Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
AP1000 Reactor Subcommittee Meeting
Open Session

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Thursday, November 18, 2010

Work Order No.: NRC-558 Pages 1-49

NEAL R. GROSS AND CO., INC.
Court Reporters and Transcribers
1323 Rhode Island Avenue, N.W.
Washington, D.C. 20005
(202) 234-4433

DISCLAIMER

UNITED STATES NUCLEAR REGULATORY COMMISSION'S ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, as reported herein, is a record of the discussions recorded at the meeting.

This transcript has not been reviewed, corrected, and edited, and it may contain inaccuracies.

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

AP1000 REACTOR SUBCOMMITTEE MEETING

OPEN SESSION

+ + + + +

THURSDAY

NOVEMBER 18, 2010

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Advisory Committee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., Harold B. Ray, Chairman, presiding.

COMMITTEE MEMBERS:

HAROLD B. RAY, Chairman
J. SAM ARMIJO, Member
SANJOY BANERJEE, Member
DENNIS C. BLEY, Member
MARIO V. BONACA, Member
CHARLES H. BROWN, JR., Member
JOY REMPE, Member
MICHAEL T. RYAN, Member
WILLIAM J. SHACK, Member
JOHN D. SIEBER, Member

NRC STAFF PRESENT:

RALPH LANDRY, NRO/DSRA
EILEEN MCKENNA, NRO
JOHN MCKIRGAN, NRO/DSRA
BRIAN THOMAS
WEIDONG WANG, Designated Federal Official

PRESENT FROM WESTINGHOUSE:

TIM ANDREYCHEK
ED CUMMINS
JOHN DEBLASIO
CESARE FREPOLI
ANDRE F. GAGNON
DANIEL GOLDEN
JASON KARNS*

PRESENT FROM WESTINGHOUSE:

TOM KINDRED

MEGHAN LESLIE

DONALD LINDGREN

PHIL MATHEWSON

MIKE MELTON

RICHARD ORR

JAMES PARELLO

NIKOLAY PETKOV

THOMAS RAY

GERALD RIEGEL

GIUSEPPE SCADDOZZO, Ansaldo Nucleare/WEC

TERRY SCHULZ

BOB SEELMAN

ROB SISK

LEE TUNON-SANJUR

AMIT VARMA, Purdue University/Westinghouse

RON WESSEL

ALSO PRESENT:

AMY AUGHTMAN, The Southern Company

EDDIE R. GRANT, NuStart

THOMAS S. KRESS, ACRS Consultant

GRAHAM B. WALLIS, ACRS Consultant

*Present via telephone

C O N T E N T S

Opening Remarks and Objectives.....................5
Action Item 55 (Continued Discussion)..............7

PROCEEDINGS

(8:32 A.M.)

CHAIRMAN RAY: The meeting will now come to order.

This is a meeting, the second day, of meetings for the API1000 Reactor Subcommittee, a standing committee of the Advisory Committee on Reactor Safeguards, and I'm Harold Ray, chairman of the subcommittee.

ACRS members in attendance today are Mario Bonaca, Charles Brown, Joy Rempe, William Shack, Michael Ryan, Sam Armijo, and Sanjoy Banerjee, and Jack Sieber.

We also have the benefit of ACRS consultants at the table with us, Tom Kress and Graham Wallis.

Weidong Wang is the designated federal official for this meeting.

The meeting is a part of the ongoing review to the Proposed Amendment to the AP1000 Pressurized Water Reactor Design Control Document. We've had eleven multiday meetings in the past. This meeting will continue the review of the safety evaluation reports for Revision 17 of the AP1000 DCD.

It's a three day meeting, during which we'll review Chapters 315, 23, and action items, and the other matters that I have mentioned previously, concerning AIA, GSI-191.

We will hear presentations from the Applicant, Westinghouse, and the NRC staff. We have received no written comments or requests for time to make oral statements from members of the public regarding today's meeting, and as shown on the agenda, some presentations will be closed in order to discuss proprietary information. Other portions will be closed to discuss classified information.

During the proprietary sessions, Westinghouse representatives, and NRC consultants, staff, and those individuals and organizations who have entered into appropriate confidentiality agreement with them may be in attendance. Otherwise, we will need to confirm that we have only eligible observers and participants in the room for the proprietary closed portion.

The subcommittee is gathering information and will analyze relevant issues of facts and formally propose positions and actions, as appropriate, for deliberation by the Full Committee.

The rules for today's meeting, for

participation in today's meeting, have been announced as part of the notice of this meeting, previously published in the Federal Register. A transcript of the meeting is being kept and will be made available, as stated in the Federal Register notice. Therefore, we request participants in this meeting use the microphones located throughout the meeting room when addressing the subcommittee.

The participants should first identify themselves, and speak with sufficient clarity and volume, so that they may be readily heard.

And we will now proceed with the meeting. As I say, previously, this is a continuation of a discussion that concluded the day yesterday and it will address our action item identified as Item 55, having to do with squib valve functional testing, and Don, the floor is yours.

MR. LINDGREN: Okay. Good morning. Once again, my name is Don Lindgren. I'm from Westinghouse Electric. Gerry Riegel is beside me. He is our lead engineer on the squib valve design procurement testing. In the audience, I have Ron Wessel and Jim Parello, who are in the EQ area. I do have a response which I've written out, which is mostly just this information again. So we'll continue. I've written down the questions we got on squib valves, testing of squib valves, verification, qualification program, IST, from Dr. Banerjee. Details of how many tests, what's the configuration, what about the steam pressures, and et cetera, aside from how do you test them once they are in service.

Our squib valve design and development includes functional testing, lot acceptance testing, equipment qualification testing, and in-service testing. We're going to talk about all of it.

The design and development program includes functional testing of the design and extreme conditions. Variables include propellant loads, material properties, environmental conditions, and machining tolerances.

Seventeen tests have been completed with prototype valves, with all the valves opening.

Propellant loads ranged from--generally ranged from 80 percent of the nominal load to 20 percent of the nominal load, and in a couple of cases, higher.

MEMBER BROWN: Is that part of the design? Excuse me. The manufacturing, is that--does that reflect their quality control in terms of propellant loads, or is that just--

MR. RIEGEL: No; it's just prototype testing, and it was--part of the testing was to develop the actual propellant loads. That's why some of the tests were actually higher--

MEMBER BROWN: Okay. So this is to identify what it took to make, again, whatever the environmental pressure conditions, pipe conditions, whatever you would be facing, that was to find what loads you needed to make sure that you had reliable opening?

MR. RIEGEL: Exactly.

MEMBER BROWN: Now in the manufacture, I presume there's some way to confirm that your well--

MR. LINDGREN: There is a lot acceptance test of the charges.

MEMBER BROWN: Okay. You're going to talk about that?

MR. LINDGREN: Yes.

MEMBER BROWN: Okay.

MR. LINDGREN: Shear cap thicknesses include nominal, minimum, and maximum thicknesses, and the tension bolts, which are also broken, are as part of the opening.

MEMBER BROWN: Before you flip, your test pressure's up to 450. Is that--

MR. LINDGREN: That's higher than--these are the Stage 4 squib valves, and they open at a much lower pressure. You know, they're the fourth stage, so the first, second, and third stage have opened and relieved most of the pressure by that time, incidentally, if you ever have to use them.

DR. WALLIS: But they will be subjected to higher pressure.

MR. LINDGREN: They will sit at higher pressure but they don't have to open.

DR. WALLIS: They will have experienced that pressure for a long time--

MR. LINDGREN: They will experience that pressure, yeah, in service, but the opening pressure is--and of course the opening--the pressure tends to push them open, once you start the process.

MEMBER BANERJEE: Do you have, just to remind us, a little sketch of what this thing looks like?

MR. RIEGEL: This actually walks through the operation of the squib valve. There's two different types. There's the ADS valve, which has one shear cap, essentially, and then the 8-inch valve, the injection valves, and there are circulation valves just of a slightly different design. If you scroll through it, it walks through the operation, so the tension bolt broke there and then--

MEMBER BANERJEE: Can you tell us, explain what is what here?

CHAIRMAN RAY: And you'll have to speak more loudly because we are making a transcript here.

MEMBER BANERJEE: Yes. You can't--you need to be miked.

MR. LINDGREN: Here. Run the cursor.

MR. RIEGEL: So this is the valve body. We have a bonnet up here. Not shown here is where the--what we call the actuator, it's where the propellants are kept, and there will be electrical leads that come into it. Once it's initiated, pressure builds up above the piston, the tension bolt will break, the piston will come down, impact the shear cap. At the end of the shear cap, it has this clamp mechanism on it to retain it, and then it will flop down. There's pins in here that retain the shear cap and that clamp mechanism, and there's a position indication switch down here that will indicate that--

MEMBER BROWN: Can you do that again. Is that open volume where the propellant is? Is that an enclosed--I see a little light line up there. So it goes into an enclosed volume to get the force to push that piston down? Hopefully.

MR. RIEGEL: Yes. This is actually a older design. During the testing, there were some modifications to the piston. This volume is a lot smaller now. But yes, this is the volume that--

MEMBER BROWN: So it's that little odd volume that you're talking about?

MR. RIEGEL: Right here; yeah.

MEMBER BROWN: Okay. And the connection between--the propellant then gets its charge and blows it into that volume?

MR. RIEGEL: Yes.

MEMBER BROWN: Okay.

MR. RIEGEL: And the tension bolt breaks at this design failure spot.

DR. WALLIS: That was very quick.

MR. RIEGEL: How it breaks off is not clear.

How it breaks off is the gas builds up above the piston here--

DR. WALLIS: No. How does the shear stuff breaks off when it gets hit?

MEMBER BROWN: Point to the areas down

there where things happen.

DR. WALLIS: They were suddenly lying on the floor. But how does it actually rip off

MR. RIEGEL: The shear area is--this here is the shear cap and it's one continuous piece machined out of bar stick, and there's a very--not very--there's a thinned area here. When the piston impacts, it breaks right on this small area here, it shears off, and, yeah, there's no in-between step but it--

MEMBER BROWN: It's hinged in that lower corner.

DR. WALLIS: Go backwards to the beginning one again.

MEMBER BROWN: Okay. So the light brown goes down and pounds that little oddball thing that goes around, that purchases that downwards--

MR. RIEGEL: Yeah.

MEMBER BROWN: --breaks the--

MR. RIEGEL: Guillotine.

MEMBER BROWN: --little connection higher, that's on the left.

MR. RIEGEL: Correct.

MEMBER BROWN: And then it's the working fluid that knocks it into place?

MR. RIEGEL: The working fluid assists in knocking it into place. It's designed, that it'll fall without any pressure behind--

MEMBER BROWN: Even with gravity, it'll just fall?

MR. RIEGEL: Yeah.

MEMBER BANERJEE: So where is the working fluid?

MEMBER BROWN: To the left.

MEMBER BANERJEE: To the left?

MR. RIEGEL: Yes. This is the pipeline, coming in here. So this is all full of fluid. And it's designed for the reactor pressure.

DR. WALLIS: What's all that other stuff, which is holding that--

MR. RIEGEL: This here stuff, here?

DR. WALLIS: The stuff on the right. There. All that stuff. What's all that stuff?

MR. RIEGEL: This here is--

DR. WALLIS: It's a hinge?

MR. RIEGEL: Yes; it's hinged. There's a--you can't necessarily see it but there is an L bracket here, and a pin here, that retains all this inside the valve, so that we don't generate--

DR. WALLIS: And the pin doesn't break?

MR. RIEGEL: No; the pin does not break.

DR. WALLIS: But it has to move?

MR. RIEGEL: Yes.

MEMBER BROWN: And you're only cracking this thing at the top? Or does it crack all the way around, kind of force?

MR. RIEGEL: Cracks all the way around; yes.

MEMBER ARMIJO: So it's like--it's a circular cap; right?

MR. RIEGEL: Yeah.

MEMBER BLEY: So it's got some lateral movement as it breaks.

MEMBER BROWN: Okay. So you push down on it and that breaks the seal, right in there.

MEMBER BLEY: Breaks that tube, actually.

MEMBER ARMIJO: It breaks the end cap off the-

MEMBER BROWN: So is that a cap that's inside of that thing there? I still don't get it.

MR. RIEGEL: This here is all one piece, through here.

MEMBER BANERJEE: So in the testing, that when you say sheer cap thickness included nominal, minimum, maximum, where was it minimum/maximum?

MR. RIEGEL: So for the sheer cap, we did analysis to take into account material variabilities, temperature, fluid pressures, everything we could think of, and since we didn't want to do all the separate tests, we adjusted this thickness to account for all those different properties.

MEMBER BANERJEE: So it's that thickness as--which you showed the--

MR. RIEGEL: Yes. This thickness here is what we varied.

MEMBER BROWN: Right--oh, I'm sorry.

MEMBER BANERJEE: And that's very critical for--that's the critical thickness?

MR. RIEGEL: Yes.

MEMBER SIEBER: How much pressure does it take to fracture that without the actual actuation of the charge? What's the hydrostatic test pressure of the--

MR. RIEGEL: We hydrostatic test these to--the design pressure is 2485, 2, 485 TSI.

MEMBER SIEBER: Okay.

MR. RIEGEL: So that we pressure test to 1.1 times that.

DR. WALLIS: What's the minimum charge--

MR. RIEGEL: 1.1 time that.

DR. WALLIS: What's the minimum charge which will break this?

MR. RIEGEL: 80 percent.

DR. WALLIS: Only 80 percent? You only have a 20 percent margin in charge?

MR. RIEGEL: We did test to ensure that 80 percent will break. It may break at less than that.

DR. WALLIS: 60 percent might not break it?

MR. RIEGEL: 60 percent may not break it.

DR. WALLIS: So it's reasonably marginal.

MEMBER BROWN: Yes.

DR. WALLIS: Yeah. I just wondered what the probabilistic spread is in the breaking of this.

MR. RIEGEL: It's 80 percent, we know will break it. We will never load a cartridge in the plant at 80 percent. I mean, they will always be loaded at nominal, and what we did--

DR. WALLIS: So it means that the force to break it is within that range, is 20 percent, plus or minus 20 percent or something?

MR. RIEGEL: Yes.

MEMBER BROWN: So this thing slides down vertical and breaks that--it's got to have vertical motion and then it rotates?

MR. RIEGEL: If there's no pressure behind it, yes, that is what happens. If there's pressure behind it, it will start to rotate before it ever reaches the bottom.

MEMBER SIEBER: Now what form is the charge in? Is it like gunpowder, or-

MR. RIEGEL: Essentially. Yes.

MEMBER SIEBER: So you pour it in as crystals?

MR. RIEGEL: There's several different forms. There's an initial form--I don't know how much I can talk about it. There's two different types of propellant. One's an initiating and the other one is the gunpowder type, and it's actually in two stages, a powder and a granular type.

MEMBER SIEBER: Are they separated by some kind of membrane?

MR. RIEGEL: Yeah. They're separated by a thin metal membrane.

MEMBER BANERJEE: And they're electrically activated here?

MR. RIEGEL: Yes.

MEMBER BANERJEE: So the combustion is electrically--

MR. RIEGEL: It's initiated by an electrical current that heats up a bridge wire and ignites the propellant, the initial propellant, and that propellant ignites the next stage, and the next stage, and then increases the gas that actuates the valve.

DR. WALLIS: Well, I'm not familiar with this, but if you--there must be a probabilistic curve for the probability of this thing popping with various loads. And I don't know how big--how wide the tails are. But there must be some plus or minus, and 80 percent seems a little lower margin for me.

MR. RIEGEL: What we did--

DR. WALLIS: I would like to have it hit with something--three times what would break it, rather than the 20 percent more than what would break it.

MR. RIEGEL: The 80 percent is on the cartridge load. What's not in that 80 percent is--so when we use the 80 percent cartridge load, this thickness here is larger than it will normally be, to account for material variations, and all the other tolerance backups, and everything else.

DR. WALLIS: But it has to break that pin at the top as well.

MR. RIEGEL: Yes; it has to break this pin at the top.

DR. WALLIS: So there's a statistical spread of that breaking as well.

MR. RIEGEL: Yes.

DR. WALLIS: I just wondered, have you done any kind of uncertainty analysis on this?

MR. RIEGEL: That was taken into account in the prototype testing as well. We varied the diameter here, as well as other factors in it, to the minimum break strength and the maximum break strength.

DR. WALLIS: But you could do an analysis, which would give us some idea of what's the probability of it not working.

MR. LINDGREN: This design is mostly empirical.

MR. RIEGEL: Yes.

MR. LINDGREN: The manufacturer's experience.

CHAIRMAN RAY: On that point, maybe you could tell us where these things are used elsewhere, how long they've been in service for whatever applications they're used in, that sort of thing.

MR. RIEGEL: Valves of this size have not been used elsewhere. There was another design, very similar to this one, that was developed for the Department of Energy and GE, but it was never put into production. There are lots of valves of these types, that are of a smaller type, up to two inches, that are used in aerospace and military applications.

CHAIRMAN RAY: Okay. Well, tell us about that, because, you know, this is something we've never, most of us never encountered before. Just tell us about their use in other aerospace applications.

MR. RIEGEL: I'm not the expert on that. My boss would have been a better--

(Laughter)

MR. RIEGEL: My experience is mainly with the design of these. What I have gathered from working on these is that the aerospace industry uses them in things such as canopy ejection for fighter jets. I know commercial jets use similar things for air bag deployments out of the exit doors. The initiator that's used in this is also very similar to the initiates that are used in automobile and the air bag system.

CHAIRMAN RAY: Okay. Well, that's useful information.

MEMBER BANERJEE: So this scaling, in terms of size, is what order? Would be a factor of four in charge, or ten, compared to this experience?

MR. RIEGEL: I--

CHAIRMAN RAY: Compared to air bags in a car, it's probably a hundred, but--

MR. RIEGEL: Yeah.

MEMBER BANERJEE: Air bags in a car. But I'm talking about aerospace applications.

MR. RIEGEL: I couldn't answer that.

MEMBER BLEY: Let me ask you a different question. This shearing mechanism that you use in this large valve, is that the same physical arrangement that's used in--and I think they use squib valves a lot in the processed chemical industry too. But is that the same style that's used in all of the other BWR applications and in the aerospace business?

MR. RIEGEL: It's the same basic function, that it has a--

MEMBER BLEY: Machined tube with a banging on one side to shear it off?

MR. RIEGEL: Yeah.

MEMBER BONACA: But it is much larger.

MR. RIEGEL: These are much larger.

MEMBER SIEBER: I presume the explosive charge is similar, chemically and physically, to gunpowder?

MR. RIEGEL: Yes.

MEMBER SIEBER: Okay. So the repeatability should the same as a hand lever would get measuring velocities for a given charge. I've done a lot of that, so that's pretty accurate.

MR. RIEGEL: It's pretty repeatable. I agree.

MEMBER BANERJEE: So this is much more repeatable than what the chemical industry normally uses, which is rupture disks for emergency relief, multiple rupture disks. So that's why you're using this rather than that.

MR. RIEGEL: This is used--well, no, see, we--this normally sits at reactor coolant pressure. So when we do fire it, it's the fourth stage, so you're down around--

MEMBER BANERJEE: Yeah. So you can't use the--

MR. RIEGEL: So you can't use--

MEMBER BANERJEE: --emergency relief system-

MEMBER SIEBER: The higher the pressure,

the better off you are.

MEMBER BANERJEE: Right.

CHAIRMAN RAY: It's not a relief valve.

MEMBER BANERJEE: It's not a relief valve. Thank you.

CHAIRMAN RAY: Well, we brought you off onto the valve, which is all very interesting, maybe we'll come back to that, but let's try and finish--

MEMBER BANERJEE: There's 17 tests--sorry.

MEMBER BROWN: I have one other--maybe two other questions. You said this is--there's three other--there's three other valves. Are they al the same?

MR. LINDGREN: No; no.

MEMBER BROWN: And I know they're different sizes.

MR. LINDGREN: First, second, and third stage are--they're motor-operated valves.

MEMBER BROWN: Okay. They're not squib valves.

MR. LINDGREN: They are the valves that sit on the top and pressurize it.

MEMBER BROWN: Okay. All right. They're not squib valves.

MR. LINDGREN: They're not squib valves.

MEMBER BROWN: Then go back to the other one again. We had a note down at the--keep going--down at the--yeah. The last one. You say travel before impact was two inches. Then you say the production design has four inches.

MR. LINDGREN: Yes.

MEMBER BROWN: What does that mean? Does that mean the prototype only had two but the production's going to have four?

MR. RIEGEL: The first round of prototype testing we did, we have initially started with a two-inch travel to reduce the loading that was seen on the piping. Because of the actuation of these valves, we made some adjustments, and one of the adjustments was to increase the travel before impact. That reduced the amount of propellant we needed and--

MEMBER BROWN: If it has to go farther, you need less charge?

MR. RIEGEL: Yes. You have time to speed up.

MEMBER BROWN: So it's strictly the acceleration that you're dealing with.

MR. RIEGEL: Yeah.

MEMBER BROWN: Now when you ran through all your tests, which did you use? The two inch or the four inch?

MR. RIEGEL: We used the two inch for the first six tests in the last 11 tests. So that number's right.

MEMBER RYAN: Just so I understand the scale, what's the height from the bottom of the valve to the top of the--

MR. RIEGEL: Here is 32 inches, so this is probably about fifty, something. 60 inches.

MEMBER RYAN: Sixty inches, round numbers, just to get a--thanks.

MEMBER BANERJEE: And the upstream pipe? Remind us.

MR. RIEGEL: There is no upstream pipe.

MEMBER BANERJEE: No. I mean, on this left side.

MR. RIEGEL: Oh, okay. This is a 14-inch pipe.

MEMBER BROWN: Okay. Now back to the other question. You said six of the, your qualification or quantification tests--

MR. LINDGREN: These are development tests.

MEMBER BROWN: Development tests. Are those same tests repeated now in the production design, to make sure that whatever you used in the development side is repeated in the production, to make sure you're got prototypical--

MR. LINDGREN: I've got a test matrix.

MEMBER BROWN: I don't know whether I can answer that from looking at your matrix.

(Laughter)

MEMBER BROWN: But anyway, more than willing to work up a matrix, but I think I'm going to need you to tell me.

MEMBER BANERJEE: You guys are well-prepared

CHAIRMAN RAY: While he's passing it out, we're using different terms here, I think.

You have your functional testing and lot acceptance testing. That's what you meant by development testing and--

MR. RIEGEL: We have what we call the functional testing, is the prototype testing we did during the design development phase. There'll be some lot acceptance testing during production.

CHAIRMAN RAY: I was trying to go back to what Don had said. He used the word "development," and I was trying to figure out, is that the same as functional testing?

MR. RIEGEL: Yes, I believe, in the context.

MR. LINDGREN: Yes.

MEMBER BROWN: So the functional tests you're talking about here are really development tests, not what you would call production--not production test.

MR. LINDGREN: Yeah. We've got three more types of tests to tell you about.

MEMBER BLEY: Let me get at one of Graham's questions in a slightly different way. These things are modeled in your PRA. How did you get from a handful of tests to a failure rate for this valve to use in the PRA?

MR. LINDGREN: I do not know that answer.

MR. CUMMINS: This is Ed Cummins. This question was investigated, significantly in the AP1000 design cert. So we had a Sandia expert come to say--and basically, the process was one where the key is the actuator. And we did by, I'll say mechanics, say if the actuator works, everything will work. And so what is the probability of the actuator working?

And they had millions of actuations, huge amounts of data of the same kind of actuator, and they had--I don't remember the exact numbers--but very good reliability, extremely good reliability.

So this turns out to be more reliable than--I'll say any of our--I'm not sure absolutely--but any of our other valves, because if you can accept that when the actuator works, that the valve opens, than that's what we used in the PRA for the probability of the valve working.

MEMBER BLEY: Okay. And if I go back to the original certification, I'll find that information?

MR. CUMMINS: I think--yes. We had presentations to the ACRS about the prob--what the actual probabilities were, and what the justification was. Yes.

MEMBER BLEY: Okay. And got into things, like this variability in charge, or the variability in strength of the--

MR. CUMMINS: I would say not so much as I recall. Most of it was proved to me that the actuator actuates, and tell me what--show me that your data is relevant to this application.

MEMBER BLEY: To this larger valve; okay.

MEMBER ARMIJO: By actuator, you mean the charge and--

MR. CUMMINS: The piston.

MEMBER ARMIJO: So the mechanical design and all of that, it does not go into your PRA number?

MR. CUMMINS: No; it didn't.

MEMBER ARMIJO: Okay.

MEMBER SHACK: He bounds that uncertainty, you know. I mean, you deal with uncertainties in different ways. In this one, they, you know, they debound that, and then they're left with the one thing they can't bound, which is the--

MEMBER BANERJEE: So by actuator activating, it means you need to break that--

MR. CUMMINS: The electronic device, when you put the electricity on it, it's like a firing cap or--you can say it better, I'm sure, but--

MR. RIEGEL: Yes. There's a small resistor, and when you put the current through it, it heats up and ignites the initial propellant.

MEMBER BANERJEE: But it's not actually breaking that thing up there. That's not--no, that little--

MR. RIEGEL: This here?

MEMBER BANERJEE: Yes. That's not

included in the actuator actuating?

MEMBER BLEY: It's not--

MR. RIEGEL: No. An actuator is, does it go off? and does it produce the amount of gas it's supposed--

MEMBER BANERJEE: As long as we understand what, precisely, it was.

MEMBER BROWN: Okay. Can I--are you all finished with that? I want to go back, still trying to figure out what tests you did on the two-inch valve, and now you're going to build a four inch impact, or travel. What's--that's not in this. So you've got a set of tests that were done on a non-prototypical valve. And how do you determine that those tests are valid, relative, and not have to repeat all of them? I can't tell from this matrix what the--

MR. RIEGEL: We did several rounds of testing. The first rounds, like I said, were done with this two inch travel. Then we did another round, and the first round was, I believe, six tests, and then the second round was the additional 11 tests, and they were done--they were done with the 14--or the four inch travel.

MEMBER BROWN: Are they the same tests

that were the first six?

MR. RIEGEL: No. The first six were mainly a proof of concept.

MEMBER BROWN: What does that mean?

MR. RIEGEL: Ensure that the way we are designing it, and the loads we have, will actuate the valve.

MEMBER BROWN: But they're going to be-- aren't they going to be different, if you've got a four inch travel as opposed to a two inch?

MR. RIEGEL: Yes, they are, and that's why we did another round of testing, to ensure that all the changes that we made because of the first round of testing still actuated the valve and the valve functioned properly.

MEMBER BROWN: Did you do it with the same 80 percent, 120--

MR. RIEGEL: Yes.

CHAIRMAN RAY: The pressures, all the other "schefaffe" that goes along with this.

MR. RIEGEL: Yes.

MR. CUMMINS: So this is Ed Cummins. These tests were not tests that we would call qualification tests. They are tests that let us figure out how to do the design of the valve.

MEMBER BROWN: Okay.

MR. CUMMINS: So they're development tests, and we can adjust--based on the results of the tests, we keep adjusting the design of the valves until we get it to where we want. Then once we have the design, then we do a qualification test.

CHAIRMAN RAY: What's the status of that, Ed?

MR. CUMMINS: We haven't started qualification test.

CHAIRMAN RAY: Okay.

MEMBER BROWN: Are you going to discuss the qualification tests you intend to run?

MR. RIEGEL: Yes.

MEMBER BROWN: Okay. I'll stop now.

(Laughter)

MEMBER BONACA: Once everything's approved, you put it in place, you leave it for 60 years?

MR. RIEGEL: No; no.

MEMBER BONACA: You are testing to do a replacement?

MR. RIEGEL: We'll cover that also.

MEMBER BROWN: Are you going to address

the aging of gunpowder?

MR. RIEGEL: Yes.

MEMBER BONACA: That's what I was thinking.

CHAIRMAN RAY: So now with that, we'll get back to the--

(Laughter)

CHAIRMAN RAY: See what happens. That was very useful.

MR. LINDGREN: I was--it was my fault. I said we would breeze through this. I know better than that.

CHAIRMAN RAY: Well, I'm glad you had the stick with you, cause I think that helped a lot.

MR. LINDGREN: Okay. We've beat that one to death. Okay. We do lot acceptance testing of the production lots of the critical one-time valve internal parts. These are the shear caps and the tension bolts. For the current production orders, there were a total of 22 full-scale tests for the various sizes and configurations of valves, and these were all done with actuator loading at 80 percent of nominal.

The actuators also have a sample size of 10 percent, that are tested as part of lot acceptance testing.

CHAIRMAN RAY: Now you're going to get to qualification testing or--

MR. LINDGREN: Yeah. We'll get here.

CHAIRMAN RAY: All right.

MEMBER BROWN: But when you talk about lot, I mean, how many--there's not a whole lot of valves in here, so a lot--

MR. RIEGEL: A lot of material--so we buy a lot of material and it all goes through a machining process in one timeframe. So that batch of shear cap, or that batch of tension bolts, is what is tested.

MEMBER BROWN: I mean, when you say you buy a lot of them, does that mean a thousand, or a hundred? Or ten, in which you test one?

MR. RIEGEL: It depends. Right now, we have ten plant works, and there's 12 valves in each plant, so--

MEMBER BROWN: But you test ten or twelve, or something. That's 120 times 10 percent would be--

MR. RIEGEL: Of the cartridges. The other materials, the sheer caps and tension bolts, we'll test one out of each lot.

MEMBER ARMIJO: Could you put it kind of in perspective. What's the size of this cartridge? Equivalent to a .30 caliber cartridge? A .50 caliber cartridge? A stick of dynamite? What's the size?

MR. RIEGEL: The analogy I received from our propellant experts was it's--I believe he said a 100 grams is equivalent to 30 shotgun shells.

MEMBER ARMIJO: Thirty...?

MR. RIEGEL: Shotgun shells.

MEMBER ARMIJO: So these are 100 grams of your propellant?

MR. RIEGEL: It varies.

MEMBER SIEBER: Your loadings have been from 80 grams to 590 grams in your test cases.

MEMBER ARMIJO: 590. That's a lot.

MR. LINDGREN: Yes.

MEMBER SIEBER: So that's more than twelve gauge.

MEMBER ARMIJO: More than any twelve gauge I've ever shot. It's a mortar.

MR. LINDGREN: Okay. We already include in our IST table, in the DCD, that these valves will get a charge test fire of 20 percent every two years. A full 20 percent of them out every two years, and the squib valve is removed and it's test-fired outside of the valve. Squib valves are not exercised for in-service testing. This is consistent with--there are actually ASME OM requirements on--for these types of valves.

There is also a charge lifetime; right?

MEMBER BANERJEE: Sorry. I missed the frequency.

MR. LINDGREN: Shelf life.

MEMBER BANERJEE: Is every two years?

MR. LINDGREN: Every two years. You have to charge--you have to test-fire 20 percent of the actuators. There is also a shelf life for these actuators, and w hen you read the end of the shelf life, you have to remove them, and now you're dealing with a new batch.

MEMBER BANERJEE: And hat is that shelf life?

MR. RIEGEL: There is an in-service life of eight years. With the amount of charges in the plant, they'll all be replaced before then.

MEMBER BANERJEE: And 20 percent are tested every two years.

MEMBER SIEBER: How many valves are there? Six?

MR. RIEGEL: Twelve.

MEMBER SIEBER: Twelve. Okay. Great.

MR. LINDGREN: Westinghouse will provide additional in-service inspection and testing recommendations to utilities, as appropriate, as we continue and complete our design and development activities. They are also subject to equipment qualification testing for the guidance--

MEMBER BANERJEE: Let me just ask you a question. Is there any potential corrosion path for these--you know, the whole thing is hanging on this relatively small thickness of material. Can--

MR. LINDGREN: The shear cap.

MEMBER BANERJEE: Yeah. Can that corrode, or--

MR. RIEGEL: Everything's made out of corrosion-resistant materials as well as the tension bolt part, that you're talking about, is also chrome-plated, part Armoloy.

MEMBER ARMIJO: But the tension bolt isn't exposed to the coolant?

MR. RIEGEL: No.

MEMBER ARMIJO: But the shear cap, it's not welded, right? It's machined out of a--

MEMBER BANERJEE: Single cap.

MEMBER ARMIJO: --tube that--so it's not-

-doesn't have any--the worst thing could happen, it corrodes, it was a little weaker, and--

MEMBER SHACK: It's not going to corrode. He's going to stress corrosion, correct, I mean, you know--

MEMBER ARMIJO: But not if it's machined out, you know, a weld--

MEMBER SHACK: Well, they're picking a resistant material, obviously, but I mean the mode of failure you would worry about would be stress corrosion. You know, this is stainless steel, it's not going to corrode in a general sense but--

MR. RIEGEL: It's actually in 690.

MEMBER SHACK: Oh, 690.

DR. WALLIS: Another mode of failure would be thermal fatigue. Thermal fatigue. If you have some way in which a dead end had some circulation of hot and cold fluid, it's got a thermal fatigue problem with it.

MR. RIEGEL: That's been--

DR. WALLIS: Which has happened in other places in reactor circuits.

MR. RIEGEL: Those analyses have been done.

DR. WALLIS: You've done that analysis?

MEMBER BANERJEE: So this is how far up from the hotleg? The vertical structure moves in and out. Is there possible thermal fluctuations that it would be exposed to?

MR. RIEGEL: There is a cold track in front of this. It's not extremely big. So there are some fluid--there is some circulation there. But we've done those analyses and we know what temperatures will be seen, and we've designed for those.

MEMBER BANERJEE: This was done as part of the original certification, I imagine. Can you--

MR. CUMMINS: The thermal analysis was done; yes.

MEMBER BANERJEE: Yeah.

MR. CUMMINS: The development of the valve is--wasn't--we are just developing the valves now. I mean, we had functional requirements for the valves at the time of the certification. So now it's time to deliver.

MEMBER BLEY: If I understood it right, though, you pull out the charge and test those. But the body of the valve, and the little hinge, and all that stuff, that keeps things from going downstream, is there for the life of the plant. Forty, sixty years, it's going to sit there with nobody every looking at it. That's right? Did I understand that right?

MR. LINDGREN: I believe we have not got that into our schedule. As I said, we're still evaluating that. That's--

MEMBER BLEY: Okay.

MEMBER BANERJEE: There's no inspection procedure to the valve itself, only testing of the charge. Is that--

MR. LINDGREN: We've not committed to any inspection. These valves are actually removed to do a system test every ten years.

MEMBER BANERJEE: Oh, they are?

MR. LINDGREN: Yes. That's why they're flanged. And that they could be inspected at that point.

MEMBER BLEY: I mean we have had, you know, hanging, you know, swinging check valves that disconnect and end up blocking the pipe somewhere in the--

MR. LINDGREN: Yeah, but those in the fluid, and these, of course, aren't in the fluid. And that is in fact why we have the hinge, is so that the shear cap doesn't become a missile, or get caught some way.

MEMBER BLEY: Understand that.

MEMBER SIEBER: Well, the hang-up in the Velan valve is just getting caught inside the case. From the drawing that was here, it looks like the downstream portion is the same diameter, or larger than the plug itself. And there's no opportunity for it to hang up on the thing.

CHAIRMAN RAY: Let's try and get through the balance of what you wanted to say.

MR. LINDGREN: Okay. Anyway, there is environmental qualification testing for the--

MEMBER BROWN: I'm sorry, Harold. You say you test 20 percent of the charges every two years?

MR. LINDGREN: Yes.

MEMBER BROWN: Okay. So if you do that, theoretically, if you test old stuff, if you take old ones out every time, you would replace them every ten years. You've made a comment that the service life of the charge was only eight years.

MR. RIEGEL: I believe our averages are every 18 months, so, in fact, we'll be taking them out sooner. And the 20 percent is for each type. So the math works out that every eight years--before eight years, they will be--

MEMBER BROWN: So every--that's what I was just trying to get to. Every eight years, you would end up with a total replacement. But the first ones you replaced would be ready to be taken out and tested, the next 18 month cycle, whatever it is.

MR. RIEGEL: Correct.

MEMBER BROWN: Okay. All right. The comment didn't add up until you changed it.

MR. RIEGEL: Okay.

MR. LINDGREN: Okay. I'll try again. The actuators are subject to environmental, seismic and design basis accident simulations and EQ test, and the non-metallic components and valve functional testing and flow testing is also part of the equipment qualification testing.

The NRC Component Integrity Branch has been very much involved in this process. They've audited our equipment qualification methods. They've audited our squib valve design specifications. They've attended, which really means "participated in," our design reviews.

They've witnessed some of the valve testing that we've done. Our manufacturer is in Erie, Erie, Pennsylvania, so it's relatively easy to get to there. So we have had a great deal of participation by the staff on this item.

MEMBER BROWN: From a seismic standpoint, after you've gone through the seismic tests, do you then perform a full-bore test, to make sure it still actuates, by firing the charge, and just make sure it doesn't break? I mean, you know, about physically break.

MR. LINDGREN: Mr. Wessel.

MR. WESSEL: Hello. I'm Ron Wessel. I met you yesterday. I'm the EQ lead for the squib valve. After each sequence in the IEEE testing of the actuator, a set of the actuators will be fired, to see if there's been any change from the baseline tests, when we started the program, all the way through to design basis accident. During the seismic, we don't want it to go off. So that's our goal, of showing that the valve--the actuator won't go off during a seismic. But after the seismic simulation, we will take a cartridge and fire it, to make sure that it's still viable to--

MEMBER BROWN: Why wouldn't you take a valve and test it, to make sure it still actuates and it hasn't been bent, deformed, or what have you? I mean--

MR. WESSEL: Well you don't fire the valve until the design basis accident. So you don't--you know--

MEMBER BROWN: Well, you want to make sure it does. I mean, that's--

MR. WESSEL: Oh, yes, that's right. But you also have all the ASME code that--design reports that have already analyzed, including the seismic loading in the valve. So you don't necessarily have to show that. Now we will be doing QME1 testing at the end, where we will actually be firing the valves, the full valves, with cartridges, and doing full flow testing with them.

MEMBER BROWN: It had been seismically tested, or the production--my point being is you've got--you don't necessarily shut down a plant after a seismic event, if everything's okay.

MR. WESSEL: That's correct.

MEMBER BROWN: Am I correct?

MR. WESSEL: That's correct.

MEMBER BROWN: So you'd like to know that the valves for subsequent operation didn't have some other deformation, or mechanical deformation, or mechanical, internal, that you couldn't see, such that the charge goes off--

MR. WESSEL: But you don't do that with a motor-operated valve. You don't test the whole seismic--

MEMBER BROWN: I'm not talking--I'm not working on motor-operated valves right now.

MR. WESSEL: I understand that, sir.

MEMBER BROWN: I'm only working on squib valves.

CHAIRMAN RAY: Wait a minute. I think he's clearly said--

MEMBER BROWN: Question.

CHAIRMAN RAY: And we've gotten the answer.

MEMBER BROWN: They don't test it.

CHAIRMAN RAY: That's right.

MR. WESSEL: We do not test the size of the valve--

MEMBER BROWN: I've got that. It doesn't make sense to me. That's all--

MR. WESSEL: The actuator, we do test.

MEMBER ARMIJO: In your test matrix, all of the tests are done at ambient temperature and ambient pressure in his matrix. So how do you account for the actual correct--or the actual temperature and pressure that this valve would have to operate at.

MR. RIEGEL: The temperatures were taken into account, and as I said, we varied the thickness of the shear cap. So the temperature affects on the materials were added to the thickness, to account for any temperature--

MEMBER ARMIJO: But you don't do a complete integral test, at prototypic conditions, anywhere along in this development program?

MR. RIEGEL: Not in the development program. In the equipment qualification test that Ron just spoke of, when we--

MEMBER ARMIJO: Will do that then?

MR. RIEGEL: --do the valve test, it'll be at temperature and pressure.

MEMBER ARMIJO: Okay.

MR. WESSEL: And that will be a production valve, not a prototype valve.

MEMBER SIEBER: Now the igniter itself is like a blasting cap?

MR. RIEGEL: Essentially, it's like an electronic blasting cap.

MEMBER SIEBER: What voltage does it take? Is it 100 volts, or something like that?

MR. RIEGEL: Which one do you--we can

talk about that?

MR. LINDGREN: Yeah; you can talk about it.

MR. RIEGEL: It's a very low current, is what we require. Three point something, I think. I don't know the voltage offhand.

CHAIRMAN RAY: You're done?

MR. LINDGREN: I'm done.

CHAIRMAN RAY: I see.

MR. LINDGREN: You're done?

CHAIRMAN RAY: Well, I don't know. Let's see. Sanjoy, the question that we had was to understand the program, both for verification and qualification and for in-service testing. Did we satisfy--

MEMBER BANERJEE: You have answered my questions.

CHAIRMAN RAY: Okay. Thank you. And the other question we had was, Charlie, the details of the test, how the test is conducted, and basically what--the information that's associated with in-service testing. Have we gotten the information we were looking for there?

MEMBER BROWN: They provided an answer; yes.

CHAIRMAN RAY: Okay. Thank you. All right. So we'll close this item. If we have any open items as a result of any further concerns, we'll let you know.

(Whereupon, at 9:20 a.m., the open session was concluded.)