied by the battery --

MR. ROSA: By the battery during normal operation.

MR. TAJADDODI: That will be, yes. I will say it will not be a desired condition. It will not be a desired condition if that happens, yes.

MR. ROSA: I think you ought to seriously consider putting one in there.

MR. TAJADDODI: A high discharge --

MR. ROSA: A battery high discharge rate alarm.

MR. TAJADDODI: Is that a requirement of NRC?

MR. ROSA: No, we don't have -- well, we have a position that we apply in the course of a review. We haven't gone through the formality of taking it to the Regulatory Requirements Review Committee and revising our Standard Review Plan yet to put it in, but we are emphasizing that it should be in the system.

MR. KREUTZIGER: Faust, I heard two things. One, I heard a high discharge indication, alarm, then I also heard the fact that since normal operation is essentially zero, we have it very low. Are you combining both of those? In other words, let's say if the normal operating design basis on one of these batteries is, let's say, three hundred

and some amps, would I interpret that requirement to be set something maybe at 50 amps or are you talking about something also in excess of 300 amps?

MR. ROSA: No. Really what I am concerned with is the operator knowing that there is something wrong with the system which allows the battery to discharge even a few amps.

MR. TAJADDODI: But won't it be that the floating voltage will be below the level that we have set it at? It will be indicated to the operator because the instrument will be reading below 130 volts fully charged if that is the case.

MR. ROSA: Yes, that is a possibility.

MR. TAJADDODI: So he will be aware of the fact that the battery is discharging, because he cannot maintain the floating voltage if the battery is at 130 volts. We've got those instruments. Anything below 130 will be an abnormal condition for the battery, which will be the case of discharging through the system in your normal conditions.

MR. VAN BRUNT: Bill, I guess I would ask that you take a look at the concern that has been raised by Mr. Rosa and get back to the panel as to the disposition of it whether through the alternative that Fred has suggested that it maybe covers his concern adequately or whether some corrective action ought to be taken.

MR. BINGHAM: I wanted to make sure that we understood

the concern so that we could answer it properly.

MR. ROSA: We have been getting this alarm on some designs.

MR. TAJADDODI: You have special instruments indicating the rate of discharge through the batteries?

MR. ROSA: Right, a discharge rate alarm.

MR. TAJADDODI: We will address that.

MR. ROSA: I've got another question. On the backup chargers, do they have the same instrumentation that is shown here?

MR. TAJADDODI: They are identical as far as instrumentation. The only difference between the normal charger and the backup charger is the two output breakers were isolated breakers and equipment. As far as instrumentation is concerned, they are identical.

MR. ROSA: I want to make a general comment just to advise the people here about what the thinking is with regard to dc systems reliability at the NRC. Maybe you are all familiar with that issue that was raised about three years ago by an ACRS consultant on dc systems reliability, and we put out a new regulation on it at the time. The bottom line of the new regulation was that our analysis indicates that the reliability is adequate. However, the concern is important enough to look deeper and in more detail. As a result of that, we initiated Task Action Plan A-30, DC Systems

Reliability. The Power Systems Branch originally initiated that, but then it was turned over to the Office of Research and our final draft report has just been circulated in house and it looks like it is a good piece of work. I commented on it and it appears to me at this time that it is a probabilistic type analysis. It takes the minimum system and calculates probabilistically what the failure probability is for random failure and common mode failures and also takes into consideration decay heat removal without any dc or ac, too. The conclusion of that report seems to say that whatever value you take for dc system reliability is going to depend on the effectiveness of the surveillance of the system, which brings us back to this. If there are any new positions to be derived when this report is finally issued, I expect them to be in the area of improved systems monitoring and surveillance. I just put this on the table to make you aware of it. This is worth a good look at right now.

MR. TAJADDODI: What particularly in your view is the monitoring emphasizing as far as this new regulation is concerned?

MR. ROSA: Well, it doesn't go into design details. It just simply states that there is a large uncertainty in battery probability of failure because the means available for, first of all, performing surveillance on the batteries don't give you an exact answer.

MR. TAJADDODI: You mean the relays do not indicate properly the status of the battery?

MR. ROSA: Not just the relays. If you look at the system, just the system configuration, all your breaker position indications and all your voltage sensing and current sensing elements should be such as to give the control room a good, thorough picture of the condition of the whole system. In other words, I am glad to see that you have overvoltage and undervoltage at the bus in addition to the charger, because, you know, chargers can be disconnected, and so on. You have breaker position indication, and that's great. Certainly the control room should know what is connected and what isn't. The other aspect of battery surveillance is what is done periodically, the pilot cell specific gravity checks and voltage checks. The people that did this study went back through the license event reports, and there is a large number of them, but quite a few of them, over half I would say, are just simply reports that the specific gravity doesn't meet the textbook number. Now, the question is is that a failure or isn't it a failure, and that is where that uncertainty comes. Obviously, they take the conservative view. If the pilot cell doesn't meet text spec requirements, they'll say well, it's a failure, and then they come up with a probability of failure and you have a number that reflects that conservatism. So anything you can do to demonstrate the

effectiveness of battery surveillance either during the periodic checks or by means of the instrumentation you have on the system is going to be a plus.

MR. TAJADDODI: Is this just coming out?

MR. ROSA: The draft report went back to Research about two or three weeks ago. They got quite a few comments and they are reworking it before putting it out final draft form. I expect it will be published probably before September.

MR. BINGHAM: I appreciate your comments, Faust, and, as I understand, the Board will desire to take a look and see how this applies to our system and to look at any subsequent monitoring that may be necessary, is that correct?

MR. VAN BRUNT: That's correct.

MR. BINGHAM: Are there other questions?

MR. VAN BRUNT: Okay, go ahead.

MR. BINGHAM: The next subjects are Tests and Inspections.

MR. TAJADDODI: In addition to our preoperational tests and acceptance tests that are required to meet the requirements of IEEE 450, we have summarized some of the areas that tests and inspections should be looked into. [Figure 29] For instance, upon what you were talking about, Mr. Rosa, is that we are going to monitor float voltage. We are going to check cells for cracks or any leakage of acid or electrolyte. The plates of cells are checked for buckling, discoloring, grid cracks, and any kind of abnormality. The specific gravity

of each cell is going to be measured. Of course, I don't know about the criteria, how much we can deviate from that specific gravity and still maintain the acceptance if that is within that NUREG requirement. Voltage reading of each cell is measured, and electrolyte level of each cell is checked, and if it needs water, it is added. Temperature of the electrolyte in representative cells is also measured. The charger current is measured with the battery in service, and we've got periodic tests, capacity tests of the battery discharge per requirements of IEEE 450.

MR. ROSA: One other piece of instrumentation that we consider important that hasn't been mentioned yet is do the chargers have an alarm when they are operating at their current limit level?

MR. TAJADDODI: No, there are no overcurrent relays or devices in the control room for overcurrent. We've got overvoltage and undervoltage. We've got breaker open positions signifying no current flowing, but overcurrents, no, we don't have that.

MR. ROSA: The charger is current limiting, I presume.

MR. TAJADDODI: Yes.

MR. ROSA: Normally, you wouldn't expect it to operate at the very top of its current output capability. If it does, there may be something wrong somewhere.

MR. TAJADDODI: That's true.

MR. ROSA: That is an item that I think should be monitored.

MR. TAJADDODI: Well, we think that if there is that condition, we are going to an undervoltage condition to begin with. You are talking about going over.

MR. ROSA: If you go over, yes, I would hope to see some detective action.

MR. TAJADDODI: That would be a faulted charger, which is going to signify an undervoltage condition. We don't consider that you are going to have an overcurrent and maintain the same voltage at the same time, so if you've got an overcurrent or you are reaching about the level of its capacity as far as current is concerned, it is going to reflect it in the undervoltage condition and undervoltage relay is going to indicate an abnormal condition which is going to be causing more current to flow, so we don't think we need the other one. It will be a complementary device rather than having to indicate a particular abnormality which is not indicated by the undervoltage relay.

MR. BINGHAM: Just a moment. What I sense from hearing this discussion is perhaps you are looking for or the Board is considering better operator information or use of these various signals that would come from instrumentation that you have and put it into a form that the operator could really have a better understanding of what the equipment was doing.

Is that what I'm hearing?

MR. ROSA: That's right.

MR. BINGHAM: I think that is an important point for us to consider. While Fred can tell you the reasons or, you know, if you were smart enough to look at this, you would know that that was the case or this can't happen. Perhaps that is not sufficient as we see it today for the operators, so I think we understand the concern and we will be looking at it.

MR. ROSA: Here is what I am faced with. I would like to be able to say when we go down to the ACRS after getting this report and developing a more detailed position, I would like to be able to say to them look, this is what we require in the way of detailed instrumentation for monitoring dc systems, and, given this, we are assured that we can detect all the incipient modes of failure so that we can say at any time that all these things are normal, that our battery is reliable. That is what I would like to be able to say to them, and I am going to have to say something like that, because they require completion of this study and the development of any new positions about every six weeks.

MR. BINGHAM: We appreciate the concern and we will take a good look at that and make sure we have addressed it.

Shelly I think has a question.

MR. FREID: The question I have essentially relates to

that. Looking through this, I presume all of this is on each charger. Does the operator know in the case of the swing chargers which charger it is attached to?

MR. TAJADDODI: It is going to be attached only to one charger. Due to the administrative controls, he will know which dc distribution system it is attached to. That is part of the requirements of the operator, to know which of these.

MR. FREID: Well, it is easy in the A room because the ac swing charger is in the A room and he can see a breaker, but he cannot see the C charger, whether it is open or closed, from that room.

MR. TAJADDODI: We are talking about control room position? He knows in the control room.

MR. FREID: In the control room, he knows?

MR. TAJADDODI: Yes. On every one of those, we've got both local and remote indication of the breaker.

MR. FREID: Including the swing bus?

MR. TAJADDODI: Yes.

MR. KREUTZIGER: Is that a mimic display in the control room?

MR. TAJADDODI: I don't exactly recall, but it must be a mimic report. If not, it is indicated by the breaker number of each of these chargers.

MR. BINGHAM: I am pretty sure that it is not a mimic.

MR. FREID: But he knows which way that charger is going?

MR. TAJADDODI: I think your question was something like a mimic. Is that what your question was, Karl?

MR. KREUTZIGER: I have not seen the control board, and from a general standpoint, we talk about breaker positions, we talk about undervoltages, et cetera. One way to display that is a mimic display where you can show this bus and you can show that that breaker is connected. The other aspect is just to have a series of breakers in some arrangement, orderly arrangement, to interpret. The question I had is does a dc system status panel, is it at all a mimic display?

MR. TAJADDODI: No. Bill answered that question.

MR. BINGHAM: It is not.

Don, did you have a question?

MR. KARNER: Yes, just for some clarification. Fred, in looking through the instrumentation description that is given here, it mentions that there is an ammeter on both the charger and the battery. That is displayed in the control room, is that correct?

MR. TAJADDODI: Yes, that's right. We would like to know when the charger is off, and when it is operating, we would like to know how many amperes the battery is providing and how many amperes the charger is providing, so there is an ammeter for both of them.

MR. KREUTZIGER: Then I have one further point. Maybe Faust Rosa could give some clarification as to whether the staff's concerns are leaning toward alarming those kinds of malfunctions or whether instrumentation of the battery and the charger is the type of thing that you are looking for.

MR. ROSA: Well, I've got a list of monitors and alarm indications and alarms that we made up here a while back and I could read that to you. You've got just about everything there except the battery high discharge rate alarm. We have a ground alarm, also, but I believe you have that.

MR. TAJADDODI: Yes, ground detector relay No. 64 and indication light.

MR. ROSA: Which gives an alarm?

MR. TAJADDODI: Yes.

MR. ROSA: So you've got just about everything except that battery high discharge rate alarm. The battery ammeter, that is a center reading zero, is it?

MR. TAJADDODI: As far as how it reads, I cannot be very specific, because I don't know exactly, but it must be. From what I gather or recollect a few years ago, it is a center reading, but I cannot assure you of that right now. We can take a look at it and find out.

MR. ROSA: It should be.

MR. TAJADDODI: Yes, it must be, but I don't know for sure right now.

MR. PAUL: As far as surveillance of the battery conditions, I wonder if this mention of a mimic might be worth considering for the operator to see at a glance the condition of a system.

MR. BINGHAM: A hard mimic on the board is what you are talking about?

MR. PAUL: Instead of random lights or random indications, it would give him a system indication. If this breaker is open and this breaker is open, it might be more meaningful for him.

MR. BINGHAM: Ed, the question that Mr. Paul asked was whether we should consider a mimic on the board. Of course, we have that alternative. We also have the CRT display that could be used to provide this same information to the operator If you desire, we could look at that aspect.

MR. VAN BRUNT: I think that we ought to take a look at our particular arrangement, because I gather from what Karl said that possibly by just the arrangement of the board you may have adequately covered this so that the operator wouldn't become confused or anything else. I think we ought to take a look at that just to determine the accuracy of that arrangement, and if we feel that it has some weaknesses, then consider some corrective action, whether it be through mimicing or through CRT or whatever.

MR. ROSA: One other comment. If you people are

interested in speeding up the review process, a line diagram of the system like you have which indicates also all the instrumentation --

MR. TAJADDODI: I was just coming to that. I was going to display that right now.

MR. ROSA: -- and breaker positions and everything, the whole business, would be very useful.

MR. TAJADDODI: While we are on this subject, I would like to display --

MR. BINGHAM: Is this in the handouts?

MR. TAJADDODI: These are backup slides. They are not in the handouts.

MR. VAN BRUNT: Can you provide copies of these?

MR. TAJADDODI: We can provide you copies, but I don't think we can make copies of these slides the way they are today. I don't know whether we can. It is up to Don. If he can do it, we will. But let's go over those concerns a little bit.

First of all, to answer Mr. Rosa's instruments, yes, they are center. I don't know whether you can see that from there. Our instrument is zero to 1,500. I don't think you can see that from a distance, but all our ammeters are center position. We've got all those volt meters under voltage relays both at the bus and at the charger and, as you can see, we've got indications going from each of these relays to the

control room. We've got both indication and alarm. So all of those are both monitored locally at the bus and in the control room. As you can see, we've got all the details of the voltages and switches that are on the buses and the charger and going to the control room.

MR. KREUTZIGER: Another question. The alarm in the control room though is a system malfunction alarm or is that -- In looking at that table we had, it appeared that -- the slide you had up earlier -- some of these conditions have a common alarm in the control room.

MR. TAJADDODI: No. As we can see here [Figure 30] 27C has a separate alarm and 59 overvoltage has got a separate alarm and undervoltage 27 has got another individual alarm. We don't combine them in here into one system malfunction.

MR. KREUTZIGER: On that sheet you had before, you have under relay number 27 at charger to alarm an ac undervoltage input and you have a lot of these others at charger, ac-dc breaker position indication at charger. Then you have charger malfunction alarm in the control room. My question was is this charger malfunction alarm -- Sometimes we group a number of inputs to a malfunction alarm in which then you have to go down to the equipment to see specifically whether it was undervoltage or overvoltage.

MR. TAJADDODI: That is anything that can happen abnormally inside the charger and it will be reflected in one

of these four instruments, either an undervoltage or overvoltage condition.

MR. KREUTZIGER: If I am at the control room, then if there is an overvoltage condition, without looking at the meter -- I can always say that I can look at the voltage meter on the bus, but will I be able to see that there is a charger malfunction, or would I be able to, or would I see a specific alarm window that says overvoltage.

MR. TAJADDODI: You will see an overvoltage specifically, because we'd take it from the 59 relay and go directly to the control room and say it is an overvoltage alarm.

MR. ROSA: His remarks just now illustrate the problem with the reviewer back there when he sees a list like this and a simplified line diagram that doesn't show these alarms and indications, specifically where they are taken from, and so on. He tries to put all of this together and he finally reaches a conclusion, you know, I think it is adequate, but I am not sure. So what does he do? He sits down and writes a question, which requires that someone in your shop sit down and write an answer, and then we have to review it again.

MR. VAN BRUNT: Faust, we have made a note of your comment and we will provide some kind of a simplified drawing that takes care of this situation.

MR. ALLEN: Also, Faust, in many cases here, we are

going to ask that they come back to the panel and indicate which of these actual specific relays are read out on the computer, because many times you will have a system alarm on your annunciator and then you can go over to the computer, which doesn't show up on here most of the time, and it will say charger number one overcurrent, so that is the type of stuff I think the manager should review, also.

MR. BINGHAM: Let me make a comment. I know there are probably some other questions. During our informal meeting with the Board, this issue was discussed and I believe we did realize that there is quite a bit of advantage to know schematically, at least, where all the instruments are and what they look like. What we did at this presentation was to use the design drawings, which are a little more confusing for a reviewer, but it is coming around. We made some copies for you and we do appreciate that particular point and we are going to do something. We just at this time haven't come up with what the best way to handle this particular issue is.

MR. KOPCHINSKI: I would like to add, and this may partly help, Faust, in Section 1.7 of the FSAR, there is a list of all of the E&I drawings and I believe we are committed to supply two or three copies of all of those as part of the docket, so drawings like that you will have.

MR. ROSA: I guess what I am saying to you is this: If we can get all of the minimum information that we need out

of the FSAR without going to detailed engineering drawings --

MR. BINGHAM: Yes, we hear.

MR. ROSA: -- and schematics, we are way ahead of the game.

So the more concisely and completely you can present the information in FSAR drawings, the better off we are, I believe.

MR. VAN BRUNT: Any other questions?

MR. ALLEN: I would like to go back to the slide on testing. (Figure 29) What we have identified here are periodic tests. What I would like to know is which test you will specify in your start-up test guidelines which will be incorporated into the start-up test procedures?

MR. TAJADDODI: That will be extracts of principally of what IEEE calls for, which includes the preoperational tests, acceptance tests.

MR. ALLEN; Well, I think there is a little bit more to it than 450, isn't there?

MR. TAJADDODI: Well, those will be the minimum requirements on top of whatever SRP would like to see, and that will be probably a requirement that you people would like to add to it, but as far as meeting the requirements of NRC is concerned, they will be basically what IEE 450 indicates.

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MR. ALLEN: And the Reg. Guides?

MR. TAJADDODI: And the Reg. Guides that are complementing them, yes.

MR. ROSA: As to the technical specifications, the standard specifications that provide the same numbers for voltages and specific gravity that are in IEEE 450, historically every time an applicant comes back with those specifications for his plant, there is always a difference of opinion, they have changed the numbers somewhat to a less conservative number, and we are trying to resolve that in some way. We find that we can't back up any numbers other than what appears in something like IEEE 450, and to do anything less than that puts us in a rather untenable position. So unless an applicant has some strong justification, we are going to go for those numbers.

MR. ALLEN: Sometimes the applicant, I am not talking about this particular applicant, would like to see something above and beyond what 450 calls for, which is, I think, admissible.

MR. ROSA: That's fine.

MR. TAJADDODI: As long as it meets as a minimum the requirements of 450, which definitely we will look into to make sure they are going to meet IEEE 450. I don't think there is anything wrong with meeting something above that.

MR. ROSA: No, not above. There is something wrong

with meeting it below. We can't very well live with it.

MR. TAJADDODI: Oh, definitely. I think as we covered this morning, we said that all the tests have got to meet the requirements of 450 and the appropriate Reg. Guides that are complementing IEEE 450.

MR. ROSA: It is my understanding that a working group of NPEC Subcommittee 4, I believe, is working on standard technical specification requirements in this area. I think they had a meeting a couple weeks ago. So something may be coming out of that group that the NRC will pick up on.

MR. TAJADDODI: Will that be along the lines of IEEE 450 or will it be in a separate vein?

MR. ROSA: It will be along the IEEE 450, but it will be specific technical specifications for battery surveillance.

MR. KREUTZIGER: We are aware of that. We have a member from Bechtel who is on the committee. There is another committee meeting I think June 15th to work on that area of technical specifications.

MR. ROSA: Well, we hope what comes out of that working group will clear up this area of controversy between the NRC and every applicant on our requirements.

MR. BINGHAM: Are there any other questions? I saw some other hands. John, did you have a question?

MR. BARROW: That list of the alarms again, (Figure 30) the one called charger malfunction alarm and you just list a brief

bunch of things it includes, does that also include any kind of indication or alarm of ac injection into the battery from the charger? In other words, an ac pass-through.

MR. TAJADDODI: I doubt it, no. I don't think -- No, it does not.

MR. BARROW: I suggest it to you and I will bring it up when we get to the failure mode and effects analysis.

MR. TAJADDODI: The reason why it doesn't is because, as we pointed out, the charger is designed with a lot of isolation diodes, blocking diodes, so there is very little possibility, I cannot quantify that, of ac being injected directly to dc. There is a remote possibility of that happening and we don't have that being monitored.

MR. BARROW: Well, when we get into the failure mode and effects analysis of components, I suggest that that ought to be shown under the failure mode.

MR. TAJADDODI: We will consider that. We will discuss that when we get there.

MR. BINGHAM: Other questions?

MR. VAN BRUNT: Anybody got any other questions?

Okay, Bill, go ahead.

MR. BINGHAM: The next subject is single failure analysis.

MR. TAJADDODI: We have drawn the system that we are going to discuss. [Figure 31] The failure mode and effects analysis --

actually, the system stops right here (indicating). This (indicating) is the additional system that shows the whole interface. We have numbered all these breakers as to what each of these breakers is going to, what will be the effect of each of those components failing from the charger, batteries, the breakers, the buses, all the way down, and the following chart (Figure 32) gives a descriptive analysis of the failure of each of those items. These items are shown in your left-hand column pertaining to this previous sketch. It shows item number 23, which is a battery, and what will happen to the system if there is a component malfunction. It gives you its normal function, its failure mode, effect on the subsystem, and it should be effect on the "system." If we've got a battery malfunction, there will be loss of standby power to the bus. However, the effect on the total dc system is nonexistent, because the batteries will be providing the source of power to the dc loads and there will be no degradation of the system.

If the battery charger fails, the effect on the system also will be zero, because the battery provides power to the bus and the standby charger can be connected to provide the power for extended periods of time.

If there is a problem with the battery circuit breaker and its failure mode fails to open, it does not open on fault, there will be loss of standby dc power. The

effect on the dc system will be that actually there is no degradation on the system. The battery provides standby power to the bus and the charger provides the dc power.

Likewise with the battery charger circuit breaker, normally closed, which provides protection to the charger under fault conditions and supplies power to the dc bus under normal conditions. If it fails to open, there will be loss of power to the bus. However, the effect on the dc system is nonexistent. The battery supplies power to the dc bus through its breaker.

The last item that can fail is the dc bus itself, and its failure mode is having a fault on the bus. If that happens, there is power available to the other three redundant channels. That whole channel will be completely lost, but we will still meet the two out of four requirements to maintain the redundancy requirements for the loads and provide power from the other three channels.

MR. BINGHAM: Any questions?

MR. BARROW: Under the battery charger, if you put in another failure -- you've got one failure mode for battery charger and that fails to provide dc power, if you have another failure mode, which I just mentioned, that provides other than dc power, for instance, provides unfiltered ac or provides some dc with ac components or whatever, couldn't your net effect be that it could cause damage of the battery

that it feeds, especially if it is not alarmed? Consequently, couldn't you have a failure effect like on the bottom; in other words, complete loss of the charger and the battery and then power available to the other three redundant channels?

MR. TAJADDODI: Yes, it will be similar to this. The only thing we don't know is that we don't know the effect of it. We have asked the manufacturers to tell us what this effect will be. As a matter of fact, last week we had the battery suppliers and we asked them the question. They didn't have the answer to that. But, at worst, it will be similar to this here. You will just lose one channel, period, and you still have the other three channels available to provide you with power. We don't know exactly the nature of interaction of ac and dc on CE equipment, for instance. We don't know how it is going to react. All we know is it is going to take one channel out under worst conditions.

MR. BARROW: I suggest that that be shown on the failure mode and effects analysis just so you've got a record that you have considered it and are considering it.

MR. TAJADDODI: We will put that in here.

MR. BINGHAM: Let's make sure, now. This is in the licensing document, is that correct?

MR. TAJADDODI: Yes.

MR. BINGHAM: That is where you got that.

Ed, you heard the request from the Board member

that we modify the SAR to include this particular event.

MR. VAN BRUNT: I would suggest that it might be premature to suggest that we modify the SAR, but I would suggest that you ought to take a look at this particular item that John has raised and see whether any current corrective action needs to be taken.

MR. BINGHAM: All right.

Other questions?

MR. ROGERS: A recent event was the failure of a non-IE dc power system in a particular plant that caused loss of most of the instrumentation in the plant and the plant went into a nonsafe condition. This is a IE system. This was a faulty ground that occurred. I am wondering if a faulty ground could in any event cause us to lose instrumentation read-out or cause our control system to operate improperly and get us into an unsafe condition.

MR. TAJADDODI: You are talking about a ground condition on the bus?

MR. ROGERS: It was a non-IE system.

MR. TAJADDODI: Let's first of all address the non-IE system. They are completely divorced from our IE. They are not tied to each other, so they are absolutely separate. We don't have our non-Class IE loads connected to the Class IE system. If there is a condition that can cause a fault, we've got a ground fault detector that is going to cause an alarm

in the control room. The operator is going to be aware of that condition and he is going to take appropriate measures either to isolate it or make sure that the system is in operating condition or that it was a nuisance alarm, but there is an alarm in the control room and locally to provide the information to the control operator what the status of that thing is.

MR. ROGERS: To clarify, a ground fault won't trip on a dc system by itself?

MR. TAJADDODI: No, we don't have automatic tripping on a ground fault. It will be left to the option of the operator to take remedial action, either isolate it by opening the appropriate breakers, or if he wants to run the equipment under ground fault conditions, if he deems it appropriate to run the loads under the degraded conditions, it is up to him.

MR. ROGERS: Could you explain in a little more detail why you can operate this system with a single ground fault?

MR. TAJADDODI: Well, sometimes a ground fault in a dc system does not indicate that necessarily you've got a very severe condition and it is left to the operator's discretion to make that judgment, and we don't want necessarily to disrupt the continuity of service just because you might have nuisance alarms on the system, to isolate the very vital

loads on the dc system which can actuate an ESF actuation signal. That is very important. We don't want to shut down the plant just because there is a small and inadvertent nuisance alarm on the dc system.

MR. ALLEN: What happens if the operator doesn't do anything?

MR. TAJADDODI: If the operator does not take remedial action and there is a severe fault, it can damage the equipment.

MR. ALLEN: It won't trip out due to an overcurrent somewhere?

MR. TAJADDODI: Well, as I said, the breakers will open under a bolted fault condition, not on the high resistance ground fault condition. If the ground fault will go into a bolted fault, the breakers are going to open, but before that happens, there might be a lot of extensive damage.

MR. ROSA: We have one incident of a plant operating with a ground fault on one of their, I think it was an ac system, though, and finally resulting in a spurious operation of I think it was a main cooler.

MR. TAJADDODI: You are talking about an ac system?

MR. ROSA: Yes, but it resulted from sustained operation with a ground fault in existence that wasn't cleared.

MR. TAJADDODI: On our ac systems, the only time you

don't open a grounded condition is on the diesel generator under operation. That is the only time we don't open. Every ground fault is automatically isolated on the ac system.

MR. BINGHAM: I think we are trying to deal here with the dc side, and if I heard the question properly, it is what are the consequences of not tripping it.

MR. ROSA: No, what I am saying is there is a danger to sustained operation with a ground fault indication showing.

MR. BINGHAM: Yes.

MR. TAJADDODI: We realize that. That is why the operator should take it into consideration.

MR. BINGHAM: There is a danger in flipping everything off, too. I guess that is the fine line that we are balancing.

Is there some action that the Committee wishes done on this particular issue?

MR. ROGERS: I have another incident.

MR. BINGHAM: Well, maybe the Committee would like to hear the other incident first.

MR. ROGERS: This was on a IE dc system, 480 volt grounded system, which is a little different from our system, I understand. This unit was in a shutdown cooling situation and a fault to ground occurred which resulted in the opening of valves, dc motor operated valves, to the sump, which, of course, was empty. As a result, there was air brought into

the shutdown cooling system in the plant and they lost all shutdown cooling and they had no shutdown cooling in the plant for a period of two and one-half hours according to a recent account. I don't see that type of thing addressed on the failure mode and effects analysis, but I looked on the chart that you had earlier and it showed that the dc system is used maybe not with the shutdown cooling valves, but it is used with certain auxiliary or emergency feedwater system valves. I am wondering if there is any condition that we could get into with our system, which I gather is ungrounded, which would cause an unsafe condition in either an operating or a shutdown mode of operation which could cause us an unsafe condition.

MR. TAJADDODI: First of all, we've got four redundant channels. We don't anticipate that you are going to have the same thing happen simultaneously in all four of them, but given the condition that it will happen and we have a ground fault which is not cleared, we are going to degrade the condition of that particular channel. There is no doubt about that. Its normal condition is annunciated in the control room and your voltage release and current indications are going to tell you that it is an abnormal condition that has got to be remedied. As far as mitigating the consequences of an accident or shutdown, anything of that sort, fortunately we've got redundant channels and you can reroute equipment

to bring the plant into a safe shutdown condition with the redundant equipment. That particular channel would be out of service, but the other three are going to be available to function.

MR. ROGERS: All right. Let me give you a possibility. Say that we have just initiated a shutdown, so we are not into the shutdown cooling system operation yet. What would happen if we would have a fault on our emergency feedwater system or our auxiliary feedwater system on the IE side while we were using that system for a shutdown?

MR. TAJADDODI: We've got two redundant auxiliary feedwater systems. We've got one ac driven and one redundant turbine driven. If there was a problem with the turbine driven -- is that what your postulation is?

MR. ROGERS: No, the postulation is the one that is on dc. There is only one on dc.

MR. TAJADDODI: Well, hopefully the ac driven, which is Class IE, is going to function.

MR. ROGERS: Say the valve closes so it isolates all feedwater into a steam generator, the steam generator goes dry. Could that happen?

MR. BINGHAM: I think we are getting into double failures the way you have given the scenario, and I guess if you take double failures, that could happen.

MR. ROGERS: I realize this is double failure and I

didn't intend to get into double failures.

MR. BINGHAM: That is the way I interpreted it. Maybe I didn't hear you quite right, but that is the way I interpreted what you were saying.

MR. ROGERS: A fault on a dc system causes a feedwater valve to go closed -- this is a IE system we are talking about -- therefore preventing water from going into one or both, if that is possible, of the steam generators, thereby removing our ability to remove heat from the system during the initiation of shutdown.

MR. BINGHAM: As I understand the condition -- let me try my version -- if the plant is just shut down, we are now on the normal auxiliary feedwater pump, which, as you know, is non-IE, but, in any event, it is feeding this, and I presume that you are postulating that that all of a sudden disappears.

MR. ROGERS: We are reviewing right now the IE system, not the non-IE.

MR. BINGHAM: Well, you see, in normal shutdown, you don't use the IE system, so go fail it if you want.

MR. VAN BRUNT: Does that satisfy you?

MR. ROGERS: That satisfies me.

MR. VAN BRUNT: Any other questions anybody wants to raise?

MR. PAUL: If you have a ground on your dc system, can

you open all the individual breakers one at a time to isolate it without upsetting the system?

MR. TAJADDODI: That is one of the requirements.

MR. PAUL: They are all fail-safe, then?

MR. TAJADDODI: You should be able to isolate any equipment. That is a requirement of 308 and Reg. Guide 1.6.

MR. BINGHAM: Additional questions? We are moving right along. Let's get on to the interface information. [Figure 33]

MR. TAJADDODI: Fortunately, we have covered ventilation and fire protection. Our ventilation system provides both the circulation of the air and removal of the hydrogen in the battery rooms and the adjoining rooms and provides for the maintenance of the ambient in the control room. The fire protection system, we've got as a primary source of fire protection the CO_2 system. If the CO_2 system is not available or for some reason it malfunctions, we've got a backup fire protection system, which is the fire sprinkler and manual water hoses.

On the ventilation system, I want to emphasize that we have found a major design defect which our task force has identified as far as a single failure is concerned that we did discuss to some length in the beginning, and we are trying to rectify that condition as far as the single phase of it is concerned to make sure that it is not going to degrade the system.

The third item that we would like to discuss is the effect of induced transients that might happen in trays and raceways where the dc cables are laid out. Sometimes if these cables are laid out on the higher voltage level, induced transients from the ac can have some impact or effect on the performance or the quality of power in the dc system. We have made an analysis regarding this and have found that under most adverse conditions, the maximum voltage that is induced in the cable is about 2 to 3 volts. One of the reasons that it is so low is because we are using shielded cables and the actual inducement of sparks from other external sources have got minimum impact on the dc system operation.

Are there any questions on this chart?

MR. FREID: I guess just for the record, fire protection, and I think Denny mentioned this earlier, is strictly train to train and not channel to channel.

MR. KEITH: I didn't mention that, but I am not sure.

MR. KOPCHINSKI: Well, the battery rooms are channelized.

MR. TAJADDODI: You said in general, I believe, that they were on the train basis, but in the battery rooms, at least, we've got the CO_2 system.

MR. FREID: But not in the charging rooms?

MR. TAJADDODI: No. I don't think that is --

MR. FREID: It includes the swing chargers. You bring

the channels together.

MR. TAJADDODI: Right.

MR. FREID: So the design basis is strictly train to train separation for fire.

MR. KEITH: I'm sorry, maybe I misunderstood. You are talking about the fire protection --

MR. FREID: The fire protection design basis for the dc system is that you protect train A from train B from both being wiped out in a single fire, but not necessarily channel A from channel C or channel B from channel D being wiped out in a fire.

MR. KEITH: We are protecting them on a channel basis. What I said, to clarify what I said earlier, we are protecting the batteries on a channel basis, because each one of those is in a separate room which has a three-hour fire wall surrounding each battery, so they are protected on a channel basis. What I said was that if we get into the conduit running to the control room from the various instruments and all that there we probably protect on a train basis from the exposure fire. We are separated per Reg. Guide 1.75 on a channel basis, but not from the exposure fire.

MR. FREID: Except that you do cross trains. You cross channels in the battery rooms as well, because you run your C channel across your A battery room to get to your swing charger.

MR. TAJADDODI: What Shelly is saying, Dennis, is this. What he is talking about is that we've got a room -- for instance, here (indicating) we've got A and C in one area.

MR. FREID: Plus the fact that the cable comes across.

MR. KEITH: When you are using the swing charger is the only time that line will be energized, but during that period of time, I think you're right that we wouldn't be separated on a channel basis.

MR. TAJADDODI: If the swing charger is operating and there is a fire, then you've got a train wiped out.

MR. BINGHAM: Any other questions?

MR. BARNOSKI: I have a question on the ventilation system. There is cooling associated with that?

MR. TAJADDODI: It is heat and ventilation. I believe it is both.

MR. BINGHAM: Heating and cooling.

MR. BARNOSKI: Where does the cooling come from?

MR. BINGHAM: Well, it is generally in the control building basement.

MR. BARNOSKI: This is like a self-contained air conditioner or are you using --

MR. BINGHAM: It uses chilled water.

MR. BARNOSKI: A safety grade chilled water system?

MR. BINGHAM: Yes. Any other questions? Is that it?

MR. VAN BRUNT: Any other questions on that subject?

MR. BINGHAM: Our last subject is equipment qualifications and the status (Figure 34). Why don't you go through that and then I think Faust had a question earlier on that and we will hear that again and then respond to that.

MR. TAJADDODI: I would like to give you a brief status of the qualifications of the equipment as of today. We have achieved limited qualification for approximately three years on the batteries to meet the requirements of IEEE 323, and we are trying to extend that requirement above and beyond those three years. The actual tests are in progress right now. They are supposed to be completed by the end of this year.

As far as the chargers are concerned, we have reviewed the test plans as far as meeting IEEE 344 and 323. We've got some comments on them and the comments are being resolved and Environmental Qualification is in progress to meet those reports.

The distribution center qualification test plans have also been received and have been commented on. Testing is in progress. The final reports are due by the end of June of this year.

The distribution panels, qualification test plans; we've got some comments on those, and the qualification testing is proceeding per 323 and 344. The completion of that equipment is due by mid-1980.

Above those, we've got instruments and meters in the control room that have got to meet the requirements of IEEE 323. They are also in progress and the completion date is about the end of this year.

MR. ROSA: When you say qualifications in accordance with 323-'74, that includes aging; right?

MR. BINGHAM: That's correct.

MR. ROSA: And this aging accelerates the aging performed prior to the seismic test downs?

MR. BINGHAM: Certainly in the proper sequence.

MR. ROSA: In plants that are in final stages of licensing right now near term OL's, we are applying a license condition with regard to qualifying seismically the batteries with aging being performed prior to qualification because of the plate embrittlement concern that has been identified, so you are all aware of that.

MR. KREUTZIGER: Is that in addition for plants that have IEEE 323?

MR. ROSA: Yes.

MR. TAJADDODI: Is that in addition to IEEE 535 requirements?

MR. ROSA: No. If they qualified in accordance with IEEE 535, they have already met the requirements. What the licensing condition says is that there is no assurance that the seismic qualification is valid for more than ten years if

you haven't aged prior to seismic qualification, so the licensing condition says that if your batteries are now ten years old and you didn't consider aging before, you've got to extend the qualifications someway or replace the battery.

MR. BINGHAM: Are there any other questions or comments on equipment qualifications?

MR. BARROW: In light of Faust's observation, you might just want to mention for the record what our goals are in terms of battery qualification on the project in terms of qualified life.

MR. BINGHAM: Well, we did try to touch on that in the beginning. We said we are looking to get extended life. Whether we can get the 40-year plant life or not is probably a question at hand, but we are looking to do that. As a matter of fact, throughout all that equipment, we are looking to obtain the longest qualified life possible. That is our goal. If we can do that within the constraints of Licensing Unit 1, we will certainly do that.

MR. KARNER: Is your qualification program for the dc system now in accordance with NUREG-0588?

MR. BINGHAM: I believe so, Don. There may be one or two exceptions, but the intent is to be in accordance with NUREG-0588 for this plant that is committed to the 1974 version of 323.

MR. VAN BRUNT: Are there any other questions in this

area?

MR. ALLEN: One question that is related to equipment qualification. You mentioned it briefly at the beginning of the day. How are we assured now that the battery chargers, for example, don't exceed their qualification temperatures? In other words, we specify somewhere when we come up with our qualification profile that the qualification temperature is going to be 120 degrees, let's say. How do we ensure that we don't exceed that 120 degrees?

MR. BINGHAM: We are currently developing envelopes. You can't just take the temperature, but you've got to take the whole envelope. You've got to take the low temperature and high temperature at the wet bulb and everything. Those are compared with the documentation that comes from the particular vendor. If that information isn't available, it should be requested from the vendor or it should have been part of the plan originally. As you probably know, or maybe the Board doesn't know, equipment qualification is a very difficult area right now to get the proper information to have that assurance, so there are several different efforts going on not only on Palo Verde, but other jobs to come up with the information to assure that we are getting equipment that meets the criteria.

MR. ALLEN: Well, what I meant, Bill, was after the equipment is in the plant, what I am talking about is the

environmental conditions present in the plant after we are operating, for example.

MR. BINGHAM: The issue is would we have monitors in various compartments in order to have good assurance that everything is okay? We are looking at that at the present time. Presently, we don't have temperature monitors throughout everyplace in the plant. What we have done is assume that there are conditions of HVAC being out and that is giving you maximum temperatures. Those, of course, will be confirmed during the preoperational testing period or, if it is a hot time in the year, at some time subsequent to assure that even if the stuff was out, you don't exceed the design temperatures that you have. That is a technique that is being used in lieu of monitoring in each, and when I talk about monitoring, I am talking about read-out in the control room or alarms, that sort of thing. If a utility or if we see some uncertainties, we can certainly have local temperature recorders just to see what is happening and get the trend of what is going on. I'm sorry, I misunderstood your original question.

MR. VAN BRUNT: Are there any other questions?

MR. BINGHAM: Ed, that completes our presentation on the system.

MR. VAN BRUNT: I suggest that we take a five-minute break and then we will come back and finish up our discussion.

MR. BINGHAM: Does the Board want to meet privately?

MR. VAN BRUNT: We will do that in the break.

(Thereupon a brief recess was taken, after which proceedings were resumed as follows:)

MR. VAN BRUNT: Bill, I have one more question I wanted to ask you. This morning we talked at some length about separation in the control building and auxiliary building and this kind of thing between mechanical components and electrical components of like trains and differing trains. In passing, you mentioned that that separation does not apply within the containment building.

MR. BINGHAM: The compartmentalization?

MR. VAN BRUNT: Physical compartmentalization does not.

MR. BINGHAM: That's right.

MR. VAN BRUNT: What kind of separation criteria is being used to deal with the electrical separation between trains and between channels within trains and between the mechanical and electrical stuff of differing trains within the containment building where you don't have compartmentalization?

MR. BINGHAM: Generally, distance and barriers are what are used in the containment. What I mean by that is that one train of instrumentation will go to one steam generator, the other train will go to the other, and they will come in at separate points through separate penetrations separated maybe by half the circumference of the containment. The

difference in the containment is that we do have to take a look at specific cases where distance or barriers are not available. Give me a moment here.

MR. VAN BRUNT: Okay, we will go off the record for a minute.

(Thereupon a brief off-the-record discussion ensued, after which proceedings were resumed as follows:)

MR. BINGHAM: The criteria are the same, and I wanted to make sure that you understand that the method of attacking the problem is different. Outside the containment, we have done it by compartmentalizing of the thing. Inside the containment, we don't have that capability to compartmentalize everything, because, as you know, everything inside the containment is open for iodine removal capability and other issues. The criteria are the same. We do try to keep that criteria as far as putting things in conduit having the proper separation, reviewing the pipe breaks, impingement effects on conduit, trays, and we have an extensive documentation system of calculations that are a result of that review.

MR. KREUTZIGER: Is it not correct that in the containment, you have modeled all conduits in the containment?

MR. BINGHAM: That is correct.

MR. KREUTZIGER: So in the containment, because of this less compartmentalization, you actually are modeling all the raceways, including the conduit that is inside the

containment.

MR. BINGHAM: And the instrumentation, that's right.

MR. KREUTZIGER: And all the instrumentation.

MR. VAN BRUNT: Does anybody else on the panel have any other questions that they would like to raise at this point in time?

(No response.)

MR. VAN BRUNT: What I would like to do now is ask Don Karner, who has been keeping track of the open items, to recapitulate those to be sure that we have all the items listed and we have an understanding of what the items are.

MR. KARNER: The first item was the request that Bechtel provide additional information on the drainage for the battery room. That information was provided later on in the presentation, so that item is closed out.

The second item is that Bechtel provide information on monitoring of the door between charger rooms C and D.

The third item, that Bechtel provide information discussing the failure of the damper in the single duct leading from the battery rooms.

The fourth item was for Bechtel to provide additional discussion on the use of an air circuit breaker between the batteries and the dc bus. This discussion should include the mention of the circuit breaker being replaced by a disconnect, discussion of whether this would provide easier maintenance,

and a discussion of how false trips of the ACB are prevented.

MR. BINGHAM: Excuse me, may I have a clarification on that particular item? In our notes, it appeared that a simple fault tree analysis was what might be required for the response to the third part of that particular request.

MR. ALLEN: Well, one thing on that, I think on the third part of that there was some discussion on these false trips may be common mode.

MR. BINGHAM: Yes.

MR. ALLEN: For example, if they weren't set properly and you had an in rush on an accident load or something like that, if it was a common mode, you would trip them all off and leave yourself without dc, and that should be considered. Additionally, one other thing should be added on there. Bechtel was to determine what they are doing on other projects related to these items.

MR. VAN BRUNT: Does that clarify it for you, Bill?

MR. BINGHAM: Yes, I think so.

MR. KARNER: The fifth item was that Bechtel would discuss with the Palo Verde charger manufacturer any failures of their equipment that had been experienced and discuss how like failures will be prevented on Palo Verde.

The sixth item was that Bechtel would examine the dc power system's capability to withstand multiple failures;

that is, to go beyond the existing regulatory requirements.

MR. BINGHAM: I think we will have to work with the panel to make sure that we have the bounds as to just how far we go with multiple failures. Again, this gets back to the fault tree analysis I was talking about whether they should go beyond a certain point or a probabilistic look at it if there is no gain or benefit.

MR. VAN BRUNT: I think the intention of that question was tied into some of the discussion relative to whether the regulations were minimum requirements or whatever and, as I remember, I asked that question, and what I was interested in was pushing the system beyond the design basis to see how far it would go.

MR. BINGHAM: Yes, and the issue that I was focusing in on, Ed, is what is the acceptance criteria. In other words, if you want to know how far it can go, how far can it go compared to what?

MR. VAN BRUNT: How far beyond the design basis it can go.

MR. ALLEN: Also along the same lines as multiple failures again as it applied to common mode type failures. I think that is where more of the emphasis was.

MR. BINGHAM: That's right. We are talking about operator error, and there can be a combination of common mode operator error, two failures, or any combination of all

of those might have the same outcome of unavailability, for example. That is why I was setting the criteria. Perhaps we could take the probability of performance for the base system and then run the scenarios and compare them.

MR. VAN BRUNT: That is what I was trying to get at.

MR. BINGHAM: We can handle that.

MR. KARNER: The seventh item was to verify that there are no adverse interactions between acid spills in the battery room and the floor coatings. That item was also discussed further later on in the presentation. However, there was a supplementary item that was requested that Bechtel investigate that the battery rack embeds and mounting wells are protected from acid spills.

The eighth item was a request that Bechtel investigate how the battery rooms are protected from flooding by fire protection water sprays in the lower cable spreading room.

The nineth item was for Bechtel to verify that all equipment in the battery rooms is Seismic Category I or, if it is not Seismic Category I, it cannot cause damage to the batteries during or after a seismic event.

Item number ten was for Bechtel to verify the allowable fluctuations in the ac power source to the battery chargers.

MR. BINGHAM: Can we stop at the tenth item just a

moment? Would you repeat that item again?

MR. KARNER: That item dealt with a determination of how much fluctuation was allowable in the ac power source in order to meet the plus or minus 2% allowable fluctuation in the dc.

The eleventh item was for Bechtel to explain the differences which exist between the Palo Verde FSAR battery loading tables and the loading tables shown in the system description.

MR. TAJADDODI: Well, let me put it this way. That is not a system we attached. It is not part of the system description the way it is right now. This was only for presentation purposes.

MR. BINGHAM: It is the present design.

MR. TAJADDODI: It is the present design. It is not part of the system description.

MR. BINGHAM: That is what we have in our notes, to compare the present design of the FSAR and advise you of what we should be doing.

MR. KARNER: You have then verified that the presentation is the present design?

MR. BINGHAM: Yes.

MR. KARNER: The twelfth item was to verify that the presentation reflected the current battery capacities.

The thirteenth item was to investigate the use of

a battery high discharge alarm and charger overcurrent alarm.

The fourteenth item was to verify that the battery ammeter is center reading zero.

MR. TAJADDODI: We did verify that.

MR. BINGHAM: We did verify that from the drawing that was part of the presentation.

MR. KARNER: Then that item can be closed out.

The fifteenth item was for Bechtel to examine the control board layout for the dc power system to determine if the operator interface could be improved.

The sixteenth item was for PVNGS operations to verify that their procedures will require monitoring of battery air flow or battery room air flow.

The seventeenth item was to determine if the failure mode and effects analysis presented should include failures that would introduce ac power components into the dc system.

That completes the list of outstanding issues.

MR. ALLEN: I would like to add one more thing on item number eight, and that is to verify that we can't have any flooding in the corridors where the water could come into the battery rooms or charger rooms and cause any problems. In other words, do we have sills on the doors or are the floors sloped down or necessary drains are there to prevent the water in the corridor from coming on and going into the rooms.

MR. ROGERS: Don, a clarification on number seven. In addition to what you had on the notes, we requested Bechtel to specifically tell us if there were any cinch anchors or concrete expansion joints used with regard to the batteries.

MR. BINGHAM: We also have one other on our list, which was to consider the schematic information presented in the FSAR to speed up evaluation processes.

MR. VAN BRUNT: That's correct. That should be in, yes.

Does anybody have any further questions? Do any of the panel members want to make any comments? Are you satisfied with the review? From my own viewpoint, I think it was a very useful discussion.

John has a comment he wants to make.

MR. ALLEN: One more concern. Faust had asked us to make sure that we keep in the back of our minds the reasoning for having this extra instrumentation and everything as it relates to the task item A-30, so we want to make sure that we keep that in the back of our head while we are looking this stuff over.

MR. VAN BRUNT: Does anyone want to make any comments? Faust, would you from your viewpoint like to make any comments?

MR. ROSA: I just wanted to reiterate what you just said. I think it has been very useful. I think that the more of this type of meeting, the quicker we are likely to

arrive at a process of regulatory review that is as efficient as we would like to have it. The NRC as well as the applicants, I am sure, are aiming in that direction. I don't know exactly what this particular meeting will lead to as far as review procedures are concerned. This is the first of its kind and the attempt is being made, I guess everyone should realize that, and the attempt is being made to speed up the review process without sacrificing any safety considerations. Let's all go back to our respective workshops and come back with any suggestions that are likely to lead to that result. Feel free to communicate with us, any of you, on this with any ideas that you have and we will be glad to consider all of them.

MR. VAN BRUNT: Very good.

MR. ROSA: Thank you very much.

MR. VAN BRUNT: Our intentions from this point on are that as soon as we get the transcript back, we will review it for accuracy. Then we are going to send a copy to the Nuclear Regulatory Commission with some appropriate comments, and it would be my intention that I will then ask for a specific meeting where we can discuss the procedure that we have used here and determine what improvements we can make to make it useful from both of our viewpoints to speed up the process, as has been indicated.

Anybody have any further comments they would like

to make? If not, I want to thank you all for your participation. Again, I feel that it has been very useful, a very educational way to transfer information and get some questions and concerns answered and look forward to doing the next one.

MR. BINGHAM: We have several open issues that the Board wants a response on. Are you to the point on how you would like that response for the Board?

MR. VAN BRUNT: Bill, I think there are two ways we can handle that, and I am not going to push either way right this minute. I think one way is we can handle those as written questions. You will get a copy of the transcript and we can handle that as a written question, in essence. The other way would be the next time we have a meeting, we can handle it as an individual item. If, for example, the next review we do is, say, the electrical system, ac electrical system, you probably will have the same people here, so we could clean up those items. If we go into the mechanical system, then maybe that is not a proper way to do it. I won't anticipate. I think the easiest way possible would be to consider the record as a written question and you can respond in writing.

MR. BINGHAM: Fine. We will respond to that.

MR. VAN BRUNT: Thank you very much.

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I HEREBY CERTIFY that I was present upon the meeting of the Power Systems Review Board of the Palo Verde Nuclear Generating Station; that I made a shorthand record of all proceedings had upon said meeting; and that the foregoing 178 pages of typewritten matter constitute a full, true, and accurate transcript of said record, all to the best of my skill and ability.

Mark M. Grumley

Mark M. Grumley
Court Reporter

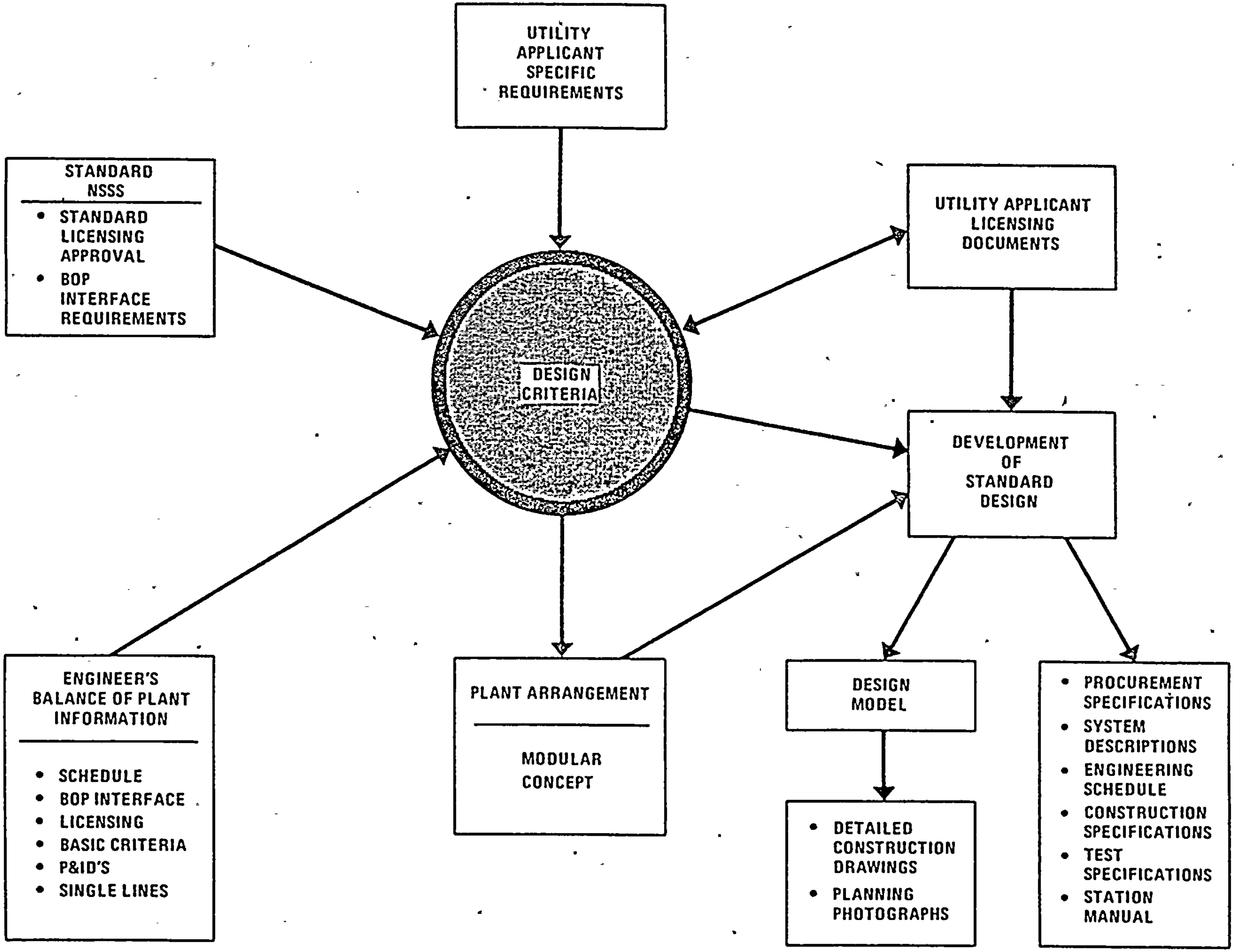

FIGURE 1

DEVELOPMENT OF STANDARD DESIGN

OUTLINE

1. PURPOSE FOR HAVING THE CLASS IE DC SYSTEM
2. DESIGN CRITERIA
3. FSAR COMPLIANCE
4. SYSTEM DESCRIPTION
5. COMPONENT DESCRIPTION
6. SYSTEM OPERATION
7. INSTRUMENTATION DESCRIPTION
8. TESTS & INSPECTION
9. SINGLE FAILURE ANALYSIS
10. INTERFACE
11. QUALIFICATION

FIGURE 2

DATE	ARIZONA NUCLEAR POWER PROJECT JOB 10407	DESIGN CRITERIA MANUAL DETAILED DESIGN CRITERIA	PART III

SYSTEM DESIGNATION PK - TITLE CLASS IE 125-V DC POWER SYSTEM

PRINCIPAL RESPONSIBILITY Bechtel-Electrical

CONTENTS

5

QUALITY CLASS Q

SAFETY CLASS NA

SEISMIC CATEGORY I

NRC REGULATORY GUIDE 1.6, 1.22, 1.29, 1.32, 1.41, 1.47, 1.53, 1.75, 1.81, 1.93 6 11

NRC GENERAL DESIGN CRITERIA 17, 18

REFERENCES:

FSAR SECTION 8.3.2 6

P & I DRAWINGS NA

OTHER MAJOR DRAWINGS 13-E-PKA-001

APPROVAL SIGNATURES

GS OR EWP (ORIGIN) ______ DATE ______

CHIEF ENGINEER ______ DATE ______ 6

PROJECT ENGINEERING MANAGER ______ DATE ______

DATE OF ORIGIN 10/28/74

DATE(S) OF ALL CHANGES 3/12/76 1/14/77 4/13/79 10/5/79 1/18/80

FIGURE 3

PP-874 (10407) 5/77

1. CLASS IE 125-V DC POWER SYSTEM

1.1 PRINCIPAL FUNCTION

The Class IE 125-V dc power system provides four separate reliable sources of continuous power for the four independent groups of Class IE, dc loads.

1.2 CODES AND STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE) Standard 308, Standard Criteria for Class IE Power Systems for Nuclear Power Generating Stations; Standard 323, General Guide for Qualifying Class IE Electric Equipment for Nuclear Power Generating Stations; Standard 344, Seismic Qualification of Class IE Electric Equipment for Nuclear Power Generating Stations; Standard 384, Criteria for Separation of Class IE Equipment and Circuits; Standard 450, Maintenance, Testing, and Replacement of Large Stationary Type Power Plant and Substation Lead Storage Batteries; Standard 485, Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations. 1 6

B. National Electrical Manufactures Association (NEMA), Standard AB-1, Molded Case Circuit Breakers; Standard PB1, Panelboards; Standard SG-5-71 Power Switchgear Assemblies. 1

1.3 DESIGN CRITERIA

A. Each unit's Class IE 125-V dc power system shall be designed in accordance with IEEE Standard 308 and shall be divided into four independent redundant systems. Each of the four systems shall be capable of distributing power to one of four channels (A, B, C and D) of plant protection and engineered safety features (ESF) equipment. IEEE 308 RG 1.6 GDC 17

B. Physical independence of the redundant Class IE 125-V dc power systems shall be maintained in accordance with NRC Regulatory Guide 1.75 and IEEE Standard 384, except that reference made in Regulatory Guide 1.75 to "associated circuits" shall be taken to apply to associated cables. Non-class IE loads connected to Class IE dc systems shall be treated as Class IE devices up to and including the isolation device. 6

C. Each source shall have the following:

1. One full capacity battery charger to supply power under normal conditions, and one full capacity backup battery charger to supply power to either channel of each load group. The backup battery chargers shall be connected to either channel (A or C 1

TO ENHANCE REQ OF R.G 1.93

FIGURE 4

of group 1 and B or D of group 2). A manual selector switch provided in the backup battery charger shall be the only means of transferring from one channel to another.

2. A battery to supply power for two hours following loss of ac supply to the battery chargers.

3. A panel to distribute the power to the individual loads.

D. The battery chargers for the four channels (A, B, C and D) shall be fed from MCCs in the two load groups as follows:

Channel A: MCC fed from one load center in Load Group 1
Channel C: MCC fed from the second load center in Load Group 1
Channel B: MCC fed from one load center in Load Group 2
Channel D: MCC fed from the second load center in Load Group 2

E. There shall be no interconnections among the four Class IE 125-V dc buses within each unit. The standby battery charger cannot be connected to two dc buses simultaneously due to breaker interlocks. Separation between the output breakers meets requirements of Regulatory Guide 1.75. IEEE 308 R.G. 1.6

F. There shall be no interconnections among the 125-V dc buses of Units 1, 2 and 3. R.G. 1.81

G. The 125-V dc systems shall be designed for normal operation at approximately 130 volts. The voltage at the end of the two-hour discharge period shall be at least 105 volts. The steady state voltage shall not exceed 140 volts.

H. Each Class IE battery shall have sufficient capacity to independently supply the required loads for 2 hours. The sizing of the batteries shall be based upon electrolyte temperature of 60F. In accordance with IEEE Standard 450, initial battery capacity shall be 25 percent greater than required. This margin allows a battery replacement criterion of 80-percent rated capacity. Additional margin shall be provided for possible load growth in accordance with IEEE-485. HVAC interface

I. The capacity of each Class IE battery charger shall be based on the largest combined demand of all the steady state loads and the charging current required to restore the battery from the design minimum charge state to the fully charged state (within 12 hours); irrespective of the status of the plant while these demands occur. R.G 1.32

J. The dc systems shall be ungrounded.

K. Receptacles and switches shall not be located within the battery rooms.

FIGURE 5

L. Lighting fixtures in the battery rooms shall be vaportight. 3

M. Redundant Class IE batteries shall be placed in separate rooms within the control building. (R.G. 1.75)

N. The battery chargers and dc distribution panel of redundant channels shall be placed in separate rooms within the control building. (R.G 1.75) 3

O. The Class IE batteries, racks, battery chargers, and dc panels shall be capable of withstanding the safe shutdown earthquake without loss of function. (R.G. 1.75, 1.29) (IEEE 344) 3

P. Control room instrumentation shall be provided to monitor the status of each Class IE dc system as follows: 3

- DC bus undervoltage alarm (R.G. 1.41)
- Battery current indication (also at dc panel)
- DC voltage indication (also at dc panel and at charger) (R.G. 1.41)
- DC ground indication (also at dc panel)
- Battery circuit continuity alarm monitor
- Charger malfunction alarm, including input ac under voltage, dc undervoltage, dc overvoltage, and output breaker open. (R.G. 1.41) 1
- Charger output current (also at charger)
- AC and dc breaker position indications (at the charger) (R.G. 1.41) 1

Q. The loads supplied by the Class IE batteries shall be as follows: 3

- DC system A
  - Diesel generator 1 control and field flash
  - Miscellaneous loads associated with load group 1 and channel A 5
  - Class IE switchgear dc supplies of load group 1
  - Inverter A
  - Reactor trip switchgear, channel A
  - Deleted 4
  - Deleted 5
  - Motor operated valves

- DC system B
  - Diesel generator 2 control and field flash
  - Miscellaneous loads associated with load group 2 and channel B
  - Class IE switchgear dc supplies of load group 2
  - Inverter B
  - Reactor trip switchgear, channel B
  - Deleted
  - Deleted
- DC system C
  - Inverter C
  - Three-phase inverter for shutdown cooling isolation valve
  - Reactor trip switchgear, channel C
  - Motor-operated valves
  - Miscellaneous loads associated with channel C
- DC system D
  - Inverter D
  - Three-phase inverter for shutdown cooling isolation valve
  - Reactor trip switchgear, channel D
  - Motor-operated valves
  - Miscellaneous loads associated with channel D

R. The NSSS 125-V dc load sizes given in References 1 and 2, shall be used in sizing the class IE batteries.

FIGURE 7

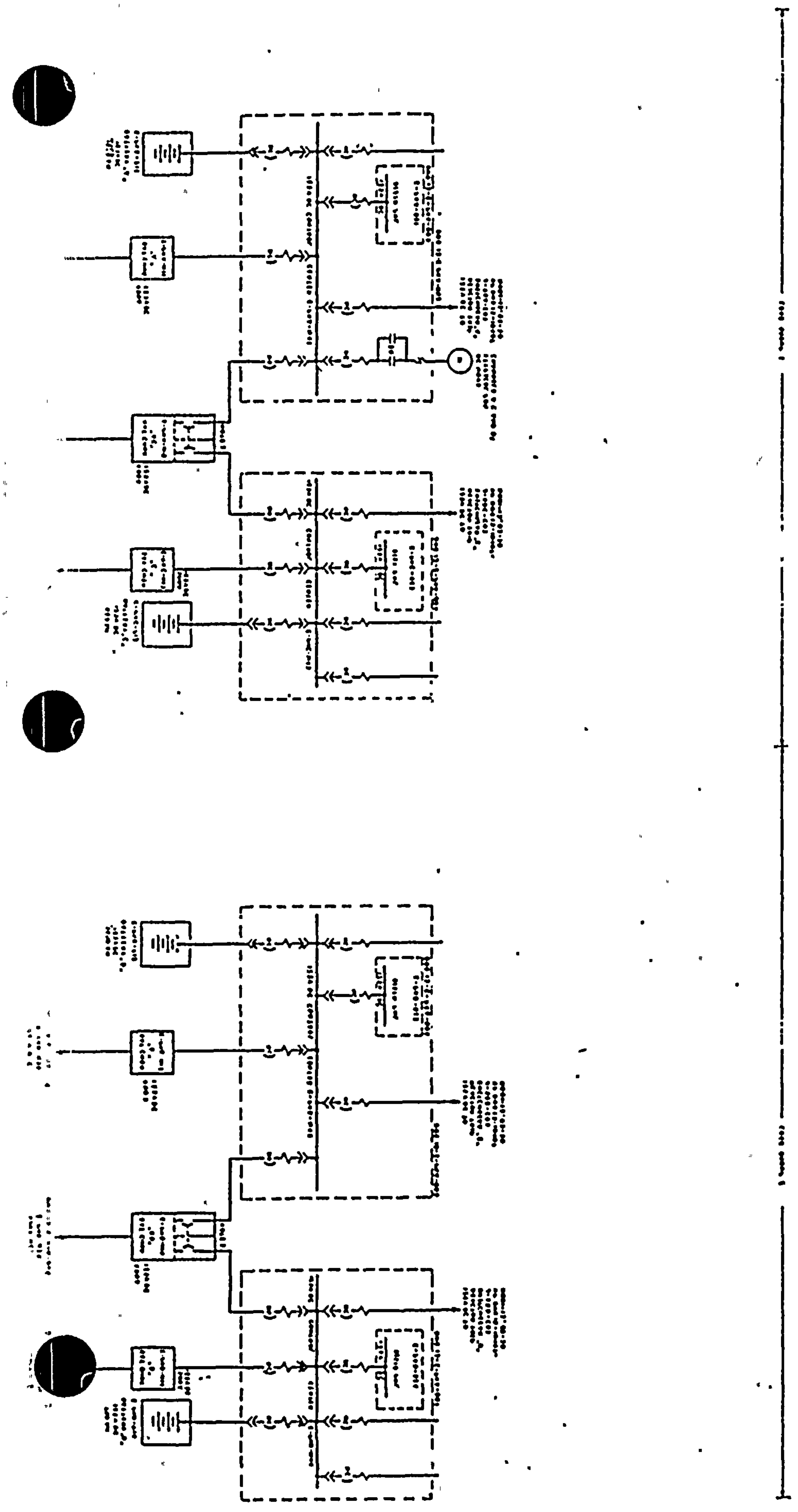

FIGURE 8

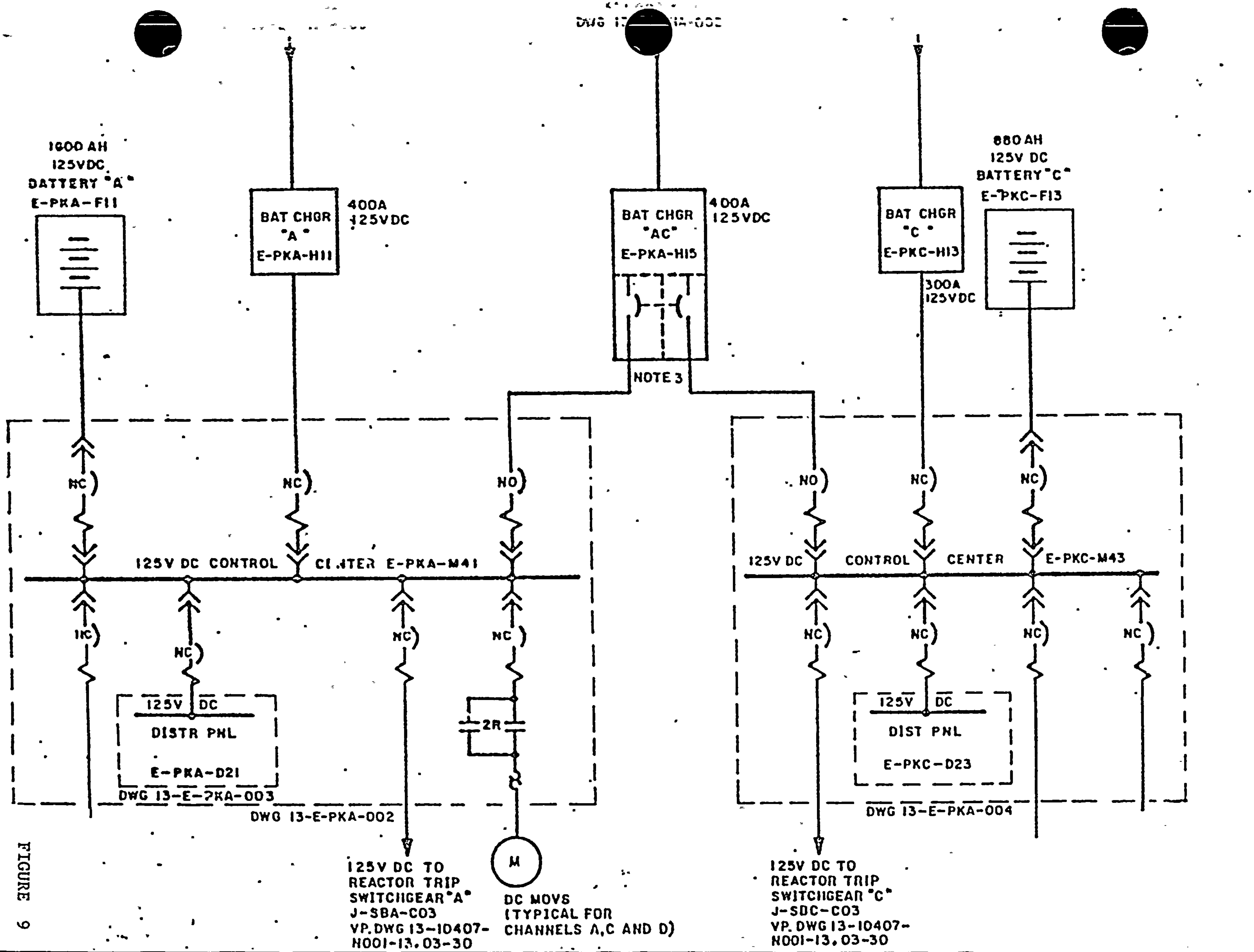
1600 AH
125VDC
BATTERY "A"
E-PKA-F11
BAT CHGR
"A"
E-PKA-H11
400A
125VDC
BAT CHGR
"AC"
E-PKA-H15
400A
125VDC
NOTE 3
BAT CHGR
"C"
E-PKC-H13
300A
125VDC
880 AH
125V DC
BATTERY "C"
E-PKC-F13
NC
NO
125V DC CONTROL CENTER E-PKA-M41
125V DC
DISTR PNL
E-PKA-D21
DWG 13-E-PKA-003
DWG 13-E-PKA-002
2R
125V DC CONTROL CENTER E-PKC-M43
125V DC
DIST PNL
E-PKC-D23
DWG 13-E-PKA-004
125V DC TO
REACTOR TRIP
SWITCHGEAR "A"
J-SBA-C03
VP. DWG 13-10407-
N001-13.03-30
M
DC MOVS
(TYPICAL FOR
CHANNELS A,C AND D)
125V DC TO
REACTOR TRIP
SWITCHGEAR "C"
J-SBC-C03
VP. DWG 13-10407-
N001-13.03-30

FIGURE 9

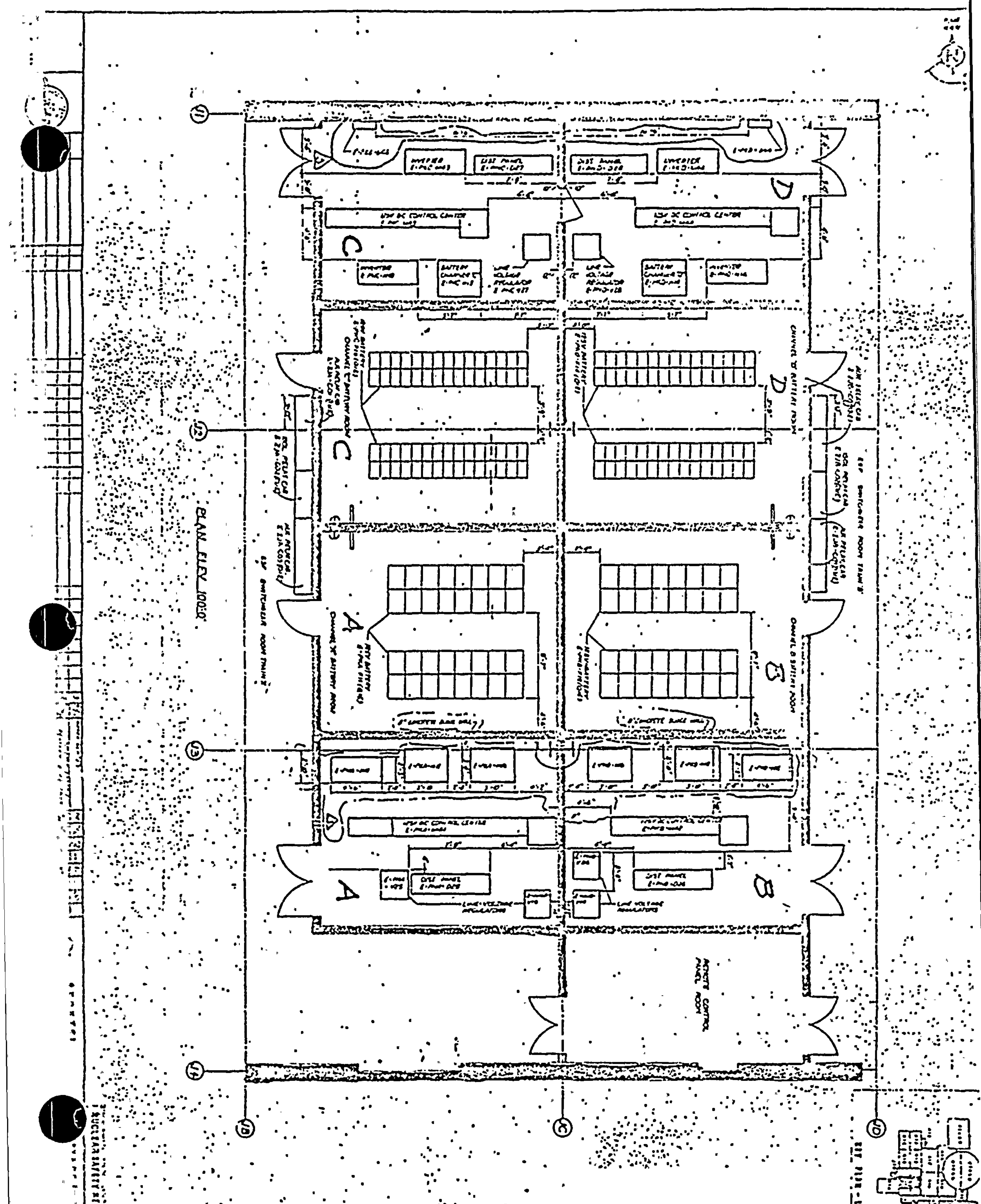
PLAN ELEV 100'0"
A
B
C
D
REMOTE CONTROL PANEL ROOM
NUCLEAR SAFETY RELATED

FIGURE 10

FSAR COMPLIANCE

FSAR requirements are met as follows:

1. Meet requirement of NRC Guides 1.6, 1.29, 1.32, 1.41, 1.75, 1.81, 1.93
2. GDC 17, 18
3. IEEE 308-1974, 323-1974, 344-1975, & 450-1975, 384-1974
4. SRP 8.3.2 Acceptance Criteria

FIGURE 11

GDC 17 ELECTRIC POWER SYSTEMS

A. The class IE dc subsystems including batteries, chargers, dc switchgear and distribution equipment are physically separate and independent.

B. Sufficient capacity, capability, independence redundancy and testability are provided in class IE dc system ensuring the performance of safety functions assuming a single failure.

FIGURE 12

GDC 18 INSPECTION AND TESTING OF ELECTRIC POWER SYSTEMS

A. Inspection and testing during equipment shutdown of wiring, insulation and connections to assess the continuity of the subsystem and condition of its components.

B. Periodic testing, during normal plant operation of the operability and functional performance of the subsystem by isolatiing the subsystem.

FIGURE 13

IEEE 308 STANDARD REQUIREMENT	DESIGN COMPLIANCE
Redundant Loads	
Should be separated into two or more redundant load groups.	Four independent load groups are provided.
Safety Actions	
The Safety actions shall be redundant and independent of safety actions by its redundant counterparts.	Safety actions of each of the (4) redundant load groups are independent.
Power Supplies	
Each of the redundant load groups shall have access to a power supply that consists of a battery and one or more battery chargers.	Each load group has a battery and battery charger. In addition a standby charger is provided to serve one channel of an independent load group at a time.
Common Power Supply	
Two or more load groups may have a common power supply if the consequences of the loss of the common power supply to the load groups under design basis conditions are acceptable.	2 channels of each load group have a common power source from the ac system. However the batteries providing power to the channels are independent.
Common Failure Mode	
The batteries should not have a common failure mode for any design basis event.	Batteries are qualified per the requirement of IEEE 323-1974 and IEEE 344-1975.
Protective Devices	
Protective devices shall be provided to limit the degradation of the class IE power systems. Sufficient indication shall be provided to identify the actuation of a protective device.	Breakers are provided to isolate parts of the system to limit degradation. Indication is provided locally and in control room to identify status of the breakers.

FIGURE 14

IEEE 308 STANDARD REQUIREMENT	DESIGN COMPLIANCE
<u>Distribution System Capability</u>	
Each distribution circuit shall be capable of transmitting sufficient energy to start and operate all required loads in that circuit.	The distribution system is capable of distributing the required energy to all the loads required for safety action.
<u>Independence</u>	
Distribution circuits to redundant equipment shall be physically and electrically independent of each other.	The distribution circuits of each redundant load group are physically and electrically separated and independent of each other per IEEE 384 and R.G. 1.75.
<u>Auxiliary Devices</u>	
Auxiliary devices to operate dependent equipment shall be supplied from a related bus section.	All auxiliary devices of each redundant channel are supplied from its respective bus section.
<u>Feeders</u>	
Feeders between the class IE power systems located in Safety Class Structure and systems located in non-Safety Class Structures shall be provided with automatic circuit interrupting devices.	All feeders supplying different loads are provided with breakers that automatically open to isolate a fault.
<u>Battery Supply</u>	
<u>Description</u>	
Each battery supply shall consist of the storage cell, connectors and its connections to the distribution system supply circuit breaker.	The batteries are complete with storage cells, and connectors. Each battery is connected to the distribution system through a circuit breaker.
<u>Capability</u>	
Each battery supply shall be capable of starting and operating all required loads.	Batteries are sized per IEEE 485-1978 to start and operate the required loads for two-hour duration.

FIGURE 15

IEEE 308 STANDARD REQUIREMENT	DESIGN COMPLIANCE
Availability	
Each battery supply shall be immediately available during normal operations and following the loss of power from the ac system.	The batteries are fully charged and connected to the distribution system.
Independence	
Each battery supply shall be independent of other battery supplies.	Each of the batteries is totally independent.
Stored Energy	
Batteries shall be maintained in a fully charged condition. Stored energy shall be sufficient to operate all necessary circuit breakers and to provide an adequate source of power for all required connected loads during loss of ac power to battery chargers.	Batteries will be maintained and tested on a periodic basis to assure the availability of its stored energy per IEEE 450-1975.
Battery Charger Supply	
Description	
Each battery charger supply shall include all equipment from its connection to the ac system to its distribution system supply circuit breaker.	Each battery charger includes all equipment from the ac supply source to the connecting breaker to the distribution system.
Function	
Each battery charger supply shall furnish electric energy for the steady state operation of connected loads required during normal and post accident operation while its battery is returned to or maintained in a fully charged state.	The battery chargers are provided to supply the steady state loads and charging the batteries from their design minimum to a fully charged state.

IEEE 308 STANDARD REQUIREMENT	DESIGN COMPLIANCE
Capability	
Each battery charger supply shall have sufficient capacity to restore the battery from the design minimum charger to its fully charged state while supplying normal and post accident steady state loads.	The battery chargers are sized so that they are capable to supply the necessary steady state loads and provide charging to the batteries from their design minimum to fully charged state.
Independence	
Battery charger supply shall be independent of other battery chargers.	Each battery charger is independent. In addition a standby charger is provided for each load group.
Surveillance	
Indicators shall be provided to monitor the status of the battery charger supply. The instrumentation shall include indication of (a) Output voltage (b) Output current (c) Circuit breaker position	Indication and alarms are provided for both input and output conditions of voltage, current and circuit breaker position.
Disconnecting Means	
Each battery charger power supply shall have a disconnecting device in its alternating current power output circuit for isolating the charger.	The input to the charger is provided with a breaker to isolate the charger.
Feedback Protection	
Each battery charger power supply shall be designed to prevent the alternating ac power supply from becoming a load on the battery due to a power feedback as a result of loss of ac power.	The battery chargers are designed to prevent the ac power supply to become a load on the batteries by means of blocking diodes.

R.G.		Requirement	Design Features
1.6	1.	Should have separate redundant load groups.	Four independent and separate power sources.
	2.	Should be energized by a battery and battery charger.	Each channel has an independent battery and battery charger.
	3.	No <u>automatic</u> connection to any redundant dc load group.	There are no automatic means to connect redundant dc load groups.
	4.	Standby source of one load group should not be automatically paralleled with the standby source of another load group under accident condition.	Standby source is within a load group. No standby source parallels two load groups. No automatic paralleling is provided.
	5.	No automatic transfer of loads between redundant power sources.	No automatic transfer of loads are provided.
	6.	If means exist for manual connection of loads, at least one interlock should be provided to prevent parallel operation.	Manual connection of standby source is provided with mechanical interlock to prevent parallel operation.
1.29		Class 1E systems should be designed as Seismic Category I and should withstand the effects of SSE and remain functional.	All Class 1E systems are designed and procured to meet SSE.
1.32	1.	A battery charger supply capacity should be based on the largest combined levels of the various steady state loads and charging capacity to restore the battery from the design minimum charge state to fully charged state irrespective of the status of the plant.	The battery charger is sized to supply all the steady state loads and charging the battery from design minimum (105 volts) to fully-charged state (130 volts).

FIGURE 18

R.G.		Requirement	Design Features
1.32 (cont)	2.	Discharge tests should be made per IEEE 450-1975.	Discharge tests will be conducted per IEEE 450-1975
1.41	1.	The onsite system should be functionally tested successively with all dc and ac sources disconnected completely for one load group.	The dc system is provided with breakers to effect isolation of system for testing.
	2.	During each test the dc buses and related loads not under test should be monitored to verify absence of voltage.	Under voltage relays and alarms are provided both locally and in control room to verify absence of voltage.
1.75	1.	Isolation devices actuated only by fault current are not considered to be isolation devices.	Isolation devices are actuated by SIAS signal in addition to fault current for power circuits.
	2.	Interlocked armored cable should not be construed to be a raceway.	No interlock armored cable is considered as a raceway.
	3.	Locating redundant circuits and equipment in separate safety class structure.	Redundant equipment is located in separate safety class structures and circuits are provided with adequate separation and isolation.
	4.	Associated circuits installed should be subject to all requirements placed on Class 1E circuits.	Associated circuits are treated as Class 1E up to isolation devices. After the isolation device they are treated as non-Class 1E. All other requirements of R.G 1.75 are met.
1.81	1.	DC systems in a multi-unit plant should not be shared.	No shared systems are present between units.
	2.	A single failure should not preclude the capability to automatically supply minimum ESF loads.	A single failure will not degrade the capability of dc system to supply minimum ESF loads.

FIGURE 19

R.G.		Requirement	Design Features
1.81 (cont)	3.	Onsite power capacity should be provided to energize sufficient Seismic Category I equipment.	The capacity of the dc system is sufficient to energize the necessary dc loads.
	4.	The interaction between each units ESF electric circuits should be limited.	No interaction exists between units.
1.93		If only one dc source is not available, power operation may continue for 2 hours.	The standby charger enhances the operation of the plant should one charger and battery be unavailable.

FIGURE 20

SRP ACCEPTANCE CRITERIA	COMPLIANCE PER FSAR
1. System Redundancy Requirements	
The acceptability of the onsite dc system with regard to redundancy is based on conformance to the same degree of redundancy required of safety-related components and system by GDC 22, 33, 34, 35, 38, 41, and 44.	The redundancy requirements of the systems mentioned in GDC 22, 33, 34, 35, 38, 41, and 44 are met by four redundant power supplies.
2. Conformance with Single Failure Criterion	
Should meet the requirement of GDC 17, IEEE 308 augmented by Reg. Guide 1.6 and Reg. Guide 1.81 implementing the requirement of GDC 5 "Sharing of Systems, structures and components", and Reg. Guide 1.75.	These requirements are met per the following paragraphs of FSAR: GDC 17 - para 8.3.2.2.11 IEEE 308 - para 8.3.2.2.1.19 Reg. Guide 1.6 - para 8.3.2.2.1.3 Reg. Guide 1.81 - para 8.3.2.2.1.16 Reg. Guide 1.75 - para 8.3.1.2.2.16
3. Power Supplies	
a. Basis of selection of battery and battery charger should be based on IEEE 308.	The battery and battery chargers are selected and sized per IEEE 308-1974 augmented by R.G. 1.32 for sizing the chargers (8.3.2.2.1.17 and 8.3.2.2.1.19).
b. Sharing of dc power systems between generating units will not be permitted.	No power systems are shared per R.G. 1.81 (8.3.2.2.1.16).
c. Non-safety related loads connected to safety power supplies should conform to Regulatory Guide 1.75.	The only non-safety load connected to safety related dc power system is the status panel. Its connection meets the requirement of R.G. 1.75 (7.5.2.6 and 8.3.1.2.2.16).

FIGURE 21

SRP ACCEPTANCE CRITERIA	COMPLIANCE PER FSAR
d. Thermal overload protection of safety-related valves should meet BTP EICSB27.	The thermal overload protection is bypassed on SIAS per the requirement of R.G. 1.106 (EICSB 27 is superseded by R.G. 1.106).
4. <u>Identification of Cables and Cable Trays</u>	
The method used for identifying dc power system cables and cable trays as safety-related equipment and identification scheme used to distinguish between redundant cable and cable trays should be per R.G. 1.75.	All power cables are color-coded to identify the channels they are associated with. Their respective raceways are identified by tags at specified intervals per IEEE 384 and R.G. 1.75 (8.3.1.3).
5. <u>Vital Supporting Systems</u>	
The instrumentation, controls and electrical equipment for those supporting systems identified as vital to the proper functioning of the safety-related systems and acceptable if the design conforms to the same criteria as the safety-related systems supported.	All the instrumentation, controls and equipment meet the redundancy, qualification, identification, and separation that is provided for the safety-related systems.
6. <u>Systems Testing and Surveillance</u>	
a. Preoperational and initial start-up test per R.G. 1.68 and 1.41. b. Periodic testing per IEEE 450 and R.G. 1.22. c. Surveillance of dc power supply should be in accordance with R.G. 1.47 and BTP EICSB 21.	The protection system is provided with means to perform testing of protection system actuation functions per requirements of R.G. 1.68, 1.41, 1.22, 1.47 and BTP EICSB 21. These systems are covered fully in section 7 of the FSAR.

SRP ACCEPTANCE CRITERIA	COMPLIANCE PER FSAR
7. <u>Other Review Areas</u>	
a. <u>Seismic Design Requirements</u> The electrical and mechanical equipment should meet the requirements of IEEE 344 and EICSB 10.	Systems and components are designed and procured to meet IEEE 344-1975 and R.G. 1.100.
b. <u>Quality Assurance</u> The requirements of IEEE 336 and R.G. 1.30 should be met.	

FIGURE - 23

Table 8.3-6

CLASS IE DC SYSTEM LOADS (Sheet 1 of 5)

	Load on Bus		
	Normal Amperes	Emergency Amperes	
		1 minute	2 hours
DC subsystem A			
1. Inverter A E-PNA-N11	160	200	160
2. Reactor trip switchgear, channel A, J-SBA-C03	-	88	-
3. Aux. feedwater rgltr valve J-AFA-UV-32	6.3	34	-
4. Aux. feedwater isol valve J-AFA-UV-37	16	46	-
5. Aux. feedwater trip & throttle valve J-AFA-UV-54	3.4	16.5	-
6. Stm. gen. 1 to aux. fdw. pump A stm. supply vlv J-SGA-UV-134	25	113	-
7. Stm. gen. 2 to aux. fdw. pump A stm. supply vlv J-SGA-UV-138	25	113	-
8. Distribution panel E-PKA-D21			
Auxiliary relay cabinets of load group 1	17	17	17
Class IE switchgear & load centers dc supplies of load group 1	5	107	5
Diesel generator A control and field flash, J-DGA-B01 & B02	10	59	10

FIGURE 24

SYSTEM DESCRIPTION

1. Four independent DC systems.
2. Each system consists of normal charger, battery and control center.
3. Standby charger to provide power to either channel of a redundant group.

BATTERY PROFILES

Battery	PROFILE DESCRIPTION			
	0-1 MIN	1-119 MIN (Steady State)	Miscellaneous	119-120 MIN (Includes random load)
A.	912A	340A	13 - 1 min. pulses of 443A including steady state. Pulse intervals are every 3-1/2 min from time 0 to 46-1/2 min.	468A
B.	685A	337A	None.	447A
C.	315A	166A	13-1 min pulses of 269A including steady state. Pulse intervals are every 3-1/2 min from time 0 to 46-1/2 min.	455A
D.	212A	104A	None.	452A

FIGURE 25

Systems Operation

1. The system operates normally from the battery chargers.

2. The stand-by battery can provide power should the normal charger be under maintenance.

3. The batteries will supply power should the ac preferred power be unavailable.

4. The batteries will supply power for 2 hours under accident conditions.

5. Upon restoration of power the chargers will supply all the normal loads and charges the battery from design minimum voltage to fully charged voltage.

FIGURE 26

COMPONENT DESCRIPTION

1. Battery Charger

   a. Three phase constant voltage unit using solid state circuitry with (SCR) to convert ac to dc power.

   b. A self-supporting, free standing structure with hinged panels.

2. Batteries and Racks

   a. Lead Calcium type batteries

   b. Heat resistant, shock-absorbing, plastic containers, with leak proof seal covers.

   c. Battery racks are of structural steel with acid-resistant coating.

3. DC Control Centers

   a. Vertical free standing structures

   b. The incoming section houses electrically operated drawout type circuit breaker.

   c. Control Center section consists mainly of manually operated breakers, starters and distribution panel.

FIGURE 27

APPENDIX PK-A
EQUIPMENT DATA

This Appendix provides equipment data as indicated in the following:

A. Battery

Manufacturer	Exide
Quantity	4
Description	60-cell, Lead-Acid, Storage Battery

Tag No.	Battery type	Nominal Capacity AH	1-Minute Rating, A	Max sc Current, A	8-Hour Rating, A	Inter Res, OHM
E-PKA-F11 (A)	GN-19	1600	1830	18,000	199	.0084
E-PKB-F12 (B)	GN-19	1600	1830	18,000	199	.0084
E-PKC-F13 (C)	EC-21	880	1210	10,980	110	.012
E-PKD-F14 (D)	EC-19	790	1130	9,800	99	.014

B. Battery Charger

Manufacturer	Power Conversion Product Inc.
Quantity	4
Backup Battery Chargers	2

Tag No.	480 V Input ac Current A	125 V Output dc Current A
E-PKA-H11	110	400
E-PKA-H15	110	400
E-PKC-H13	85	300
E-PKB-H12	110	400
E-PKB-H16	110	400
E-PKD-H14	85	300
Transient Voltage		5000V
Charge Voltage		130V
Equalizing Charge Voltage		140
Floating Voltage Minimum		130
Floating Voltage Maximum		135
Regulation NL to FL		±1/2%
Ripple		2%
Efficiency		90%
Power Factor		75%

FIGURE 28

TESTS AND INSPECTIONS

The following tests and inspections will be performed periodically on Class IE 125-V-dc systems.

A. Float voltage is measured.

B. Cells are checked for cracks or electrolyte leakage.

C. The plates of cells are checked for buckling, discoloring, grid cracks, and plate growth.

D. Specific gravity of each cell is measured.

E. Voltage reading of each cell is measured.

F. Electrolyte level of each cell is checked, and all water additions are recorded.

G. Temperature of the electrolyte in representative cells is measured.

H. Battery charger current is measured with battery in service.

I. Periodically, a battery capacity discharge test is performed.

FIGURE 29

INSTRUMENTATION DESCRIPTION

1. Battery Charger Instrumentation

   - Ammeter at charger and at control room for charger output dc current
   - Voltmeter at charger and at control room for charger output dc voltage
   - Undervoltage relay No. 27 at charger to alarm at ac undervoltage input
   - Undervoltage relay No. 27C at charger to alarm at dc undervoltage output
   - Overvoltage relay No. 59 at charger to alarm at dc overvoltage output
   - Ac and dc breaker position indication at charger
   - Output breaker open alarm
   - Charger malfunction alarm in the control room, including ac undervoltage, dc undervoltage, dc overvoltage, and output breaker open

2. Battery Instrumentation

   - Ammeter at dc control center and at control room for battery current indication
   - Voltmeter at dc control center and at control room for dc bus voltage indication
   - Undervoltage relay No. 27A at control center for dc bus undervoltage alarm
   - Ground detector relay No. 64 and indication light for dc bus ground indication to alarm at dc control center and at control room

FIGURE 30

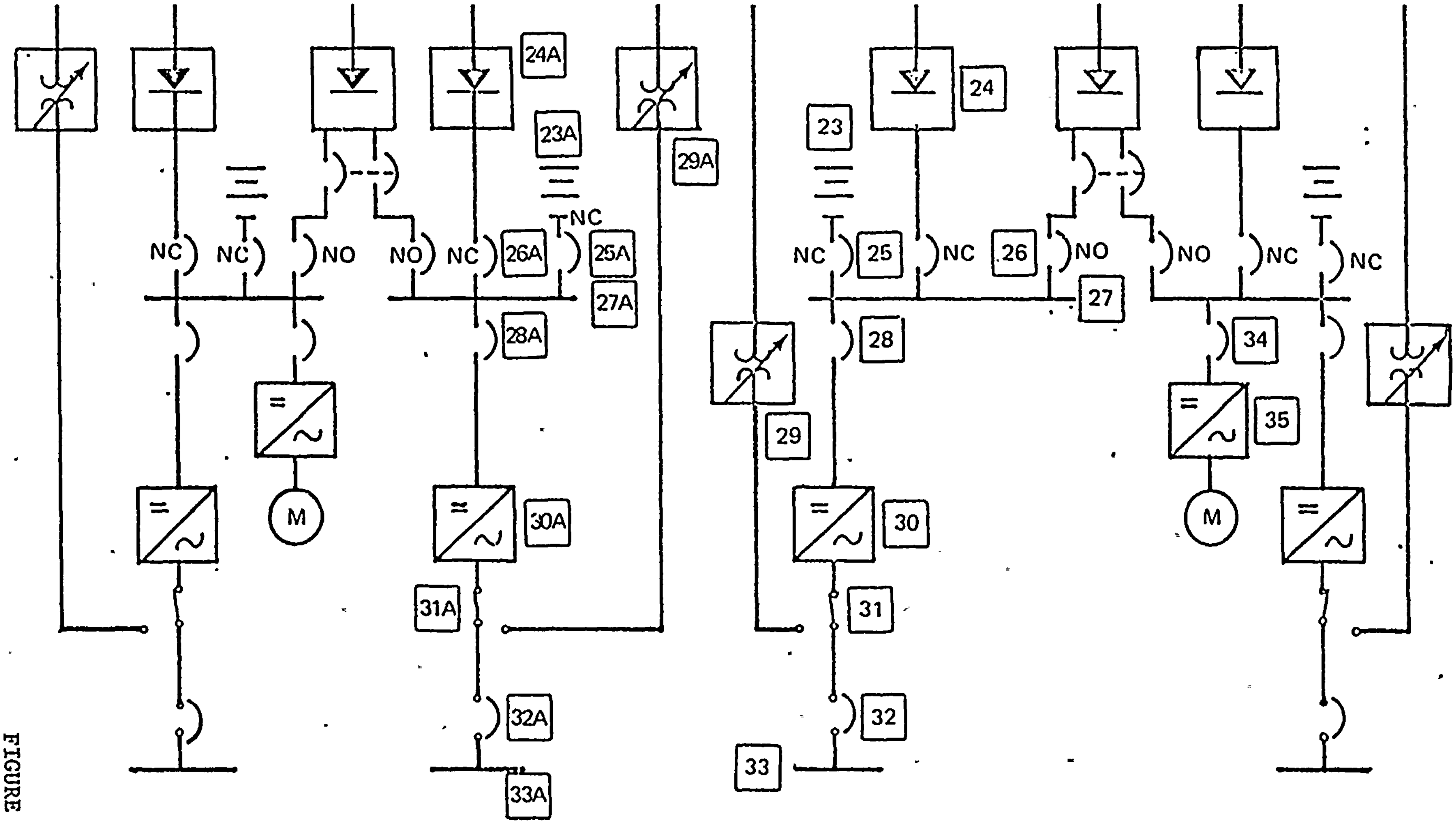
24A
23A
29A
23
24
NC
NO
26A
25A
27A
25
26
27
28A
28
34
29
35
M
30A
30
31A
31
32A
32
33
33A

FIGURE 31

FAILURE MODE AND EFFECTS ANALYSIS

Identification No.	Component Name	Component Function	Failure Mode	Effect on Subsystem	Effect on Subsystem
23	Battery	Provides dc power to the bus	Fails to provide dc power	Loss of standby power to the bus	No effect - The batteries serve as the source of standby dc power to the bus. The charger provides the dc power under normal conditions.
24	Battery Charger	Provides dc power to the bus	Fails to provide dc power	Loss of primary dc power.	No effect - The battery provides power to the bus and the standby charger can be connected to provide power for extended period of time.
25	Battery circuit breaker	Provides protection to the battery under fault conditions and provides power to the bus under normal conditions.	Fails open	Loss of standby dc power	No effect - The battery provides standby power to the bus. The charger provides the dc power.
26	Battery charger circuit breaker (NC)	Provides protection to the Charger under fault conditions and supplies power to the dc bus under normal conditions.	Fails open	Loss of dc power to the bus	No effect - The battery supplies power to the dc bus through its breaker. Standby battery charger breaker can be closed to supply power to the loads and battery.
27	DC bus	Distributes dc power to ESF loads	Fault	Loss of dc power to one channel.	No effect - Power available to the other three redundant channels. No actuation of ESFAS system due to 2/4 logic.

INTERFACE

(1) VENTILATION

(2) FIRE PROTECTION

(3) INDUCED SURGES

FIGURE 33

QUALIFICATION STATUS

Batteries - Achieved Qualification for approximately 3 years. Trying to extend Qualification per IEEE 344-1975 and IEEE 323-1974. Environmental testing is in progress - to be completed by 12/80.

Battery Chargers - Seismic and Environmental Test Plans and Reports per IEEE 344-1975 and IEEE 323-1974 were submitted and reviewed with comments. Environmental Qual. in progress.

Distribution Centers (MCC) - Qual. Test Plans per IEEE 323-1974 and IEEE 344-1975 have been received. Qual. testing is in progress. Reports scheduled for 6/80.

Distribution Panels - Qual. test plans have comments - Qual. testing per IEEE 323-1974 and IEEE 344-1975 is in progress. Completion by Mid-1980.

Instruments & Meters (in the Control Room) - Qual. test plans have comments - Qual. testing per IEEE 323-1974 and IEEE 344-1975 is in progress. Completion by 12/80.

FIGURE 34

ERRATA

Page 12, lines 2 and 3

Reference is made to Reg. Guide 1.41 - the correct reference should be to Reg. Guide 1.75.

Page 29, lines 19 and 20

Replace the sentence which begins on line 19 with the following:

> "We have tried to maintain separation for A and C channels, which are related to train A, similarly for B and D; so we can have more reliable separation and isolation of the circuits."

Page 33, line 16

Reference is made to a "non-seismic event"; this should read "seismic event."

Page 40, lines 21-25; page 41, line 1

Replace the paragraph which begins on line 21 and concludes on page 41, line 1, with the following:

> "A single failure should not preclude the capability to automatically supply minimum ESF loads, and we have seen that with four redundant channels and the occurrence of a single failure, we can still operate in the 2 out of 3 mode."

Page 41, lines 2 and 3

Replace the sentence which begins on line 2 with the following:

> "The onsite power supply capacity should be sufficient to energize the appropriate seismic category I equipment."