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NUCLEAR REGULATORY COMMISSION

Staff Briefing on

Review and Evaluation of WNP-2 Sacrificial

Shield Wall, Pipe Whip Restraints,

and Related Structures

Presented by

Washington Public Power Supply System

Fifth Floor Hearing Room
East West Tower Building
4350 East West Highway
Bethesda, Maryland

6 February, 1980
9:00 a.m.

PRESENT: J. B. Henderson, Nuclear Regulatory Commission, presiding

G. W. Reinmuth, Nuclear Regulatory Commission
R. E. Shewmaker, Nuclear Regulatory Commission
T. W. Bishop, Nuclear Regulatory Commission
R. C. Haynes, Nuclear Regulatory Commission
W. J. Wagner, Nuclear Regulatory Commission
R. Gamble, Nuclear Regulatory Commission
S. P. Chan, Nuclear Regulatory Commission
H. D. Thornburg, Nuclear Regulatory Commission
R. P. Snaider, Nuclear Regulatory Commission
R. P. Georgiev, Nuclear Regulatory Commission
A. Robart, Nuclear Regulatory Commission

R. Foley, Washington Public Power Supply System
R. T. Johnson, Washington Public Power Supply System
O. K. Earle, Washington Public Power Supply System
M. E. Witherspoon, Washington Public Power Supply System
D. Burns, Washington Public Power Supply System

ENCLOSURE A

PRESENT: (Continued)

M. J. Parisie, Burns and Roe
L. Akers, Burns and Roe
L. Good, Burns and Roe
J. O. O'Donnell, Burns and Roe
R. Snaith, Burns and Roe
J. Celnik, Burns and Roe
M. Fialkow, Burns and Roe

G. H. Hansen, EFSEC

E. Cloth, Stone and Webster

N. D. Lewis, State of Washington

P. Francisco, Niagara Mohawk Power Company
K. Ward, Niagara Mohawk Power Company

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P R O C E E D I N G S

MR. HENDERSON: Okay. I guess we can get started now. I am Jim Henderson from the IE Office here in Bethesda. And I will be chairing this session, and I will have some, but limited, technical input to it.

These other gentlemen, I think I will let each one of them identify himself. It is a little simpler.

MR. WAGNER: I'm Bill Wagner from Region V.

MR. HAYNES: Ron Haynes, section chief, reactor construction support branch, Region V.

MR. BISHOP: Tom Bishop with Region V.

MR. SHEWMAKER: Bob Shewmaker, structural engineer, headquarters.

MR. REINMUTH: G. W. Reinmuth, RCI, headquarters.

MR. GAMBLE: Ron Gamble, materials engineering, licensing.

MR. CHAN: S. P. Chan, structural engineering.

MR. HENDERSON: I think maybe I have a little bit of an introductory statement to see whether we have this -- our understanding is the same as yours.

The Washington Public Power Supply System is the sponsor and licensee for a nuclear power plant generator identified as WPPSS-2, an 1100 megawatt boiling water reactor with a Mark II containment. I understand it was designed by Burns and Roe to functional specifications provided by General

Electric Company.

A vital element of this containment system is an internal structure called the sacrificial shield. The sacrificial shield is an annular element which surrounds the pressure vessel and serves several functions. It restrains the reactor vessel from excessive radial and ~~contortional~~ rotational movement under various design basis occurrences.

It provides anchorage for various pipe whip restraints. It supports structural elements which in turn support both safety related and non-safety related equipment. And it provides neutron and gamma shielding for radiation sensitive equipment and for plant personnel when the reactor is shut down.

In consideration of the various loads that the structure may experience, the structure is massively designed and fabricated from steel plates.

Individual compartments within the shield are filled with concrete for biological shielding.

Significant problems have been identified in the fabrication and erection of the steel for the sacrificial shield. During investigative work on this subject, voids were detected in the concrete shielding fill. Fabrication problems have also been identified in pipe whip restraints and concerns have been raised about fracture toughness of certain parts.

As a result, the licensee agreed with Region V that

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work on these areas should be halted pending further resolution of construction quality problems. Work should not restart until the NRC staff has been apprised and has been convinced that proper corrective action has been described.

WPPSS feels it is now at the point where it has sufficient information to satisfy that condition and through Region V has requested this meeting.

I have cautioned that we cannot absorb and digest the necessary information fast enough to permit an NRC agreement on work restart today.

We need time to review and understand the material. I am advised that WPPSS recognizes this and believes that today's meeting will nonetheless be useful.

I have had the opportunity for a cursory review of an advance copy of a document which I understand will be distributed today. And based on that review, I agree on the benefits of this meeting. Ed Note: The document was not released. JH 7/19 See p.5.

So, I guess with that, I will turn it over to you, Mr. Foley.

MR. FOLEY: Okay. Mr. Henderson, you have outlined the nature of the session here today. I am Roger Foley, the deputy project manager for engineering at unit 2. I would like to introduce -- without introducing all of the people who are here today, though, I would like to introduce Mr. Mickey Witherspoon who is the corporate quality assurance manager for

Supply System.

We have a number -- you mentioned in your opening remarks that we would distribute our report here today, and we did not bring a distribution set, although I think we have a number of them amongst the team. We would be happy to leave some with you. And any additional copies we would be happy to forward them to you.

MR. HENDERSON: I think, administratively, since the ultimate technical review is an NRR function, that you might as well forward those copies to Dave Lynch, perhaps with a copy of the transmittal to me, but not necessarily a copy of the report itself.

MR. FOLEY: Our purpose here today is to summarize the results of the Supply System's evaluation of construction on the sacrificial shield wall, pipe whip restraints, and related structural steel containment in unit 2 and the quality records associated therewith.

Our presentation, is in response to some 21 concerns identified and documented by Region V in October and succeeding weeks of this past year. We have organized the presentation into three sections: the sacrificial shield wall, pipe whip restraints, and structural steel.

Will will attempt to briefly summarize after each section so as to segregate them clearly. In each instance we will provide a brief introductory review of the design

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considerations associated with that particular structure.

With respect to the sacrificial shield wall, there are some 12 concerns expressed; we have divided those concerns into essentially two parts: three that we judge to be primary concerns; and nine secondary concerns.

The primary concerns are a correction weld as a result of a construction deficiency between rings two and three of the wall; a repair of shielding voids; and a discussion of general weld quality in the fabrication process. In connection with the third item, the third principal concern on the sacrificial shield wall, this report and this discussion today is a status report.

As you will see, we have not concluded -- made any final conclusions with respect to the construction quality. Our evaluation and inquiries into that area have been complicated, and we have enlarged the scope of that inquiry as a result of the kinds of deficiencies that are coming to light on the pipe whip restaints. Since the pipe whip restraints and the sacrificial shield wall have the same fabricator, we feel it incumbent upon us to consider the interrelationships between the two kinds of problems that were discovered.

And so this again is a status report, particularly on weld quality and some of the documentation deficiencies.

The initial presentation on the sacrificial shield wall is by Dr. Morris Fialkow, who is the -- who is a civil

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engineering specialist with Burns and Roe and the design engineer for the sacrificial shield wall.

DR. FIALKOW: My talk will cover the structural aspects of the shield wall as originally designed, and it furnishes background information pertinent to the various concerns and corrective measures which will be discussed separately and subsequently.

I have a series of flimsies or transparencies, and I will proceed with those.

(Slide)

In short, this talk will cover methods of analysis and design and a few brief construction features of the wall. And as was noted earlier, this wall is an important component of the BWR Mark II type containment at Hanford.

We see here the shield wall in relation to other principal structures in the dry well. The wall basically has a 15 foot outside radius, two feet thick, about 48 feet high, cylindrical shaped structure filled with concrete; it rests on a pedestal below and is supported above by a stabilizer truss, which in turn is supported by the biological shield wall.

Inside of the shield wall is the reactor vessel which is separated from it by the so-called annular space.

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The shield wall is shown here in some detail. We see again that it is a cylidrical structure, the framework

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consisting of vertical columns and horizontal ring beams. But the vertical columns are shown in the section below and have either the wide flange shape or are box shaped.

They occur at 15 degrees around the periphery of the wall. The ring beams are shown in the sectional elevation and are either in channel cross section or box cross section. While I have this here, I would like to point out a pertinent erection feature of the wall. In order to accommodate the reactor vessel which comes with protruding pipe ends, which then extend into the space occupied by the shield wall, the shield wall was erected in two main phases; the lower phase up to elevation 541 was erected in place inside the containment.

The upper portion of the wall was built outside containment as three 120 degree assemblies, each the full height. These assemblies were temporarily joined as one unit outside containment, lifted into the containment and set on top of this wall, the lower portion.

Then the temporary joining of the assemblies was disconnected, and the three assemblies were jacked out about two feet eight inches to accommodate insertion of the reactor vessel, which was then lifted from outside containment and placed inside.

Subsequent to lifting in of the vessel, the three assemblies were jacked back into their final position, and the erection was completed. The individual panels formed by the

network of verticals and horizontals are each covered on the inside and outside by skin plates, except where there are openings to accommodate the pipe passing through.

(Slide)

Certain basic features pertinent to the wall are noted here. In response to requests by NRC, a reporting listing the methods of analysis and design was submitted and subsequently approved by NRC by a letter dated October 15, 1975. In short, the report indicates that these methods were in conformance and are in conformance with the Standard Review Plan 3.8.3, which is the pertinent document; in particular, the loads, the load combinations,and acceptance criteria as used conform with that document.

And the general basis of design was the elastic working stress method, Part 1 of the 1969 AISC design specification.

As indicated in the report just referred to, the shield wall is analyzed as a space frame, and here we see a flat elevation of the cylindrical framework that was adopted for analysis.

(Slide)

We see that model, structural model is the full circle from zero to 345 and back again to zero. It extends from the base at the pedestal to the biowall and includes the stabilizer truss. To get the legend behind what is shown here, the solid

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lines represent columns and the ring members; the panel having an opening is represented by a panel with crosslines in it, and all other panels are covered by skin plates. There are 24 bounding nodes along the top of the pedestal and eight bounding nodes at the junction with the biowall.

An idea of the size of the model is indicated below where the breakdown is listed. We see that there are 378 members included and 136 elements representing the skin plates.

(Slide)

As I just indicated, the wall was analyzed as a space frame; by this method, the analytical model closely approximates the actual structure. The beams and columns are represented as members of this space frame with continuity at all internal joints. The model extends from the pedestal up the stabilizer truss to the containment vessel, and the skin plates have been included in the structural model as finite elements with nodes at the framework joints.

The actual analysis is then done using the commercially available computer program STRUDL.

(Slide)

The boundary conditions as used in the source model are listed here. In short, at the 24 joints along the pedestal, the restraints are in the circumferential direction and of course in the vertical direction; at the junction with the stabilizer truss, the only constraint is in the tangential direction.

The significant loads which were included in the analysis were dead and live loads, seismic, including OBE and safe shutdown earthquake, annulus pressurization and reactions due to pipe break.

The annulus pressurization was taken as due to recirculation outlet and inlet lines, breaks in the feedwater lines, and breaks in the RHR-LOPCI lines. The pipe break reactions which were included were those that caused the annulus pressurization and in addition various main breaks in the dry well proper.

In considering the load combinations listed in the Standard Review Plan, it was determined that only the factored load combinations were critical.

(Slide)

These are listed here with the associated permissible stress levels; of these, in general, combinations five and six were the controlling ones. And we see in each of those that the previously called out significant loads were all included in five and six.

(Slide)

This last transparency shows highlights of the design of the wall. As I previously reported, the elastic working stress methods, Part 1 of the 1969 AISC code, was used; as to materials, all plates and members, except for the top ring, are A36 steel. The top ring was a high strength steel., A5888.

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The weld metal was in the E7000 series or equivalent. The member design starts with the computer output for these members, which of course were the ring beams and columns. And the computer output furnishes each end of the member three components of force and moment. Intermediate values are determined where pertinent.

The wall in general consists of specific types of members, and for each type the controlling stress results were used throughout the design. And connections are full strength welded connections.

The skin plate design also starts with the computer output, which furnishes the membrane stresses as the normal and shear stresses. And the plate thickness and attachment welds were also determined from these controlling stresses.

This concludes by talk. If you have any questions, we can take them up.

MR. HENDERSON: Yes, I will start out with one, sir. Have you done anything about looking at the as-built conditions, the as-built dimensions as against the prescribed dimensions?

DR. FIALKOW: The as-built dimensions that are the subject of a further talk later today are those which characterize the nature of the welds which were accomplished. The members themselves, I believe, are not in any question, nor are the overall dimensions of the wall.

MR. HENDERSON: My question arises from the fact that in your original submission on this a great point was made of

circularity to within 1/8 inch of plumb, within 1/4 inch from top to bottom, within 1/8 inch in any 10 feet.

And looking at the projection of how a weld might be applied, there is a clear indication that your eighths of inches are more like ten times that much.

DR. FIALKOW: May I refer this question to someone. I have no --

MR. HENDERSON: I have no specifics, but since that degree of dimensional control was identified as a very important thing in the original submission, I was just wondering if you had gone back, if you had been provided the as-built dimensions, and have gone back through this to find out what difference that makes.

DR. FIALKOW: I have not done that. My impression at this moment is that these types of deviations would be relatively minor in so far as the structural behavior of the wall is concerned.

MR. FOLEY: I do not have Mr. Gioninni here. Unless Larry can speak to that -- I suspect that Mr. Gioninni would have been the individual who was following that most closely. But I have no reason to believe at this point that we have any difficulty there, and I know that there were close controls, for example, on setting the bottom ring beam on the reactor pedestal to get them off to the right start there.

One of our difficulties in the construction process

arose from the shimming that was required to achieve plumb, and so on and so forth.

So while I cannot give you absolute confirmation as to a statement of fact that that has been taken care of, I have reason to doubt at this point that it was not properly pursued in the field.

If there are no questions, Morris can just go ahead.

MR. BISHOP: I have one question.

MR. JOHNSON: I am Roger Johnson, QA manager for unit 2. And we have no documented non-performance based on our inspection program as far as the dimensional tolerances for plumb on the wall itself.

MR. HENDERSON: Do you have any documented record of the as-built dimensions that confirms they are within specification records?

MR. JOHNSON: We do have an as-built --

MR. SHEWMAKER: Are the specs the same as those that Mr. Henderson mentioned that were in the original submittal, or were the specs it was actually built to somehow changed from the submittal?

MR. HENDERSON: This is 74-2-R2.

MR. FOLEY: We would have to go back and examine that.

MR. HENDERSON: Apparently, revision zero.

MR. FOLEY: We would have to go back and look specifically at that.

DR. FIALKOW: I do feel that these changes in dimension, the absolute circularity is not something that affects the design to any great extent that I can see offhand.

So if there are such deviations in the vertical direction or in the off-perfect circularity, I would not envision that that is going to change the nature of the design loads or the design conditions to any extent.

MR. HENDERSON: I think it would probably be necessary to speak specifically to that. One of the greatest areas of staff concern these days is the asymmetric blowdown loads. And if the cylinder is asymmetric also, that further complicates things.

DR. FIALKOW: You had another question?

MR. BISHOP: Dr. Fialkow, concerning the significant loads used in your analysis, you did not specifically mention loads from reactor vessel lateral stability and loads from the radial beam system.

Were those included in the analysis?

DR. FIALKOW: The reactor vessel is supported up above, not directly to the wall, but it is supported up above, and basically the lateral load from the reactor vessel is carried by the stabilizer truss out to the shield wall without directly loading the shield wall.

What was the other?

MR. BISHOP: The radial beam system.

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DR. FIALKOW: The radial beam system; loads that were included under the heading of dead and live loads.

MR. HENDERSON: Is this radial beam system you are talking about something aside from the trusses that your diagram showed?

DR. FIALKOW: Yes. The radial beam system might show up in one of these.

(Slide)

This is part of the radial beam system; there are various platforms that are -- and pipe whip restraints that are supported off the wall. In general, the junction there is free to go radially. So the load imparted to the wall is vertical or bending moment.

MR. FOLEY: We will discuss that radial beam matter in the third section of the presentation, and we have one slide which will illustrate the radial beams in the containment.

MR. BISHOP: All right. Thank you.

DR. FIALKOW: If there are no other questions, then, I will go on to concern number one, which involves the interface at elevation 541. Let me begin by putting in the written concern as it was written in the NRC memo. Let me read it: "Ring three and ring four of the sacrificial shield wall are not welded together as shown on the design drawings. Numerous welds were made to shims between the rings in lieu of actually welding the rings together. The AE tentatively intends to

install a two inch partial penetration weld around the circumference of the shield wall to structurally join rings three and four."

Let me just show an illustration of these rings. I would like to start off by saying that the terminology, now, the designation of the rings which we use in this presentation are those on the Burns and Roe contract drawings. And as you see, they are designated two and three, and that is the way we will be referring to them.

We have the problem, then, of transmitting shear across this interface between two and three, which was the level of the interface between the lower portion of the wall which was constructed in place and the upper portion which was lifted into place.

Just going back now, repeating in other words, so to speak, what our concern is: we are dealing with the transmission of horizontal shear across this interface at elevation 541.

And the concern develops because rings two and three have not been welded together as shown on the contract drawings. What we propose is a partial penetration weld along the exterior circumference between the rings. And this represents a change from the original design.

In this talk in connection with this problem, we will be covering the original contract requirements and description of

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the correction weld, discussion of the design concept used for the correction, and a summary of the controlling features of the correction.

(Slide)

This vu-graph shows or is intended to show that the original contract requirements in the section below, what was required -- we should see what was required. And that was constructing slot welds by cutting the slots in a web of number two above and then joining members two and three through those slot welds.

The plan shows a number of these welds; there were four such welds at each 24 columns,placed symmetrically around each of the 24 columns around the wall.

Inadvertently -- rather, to plumb up the upper portion of the wall, shim plates were installed between members two and three and then inadvertently in many cases the welding of the slot welds was made from number two to the shim plate in between. That vitiated the intent of the design.

(Slide)

The extent and nature of the corrective measure is shown here. This is the outside of the wall,and what is intended is to build a correction weld along that circumference; the extent will be such that in every panel of the wall the corrective weld -- correction weld will be done for the width available between splice plates, column splice plates, and this

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will be done in each of the 24 panels around the wall.

(Slide)

This transparency shows the two types of correction welds that will be used; the type that is adopted depends on the width of available ledge at the wall. Where that ledge is at least one inch in width, we use the upper type weld, which only requires cutting of number two as preparation for the weld.

The lower type weld will be used where we do not have one inch available and there cutting of both numbers two and three is required.

Both welds, for design purposes, have the same minimum effective ~~throw.~~ throat

(Slide)

We highlight here the design concept that will be used for this correction. As has been said, what we are doing is transmitting or providing for the transmission of horizontal shear between channels, the upper ring, ring two, and the lower ring being three.

These shears in the channel result from reactions between the skin plate and the channel and reactions between the upper columns and the channel. The directions of these shears are tangential or circumferential from the skin plates and both radial and tangential from the columns.

The analysis is based on a 115 degree panel and is based on that panel which has the largest combined shear. The

same correction is then applied uniformly to all panels around the wall.

Welding design and welding procedures will be qualified in accordance with the structural welding code, AWS D1.1, and allowable stresses used for the design are those associated with partial penetration groove welds.

(Slide)

This transparency shows the applied forces and the design loads and then the resisting forces which develop in the weld, in the correction weld.

Above we see the design loads. We have a tangential load which results from the reactions of the skin plates and from the column, and this total load is taken to be equally distributed between the two outside surfaces of the upper channel.

Each has a magnitude of 163.5 kips. From the column we have a radial load which acts in -- along the line of the web of the column. The resisting forces in the weld which developed those design loads are shown below; due to the total tangential load, we developed a uniform tangential weld force of 9.9 kips per inch.

Due to the eccentricity of this portion of the tangential load with respect to the correction weld along the exterior surface, a moment develops which causes a radial load of uniformly varying magnitude. Its largest value is 21.6 kips

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per inch, and due to the radial load from the column, we developed a radial weld force for this weld which acts only over a portion of this weld and has a magnitude of 2.7 kips.

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In this last transparency, we summarized the controlling features of the proposed correction. The controlling panel shear is due to a combination of dead, live, OBE, seismic, and annulus pressurization of pipe reaction all caused by a feed-water break.

The magnitudes we are talking about are 327 kips in the tangential direction and 27.4 kips radially. The controlling load combination is combination five and has an associated permissible stress level of 1.6 times the normal stress, normal allowable stress. And then the controlling design margin which results, which is the ratio of the permissible stress to the actual stress developed, is 2.3.

This concludes my talk.

Are there any questions?

MR. HAYNES: Dr. Fialkow, in all cases, is there a ledge or is there overhang?

DR. FIALKOW: I do not believe there is any overhang. There is always some kind of ledge. It might be quite small. Someone correct me if I am wrong on that.

MR. FOLEY: No, that is true.

DR. FIALKOW: There is always something there.

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Design-wise, there was supposed to be a ledge.

MR. SHEWMAKER: What was the magnitude of that ledge, design-wise? What was the specification?

DR. FIALKOW: Something on the order of, I think, a little more than an inch.

MR. SHEWMAKER: Was it uniform all the way around?

DR. FIALKOW: It was supposed to be uniform all the way around.

MR. SHEWMAKER: I think we need to know. That would give us some idea of what kind of tolerance that -- of those two pieces when put together if we know what the design ledge is supposed to be.

Let me ask another question: the only force that you are transmitting across the interface is shear?

DR. FIALKOW: Due to the slot welds, the vertical forces are taken care of on those column splice plates I talked about earlier. There is no problem on those. We are concerned only with replacing those deficient slot welds.

MR. SHEWMAKER: I had heard or someone had told me that some of those column splice plates were also shimmed to make up for this.

DR. FIALKOW: There were adjustments made design-wise. I believe we effected the intent of the original design.

MR. SHEWMAKER: Have there been any stress calculations run on any of those splice plates that were not put in place the

way they were designed?

DR. FIALKOW: The adjustment methods that were adopted were based on calculations.

MR. CHAN: How thick are those plates, the vertical plates?

DR. FIALKOW: The splice plates?

MR. CHAN: Yes.

DR. FIALKOW: The one on the exterior and the interior are different. I cannot give you a precise answer. It is on the order of an inch, I would venture to say.

MR. CHAN: And the supports of those plates, did you check the buckling strength of them?

DR. FIALKOW: Actually, you have number two resting on number three, in effect, so as far as compression is concerned, there is a large area for transmitting the compressor forces.

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These are designed -- there is weld all around this thing, so there is no real unsupported length. And then the load is transmitted from the column and from the channel, which in turn has received certain upward -- let's talk tension for the moment -- from the steam plate and all through these welds all around.

These go into the splice plate, and then the weld along this surface, this is transmitted into this box beam below. Now, compression-wise, basically there is member resting on member,

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and this,then,this splice plate is in effect fully supported all around.

MR. CHAN: Is it possible to have tensile strength at those connection welds due to overturning or due to earthquake?

DR. FIALKOW: Yes, it is; that is one of the conditions we designed for, especially of course with -- take the annulus pressurization. If we assume the break was right in this panel somewhere pushing the wall this way, you tend to get tension as a result of overturning.

MR. DIPINSKI: Was that based on the as-built conditions or original designs?

DR. FIALKOW: In general, design was based on the original conditions, but basically if we go back to the space frame -- if we go back to the space frame that was adopted, we did not crank into the definition of that space frame that it had to be absolutely vertical or it had to be perfectly circular.

We cranked in the coordinates of the node points, and that is what defines the spatial configuration of the wall. And if those coordinates vary by a small amount, it would not affect the stress on the members. We did not -- in other words -- study this as a shell; we studied it as a space frame made up of some 300-odd members and included the skin plates as finite elements joined to those nodes.

So it is my feeling that whether these deviate from

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circularity or from perfect vertical conditions, our end stresses in the members would not be affected to any degree.

MR. DIPINSKI: But your conclusion is based on theory. Do you have something more than just a theory?

DR. FIALKOW: We ran no calculations, no.

MR. GAMBLE: Would you put up your figure that shows your overview of the vessel on the wall?

(Slide)

DR. FIALKOW: Is it this one?

MR. GAMBLE: Right. The vessel is supported by the shield wall and --

DR. FIALKOW: Oh, this vessel? This vessel has support down below through this skirt. It is supported laterally at this level by a stabilizer; then in effect it is joined to the shield wall. But this passes right through the stabilizer truss to the bioshield wall.

MR. GAMBLE: So you really do not have -- you really do not have the -- there is really no load carried from vessel to the shield that --

DR. FIALKOW: Not in here, not in here.

MR. GAMBLE: It is down on the containment or down on the concrete.

DR. FIALKOW: That is right.

MR. GAMBLE: Thank you.

DR. FIALOW: If there are no other questions, I will

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introduce the next speaker who will talk on concern number three, and that is Mr. Good.

MR. GOOD: My name is Larry Good. I am the assistant site resident project engineer, and my presentation is to address concern number three. Okay, and here is the statement of the concern: that is, it deals with the sac shield wall. And the concern is that numerous deficiencies in the structural weld quality have been identified in the sac shield wall structure.

The deficiencies were identified in welds which were supposedly inspected and accepted. Deficiences include cracks, undercut, overlap and slag on welds, indicating that inspections could not have been properly performed.

(Slide)

In response to this concern, the project has developed an action plan that basically started with issuing a stop-work order to offsite contractors who had done any work on the sac shield wall.

The second thing the project did was institute an investigation which so far has included review of inspection records on the sac shield wall by any contractors in the last two years in which the fabrication was basically done.

We established a reinspection program and performed sample UT examinations on the wall. These three things I will cover in more detail.

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And then the last thing I want to cover is the current status, since the investigation is not completed at this time. Okay. The first thing, as I mentioned, is we went back to the inspection records, and what we have concentrated on were the inspection records that have been generated against the sac shield wall; as I mentioned, for the last two years, there have been various contractors working inside the dry well who have been working on the wall and around the wall.

And there have been approximately 500 attachments made to the wall in the last two years, and these attachments all generated inspection reports. We then went to the inspection reports by the prime contractor, the mechanical contractor and sorted out all of the inspection reports that identify defects in the wall.

And I have listed this in the second part which is -- there have been 31 identified defects on inspection reports and nonconforming reports by the prime mechanical contractor. And the breakdown is that three dealt with porosity and slag; two with cracks in the base material; eighteen cracks in the weld; two dealt with undercut; and six dealt with lack of fusion or cold lap.

I would like to point out that of these 31 defects that were identified by the prime contractor, 18 were found using magnetic particle examination, which is a more rigorous examination than was applied on the wall during the fabrication, which

goes into the third part of our records investigation, the magnetic particle examination.

The project has invoked what we refer to as work procedure 84 in January of 1978. And this work procedure basically requires that if the contractor makes any attachments to the wall or if he removes anything off the wall, he is required to do a magnetic particle examination.

We have, therefore, well over 1000 magnetic particle examination reports on file, and we arecurrently reviewing those. So, like I said, we basically have gone to the inspection reports and the nonconforming reports, and we are looking at the magnetic particle examinations.

And we have not been able to put it all together. But this is the current status.

(Slide)

The second part of our investigation which is parallel to the first part is that we instituted a reinspection program. The reinspection program consisted of a 100 percent reinspection of all accessible welds in the sac shield wall, and this inspection is being performed by an AWS certified weld inspector from our QA department and a welding engineer from our welding group. They have been requested to identify the type of deficiency and the extent of all code deficiencies.

The current status is that out of approximately 13,000 welds in the sac shield wall, we feel we can reinspect 1500. Of

the 1500, as of January 31, 1979, we have inspected 1014 and found that 509 conform completely to the AWS code.

Yes, sir?

MR. ROBART: January 31, '80?

MR. FOLEY: That is correct, '80; we have '79 up there. It is 31 January of '80.

MR. GOOD: Okay. We find 509 fully in conformance with the code and 505 that had a deficiency to a code requirement to some extent.

And I want to clarify that when I say we have 505 that have a deficiency, it may be one inch in five feet; it may be two inches in ten feet.

What we are doing is we are writing it down; we are making sketches of them, and that is what is taking us so long. The type of deficiencies that we are finding are porosity; incomplete fusion, which is overlap or cold lap on the surface; improper profile; excess convexity; undersized; craters; and arc strikes.

It should be noted that our reinspection program has not identified a crack or what we consider to be a serious structural defect. From this reinspection, we feel that the contractor did perform the required visual inspection of the wall because we have reviewed his records and found that he has identified defects in his welding.

We have gone back out there and looked at them, and

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they have been repaired.

It appears that he had taken a lenient interpretation of the code in that most of these defects are workmanship type defects; they are defects that are in excess of what the code allows.

MR. REINMUTH: Let me see if I understand what you are saying. 500 defects you found by visual inspection and only 31 you found by mag particle?

MR. GOOD: One was a paper review. We went back to the contractor, and we found 31 defects, that when he went to attach to the wall, whether it was the base material or over a weld, he did an inspection of the wall.

And he documented 31 defects on IRs or NCRs. Okay? That's in the paper review.

We have gone back and wherever we could get to a weld, we did a visual reinspection to the same requirements that the original contractor was required to conform. And what we found is we are finding a high percentage of deficient welds in our reinspection program.

MR. HENDERSON: None of those represented cracks where over 50 percent of the ones reported by your installation contractor represented cracks.

MR. FOLEY: That is correct.

MR. GOOD: That is right, sir. When you say 50 percent of the ones that were documented, he did over 500 attachments,

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and out of 500 attachments, he only found 31 deficiencies in the wall.

So when you say 50 percent, it is 50 percent of the documented deficiencies. You are right. Okay?

But he made 500 attachments and --

MR. HENDERSON: But in your visual examination, zero percent were identified as cracks.

MR. GOOD: Well, 50 percent of the -- I have to go back. 50 percent of the documented deficiencies.

MR. HENDERSON: Yes.

MR. GOOD: There are more than 31 IRs written on the wall; there are probably several hundred. Every time he went to the wall and made an attachment, he wrote an inspection report saying that he looked at the wall and that the wall was acceptable. Then we required him to MT it. Then we required him to butter it up and then perform another MT. And then he does another MT on the route pass; another one at 50 percent. So there -- that is why we have thousands of mag particle examinations.

And we do have hundreds of inspection reports on the wall. We went through those several hundred and identified 31 that said, hey, when we looked at the wall, we found a problem.

MR. HENDERSON: I understand.

MR. JOHNSON: Excuse me. Let me make a point here.

We want to make it very clear that it is not 50 percent of the defects that are cracks that the contractor found; what we are trying to say is that there are numerous deficiencies and out of those we identified 31 that could be called a crack. It is not 50 percent.

MR. REINMUTH: On the other hand, visual inspection, it is almost impossible to detect a crack. So when you say you are seeing those cracks visually, that is a little misleading in itself.

MR. GOOD: Okay. There is one other thing, though, that I would say -- like I said -- there are well over 1000 MTs on the wall, and out of the 1000, this is what we found, according to our prime contractor. Okay?

And what we would like to do is break down those MT reports and find out how many unique locations on the wall -- like I said, many times we did an MT on top of a previous MT. Okay?

But we do -- we feel we have well over 500 locations on the wall where we have done a magnetic particle examination, and this is all that has been documented. And the reason we wanted to take a good look at this was that there was some concern that every time somebody went to the wall to identify a defect -- what our review is pointing out is that that is not true.

MR. REINMUTH: The only report you had on your fabricator was a visual inspection.

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MR. GOOD: That is right.

(Slide)

In addition to our physical inspection, we have also selected 11 electroslag groove welds and performed a UT examination of these welds. And this was to supplement our visual reinspection program and to gain additional information about the weld quality in the wall. Due to some restrictions in the pipe whip restraints, we selected eleven locations and performed an ultrasonic examination and found that all eleven were acceptable.

Okay. The last part is the problem status. The status is at this time that we are performing the reinspection. Our metalurgical evaluation group will evaluate the effect of the deficiencies on the effectiveness of the weld joints. And then structural engineering will then determine if it has any effect on the existing design margins.

So, in summary, even though our reinspection program has not identified what we consider to be a serious structural defect, we are planning to investigate and evaluate every deficiency that we found. And at that time we will be ready to come up with a conclusion and a report.

MR. REINMUTH: This is an overall type of reassessment program you are talking about?

MR. GOOD: Right.

MR. REINMUTH: Later on you will be talking about

specifics?

MR. GOOD: Right. We will be talking about breaking it down later on.

MR. REINMUTH: What kind of inspection are you going to require on the repair welds that you are advocating?

MR. GOOD: I cannot answer that right now.

MR. FOLEY: We specified an inspection on the repair weld. Len?

MR. AKERS: Yes. Anything that is repaired on the sacrificial wall is repaired to work procedure WE4.

MR. REINMUTH: I mean the main seam weld that you are advocating as the fix for the shim problem.

MR. AKERS: Okay.

MR. REINMUTH: What kind of inspection requirements?

MR. AKERS: Yes. The way that is going to work is that the first thing that happens is the electrical resistance heaters are put on that wall; it is grounded and it is mag particled before anything is welded. And then -- and thereafter it is block welded in and each layer is mag particled. And it works out to about four mag particles, the last one being 72 hours after cooldown.

MR. GOOD: Any other questions?

MR. BISHOP: Larry, you mentioned that the review you have done thus far has included inspection reports, non-conformance reports and mag particle reports. Your contractor

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also included field change requests as identifying problems. Do you know if that is included in the scope of your document reviews?

MR. GOOD: Yes.

MR. BISHOP: Secondly, may I ask who did the sorting of the documents? Who did the review? Was it the contractor or was it the licensee?

MR. GOOD: Okay. We are looking -- we have requested a copy of every one of their magnetic particle examinations. Okay? And we are going to look at those. What was happening was we were doing a parallel review; we asked the contractor to pull out all his inspection reports on the wall and he gave us the list of all the inspection reports that dealt with the wall.

We went through every single one of those and broke it down and found that 31 identified a defect in the wall.

MR. FOLEY: To respond directly, the prime contractor is conducting a document review. He has essentially completed his document review. Now we are conducting are own review, both of the work that he has done and, where necessary, of the original document.

MR. BISHOP: The review that he did, is that the review that was done in the spring of '79, or is there a more recent one.

MR. GOOD: We just finished one.

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MR. FOLEY: It is just completed.

MR. BISHOP: A second question: of the 1500 accessible welds, do you have a feel for how many of those are field welds and how many are shop welds?

MR. GOOD: Right now, we are running about two to one field wells. I hope to have a breakdown to find out the percentage of rejectable or deficient field welds as opposed to the percentage of deficient shop welds.

But right now we have not itemized all 505. Okay?

MR. BISHOP: Do you know, roughly, again of these 1500 accessible welds how many of those were shielded metal arc or flux core arc or electroslag?

MR. GOOD: We had -- we broke down the electroslag; there is approximately 1300 electroslag welds. I think only three were made at the site. Three were made at the site, but --

MR. FOLEY: Your population -- he said "of the 1500," and you are talking about a different population.

MR. GOOD: No, I cannot.

MR. BISHOP: What I was getting at, of the eleven electroslag welds that you have ultrasonically tested, what does that represent percentage-wise of the total accessible electroslag welds? Is that --

MR. GOOD: We estimate around 40 that we can get to.

MR. BISHOP: 40 electroslags are accessible.

MR. GOOD: Yes.

MR. BISHOP: Was that UT done in accordance with the AWS code or the original contract requirements?

MR. GOOD: AWS.

MR. REINMUTH: Why did you choose to UT them? Normally the electroslag process creates large grains which causes some problems when you are doing UT. Normally they do RT.

MR. GOOD: Are you asking why we UT-ed instead of RT-ed?

MR. REINMUTH: Yes. Normally, it is not recommended to UT electroslag welds because of the large grain size, you know, with the process itself. I am wondering why you chose that process.

MR. GOOD: Okay. Our welding engineer might be better able to answer the question.

MR. AKERS: What was your question?

MR. BISHOP: I am concerned with why you chose to UT the electroslag welds. Normally, those are pretty large grains, and the -- and a lot of times it is not recommended. I will not say it is not recommended, but they choose to use some other process other than UT.

MR. AKERS: Is your question, why on these eleven --

MR. BISHOP: No. Why did you use that technique.

MR. GOOD: We could not use RT.

MR. AKERS: We have no other way because we have concrete in back of that. We have no other way to get to it.

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We have to go from one side.

MR. BISHOP: Okay. I understand that. Obviously, you felt it was acceptable. You said that. But there is some cause for concern due to interpretation because of the large grains in the welding process.

MR. HENDERSON: Pursuing this a little bit further, sometimes I think of UT as something with a deliberate bias towards success. It cannot find anything whether it is there or not; so if it does not find anything, it is not there.

MR. AKERS: It does not work that way for me.

(Laughter)

You know what I mean.

MR. GOOD: Any other questions?

MR. HAYNES: With respect to the eleven electroslag welds, how many linear inches did you UT?

MR. GOOD: Again, I am going to ask --

MR. FOLEY: How many linear inches of UT on those electroslag welds?

MR. AKERS: It averaged about two to three feet. They were short welds.

MR. GOOD: Twenty-six inch total on one; 17, 17, 17, 17. All but two are 17. The other two are 26 inches.

MR. HAYNES: Now, the remaining 29 that are available, they are the same length, or what are they?

MR. GOOD: We estimate that there are 29. We just

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really decided to do the UT reports in the last week -- two weeks ago. And I cannot give you an exact figure on that; even the 40 is give or take. It is an approximate figure.

MR. FOLEY: We spent a considerable amount of time discussing the UT, and I do not want to -- since we have spent this much time on it, I do not want to mislead you. We have one UT report -- one UT exam which we made on a weld which had a visual defect that we were concerned about.

And that UT did in fact validate our concern about that visual defect. So there are -- we did make 12 UT examinations, one on one that we picked up with a problem visually..

MR. HAYNES: That did confirm a defect?

MR. FOLEY: Yes, it did. It did confirm the defect.

MR.HAYNES: So, it looks like you were getting sound to penetrate?

MR. FOLEY: Yes. We have no reason to believe in any way that those UT inspections were not fair evaluations of the welds.

MR. BISHOP: Just for background information, one of the reasons we are asking so many questions about the electroslag process has to do with the 50.55(e) report that the Supply System sent to Region V in March of 1979 where they reported that the same contractor experienced a rejection of 34 out of 45 pipe whip restraint brackets that were fabricated using the electroslag process.

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And, as I guess we will talk about later today, we have had electroslag problems in the contract 90 pipe whip restraints. And so, obviously, we are questioning the electroslag welds also in the sac shield.

One final question that deals with the evaluation that is ultimately going to be performed by Burns and Roe Engineering: have guidelines been laid down at this point in time as to what that evaluation will consist of, what methods they will use in the evaluation?

MR. GOOD: No, we do not -- we cannot commit right now on the method. Right now we are trying to have our metalurgy department quantify these defects and try to give the structural people some information on what effect it might have on their joint inquiry.

So, until our structural people have that information, they have not committed to doing it one way. There are several ways they could do it.

Okay. If there are no more questions, I will introduce our next speaker, who is Mr. Celnik, who is our shielding specialist.

(Slide)

MR. CELNIK: Good morning. I would like to address this morning some of the shielding aspects of the sacrificial shield wall.

As mentioned earlier, the sacrificial shield wall, in

addition to its structural functions, has two basic shielding type functions: to shield safety related equipment in the dry well and to protect personnel in case of a shutdown.

The basic sacrificial shield wall design is based on a GE concept which basically consists two feet of ordinary concrete sandwiched between quarter inch steel plates. In addition to the concrete is a two inch steel plate for shielding purposes.

Burns and Roe originally analyzed this design concept using the NRN one dimensional removal-diffusion program to calculate neutron fluxes throughout the core, pressure vessel, sac wall, and bio. wall.

In addition to calculating neutron fluxes, it calculated thermal flux distributions to generate capture gamma ray sources.

These were then input into the QAD gamma ray point-kernal computer code. The fission products and gamma contribution was also included. A net radiation profile in the dry well was then made up.

Now, the basic adequacy, shielding adequacy of the sacrificial shield wall has recently been reconfirmed using what is today the standard shielding program for such inadequacies, namely, the ANISN one-dimensional discrete-ordinates program, which is a coupled neutron-gamma ray program.

This program did confirm the adequacy of the shield and

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in addition pointed out that the original NRN calculations were somewhat conservative.

The analytical results were then compared with some, not exact, but typical BWR plants that have been benchmarked by both ANISN -- ANS, EPRI work and some NRC work which is presently going on, and in addition to that, some operating data for typical BWR power plants. Some of the results, dose rate results in the dry well were compared with the types of numbers we are postulating for the WPPSS design.

The conclusion that is based on all this is that the sacrificial shield design is indeed adequate to carry out its primary safety related shield functions, and in addition, that the dose rates that we calculated are comparable to those currently being experienced in operating power plants.

Okay.

(Slide)

Now that we are confident in our basic design, there are, however, some shielding concerns due to some construction type deficiencies. These are basically of two types. And I will present each separately.

The first one has to do with the shield gap problem, and as mentioned earlier by Dr. Fialkow, the cause for the shield gaps are due to construction, the fact that the sacrificial shield wall was placed in two sections, and the shim gap problem then arose at elevation 541.

(Slide)

As to the resolution of the problem, some gaps were visually seen, and due to the fact that this is in the active core region right below core midplane, which has a potential radiation problem, which may negate, in effect, the adequacy of the shield wall -- due to this problem, a 100 percent circumferential inspection was performed all the way around the sacrificial shield wall.

And the results of this inspection are that indeed there are 40 shim gaps that were seen, of which 25 extend the full radial depth of the sacrificial shield wall.

These gaps vary in size from relatively small gaps to the largest gap, a cross section are approximately 3/8 of an inch by 2-1/2 inches. Obviously, such a gap in this location is totally unacceptable.

Okay. What are we going to do about it? The resolution of this problem and the methodology is one that we feel will be confirmed by prototype testing. We anticipate constructing channels which will exemplify and simulate the types of gaps that actually have been located and have been detected.

These channels will then be constructed. For those gaps that go all the way through to the back, a typical compensatory shield material -- something like a Chemtree product -- will be poured.

Now, I should point out that the particular shielding

material to be used, compensatory material, has a shielding effectiveness which is greater than the shielding effectiveness of the present sacrificial shield wall design.

The purpose of the prototype testing is primarily to verify the fill procedure. We will go through this until we are assured that we can indeed fill these shield gaps completely. They will be tested and looked at and verified through this prototype testing program.

This will give us confidence that at least in this area the shim gaps that have been located and detected by this visual inspection have been completely filled with a shielding material greater than present sacrificial shield wall design.

Now, we have a backup insurance program, namely, an in-service radiation scan program which is expected to detect any minor gaps at this level. We expect to have detectors placed all around the outside of the sacrificial shield wall at this elevation so that if there are any gaps that may have been missed, they will be located at this point and fixed at that time.

MR. GAMBLE: May I ask a question. Why -- you said the gaps are unacceptable. Why are the gaps unacceptable?

MR. CELNIK: Because they are straight-through holes in the active core region. The shield gap elevation is slightly below core midplane. The peak power, in many cases, is at that particular elevation. Streaming will go all the way through, and

the dose rates at that particular location could be in excess of the design criteria.

MR. GAMBLE: Are you --

MR. HENDERSON: You speak of some Chemtree product --

MR. CELNIK: Chemtree, yes.

MR. HENDERSON: In my review of the various submitted materials getting up to speed on this subject, I see that the -- that you -- at least at that time it was proposed that you use this ~~chromalie~~ pervuali (phonetic) --

MR. CELNIK: Chromalic was around the gaps.

MR. HENDERSON: Yes. Around in pipe penetrations..

MR. CELNIK: That is correct.

MR. HENDERSON: Well, now, chromalic was being used on BWRs in Japan, and it has caught fire because it just could not stand the ambient temperature, it would seem.

And General Electric abandoned use of that several years ago.

MR. CELNIK: It is being used at this project, to my knowledge.

MR. HENDERSON: What?

MR. CELNIK: It is being used at this project and at other BWR plants.

MR. HENDERSON: Okay. Now, have you examined the --

MR. CELNIK: Chemtree?

MR. HENDERSON: -- Chemtree from the point of thermal

stability?

MR. CELNIK: No, I have not, because at this point in time we have not finalized the particular product or material to be used. But we have looked at some of the aspects of and properties of fill type materials. Such products have been used at high temperatures, such as we expect.

I have not looked at that specific problem, but I do not expect it to be very difficult.

MR. HENDERSON: I am looking at a 40 year design life.

MR. CELNIK: We will look at all the properties, certainly, of the particular material. We are presently concerned more with the fill, because I do not think that this particular type of material would pose a fire hazard. I know it has been used in --

MR. HENDERSON: Frankly, I am not thinking so much about fire hazard as I am long term stability.

MR. CELNIK: I do not know -- I cannot answer that question for a fact at this point.

Okay.

(Slide)

The next shielding problem, concern has arisen about the sacrificial shield wall due to the presence of concrete voids. And I should point out that the basic sacrificial shield wall design is a compartmentalized structure. And there are three basic types of compartments. One type is the general

type of compartment in which the concrete was poured from the top, so that there is a very high degree of confidence that indeed the compartment was adequately filled.

There are, however, at this elevation 24 compartments above elevation 541 in which the fill procedure was as follows: a hole was made in the skin plate; concrete was poured from the side; and indeed voids were found at this location.

So there is reason to suspect that other compartments like this at this elevation all around here may have similar type problems due to the technique of pouring the concrete, which was from the sides, in addition to which, some time ago, a void was located right there.

(Indicating)

Now, from a shielding point of view, that presents no problem. The radiation levels at that elevation are of no real concern to us. However, it is indicative, perhaps, of the fact that this type of compartment, although the concrete was poured from the top, does contain a significant amount of hardware which may restrict the concrete flow.

So our program of fix takes that into account. Okay. What we expect to do is do a 100 percent inspection of all compartments, type B. Now, these compartments, type B, are the compartments that were filled from the side, 24 compartments, circumferentially around the sacrificial shield wall at elevation -- above elevation 541.

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In addition to that, we expect to do a 100 percent inspection of all type C. These are the types of compartments which were filled from the top; however, they have this baffling which may have created a problem.

Again, we will do a 100 percent inspection of this type in the core region where there is a significant radiation level. And in addition, we expect to do some random sampling of other compartments just to verify the accuracy of the core. Again, the resolution and its methodology will be confirmed by prototype testing.

Here is a two step process: first of all, we want to assure ourselves that our method that we will use can indeed detect the voids. What we expect to do is, because we expect the wholes to be at the corners, uppermost corners of these compartments, we expect to drill a hole in the upper corners of the compartments, borescope them.

If a void is found, we will determine the extent of the void. We then expect to remove the skin plate and do a visual examination, and compare the results of the visual examination with the borescope examination.

This will then give us confidence of our ability to use this procedure in detecting those in the first place. Given that we have all these, how are we assured that we can fill it adequately?

Well, then we can drill a hole, borescope it, locate

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the void; if there is a void, we will fill the hole, fill the gap, the void with a compensatory shield material, something like the Chemtree product.

We will remove the skin plate after it has been allowed to set and verify indeed that we have filled the void adequately. We will do this until we have assured ourselves that we can detect the holes, and once having been detected, the voids, adequately fill them.

Again, we have an insurance program which involves locating and fixing voids with the in-service radiation scanner program. This program involves using detector foils at the position where any voids may have been found earlier in this program, and also placing some voids -- some monitors at random locations near the sensitive equipment.

This, then, gives us assurance that the basic design function of the sacrificial shield wall to shield the safety related equipment has not been compromised.

Thank you.

MR. BISHOP: Mr. Celnik, will the fill of the gap between the shims take place before or after the weld repair?

VOICE: I had best answer that. It will be done after we prep it for the weld repair and then the circumferential weld will be made. So it is kind of in between.

MR. BISHOP: Will your prototype testing for the shim gap affect the space behind the splice plates, your ability to --

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VOICE: Again, we will be conservative. We will assume there is no splice plate back there. So we will insert backing.

MR. CELNIK: Backing.

MR. BISHOP: Thank you.

MR. GAMBLE: When you did the shielding calculations, did you look to see what kind of neutron radiation you got on the structural steel, the steel wall?

MR. CELNIK: Are you worried about shutdown purposes?

MR. GAMBLE: No, I was just wondering about radiation.

MR. CELNIK: No, I did not go into that question itself, but I believe it will be looked at.

MR. GAMBLE: It will be certainly a lot less than the vessel.

MR. CELNIK: That is a problem that is being looked at now by some of the NRC programs.

MR. GAMBLE: Well, what I am asking, at --

MR. CELNIK: I have not looked at it at the present time.

MR. GAMBLE: The result of your calculations will not show, for example, the neutron --

MR. CELNIK: Well, we could. We have neutron fluent levels for the sacrificial wall.

MR. GAMBLE: You just do not know the neutron level for --

MR. CELNIK: We know the neutron -- yes, we know the

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neutron levels as a function of energy. We have those numbers, yes.

MR. GAMBLE: What is it, 10^{18}, 10^{19}? The energy level, roughly --

MR. CELNIK: I have the figure. Just wait a minute.

(Pause)

Here is the table of numbers that you might consider. There is a neutron flux level at base locations, at the core, at the interface vessel, at the sacrificial shield wall. Given the neutron fluent level as a function of energy, one could then calculate the response function,the damage criteria. These precise criteria are in doubt at this point in time.

They could be used in a similar manner for potential damage to the structure of the sacrificial shield wall.

MR. GAMBLE: Whoever designed this, has -- has anybody looked at the potential brittle fracture for whatever accident loads you might have for this structure with this kind of neutron radiation? Maybe somebody who already spoke on the design --

MR. FOLEY: Do you have a question?

MR. GAMBLE: Has anybody looked at the potential for brittle fracture in the structure under the accident loadings that are considered, considering the neutron radiation level you have in the structure?

VOICE: Not based on that, no. There has been some pressure analysis done on the steel itself. Mr. Burns will

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address that later on, but not on the sac wall.

MR. GAMBLE: I did not hear the last part of your answer.

MR. FOLEY: Not on the sac wall.

MR. GAMBLE: Let me ask a question: what would happen if you did have a brittle fracture of metal, certain parts of the metal on this wall during an accident? What would be the consequence?

DR. FIALKOW: I would like to know the basis upon which you are postulating brittle fracture.

MR. GAMBLE: I do not know; I guess you are using some sort of A36, I guess it is. We have a problem identified to us in PWRs on similar shields that support the vessel. This does not support the vessel, but there -- some people have done some calculations and found out that they have quite an NDT shift because of the neutron radiation you get around structures right outside the reactor vessel, on the order of 120 or 140 degrees.

So the NDT of these materials can increase significantly and the total NDT after radiation could be up to 220 degrees fahrenheit.

That is pretty high. So that was -- that problem was indicated to us, I think, by Stone and Webster on it was -- I think it was a B & W plant.

DR. FIALKOW: Well, we have -- the relative nature of the load on that, especially the dynamic loads, we have included

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dynamic factors, and we have included uncertainty factors when characteristics such as blowdown are not known to be precise. So, the load magnitudes have been taken account of.

Then we went on from there and worked with equivalent static loads based on those factors, and the material itself was considered to be A36 steel with the usual structural properties associated with it.

We did not postulate any brittle conditions.

MR. GAMBLE: That is what I am getting at. Should you have? Or should you now make that a consideration? You apparently did not consider that this material would have a large NDT shift.

DR. FIALKOW: I cannot really speak to that.

MR. GAMBLE: Did you use a material and assume that NDT would be something like zero or 20 degrees, and if you did, is that necessary for the integrity of your design? I do not know. I am asking.

DR. FIALKOW: You are raising the question of the operating temperature of the wall, in effect? In the wall, as affecting the possibility of brittle fracture?

MR. BURNS: As I understand it, he is asking you, did you do a fracture safety design on the sac shield wall, and as I understand it, the answer is no.

MR. FOLEY: The answer is no.

MR. GAMBLE: And maybe you did not do it because you

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assumed you were picking a material that had and would always have a low value of NDT. That is certainly an acceptable way to do it. My question is: should you or did you -- or should you consider the fact that the NDT may significantly increase.

MR. BURNS: Let me answer the question. - I cannot anwer for the assumptions made in the design of the structure. All I can tell you is what we are doing today.

We are wanting to evaluate the significance of any deficiencies that we find in the sacrificial wall structure and their effect on the performance of this structure;that may or may not include a fracture safety design evaluation.

We have not addressed to date the effects of the radiation on the material properties of the sac wall structure. If we do do a fracture safety evaluation of the sac wall structure, perhaps this is one of the considerations we will have to look at.

I think you are asking -- you are raising, as I understand it, a fairly recent concern in the context of a structure that was designed some time ago.

MR. GAMBLE: That is why I asked that if the structure failed, what does that mean to you.

MR. BURNS: I think this is -- you know -- I can answer that.

MR. GAMBLE: I mean, it may not mean anything to you in which case you do not care about it. That is one possibility.

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On the PWR it was obviously important because it supported the reactor vessel; in this case, that is not true. That is what I am asking: what is the consequence of having this structure fail?

MR. BURNS: Let me ask you a question: in the recent NUREG that was put out by NRR on the fracture safety evaluation for pressurized water reactor component supports, you categorized the materials into three categories: category one, where you assume that there was no structural problem; category two, where you have already evaluated; and category three, where further information is required.

In looking through the document, I do not see a discussion of the effects of irradiation on NDT properties. You are categorizing the materials in terms of three categories, as I understand it from the document, on the basis of as-received NDT distributions.

And you provided in the report the distributions of NDT and recommended assumptions for the maximum NDT temperature. And I did not see in that document a discussion of the effects of long term irradiation on these assumed NDT values.

MR. GAMBLE: Well, that is right.

MR. BURNS: Are you planning, in other words, to require that PWR operators assess long term irradiation on the integrity of the operating PWR pressure vessel?

MR. GAMBLE: The answer to that is no; that this

dsp56

report that you are referring to deals with component supports, and it was felt that it would be no significant irradiation damage to those steels used in component supports.

MR. BURNS: So you --

MR. GAMBLE: The problem that I referred to before is the shield that surrounds the reactor vessel on PWRs and supports the vessel -- and it is only in certain designs -- so it has a high, a much higher level of neutron fluents than component supports that were addressed by the report you mentioned.

This design is very similar to the vessel support type because it does get a lot of -- apparently a lot of neutron fluents.

There is a distinction between this report on PWR component supports and the neutron problem that you might have in this plant and we see on some -- on a particular design in PWRs. It is a different question. In one case you do not have any neutron problem; in the other case you do.

MR. BURNS: There are, as I understand it, some support designs that would place regions of support in the areas of high neutron flux.

MR. GAMBLE: That is possible.

MR.EARLE: If I may interject, my name is Keenan Earle. I am a licensing engineer. And to answer your question, we cannot accept any brittle fracture in the sac shield. It is an important structure. You have raised the concern that we probably

dsp57

should evaluate it, but as far as I know, it has not been previously evaluated for any plant that I know of.

MR. GAMBLE: I think that is right; we had never looked at it before on this particular design.

MR. EARLE: So, I think it is a --

MR. GAMBLE: It is a structure that you cannot -- cannot tolerate fill under the accident condition just by the location. And I do not know the answer. I mean -- you know -- I do not know what the answer is, but -- but apparently other similar designs of PWRs do have significant shifts greater than 100 degrees. I would think you would want to look at it.

MR. EARLE: We will address the concern.

MR. GAMBLE: Well, I guess your plan now is to have a submittal evaluating.

MR. EARLE: We did not currently have a formal plan of submitting a report to NRR. It was my understanding that you were going to caucus and perhaps discuss what action NRR was going to formally take.

This report that we have, it does not really cover all the issues, and I do not know whether it covers the point NRR is concerned with in detail.

MR. HENDERSON: It goes outside the original intended scope of this meeting, Ron, and I do not think we ought to confuse the issue by asking a submission on these construction quality problems, which range off into the potential for neutron

dsp58

damage.

If you think that is of sufficient current interest to you, I think you might request that DPM address it; perhaps not only to these people, but to other people too.

MR. GAMBLE: All right, fine.

MR. HENDERSON: Sir, for the reporter's benefit, what is your name?

MR. BURNS: Dave Burns. I am a material welding engineer with WPPSS engineering.

MR. HENDERSON: Thank you.

I think it is about time for a break.

(Brief recess)

MR. FOLEY: We will start out right where we left off--

MR. HENDERSON: Fine.

MR. FOLEY: -- with some record concerns discussed by Roger Johnson. We are still on the sac wall.

MR. HENDERSON: We are still on sac wall?

MR. FOLEY: Roger Johnson is the quality assurance manager for the project.

MR. HENDERSON: Yes.

MR. JOHNSON: My part of the presentation addresses four, five, six, fifteen, sixteen, and seventeen in the items of concern in the NRC memo. We will take these beginning with item four.

We have the item stated, that NDE records associated

dsp59

with the sacrificial wall contained photocopied inspector's ultrasonic and penetrant test acceptance signatures.

Item nine has been identified on pipe whip restraints. Our review indicates that the specifications required ultrasonic testing for checking electroslag weld and tee joints, limited UT testing of base metal thicknesses of 1-1/4 inch or greater. There was no specification requirement for performing PT testing.

And checking this out with Leckenby, we determined that PT was used by Leckenby for informational purposes for cashing out defects that were identified by the UT process.

The AWS code requires verification that once a defect has been identified, you have to verify by nondestructive examination methods that all defects have indeed been corrected. Leckenby has stated to us they used ultrasonic examination to perform this.

In other words, they performed a primary ultrasonic examination and cashed out any defects using PT. And their confirmatory NDE examination was a second UT examination. There were a total of 27 ultrasonic reports issued by Leckenby. We have identified that 15 of these reports contain photocopied signatures.

Those 15 reports affect a total of 87 welds. In other words, the report contained more than one weld on each report. As far as the PT reports, there were 30 that Leckenby had indicated that had been done, and we have four of these in-house at

dsp60

the present time, and we have verified that those four, that indeed, the second UT examination was done in all cases after completion of the weld repair.

As far as actions, we have a sworn statement by Leckenby inspectors. It was taken by NRC Region V. It indicated that photocopy was used to expedite report processing, and the NRC is continuing their investigation with Leckenby in this matter. And we are obtaining this information and we will follow up any new developments or concerns and factor that into our final analysis.

Some indication that the ultrasonic examination was performed as required was the fact that we have identified four cases utilizing the PT reports that welds were in fact rejected, and we have the repair reports.

So we are confident that the UT was performed as required. We are also confident that PT was performed for informational purposes only, as stated by Leckenby.

We do intend to continue our investigations to determine that all of the PT reports that identify weld repairs were being examined by ultrasonic examination after the repairs were made.

(Slide)

Item five, the concern being that nondestructive examination qualification records cannot be located for one individual who performed ultrasonic testing on the sacrificial shield wall. This individual is no longer employed by the

dsp61

subcontractor.

We performed a complete document review of all sac shield wall NDE records; we have identified that all of the ultrasonic examinations were performed by one Mr. G. Hamilton. Qualification records for Mr. Hamilton are available, and they are under review by the project quality assurance at the present time for acceptability.

In addition to that, we have identified that a Mr. Charles Baldinger performed ultrasonic examinations on three weld procedure qualification coupons. Mr. Baldinger's certification papers are not available. They apparently have been lost. However, ultrasonic testing for weld procedure qualifications is not required by the code or by specification.

In reviewing the specific procedures, we note that the required tensile and bend tests were performed by Leckenby and that these procedures are acceptable. We will continue our investigation to assure that Mr. Hamilton's certifications are totally adequate and we will continue our investigation on record reports to assure that any additional concerns are identified.

MR. HENDERSON: There is no indication that Mr. Baldinger did any UT examinations?

MR. JOHNSON: Not on that, that is correct.

(Slide)

Item six and the next item, item fifteen, generally

dsp62

address the same subject. But item six is that no procedures were generated or records maintained on forming of the curved plates used in the sac wall.

I might note here that the item of concern here also includes an allegation regarding discoloration of the inside surface of the curved plate. I will address this further in item 15, which is the next item coming up. The requirement -- there is no requirement in the specification for procedure -- excuse me.

There is no requirement in the specifications for a procedure or record on forming of the curved plates. In discussing this with Leckenby, it turns out they have sub-contracted this work to Seattle Boiler Works, and it is common industry practice to heat and/or cold form A36 material.

Checking this out with our AE metalurgist, he confirms this is indeed an industry accepted practice with basically no detrimental effects.

The Supply System's position at this point for this item as well as the next item is that the forming of curved plate in the bending process is not a special process as defined in 10 CFR 50, Appendix B and at this time plans no additional action on this item.

(Slide)

In item 15, interviews with Leckenby personnel established that sac shield wall segments, 2A, 3A, 3B, and 3C were heat straightened without the benefit of controlling

dsp63

procedures or the maintenance of quality records. Heat straightening, the application of heat or mechanical, was applied to correct weld distortion. As indicated previously, there is no requirement in the specs for procedures or records on these types of industry practice.

Discussion with Leckenby has indicated that this is industry practice and basically not detrimental. We have some papers here that discuss the application of heat for bending large segments, heat straightening them, which is identified as an industry practice.

Therefore, we are planning no additional action at this time.

VOICE: Even though it is not in your spec that they have to have a procedure for these things, but aren't these things brought to someone's attention because they go on some nonconformance report and then the nonconformance report goes through the cycle and it gets around to somebody and they say they have a corrective action, what they are going to do on it? Then somebody has to review it. So in a way a procedure is going to be generated, in a sense, saying that these are the steps that we are going to take to straighten this or however they are going to do it.

So somebody will be looking at it. Will something like this be generated in this case?

MR. JOHNSON: For the particular sections we are talking

about here, Leckenby did utilize an in-house document which showed how they applied the heat or how the joints were welded. This was not submitted to us for our review and approval. They had a basic drawing which established the design requirement. They straightened things as necessary to meet that specific requirement on the drawings.

VOICE: Are you aware that this even goes on? Is this more or less part of their industrial practice to say, okay, this is a minor -- they call it minor or whatever. They just go ahead and do this?

MR. JOHNSON: As far as heat straightening of the large sections, that is right.

VOICE: You are not even aware it is going on then?

MR. FOLEY: That is correct. That is correct. This is an in-process thing for them. I think this became an item of concern because of an allegation with respect to some discoloration on plate, and that was pursued back into the fabrication process. And some additional information was developed there. But it did not come to us by the standard practice of an inspection report or nonconformance report.

VOICE: I was just wondering whether that was part of the normal cycle. Anyway, they had a document. In a sense, it was a normal procedure.

MR. HENDERSON: It appears to me that this is a QA problem, and normal commercial industry practice is near the

dsp65

bottom of the scale of quality.

I do not think it is consistent with the requirements of Appendix B or the requirement that Appendix B programmatic requirements be extended to contractors and subcontractors. So, now, obviously, Leckenby is providing a self-serving answer, that that is just a normal practice.

I do not share your confidence that that closes the issue..

MR. JOHNSON: Our specification did not require them to submit their application of heat for straightening beams or plates.

MR. HENDERSON: It should have; it certainly should have.

MR. JOHNSON: We did not feel it was a special process as defined in the industry.

MR. HENDERSON: It is not a special process. Activities affecting quality shall be done in accordance with quality control procedures; that is the general requirement.

MR. JOHNSON: They have an in-house procedure which they utilized to do it. We have not requested that that be submitted to us.

MR. BISHOP: They do have an in-house procedure that defines the temperature limits for heat straightening?

MR. JOHNSON: I have not seen the procedure myself.

MR. BISHOP: You are not familiar with that.

dsp66

VOICE: Even though it is industry practice, aren't you required by Appendix B to review exactly how they do there practice? And is there not a situation whereby theoretically you could find standard industry practice not acceptable for this application?

MR. JOHNSON: If we felt that a particular process was critical enough to the application that we would define it as a special process, then the answer would be yes, we would require it be submitted to us for review.

VOICE: But the question is: until you review these processes, how can you come to that conclusion?

MR. JOHNSON: These processes were known to the architect engineers who generated the specifications at the time.

VOICE: Then the architect engineers must have reviewed this and reached a conclusion based on some evaluation that indeed these standard industry practices are acceptable; is that correct?

MR. JOHNSON: No, sir. As I indicated, our specification, as issued, did not require that these particular processes--

VOICE: I am trying to draw the case that your specification -- and Mr. Henderson was trying to draw the same thing -- your specification, as issued, the possibility exists it could be deficient.

We are trying to just probe that very briefly.

dsp67

MR. JOHNSON: Let me answer that by saying this: we are, due to the particular allegation in the two items of concern, we are reviewing the procedures at this point, after the fact. When the specification was originally written, there were certain industry practices performed by a number of contractors. We do not review everything they do.

And this is basically one of those cases.

VOICE: If you do not review what their practices are, how do you know that they are not completely unacceptable practices?

MR. JOHNSON: We perform audits in-house to determine if they have control procedures.

MR. FOLEY: The architect engineer prepared the specification without the knowledge of what was to be constructed and the kind of organization or fabricator that was going to do the work. Nor has the architect engineer indicated that if he were to do it over, in this instance, that he would do it any differently.

VOICE: Is this the way you would do it as of now, knowing any problems that you might have?

MR. FOLEY: My point is that perhaps if we were doing it again now and doing it with Leckenby, we might do some things differently. We have not had any evidence that has been presented to us, nor have we uncovered any evidence, which suggests in the forming of these plates that Leckenby followed

inappropriate practices that would lead to an unacceptable product.

We have reviewed the specification, and in that light we would not change the specification.

VOICE: In your review, did that include a review of Leckenby's "standard industry practice," quote, unquote.

MR. FOLEY: I think we reviewed it in the context of what Leckenby did in this instance.

MR. HENDERSON: I think we have pursued this far enough because we do understand your position, and that is what we are trying to get.

(Slide)

MR. JOHNSON: All right. Proceeding to item 16, the specific item of concern is that the 215 -- and I should explain that this 215 relates to one of our prime contractors at the site -- the quality review of the Leckenby program -- and Leckenby was a subcontractor to 215 -- did not include verification that all required ultrasonic examinations were performed as required by specification and Leckenby procedure; the concern here being, basically, that the UT exams were performed as required.

We have gone back and reviewed the specification, and it required a sample UT program as follows: basically, at this point, for every 16 to 25 welds, we examined six. If no indication of lamellar tearing is found after 24 UT exams, the UT exams can then be reduced to two per 100 welds.

Leckenby made a total of 1270 electroslag welds, and of these, a sample of 48 welds were to be examined by UT. Leckenby has performed ultrasonic tests on 83 welds. Those test results are contained in the 27 ultrasonic reports that we discussed back in item four. This is in excess of the spec requirement of 46. In addition to that, Leckenby examined an additional 2 percent of other types of welds, so that for the total 27 UT reports that we have, they represent 200 weld areas that were examined by UT by Leckenby in addition to electroslag.

We will continue our investigations to assure that these UT examinations were performed by certified UT examiners.

VOICE: You examined this specific possibility of lamellar tearing?

MR. JOHNSON: Yes.

VOICE: And tee joints? Are they also taking into consideration that even though there is no indication for lamellar tear, there is always the possibility that you could have delayed cracking or maybe --

MR. JOHNSON: Any type --

VOICE: -- due to additional loads at a later time.

MR. JOHNSON: That is correct.

Item 17 is a two part item of concern, the first part dealing with procedure deficiencies, indicating Leckenby used liquid penetrant testing to examine sac wall structures at

Leckenby shops. Leckenby representatives reported that there was no approved LP procedure at the time inspections were performed. I would like to address this one first: as we previously pointed out, LP examinations were not required in the specs and were basically performed by Leckenby for informational purposes only.

Leckenby does have an approved liquid penetrant procedure; it was approved in the quality control program for Leckenby, which was by the 215 contractor as part of their QA review. Only three of the liquid penetrant reports were submitted to the Supply System for record purposes, since they were informational.

And we have found that at least four were subsequently examined and accepted by UT.

Addressing the second item, the Leckenby procedure which provides for weld sequence control, entitled "Sacrificial Shield Wall Assembly Procedure," has no procedure number, number revision number, no date, no evidence of ever being approved. AWS D1.1 paragraph 3.4.3 required submittal to the engineer of weld sequence and distortion control programs. Leckenby has submitted for review and approval a fabrication and erection procedure that shows the general sequence of fabrication; however, it did not show the detail of weld sequencing or distortion control.

We have gone back researching this item of concern, and

dsp71

we have obtained from Leckenby a commercial document which does depict the sequence of the weld sequencing of restraints, and this document was made available to the Supply System on January 29, and is presently under review by our engineering organization.

MR. HENDERSON: What do you mean by "commercial document"?

MR. JOHNSON: It is what they have termed as a guideline. It does not have a procedure number. It simply shows the sequence by which they welded the beams together, the sequence of weld.

MR. HENDERSON: Okay. Thank you.

MR. BISHOP: Is that specific to the sacrificial shield wall?

MR. JOHNSON: Yes.

Corrective actions: we will continue our investigation to determine that all repaired areas were re-examined by UT. We have indicated that we will complete the weld sequencing review by engineering.

Are there any questions?

MR. BISHOP: The UT examinations that were performed were performed basically by one individual. There was a second individual. You only mentioned one.

The records do indicate a second individual, a Mr. Howenstein, who also performed a review.

dsp72

MR. JOHNSON: We have no evidence from the existing UT inspection reports in-house that he had performed those. We have your statement. We have identified the problem, and we are presently reviewing that to determine just what he did do.

MR. BISHOP: But, in any event, the qualifications of the individuals who did the liquid penetrant testing were not addressed here. Do you know if you have reviewed those or intend to review those?

MR. JOHNSON: We intend to review those.

MR. BISHOP: Secondly, you stated that -- and correct me if I am wrong -- that in the 26 cases where they did liquid penetrant testing that was not re-performed by UT, you are going to check that aspect.

MR. JOHNSON: That is correct. That is part of the continuing investigation on the UT process. We will verify that in all cases where UT was performed, that the confirming UT examination was also performed, which would then substantiate their statement that it was used for information purposes.

MR. BISHOP: One other statement that you made was in reference to continuing your investigation of the UT examiner's certification. What is that continued investigation going to consist of? As I understand it right now, he had taken a written test, but he had not taken the practical qualifications test.

MR. JOHNSON: With discussions with you, we had confirmed that he had taken the general and the specific; at this

point we have also confirmed that he did take the practical. There is some problem with his eye examination, so I cannot make a firm statement that he is totally qualified.

In addition to that, we also have some problem with the procedural.

MR. BISHOP: Thank you.

MR. JOHNSON: At this time, I would like to introduce Mr. Jack O'Donnell.

MR. O'DONNELL: I would like to address, basically, three of the -- the last three items on the sac wall of concern, items number 18, 19, and 20, starting with number 18.

(Slide)

This concern is quoted from a letter from a consultant which Leckenby had hired. The original letter was sent out when we discovered a crack in the sac wall. The consultant proposed the nature of the crack. We, in turn, disputed it, and it seems a second letter was brought to light during this ongoing investigation.

(Slide)

The crack occurs at one of the main intersections of the radial beams to the sac wall. There are approximately 24 of them, and we have in turn reviewed the consultant's letter. The discussion in the letter revolves around why the crack happened. And it is still being disputed as far as contractual conditions between owner and contractor.

The "why" has been technically put in the background since we subsequently removed the two or three beams that were currently in place, repaired the wall completed, UT-ed it; using a different weld procedure, we placed those beams and remaining beams around the wall with complete success. So in contention, obviously, was the welding sequence, and I guess we could have a discussion about why the weld failed initially. But we do not consider this any longer a technical problem.

Any questions on that?

(No response)

(Slide)

Concern number 19: in some of the past visits with the NRC, the existence of the possibility of free water -- I imagine Region V was under the impression it was one isolated case. A review of the IRs during this review of Leckenby's work uncovered approximately seven IRs involving -- I have to say again -- "free water" -- quote, unquote.

In these cases, reading the IRs after the fact, I read into it there was some rust in some areas, and so forth. Now, the only source of free water possibly behind the wall would be concrete because there is no other water that is present.

(Slide)

We reviewed the seven locations, and they are all skin plates in the area of 541; in other words, skin plates that were placed on either prior to or after concrete was placed. In the

the case of these six, we had six of the seven and have records to indicate that the welds that were in fact made prior to the concrete being placed behind it; this would negate a possibility of free water existing when the weld was made.

The six welds were made after the placement of concrete in the area discussed by Mr. Celnik and Dr. Fialkow. I will point to the area in question. You have seen this slide before.

(Indicating)

This window was used by the contractor for convenience of placing concrete. After the concrete was placed, at some period of time later, he fitted up a piece of steel plate, prepared it, and welded it. This subsequent crack was found in there.

This brought us to the possibility that this may in fact have been done too soon prior to the placement of concrete and possibly free water existed in this one instance.

So what we did, we reviewed all the window plates that were susceptible to this type of construction; went back, investigated, repaired them if necessary for any cracks. We are still of the opinion that there was no free water existing when we made the weld. I do not think it would have been possible to have made the weld.

So water has seeped through deficiencies in the weld, in the weld of the skin plates after the skin plates were in place.

dsp76

Any questions on this so far?

MR. HENDERSON: Yes. What is the environment in which these plates were stored before they were finally put into their ultimate location? Were they stored in the weather outside?

MR. O'DONNELL: No. There was a building adjacent to the reactor building set up by the contractor, and this was where he prefabricated the three 120 degree rings.

Now, as far as subsequent storage on a month to month basis, I think it was fairly soon -- someone that is familiar with the basic storage -- Merle Parisie -- I guess he has stepped out of the room.

The prefabrication was done in a closed building until the time it was lifted in place. They took off the roof of the building and then lifted the three 120 degree segments into place.

Any other questions?

MR. BISHOP: On your last slide you indicated that repairs were performed to the window plates. When you say window plates, you are talking about the small cover plates?

MR. O'DONNELL: The small cover plates, yes.

(Slide)

This is the one case, this one weld that had to be made after concrete was placed in the back of the skin plate. So our conclusion was possibly they welded too soon after the placement of the concrete, and with the heating, and what have you, we

dsp77

may have had a deficiency in the weld.

However, with our preheating process, I think Mr. Akers will verify, we would have dried out any free water and eliminated it prior to welding. I do not think it was possible to make a weld of any consequence with free water present. Is that correct, Len?

MR. AKERS: Investigation shows us there was concrete in back of it; we feel that the preheat temperature that was involved should have dried it out. It was not the type of welding you would find if someone had tried to weld through water. We assume that the moisture was dried out, and as they welded it in, the heat, after that weld was being built up, possibly drew water or later on that moisture occurred because the weld did not have the indication of welding underwater or in water. It looked like it was just poor workmanship.

MR. O'DONNELL: Any further questions on that subject?

(No response)

I would like to go into concern number 20.

(Slide)

This was brought up by Region V, I imagine, on the Burns and Roe drawing S-802, Note Number Three, which refers to the specification for the post-weld heat treatment requirements of the stabilizer truss. Let me point out that at this time, although the question involved A514, A588, and SA537, the stabilizer truss is in fact A514.

dsp78

The 588 is the material that Dr. Fialkow referred to, which is the top of the sac wall. The SA537 is the attachment to the containment vessel. This was built to section three, and for those of you that are unaware of the stabilizer truss, it spans from the sacrificial wall to the containment vessel.

The question was: was post-weld heat treatment required on the A514 stabilizer truss?

And, as I said, the drawing refers to the specifications and the specifications, the requirements for post-weld heat treatment is found in section 17D of the specification. And that specification, in essence, adopts and supplements D1.1 where necessary, AWS D1.1.

A review of AWS D1.1 will lead you to the disposition that once you have tempered steel it is not recommended for post-weld heat treatment unless absolutely necessary. For the disposition of the other two materials, I have put up here the vessel attachment; this was SA537, which was in fact post-weld heat treated, as required by the code

A588, which is the high strength steel on top of the sac wall, AWS D1.1 is silent on; the contractor certified his procedure without post-weld heat treatment and it was accepted on that basis.

Any questions?

MR. HENDERSON: Have you done any volumetric examination of those areas?

dsp79

MR. O'DONNELL: Excuse me. In these areas? (Indicating)

MR. HENDERSON: Yes.

MR. O'DONNELL: I would have to say that the exact examination on the stabilizer truss, I do not have that in the specifications to answer that question. Possibly -- when you were reviewing the stabilizer truss situation, do you know if they did -- let me see. 215, I do not know whether it was mandated that there was -- I would have to look at the inspection. I would have to --

MR. JOHNSON: I would have to assume.

MR. HENDERSON: A514 calls for particular attention to the sensitivity of materials for welding. I am wondering just how that procedure for welding A514 was qualified. It assumes that the qualified procedure will be used.

MR. O'DONNELL: Absolutely, yes, there is an approved procedure. Let me point out that this is not -- for those of you who are concerned about distortion here or residual stresses, the stabilizer truss is pinned to the vessel; it is a physical pin. It is welded to the sac wall, but it is a pin, and it is a trusswith pins all around the circumference.

So for distortion control or for, let's say, residual stresses, this was not our main concern.

Any other questions?

I think there has been a change in the agenda. Roger,

dsp80

would you take over.

MR. FOLEY: This concludes the presentation about the -- that is included in your report on the sacrificial shield wall. In the process of our own inquiries on the sacrificial shield wall and in inquiries on the pipe whip restraints, we have identified these additional concerns which are not addressed in the report and have not been addressed in our presentation. But they will be addressed in supplements to this report, as required. And I -- to illustrate -- well, we do not believe there are any serious problems here, but there are problems that we do have to chase out; to illustrate, for example, concern number 24, some 26 deficiencies in -- with missing documents and missing heat numbers, and so on and so forth.

That is not on sacrificial shield wall members. Those are on washers and nuts and cotter pins and things like that. And, for example, the two weld maps, the contractor weld maps are really quite detailed. It is possible that these weld maps are misnumbered. To say that they cannot be located, we are going through an administrative process to determine if they do-- if they should exist or if this is a reporting error.

Thank you, Jack.

With respect to these six things, as I said, they largely arose as a result of our records review. And based on looking at correlation between the kinds of deficiencies we found in records, Leckenby records on the pipe whip restraints, we

dsp81

began to look for similar types of deficiencies on the sacrificial shield wall. And we will continue to do that.

Again, though, we think that these are, in terms of our meeting here today, matters of secondary concern. Again, we see the three primary concerns on the sacrificial shield wall as the correction weld for ring two and ring three, which we believe is a reasonably straight forward kind of correction, one in which we have the experience to implement.

I apologize that I did not anticipate your question on the as-built condition. We have made a call to the site; I hope before the morning is over to have an answer for that. But we are confident, without having the absolute answer, we are confident that the design is not terribly sensitive to that and that we could make the correction weld.

The solution to the shielding problem, we also believe a practical, pragmatic solution to the problem of construction oversight and error.

The weld quality problem, we may have painted a rather bleak picture; we have tried to be frank and forthcoming about that. In spite of the difficulties that we found, a review of the -- and our concern about the apparent quality of the visual inspection based on our reinspection. We are also somewhat optimistic because we have not found in our reinspection major deficiencies. We have found one deficiency which would require a major repair.

dsp82

So we are somewhat optimistic, but we do not want to draw any final conclusions today, as we just have simply not followed all the threads to the end of the line.

At your request, then, we will go ahead and I will ask Mr. Burns to speak about the structural steel and to do what previously was the third part of the presentation at this time.

MR. BISHOP: Roger, may I ask you one thing at this time. When will the Supply System be in a position to make a statement about their assessment of the technical and structural adequacies of the wall?

MR. FOLEY: I would like to be able to respond to that directly, Tom, but I think it would be speculative if I were to say that, because we have not followed all the routes down. We do not know if we are going to find something a week from now in terms of document review which would give us some technical concerns.

Right now our strategy is: if we do not find any more technical problems, to look at each of the deficiencies we have found in some analytical way and bounce that back against the design and go from there.

We think that that will prove to be -- that will prove that the wall is structurally sound, even with some of the deficiencies that we are finding. And that could take several months in the sense of coding each deficiency, describing it, running it through an analysis which says, "What is the likely

dsp83

discount and joint efficiency," and then taking that joint efficiency to the various critical members in areas of the wall that we cannot see and running that through the design.

So, as interested as we are in concluding that, we feel that a lot of time has been spent on the sac shield wall -- in fact, over two years there has been general discussion. And we are anxious to put it to bed.

So rather than, as anxious as we are to put it to bed, we feel that we have to do that in a rather detailed fashion. So I -- the short answer is: "I do not know."

MR. BURNS: I will discuss items of concern 13 and 14, both of which relate to the structural steel in the dry well. This structural steel is steel that was primarily designed to support pipe whip restraints. It is made out of A36 in the main: It is fabricated to AWS D1.1. There are three general types of structure. There are platforms which are comprised of radial beams.

There are cantilever members which are attached to the sacrificial shield wall.

And there are also a number of other specialized structures, an example being one associated with the main steam relief valves.

Just to briefly give you some background to the problem, some time ago -- approximately two years ago -- a significant construction problem was identified on some of these welds.

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Cracks were found in the some of these welds; subsequent to that time, all field welds that were made prior to this discovery of the problem were inspected by MT. That was a 100 percent inspection. And all deficiencies exceeding program criteria were repaired.

All welds made subsequent to that time were made using new procedures which we consider are very conservative; there will be MT inspections at a number of intermediate stages of completion of the weld, as well as a final inspection, and an inspection after 72 hours. In other words, we feel that we have done a very thorough inspection of all welds concerned and repaired all deficiencies that were identified.

To give you just an example of the kind of structure we are talking about, this is a sketch, a plan of the 541 elevation.

(Slide)

The inner circle is the exterior of the sacrificial shield wall. The outer circle is the interior of the containment vessel. The lines -- the radial lines are the beams we discussed, and the cross members are tie members.

These radial beams are heavy members, in general 426 pounds per section, and many of the tie members are of similar size at 550 pounds per foot.

The radial beams are welded to the sacrificial shield wall, and the tie members are welded between the radial beams.

That is an example of one of the platforms to give you an idea of what the size of the members are involved.

The first concern, concern 13, let me read it out: "The generic procedure used to repair laminations in the weld zone of the sac wall related structures requires grinding of the lamination s of a maximum depth of 3/8 inch followed by rewelding. This falls short of the AWS code which requires grinding to a depth of one inch with supplementary ultrasonic tests, as required, if laminations are longer than one inch.

The apparent concern is that we would have to identify laminations and where we have identified them, we treated them in a manner which did not conform with the AWS code.

The problem is that the examinations referred to were examinations on rolled surfaces, not on edges or on weld preparations. Where an attachment was being made to an existing member, the surface would be MT-ed prior to the attachment being made.

And then any defects would then be ground to 3/8ths. The 3/8ths was chosen when we discovered the defects we were looking for were rolling defects. This was a simple direction, just grind to 3/8ths and most grooves would be removed at that time.

In the main, the defects do not extend to a great depth. However, the problem really arises because of the term laminations. We were not looking for laminations. Laminations

that were identified on plate edges or on weld preparations were in fact treated per the AWS code. We were looking for rolling defects.

Our conclusion is that we have no -- we need no further action. The reasoning behind that is that, as I said, we were looking for the rolling defects, not lamination. The grinding was adequate in that it allowed us to remove 95 percent of the defects without further inspection.

However, having ground the defects to 3/8ths, the excavation was inspected by MT and any defect found in the bottom of the excavation was evaluated by D1.1 criteria. Further grinding was then resumed if it exceeded the criteria. If it was within the criteria of AWS D1.1, then the excavation was rewelded.

So, in conclusion, we do not feel that any further action is required on that concern.

Any questions on that concern?

MR. BISHOP: Dave, in looking at the records and interviewing the personnel onsite, we ran across this standard addenda which talks about the lamination repair, and so forth, and they indicated it was standard procedure used in 35 to 50 instances.

I think you have just told us that all 35 to 50 instances were not laminations, but were in fact rolling defects or if they were laminations, they were prepared in accordance

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with the AWS code?

MR. BURNS: It is my understanding that, having interviewed certain people, that the defects which were detected by this examination were not laminations. They were -- it is a matter of -- they were defects found on the rolled surface of the plate, not on the edge. So they were defects in an orientation that would not normally be expected to be laminations. Any defect that was found was in fact ground to 3/8ths, and then the bottom of the excavation was then MT-ed, and any defect remaining in the bottom of the excavation was removed according to the AWS criteria.

So I am not sure the terminology is really relevant. Anything that was found in this inspection was removed and reinspected according to the criteria.

MR. BISHOP: This came to us as an allegation, and the allegation was made by personnel involved in the repair of these, and their concern was that -- they did not even call them laminations; they called them cracks.

And they said it was their understanding that you were repairing these cracks by cover passes; grinding down to 3/8 inch and then covering it with welding.

It then came to light that these were not cracks but that these were laminations. So I guess to close the loop somewhere along the line, the individuals who originally identified these remaining discontinuities under that 3/8ths gouge, that

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should be pursued a little bit to find out if there is indeed the remaining laminations under that.

MR. BURNS: I think Len can explain that.

MR. AKERS: There has been some edge preparations that had laminations in it; they have been removed. What is involved here is that to add a hanger to the face of the beam requires, rather than visual, an MT. And I went back to each and every welding engineer that I had, and he said that when they are in question, they would grind them down to 3/8ths and evaluate by MT; if they saw something there that needed to be removed, in their opionion, they did. If not, they welded it.

We do have records, Tom, where there have been edge laminations, but they have been completely removed.

MR. BISHOP: Okay. Thank you.

MR. BURNS: If there are not further questions, I will go on to concern 14. Let me read it: "Steel structure bridging from the sacrificial shield wall to the containment wall have undergone significant weld repairs in the past two years. Licensee consultants have determined a need to maintain some minimum temperature of weld joints to ensure adequate nil ductility transition temperature characteristics of the structural welds."

Just a brief recapping: we did find defects in field welds. We did inspect and repair and did take conservative steps on all new field welds. The consultant that we used to provide

some assistance is setting up this procedure. They made a recommendation in their report that these structures should not be operated below -- that was postulated above 140 degrees fahrenheit.

This 140 degrees fahrenheit is supposed to be the average containment temperature. It is also above the average containment temperature of 135 degrees and it is significantly above the minimum containment temperature of 85 degrees.

The source of the 140 degrees,that was a margin above the maximum NDT temperature. The consultant recommended a margin of 90 degrees fahrenheit above the maximum NDT temperature. He chose 90 -- he arrived at 90 by a 60 degree margin plus a 30 degree additional margin to take into account the thickness of the structures.

He felt that 60 degrees is adequate for one inch thick and an additional 30 degrees was adequate for the thicknesses of interest.

The maximum NDT temperature identified was 54 degrees. The source of that was measurements made on two beams, two beams which had been identified has having cracks on them and two beams which brittle propagation of those cracks was identified The maximum NDT temperature measured from those beams was 54 degrees fahrenheit. That is the source of the consultant's recommendation.

The consultant also indicated that he felt there was

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some conservatism in his recommendation and suggested that we explore that conservatism. This is what in fact we did, and we have made an evaluation; the conclusion of that evaluation was that there is adequate margin against fracture if we operate over 100 degrees fahrenheit.

We arrived at this margin by a fracture mechanics evaluation. I should point out that it is 30 degrees more than our assumed maximum NDT, and it is 50 degrees above the consultant's assumed NDT. And it is 60 degrees above the recommended assumed maximum NDT in the recent NRR-NUREG document.

I will try and explain the source of our conclusion. What we set out to do was to perform a fracture mechanics evaluation of the fracture safety design margin on the structure at the design operating temperatures.

To do this, we had three activities: the first one was to do a detailed stress analysis and modeling exercise on three pipe whip restraint structures. We identified the three pipe whip restraint structures with the highest design stress/deflection levels.

We then assessed the material properties of interest in the structures. The controlling material we determined was A36. Then we also asked Burns and Roe to provide us with a definition that they -- of the temperature distribution within the dry well.

We used the results of the three steps to calculate critical crack sizes within these structures in terms of the

design temperatures in the containment.

In all we did about 30 -- more than 30 calculations. We analyzed 30 crack-geometry combinations. And I can illustrate the process by just taking one of the geometry conservatisms and two crack assumptions.

(Slide)

This is the joint between the radial beam and the sacrificial wall. The sacrificial wall is not shown. This is a radial beam flange. This is a plate. And this is the -- attachment is made between two cheek plates which are welded to this web and then welded to the face of the sacrificial shield wall.

(Indicating)

What we did is we did a final analysis of the structure and calculated the stresses operating at the connections, and then we did model flaws at these connections to look at the behavior of these flaws.

Again, I will just illustrate two examples of the types of flaws that were introduced. There is the edge crack running across the top of the actual -- between the cheek plates and the sacrificial wall. We, at all times, tried to look at cracks, resulting cracks from the stress.

A further example is a circular defect in a location of maximum stress. During the fracture mechanics analysis, we took into account all design loading, residual stress distribution

and in some cases we took into account stresses which would be introduced during the fabrication process.

The results of the analysis came out on graphs of this type where the stress intensity factor for a particular flaw was plotted against the dimensions of the flaw. The circumferential break and this break indicate two different types of pipe break we analyzed.

(Indicating)

So what happens is the stress intensity factor gets higher as the fracture gets bigger. The stress intensity factor being measured -- the severity of the crack takes into account the size of the crack and the stress field within which it lies.

Knowing the stress intensity factors for particular cracks, you are going to have to know the critical volume of the stress intensity factor for the material that is controlling to assess the critical crack size. As I said, the critical material was A36 in this case and it was assumed we had a maximum NDT temperature of 70 degrees fahrenheit. We also assumed the behavior of the stress intensity factor was a function of temperature, and it behaved in a standard fashion with a standard K_{1D} temperature curve index with the NDT temperature.

We plotted out the critical stress intensity factor as a function of temperature in the containment. It turns up on a line here at a mark, 70 degrees in this case. So at 70 degrees fahrenheit the critical stress intensity factor for A36, in this

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case, is 40.

As the temperature increases, the critical stress intensity factor increases, as indicated by these points.

(Indicating)

To determine the critical crack size, it is then necessary to go down to the bottom axis of the particular temperature of interest; 70 degrees, somewhat less than one-half inch; at about 100 degrees, we are about half an inch.

I should point out that this analysis is for an edge crack, an edge surface crack which extends across the complete width of the member and results in worst-case analysis. This particular detail represents the worst-case results of the total number of analyses that we did.

So we are talking about an edge crack the complete width of the member with a depth of half an inch at 100 degrees fahrenheit.

If we look at other types of crack geometry, we find the critical crack size is much larger. As an illustration, this crack -- the crack geometry in this case is a buried circular defect. At 100 degrees we are pretty close to a two inch diamater crack, which is about the same size as the cross section of the member.

Similarly, when we look at surface cracks which were not completely across the width of the member, the aspect ratio, we find again that the critical crack size is much larger. Our

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conclusion was that at 100 degrees fahrenheit, we have adequate design margin for these structures, given the conservatisms that we have used in the analysis and the worst case assumptions that we have made all the way through the analysis.

(Slide)

We feel that we have a number of further actions to take. The first one is that we need to verify the predictions of dry well temperature during test, startup,and operation. Our indication from Burns and Roe predictions that a minimum temperature of 85 degrees is at the discharge of certain heating and ventilating fans in the plume does not impinge upon any of the structures of interest.

The structures of interest, our indication has it at the moment, that the minimum temperature of those structures is 95 degrees fahrenheit. Given the errors in predicting -- making these sorts of predictions, it is pretty close to 100 degrees fahrenheit. And those are steady state conditions.

We are then going to look at effects of this temperature limitation on the plant startup. In other words, do we have any conditions during startup where a LOCA would be postulated and the temperature would not be as predicted in the steady state conditions?

Now, we intend to look at these things further. We already have a tech memo from Burns and Roe which came recently, discussing these factors, discussing the second factor. We have

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not fully evaluated that yet. We intend to provide a final report of this evaluation which summarizes -- explains in detail what we are doing and also includes any of those things that we still have remaining.

That is all I have.

Any questions, please?

MR. GAMBLE: I cannot remember. Did you say why -- what -- why did the consultant recommend that -- why did you hire him? What was he doing there? To find cracks or --

MR. BURNS: Yes. We found cracks in the structures and we had to repair them. We hired the consultant to provide assistance in setting up suitable repair procedures and suitable correction action. And we set out what we feel are very conservative inspection and repair procedures.

However, the consultant was aware of the function of the structures, and he felt that fracture safety design was required for this type of structure and this type of welding. He provided what he thought was a reasonable maximum operating -- not reasonable -- a conservative minimum operating temperature.

MR. GAMBLE: So you found some cracks. And I guess the thrust of your -- you removed them and repaired --

MR. BURNS: Yes. To the best of our knowledge is sound, no cracks. However, we are looking at the general fracture safety design of the structure.

MR. GAMBLE: And you are going to take all this and put

it in some kind of report?

MR. BURNS: Yes.

MR. GAMBLE: And that will be submitted, what, on the docket?

MR. FOLEY: Yes.

MR. BURNS: Yes.

MR. FOLEY: Yes, that is true.

MR. HAYNES: There are no cracks that extended to the surface because you did surface examinations; is that correct?

MR. BURNS: Yes.

MR. HAYNES: You did not do UT.

MR. BURNS: No, except in very limited cases for specific reasons; particularly, sacrificial shield wall attachments were UT-ed for specific reasons; that is, one of the critical attachments.

MR. GAMBLE: The residual stresses that you used in your analysis, generally, what were the magnitudes?

MR. BURNS: Right. For fillet welds, we used a distribution which included a maximum magnitude of half the yield point; other welds, we used a distribution which included a maximum magnitude of yield point.

We feel this is conservative because we are operating at a significant margin below the NDT. When you get significantly below the NDT, those stresses do not have a significant effect on fractures.

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MR. HENDERSON: This NDTT number of 54 degrees, that was not generated from specific experimental data from samples on these elements.

MR. BURNS: The consultant's recommendation was based on the 54 degrees. That was generated from two beams that we removed from the containment where we actually measured the NDT temperature --

MR. HENDERSON: Oh, it was.

MR. BURNS: -- by ASTM procedures. We measured the maximum on the two beams; one was a maximum of 41 degrees; one was a maximum of 54. We measured many locations on each beam to try to identify the NDT. We did not just use the flange region which is the normal ASTM position. We looked underneath the web at the worst case situation. We identified the worst case of 54.

But to take into account possible additional statistical variations, we used a maximum NDT of 70 degrees fahrenheit. As I pointed out, we think there is conservatism in that assumption.

MR. GAMBLE: How thick are these beams that --

MR. BURNS: In general, up to about three inches; there are specific instances where there are heavier members involved, but these are generally located in specific locations. I am thinking of one, there is one frame structure which is associated with the main steam isclation valve -- we call it the birdcage

structure -- which has members which are thicker than three inches. That is the exception. We have analyzed one of those situations.

MR. GAMBLE: And the --

MR. HENDERSON: The -- I understand that this -- you have considered only LOCA loads in defining the temperature. What is the situation with respect to seismic loads when the plant is shut down and the vessel is open, say, for refueling?

MR. BURNS: We used LOCA, seismic, live, and dead combined. We assumed coincidence of all design loads at one time, adding them all together. So we have the safe shutdown at--

MR. HENDERSON: Well, algebraically --

MR. BURNS: I am not saying the right thing. We took the maximum load --

MR. HENDERSON: That triggered something.

MR. BURNS: We added together all the loads and assumed all accidents at the same time, all possible loads.

MR. HENDERSON: That was only at 135 --

MR. BURNS: We assessed the --

MR. HENDERSON: -- operating ambient temperature.

MR. BURNS: We have assessed the design over the complete range of operating ambient temperatures, yes.

MR. HENDERSON: How about the shutdown ambient temperatures?

MR. BURNS: No, we have not analyzed the fracture

safety design at the shutdown ambient temperatures because the --

MR. HENDERSON: With, say, simple seismic loads.

MR. BURNS: The seismic loads, as I understand it from the design engineers, the seismic loads are very insignficant compared with the LOCA loads. That is, the stresses generated by the LOCA loads -- I cannot recall specific figures, but they are significantly larger than the seismic loads. So, we do not have, to answer your question, we have not examined the fracture safety design under seismic loading during shutdown conditions.

MR. HENDERSON: Okay.

MR. GAMBLE: Okay, but what you said you were going to do was you were going to go back and see if -- you were going to look at the operating conditions and see if you could have the LOCA loads at some lower temperature --

MR. BURNS: Yes.

MR. GAMBLE: -- in between, you know, during startup or something like that.

MR. BURNS: Our indication has it at the moment that the thicknesses we are talking about with the heatup, normal heatup rates, that we should not have a problem, a limiting problem at startup. We should be at the operating temperatures before we have postulated --

MR. GAMBLE: You mentioned that you did a fracture mechanics analysis; how did you determine the -- well, you had a critical stress intensity factor of K_{1C} or K_{1D} or whatever it

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was. And how did you determine that particular volume?

MR. BURNS: To determine the K_{1D} volume, we assumed a characteristic behavior of K_{1D} as a function of temperature in a sort of analogous manner to ASME section three and section eleven. And we indexed that to NDT temperature. And then we used the assumed distribution of NDT temperature to shift that standard curve along the temperature axis and then plotted the rise of K_{1D} as a function of temperature based on the maximum NDT.

MR. GAMBLE: Okay. And the value of 70 degrees fahrenheit for -- okay, you said that you had to get to a temperature -- you had to maintain a temperature of roughly 100 degrees or something like that. That was the temperature you used. And at 100 degrees, what was the value of K_{1D}?

What I am getting at is that you have to be careful because A36 may not have as much toughness as something like what you would find in the ASME code. It is going to run out of toughness before the reactor vessel steel runs out of toughness. But if the number is low, it does not make any difference.

MR. BURNS: About 60.

MR. GAMBLE: That is pretty low.

MR. BURNS: We employed a consultant in assisting us in making these assessments on the properties that we should assume for A36, and according to Bill Pellini he has analyzed available data and also looked at the available data that supports

that standard type behavior of K_{1D} versus temperature for A36.

MR. GAMBLE: Just for scheduling purposes, because we normally do not get reports like this, when do you anticipate this to be submitted to us, so that we can plan, you know, so somebody can review it from our group.

MR. FOLEY: We have a draft of the report included in there, and the final report with respect to the NDT matters will be a matter of what, four weeks?

MR. BURNS: I said in the report we should have it before April '79 -- April '80.

MR. GAMBLE: You are going to submit it on the docket which means we will have to look at it before the licensing because I can go back and find out when the licensing, when we are scheduled to finish our licensing efforts. So I want to know about when we are going to get the report.

MR. FOLEY: About April.

MR. GAMBLE: Okay.

MR. BURNS: We have just -- we have all the information together; it is just tying up these two last concerns, reviewing the Burns and Roe technical analysis; and the resulting differences, any questions, incorporating them into our final report.

Thank you.

MR. FOLEY: Any further questions about this subject?

(No response)

Well, this obviously is a subject with some history; we believe, however, we have taken a comprehensive look at this matter in the context of our situation. We have put some good talent on it. We have employed some consultants of both national and international reputation.

We think we have an analysis of the condition that we can live with and will be supportive of the project.

The last and the third area of discussion is pipe whip restraints. Mr. O'Donnell will return to the front of the room and give you a background as to the design considerations associated with the restraints.

MR. O'DONNELL: Basically, I think that the purpose here is to just bring people up to speed that may not be familiar with the design requirements for pipe whip restraints in terms of their function. I think that the terminology, pipe whip restraint, is self-identifying. It is a restraint that is placed there in case of the postulated failure of a pipe. The pipe whip restraint is the area within this dark circle.

(Indicating)

The pipe in question and the annular space in between here, which is the maximum distance that we care for this pipe to travel before it impacts on this particular restraint; these are located throughout the dry well. These weldments are supported on either structural steel in this manner, imagining this to be a wide flange beam, or another configuration we might have is

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supported off the sac wall, and the ones that I think Tom has seen more often, because they are in place, this type of restraint.

Again, the restraint is the piece of material within this area.

(Indicating)

The restraints were fabricated by Leckenby Corporation under a separate contract, contract 90, as differentiated from the subcontract work that they did for contract 215, the mechanical contract.

I like to bring that point out because during some of Mr. Johnson's discussion, this delineation of contract will be brought out.

As I said, the material is -- the pipe whip supports are procured and fabricated by contract 90; however, they are installed by contract 215; since contract 215 installs all the main piping, they in turn are responsible for the final installation here.

They are also responsible for all the shimming which is necessary and the restraint blocks. Imagine, if you will, the pipe could break in any direction. So it could impact up or sideways. The end stops take the lateral loads; the horse collar takes the vertical load. And the beam itself would take the vertical down impact.

And Dave has discussed the ramifications of the

dsp104

structural steel; these restraints are generally high strength material, 516 or 537. They have all been post-weld heat treated, impact tested, and let me also point out that down here the connection between the collar and the base plate is a full penetration weld, which ensures that the attachment of the horse collar to the base plate should be stronger than the parent material itself.

Just in closing, the loads were derived based on a blowdown analysis using the RELAP-3 program. A dynamic load factor was developed, and a static load used in the design of these with an allowable stress almost up to yield stress.

Are there any general questions before Mr. Johnson comes up?

(No response)

Mr. Johnson will now discuss the remaining seven concerns with relation to pipe whip restraint.

(Slide)

MR. JOHNSON: I would like to start with a little bit of history, some of which you just heard Jack discuss. Basically, the subject of my discussion is the seven items of concern or problems associated with QA records for pipe whip restraints. I would like to repeat that the restraints were made under a contract, contract 90 with the Leckenby Corporation. The restraints were installed by the 215 site contractor.

(Slide)

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The quantity of hardware involved, there are a total of 179 pipe whip restraints. There are four basic types with types one, two, three, four, types three and four having sub-categories which have some minor design changes on them.

Of these, 30 have been installed in place and inspection is complete and accepted. 21 have been installed and inspection is complete.

We have 128 that are not installed.

(Slide)

Once again, the specific restraints, types two, three, and four are basically of this configuration.

(Indicating)

(Slide)

Type one is of the other configuration that you have already seen.

(Slide)

In mid-1979 the quality assurance department for the project was asked to review the records associated with contract 90 prefatory to contract closeout. We reviewed at that time a sample of the documentation and found some unacceptable items; proceeded on to a 100 percent review; discovered missing documentation and some cases of material substitution.

We contacted the supplier who agreed to provide us with the missing documents, and in early November our document review revealed numerous discrepancies with the document packages.

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At that time we felt we had sufficient evidence to analyze this as a potential 50.55(e), and we did report it to NRC Region V as such. A stop work order was issued to the site contractor to cease all work on the installation of pipe whip restraints in November, and the NRC requested us to propose a corrective action plan before installation was allowed to proceed. We responded to that in December with our correction action program.

(Slide)

Before I go into our program, I would just like to give you some indication of the types of documentation problems that we have discovered in the document review. We have broken these into two categories, the second of which you will see momentarily. These are documentation problems that are, paper problems that appear to be items that can be corrected without totally impacting the hardware: wrong year on UT report; no traceability to strip chart; welder's ID missing.

And we have identified each specific pipe whip restraint affected.

(Slide)

The other items, the document problems affecting hardware, once again we have identified the specific restraints, and these are the numbers of the pipe whip restraints: wrong chemical composition on MTR; wrong weld procedure; weld

procedures not qualified for post-weld heat treatment conditions.

(Slide)

Our corrective action plan, as requested by the NRC, we have already implemented parts of it. Our review of the data for identification of problems, all of the problems associated with the documentation as related to each pipe whip restraint, we completed that in December of 1979; also it included an identification of welding and nondestructive examination conditions; in other words, what we term hardware type problems.

We have identified these on corrective action requests which are the mechanisms we use to transmit to the contractor to get a response back from him.

Project QA and engineering evaluate those responses, and then we issue NCRs for unacceptable responses to document the problems. Due to the number of deficiencies that we had and the problems with the NDE reports and welding procedures, we felt it necessary to do a nondestructive examination sample plan.

And we came up with a sampling program to go out and sample the required ultrasonic and mag particle program that had been implemented by Leckenby.

(Slide)

And this is our sample program, the bottom line being basically that for mag particle welds we had a 60 percent reject

rate; with ultrasonic, we came up with a 21 percent reject rate, which is well above our total sample program. We looked at a total of 29 pipe whip restraints out of the population of 179. So, based on the results of our sample program and implementation of it, which was completed in January of 1980, we now feel it necessary to do a 100 percent volumetric examination and visual examination of all of the pipe whip welds per the original specifications.

What this program, then -- any defects identified here, we will hire our own contractor to use qualified personnel, qualified procedures, et cetera, and any defects would be identified on nonconformance reports, which we will then tie to NCRs that we have outstanding against document deficiencies and welding deficiencies so that we have all discrepancies against any particular pipe whip restraint identified in essentially one document for easy traceability.

And we will process this through our system. The NCRs will be evaluated by our engineering organization, and deficiencies will be resolved, hardware reworked and/or released as they determine.

Okay. Now, I would like to very briefly address the seven items of concern.

(Slide)

The first one is pipe whip restraints of the same or similar design were provided under two contracts, one contract,

90, requiring NDE and post-weld heat treatment of welds, the other, 215, requiring only visual inspection of welds. 215 PWRs may not have been post-weld heat treated.

Here, the PWRs were all provided by contract 90. You heard Mr. O'Donnell say that support steel was provided by contract 215 and heat treatment was not required. The spec for contract 90 did require AWS D1.1 plus post-weld heat treatment and NDE.

The 215 required only visual examination. The NDE was specified on the pipe whip restraints because rigid weld inspection will provide additional assurance that the pipe whip restraints, the weld metal, or the welds would withsand a postulated pipe weld.

And post-weld heat treatment of the PWRs was specified to assure the dimension tolerance for the PWR for that critical dimension between the pipe wall and the collar on the pipe whip restraint. That is a critical dimension.

(Slide)

Post-weld heat treatment was not required on the support steel because the basic design of the support steel is the shim, and we have plenty of flexibility in that area. So, therefore, we did not need post-weld heat treatment to maintain even tolerances.

(Slide)

Item eight, NDE records associated with pipe whip

restraints contain phtocopied inspectors' acceptance signatures. The next few items basically all deal with record type problems, and our response is basically all of the same category for these, and this is that the -- our proposed reinspection program will put in place new NDE records for both ultrasonic and mag particle, as well as new records for performance of those NDE activities and personnel qualification.

Therefore, that negates the item of concern; however, we are still concerned with it to the point that we investigated each of these,and as shown here, we have certified statements from Mr. Moore and Mr. Hamilton saying, yes, they did use photocopying. It is a standard practice, and it did indeed affect, basically, all 179 of the pipe whip restraints.

Item nine states that NDE qualification records cannot be found for one or possibly two individuals who performed ultrasonic and MT on PWRs and that the qualification procedure is not in full accordance with SNT-TC-1A.

Reviewing the inspection reports and the qualifications, it indicates that there is questionable qualification of level two inspections and level three examiners. And in fact certification records for one Mr. Charles Baldinger could not be located.

In support of Mr. Baldinger is a sworn statement that Mr. Baldinger had the experience and was indeed probably certified in to SNT-TC-1A level two. And we have the AE's surveillance

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report that was performed on Leckenby which indicated Mr. Baldinger's certification papers were reviewed by the surveillance engineer.

And a review of the personnel qualification procedure revealed that we do have some problems with the procedure as it stands. However, our reinspection program will essentially negate all of these.

(Slide)

Item ten, the electroslag welding procedure used in the welding of the pipe whip restraints was not qualified using post-weld heat treatment as required by the code, AWS D1.1.

This deficiency was identified by us and has been transmitted to Leckenby on one of our corrective action requests. Leckenby has responded to this indicating that they will re-qualify the electroslag welding procedure, and at this time we have asked engineering to do an evaluation to determine if post-weld heat treatment is specifically required for the electroslag procedure.

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Item eleven states that approximately 90 typical joint configurations specified on design weld drawings for the pipe whip restraints use fillets which are smaller than the minimum fillet weld size specified in the applicable code.

In our review of this, we looked at the majority of the welds in question, and most of these are contract 215 welds,

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rather than contract 90.

There is a point I would like to bring out here now when I get to where I am talking about inspections. This is an important point because contract 215 inspection records for personnel qualifications are not in question at this point in time.

The specific concern here on the fillets regards the engineering rationale for acceptance; that rationale is based on the fact that the fillet does not fulfill a structural requirement. Therefore, the size is not of prime concern.

However, we did want an inspection which would indicate that it was of good quality. That inspection was performed by 215 and 213A, another one of our contracting personnel. And it gives us confidence in the original welds. Our review also indicates -- engineering has indicated that the design indicates that fillets are not needed with these strength requirements, and our inspection has shown us that no welds are basically undersized by more than 1/16 inch.

Our proposed corrective action is that for the welds installed to date we will accept as is, and for welds not installed, we will issue a change notice to our contractor, and they will be brought into line with the code.

MR. BISHOP: Roger, on that item I am confused a little bit about the 1/16 inch undersize. The document package that Burns and Roe provided me at the site showed about 36 --

38 of the 90 joint configurations have undersized welds on the order of 1/8 inch to 2/16 inch and one case where it was a 1/2 inch -- a 1/4 inch, excuse me, undersized.

MR. O'DONNELL: Tom, I can address that. The original head count of 90 was based on the 1969 edition of the AISC code, which included plate thicknesses up to six inches. Subsequently, the AWS -- let's discuss the intent of the minimum size fillet weld.

The intent is to provide enough heat so that when welding through large size metal it does not act as a heat sync and therefore cool the weld off prematurely. The AWS, recognizing this, no longer even has a requirement of materials over 3/4 inch to be more than 5/16 inch.

So the original head count of 90 -- the majority of these fall out of that category, the ones that you are referring to, and those that are not structural welds at all fall out of that category, and there are many welds that are not undersized by more than 1/16 inch.

We recognize that you cannot lay down more than 5/16 inch feasibly, and this is the maximum heat input; our concern is that to go back and try to reinforce a weld by 1/16 inch to meet the letter of the code might do more damage than the correction might pose on the structure. So I think by the time you filter out the discussion in the book there, you will find that there should not be any that are undersized by more than 1/4,

1/16.

MR. BISHOP: The one condition that officially kicked this question off was the attachment of a pipe whip support bracket to the sacrificial shield with a 1/4 inch weld. And according to the code, that should have been 1/2 inch weld.

MR. O'DONNELL: That is what I am saying. That has been superseded. The maximum size -- minimum size weld is now 5/16 inch.

MR. BISHOP: Okay.

MR. O'DONNELL: Okay. And that is required for plates up to 3/4 inch. And let me also bring up this point: we meet the intent of the code because we are basically preheating all our large size material. So the whole idea of putting the proper heat input into these welds, we have met through the welding procedures in preheating, which is basically what we are shooting for by calling for a larger sized weld than the design requires.

MR. HENDERSON: What are you using for preheat? What temperature for preheat?

MR. O'DONNELL: We vary. We vary from approximately 70 degrees up to 250, depending on the thickness of the material. In other words, there is a minimum of 75 degrees; for materials over 1-1/2 inches to 2-1/2 inches, we have been using 175 degrees, plus or minus 25.

So this would be the equivalent of the heat input, I am sure, that is intended in this minimum size weld. We have in

essence met the intent of the code, not specifically the letter of the law.

MR. BISHOP: You are saying you are meeting the intent of a newer version of the code?

MR. O'DONNELL: No, the intent of the original. If you read the commentary, even on the previous AWS code, they discuss the rationale for minimum size welds. And in that commentary they finally brought it to implementation by revising the AWS code in 1975.

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MR. JOHNSON: "Item twelve: numerous record irregularities and inconsistencies exist between weld maps, manufacturing orders, welder and inspection records associated with PWRs. Inconsistencies include," et cetera, et cetera.

The answer to this particular item of concern is that it is true; basically, all of these things do exist. We have identified those in our record review. We have identified them by pipe whip restraint number. The inspection program will resolve many of the NDE and personnel qualification provisions. The balance, as I indicated, will be put on NCRs. Any new welding identified by reinspection will be identified on NCRs and necessary rework and/or release will then occur.

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Item 21, the last item on the PWRs, "The specification requires the use of high strength A325 or A490 bolt and use of

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high strength bolting specification. Drawings call out A320 and A540 bolts. These bolts are installed but are not installed in accordance with the high strength bolting specification; that is, plate or bar washers have not been used over long slotted holes."

Reviewing the contract, contract 90 did indeed specify A325 and A490 bolts, and the requirement for the use of the high strength bolt specification. The drawings specified A320 and A540. A320 bolts were used. However, they were not installed per code requirements.

Our corrective action is that the installtion contractor, 215, will be instructed to use the strip or plate washers and the spec will be revised to require those washers. And at the time of the reinspection program, we will have to review the restraints, and it will be accomplished at that time.

Okay, are there any questions?

(No response)

MR. FOLEY: That concludes our presentation.

In summary, we have attempted to be as frank and forthcoming as we can. We are in none of our evaluations and recommendations backing away from FSAR requirements, nor are we compromising design.

We have two stop work orders. In that light I might say that, mindful of -- well, it is our understanding that these matters are still officially within the purview of Region V and

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that some discussion may occur today as to what extent these matters will be referred to other organizations.

Mindful of our need to move forward as quickly as possible, and mindful in particular of NRR's review restraints, it is our view that the technical content of these matters with respect to NRR is largely limited to the NDT of structural steel. Of course, that is certainly your decision to make.

We have two stop work orders in effect: one on the pipe whip restraints and the other on the sacrificial shield wall. We have with Region V a program which would provide for incremental release of stop work orders; we believe that in view of our investigation to date on the pipe whip restraints, their accessibility, our determination to repair them to whatever extent is necessary, that that stop work order -- we seek your concurrence in lifting that stop work order.

And mind you, I am not asking that today. I am remembering your introduction. We would like to leave you with that today. We would like concurrence in lifting the stop work order on the pipe whip restraints and lift the stop work order in an incremental fashion on the sacrificial shield wall to permit us to do whatever additional investigation, grinding, and so on and so forth, and we understand that Tom has no objection to that, but we wanted to make that clear; to engage in that work which is necessary to do the prototype testing and the repair of the shield deficiencies in the wall, which as you may recall, also

in order to proceed with that, would call for us to prepare the joint for the circumferential weld to connect ring two with ring three.

We would like to proceed with that work. We, at this time, have no pipe or additional attachments to the wall which are pressing in terms of the critical path construction process, and we would not seek to make attachments to the wall, further attachments to the wall until we could determine for ourselves that it would not in any way obfuscate any additional investigation, make repairs any more difficult.

And we believe that as our investigation continues we may find a situation where we come in for additional attachment, but that is not our point of view now.

To summarize what we would like to see on the wall: the authority to continue whatever work is necessary to complete our investigation; to do what work is necessary to do the repairs to the shielding; and to do the work associated with the repair of the circumferential weld, particularly the surface preps.

Do you have any final questions or comments?

MR. BISHOP: One thing I can do, Roger, is to perhaps provide a little background on our position as far as the immediate action letters we sent. As you explained, it was to prevent any further work on the wall and the pipe whip restraints that would make the determination of the depth of the problem more difficult.

And because of that, we do not have -- correct me if I am wrong -- we do not have any objection to you proceeding with any exploratory activity that is needed to define the scope of the problem. And I thought we had made that clear in the past, but we have no problems with that at all.

It was mainly to prevent further attachments to the wall or anything that would make it more difficult to make the assessment of the adequacy of the wall.

MR. HAYNES: If I understand what he is saying, though, you are also saying the pipe whip work installation could proceed, and that would not affect of the ability of the inspector or to repair anything on the sac shield wall; is that correct?

MR. FOLEY: And I do not mean the installation of the pipe whip restraints; I am talking about the stop work which is in effect on the pipe whip restraints themselves. We want to begin to repair the pipe whip restraints.

MR. HENDERSON: Continue the examination and repair.

MR. FOLEY: The examination we are not prohibited from doing. We are in the process of dragging those pipe whip restraints out of the building; where necessary, we will continue the examination. And as we conclude examinations of the pipe whip restraints and determine that repair is required, we want to proceed with that repair in the most timely and efficient fashion as we can.

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MR. HAYNES: Well, okay. If they were installed, taking it a step further, would that affect the ability to inspect or repair the sac shield wall?

MR. FOLEY: I would have to look at that on a case by case basis.

MR. HENDERSON: I think one thing --

MR. FOLEY: The vast majority of attachments to the wall have already been made. The number remaining are nominal. And the amount of space remaining to do inspection is also nominal. So we would be concerned about having the examination in the area.

Now, there is no question -- in our work procedure, there is no question about the quality of the material on any welding associated with the attachments;because of the work procedure 84 requirements, the kinds of testing that is done assures us that that is not a problem.

The difficulty would come -- and we addressed this in our incremental work release -- is what if somebody had in mind to pull a skin plate and we were about to make an attachment. Our incremental work release calls for all of the necessary technical and quality reviews on any piece of work that is proposed to be attached to the wall to assure ourselves internally as well as any others of interest that doing that piece of work would not detract from the overall evaluation of the program.

The reason I do not seek the lifting of the stop work

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in the whole sense is because we think that the incremental work release procedure is a workable thing and that we are not at this point pressing to make additional attachments to the wall. We would not press that unless we had determined it would not hamper our investigation or repairs as may be required, and only then if that particular attachment was schedule-critical.

MR. HENDERSON: But if you do not get them repaired, then they will all be schedule-critical.

MR. FOLEY: Precisely.

MR. HENDERSON: Are you -- I think I heard you say that you propose to use a separate, specialized contractor for this repair work.

MR. FOLEY: I did not say that; no, I did not.

MR. JOHNSON: That statement was in the context of inspection.

MR. FOLEY: Inspection, yes.

MR. HENDERSON: Oh.

MR. FOLEY: And we have not made a decision about who will do the repairs to the pipe whip restraints, nor have we made a final decision about who will perform the circumferential weld on the sacrificial shield wall, attaching ring two to ring three.

And I assure you, whoever does it, we will be monitoring that quite closely.

MR. HENDERSON: I guess that is about all we need to

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keep you here for today, then. So you will be hearing from Region V in the near future.

Thank you very much. It has been a very informative session.

MR. FOLEY: Thank you for your time and your hospitality.

(Thereupon, at 12:45 p.m., the meeting was adjourned.)

NUCLEAR REGULATORY COMMISSION

This is to certify that the attached proceedings before the

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in the matter of: Staff Briefing on Review and Evaluation of WNP-2 Sacrificial Shield Wall, Pipe Whip Restraints & Related Structures

Date of Proceeding: February 6, 1980

Docket Number: ____________________

Place of Proceeding: Bethesda, Maryland

were held as herein appears, and that this is the original transcript thereof for the file of the Commission.

David S. Parker

Official Reporter (Typed)

Official Reporter (Signature)