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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

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555TH MEETING

+ + + + +

THURSDAY,

SEPTEMBER 4, 2008

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The Advisory Committee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, Rockville, Maryland, at 8:30 a.m., William J. Shack, Ph.D., Chair, presiding.

MEMBERS PRESENT:

WILLIAM J. SHACK, Chairman

MARIO V. BONACA, Vice Chairman

SAID ABDEL-KHALIK

GEORGE E. APOSTOLAKIS

J. SAM ARMIJO

SANJOY BANERJEE

DENNIS C. BLEY

CHARLES H. BROWN, JR.

MICHAEL L. CORRADINI

MEMBERS PRESENT (Continued):

OTTO L. MAYNARD

DANA A. POWERS

HAROLD B. RAY

MICHAEL T. RYAN

JOHN D. SIEBER

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(8:28 a.m.)

1) OPENING REMARKS BY THE ACRS CHAIRMAN

1.1) OPENING STATEMENT

CHAIRMAN SHACK: The meeting will now come to order. This is the first day of the 555th meeting of the Advisory Committee on Reactor Safeguards. During today's meeting, the Committee will consider the following: the license renewal application and final SER for the Wolf Creek Station Unit 1; draft final revision 1 to Regulatory Guide 1.131, "Qualification of Safety-Related Cables and Field Splices for Nuclear Power Plants"; peer review of the TRACE computer code; anticipated advanced reactor research needs; and preparation of ACRS reports.

The meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Mr. Sam Duraiswamy is the designated federal official for the initial portion of the meeting.

We have received written comments and requests for time to make oral statements from Mr. William Horin, counsel to the Nuclear Utility Group on equipment qualification with regard to Regulatory Guide 1.131.

We have several Wolf Creek personnel on the phone bridge line listening to the discussion regarding the Wolf Creek license renewal application. Also, we have a part-time NRC employee from Wyoming on the phone bridge line, who will be listening to the discussion regarding Reg Guide 1.131.

To preclude interruption of the meeting, people on the phone bridge line are not allowed to make remarks during the meeting unless specifically requested.

A transcript of portions of the meeting is being kept. And it is requested that speakers use the microphones, identify themselves, and speak with sufficient clarity and volume so that they can be readily heard.

1.2) ITEMS OF CURRENT INTEREST

CHAIRMAN SHACK: I will now begin with some items of current interest. Dr. Edwin Hackett replaces Mr. Frank Gillespie as ACRS Executive Director.

Prior to joining the ACRS, Dr. Hackett served as Deputy Director, Division of Spent Fuel Storage and Transportation in NMSS. He joined the NRC in 1991 as a materials engineer in the Office of Research.

In 2003, Dr. Hackett became a member of the Senior Executive Service and was assigned to the Division of Licensing Project Management Nuclear Reactor Regulation as the Project Director.

Dr. Hackett earned his Bachelor's degree from Virginia Tech and his Master's and doctorate degrees from Johns Hopkins University.

Ed, welcome aboard.

(Applause.)

CHAIRMAN SHACK: We have two new ACRS staff members. Natalie Mitchell Funderberg joined the ACRS staff as a secretary on August 4th, 2008. Prior to joining the ACRS staff, she was a contract secretary for almost two years with the NRC.

Natalie holds a Bachelor's degree in health care management sciences from Howard University and a Master's degree in health care administration from the University of Maryland University College.

(Applause.)

CHAIRMAN SHACK: Banu Goldfeiz joined the ACRS staff as a program assistant in 2008. Prior to joining the ACRS staff, she worked as a secretary in NRR and RES. Before joining the NRC in 2007, Ms. Goldfeiz held graduate research assistant positions with the World Wildlife Fund and the Institute of

Marine Science and Technology in Turkey and with the Centre de Culture Scientifique, Technique et Industrielle de la Mer, Oceanopolis in France. Prior to these positions, she served as a scientific aide with Aegean University.

She holds a Bachelor's degree in fisheries science and a Master's degree in marine science from the Aegean University in Turkey.

Welcome aboard.

(Applause.)

CHAIRMAN SHACK: On a somewhat sadder note, I would like to note that Dr. Lawrence Hochreiter, professor of mechanical and nuclear engineering at the Pennsylvania State University, passed away yesterday morning.

Dr. Hochreiter, of course, has many, many years of involvement in the nuclear industry. He has appeared before the Committee on many occasions, particularly during the ACRS meetings on the AP600 design certification and more recently during the Committee's review of the proposed risk-informed revision to 10 CFR 50.46.

I would also like to note we have security, computer security, training, which is scheduled for tomorrow. We could save some time tomorrow if everybody could get on their computers and take the test today.

I've asked the ACRS staff to provide you with the log-on information and the ID information. And if you could try to do that during lunchtime today or when you have some breaks, we could save some time tomorrow. And it might make a difference to our schedule for the rest of the week if that is possible.

2) LICENSE RENEWAL APPLICATION AND FINAL SER FOR THE WOLF CREEK GENERATING STATION, UNIT 1

CHAIRMAN SHACK: Our first item of business today is the license renewal application and the final SER for the Wolf Creek generating station. Jack Sieber will be leading us through that.

MEMBER SIEBER: Thank you, Mr. Chairman.

2.1) REMARKS BY THE SUBCOMMITTEE CHAIRMAN

MEMBER SIEBER: The Wolf Creek generating station is located about three and a half miles from Burlington, Kansas, in the metropolitan area of Burlington, Kansas.

(Laughter.)

MEMBER SIEBER: It is a relatively modern four-loop Westinghouse PWR with a large dry containment. And it's lake-cooled. In our review of the SER and the application during our subcommittee meeting on March 5th, we went through in great detail a large number of items.

And in preparing today's agenda have thought it would be useful to put part of the time with the generalities of the application and Wolf Creek particulars and spend the rest of the time on the open items that existed in March. And there were five of them at the time.

The two most important of those open items had to do with cyclic fatigue of the pressure boundary of the plant. And in that respect, we are not referring to cyclic fatigue that comes from vibration and nearly an infinite number of cycles. The forces and stresses involved are not particularly significant.

On the other hand, thermally induced cyclic fatigue is a significant actor as far as degradation of the coolant pressure boundary. And that's where this work is focused.

The ASME code addresses how this should be analyzed. And that became the subject of two open items and two commitments. Now, if you look at the SER -- I think everybody got a disk with the SER on it or if you want a hard copy, you can have mine because I got both.

Appendix A in that lists the commitments that the licensee made that they must satisfy and the staff must review prior to the period of extended operation. There are 41 of those. The last two involved this cyclic fatigue issue.

And so we want to assure that the licensee has performed these commitments. It's my understanding on these last two that they have done that and that the staff reviews and approves that, which I think brings necessary closure to the process.

I don't want to take away from everybody else's discussion. So let me next introduce Brian Holian, Director of DLR, to introduce the staff and the licensee and the speakers for you today.

Brian?

MR. HOLIAN: Thank you, Dr. Sieber.

2.2) BRIEFING BY AND DISCUSSIONS WITH REPRESENTATIVES OF THE NRC STAFF AND WOLF CREEK NUCLEAR OPERATING CORPORATION

MR. HOLIAN: Good morning. My name is Brian Holian. I am the Director of the Division of License Renewal. I've been in that position just for a couple of months. I come here following nine years in Region I. So it's good to be back.

I would like to introduce some of the

staff at the table and several in the audience. To my left is David Pelton, who is the Branch Chief for the Project Management Branch I in Division of License Renewal.

Dave is also a Region I transplant. He has been in the EDO's office for about a year and has just signed onto license renewal as a branch chief. He replaces Louise Lund, who has moved on to the SES candidate government program.

He is responsible for the branch and the Project Manager, Tam Tran, who is to his left and has led the review effort for Wolf Creek. To Tam's left is Greg Pick from Region IV. He is team leader for the regional inspection effort out of the Division of Reactor Safety.

Sitting in the audience there are several reviewers to the safety evaluation report and several branch chiefs. I would like to highlight just a few.

While I was transitioning from Region I and from the time that PT Corps retired, Dr. Sam Lee, Deputy in Division of License Renewal, has headed the division for all the summer. And I thank him for that.

Other branch chiefs here from the division are Mr. Jerry Dozier. Jerry has been in our Programs

Branch in License Renewal. And he transitioned over to Dr. Chang's branch in the Engineering Audit Branch upon Kien Chang's retirement just a month ago.

We also have Bo Pham here. Bo is a new Branch Chief in the Division of License Renewal within the last month. He has been a long-time staffer in license renewal in both the projects and the environmental staff. And he takes over the Environmental Branch Chief position. So congratulations to Bo.

We also have Dr. Raj Auluck. Raj is, as you know, another of our branch chiefs for the audit areas responsible for structural, electrical, and scoping areas.

Also in from Region IV, also a new branch chief, there he is. Neil O'Keefe is in. He's been a long-time staffer in the Division of Reactor Safety there and has recently taken over the branch chief position for Division of Reactor Safety with responsibility for license renewal inspections.

George Wilson is also here, Branch Chief from Electrical Engineering Branch. And we welcome him.

As Jack mentioned, we forwarded the final SER to the Committee on July 29th. And it had several open items, basically in two areas. The first was station blackout recovery. And both of those issues dealt with both the boundary for station blackout and an issue with underground medium voltage cables.

The other open items, as Jack mentioned, were metal fatigue relating to methodology input and assumptions. During the staff review, we will provide the Committee with details of these open items and how they were closed.

In today's presentation, the applicant will lead off. And it will be followed by the staff's presentation. And, with that, I turn over the discussion to the Vice President of Engineering for Wolf Creek, Mr. Terry Garrett.

MR. GARRETT: Thank you, Brian.

Good morning, Mr. Chairman, Mr. Sieber, and members of the ACRS. Thank you for this opportunity of Wolf Creek Nuclear Operating Corporation. We express our appreciation for being here.

I would like to introduce the members of our staff who are with me today. On my left we have Eric Walker, who is a STARS project manager for license renewal. On my right is Maurice Dingler, a senior engineer. To his right is Diane Hooper, our supervisor of licensing. And to the far left here is Patrick Guevel, superintendent, modifications. Patrick is responsible for almost all of the major modifications at our station, including license renewal.

Also in the audience we have Lou Solorio, a senior electrical design engineer. We have David Dees, our superintendent of operations. Next to him we have Tim Card, a supervisor in system engineering; also Dr. Art Turner, our technical lead; Bill Ketchum, our supervisor of the PRA group; Paul Crawley, who is the Manager of the STARS plant aging management project team; Tod Moser, who is our STARS Regulatory Affairs Manager.

Also we have several members on the phone from Wolf Creek. And one key person who couldn't be here today because she is expecting a child and could not travel is our project manager for license renewal, Lori Bell. So she's on the phone. If we have to defer to her, we will do that.

Next slide. For the agenda today, then, we'll cover briefly a site description, operating history, real brief on some of the major plant improvements, talk a little bit about plant performance, spend a little bit of time on the way we went about preparing our license renewal and license renewal project team. And then, finally, we'll get into the open items, as Brian mentioned, with a draft SER and how we close those issues out.

Wolf Creek Nuclear Operating Corporation, and often referred to as Wolf Creek, is a jointly owned corporation by the owners of the Wolf Creek generating station. Those owners are Westar Energy, Kansas City Power and Light Company, and Kansas Electric Power Cooperative.

As Jack mentioned, the Wolf Creek station is approximately three and a half miles northeast of the Town of Burlington, Kansas. It is approximately 2,500 people population-wise in the metropolitan area.

It is also about 75 miles southwest of Kansas City, Kansas. The nuclear feed supply system for Wolf Creek generating station is a pressurized water reactor design that is supplied by Westinghouse Electric Corporation.

The license reactor core power is 35/65 megawatts thermal. The turbine generator output is approximately 1,228 megawatts electric. Architect engineer was Bechtel Power Corporation.

The Wolf Creek generating station site, as Jack mentioned also, utilizes a large cooling lake called Coffey County Lake for source of circling water and is also our ultimate heat sink.

The Coffey County Lake is a 5,000-acre atonement. The ultimate heat sink actually is a lake within the lake. There is an earthen dam at the bottom of the lake and has another lake. That's our ultimate heat sink.

The entire operating staff and corporate staff are located on site. We have a staff complement of approximately 940 people. We are also active members of the Utility Service Alliance and the Strategic Teaming and Resource Sharing Alliance, or sometimes called STARS.

These alliances were formed on behalf of thermal single unit operators for the purposes of resource and cost-sharing, technical administering, and then collaboration amongst its members for projects like the STARS license renewal program.

The Wolf Creek license renewal application occurred in conjunction with the STARS project aging management team, which utilized a combined utility and contractor staff, the contractor being Worley Parsons.

Next slide. A little bit on operating history, then. We received the construction permit May 17th, 1977. Our operating license was issued on

March 11th of 1985. We began commercial operations September 3, 1985.

In 1993, we increased the power four and a half percent, from 34.11 megawatt thermal to 35.65 megawatts thermal. This essentially was taking us from the design to essential safety features limit.

We also did modify the unit at that time to upgrade our transformers and modify our turbine first stage nozzle blocks to achieve the full power we wanted to realize.

Finally, September 27th, 2006, we submitted our application for license renewal. And our operating license expires March 11th, 2025.

These have been some of the major plant improvements. We performed a spent fuel pool re-rack in 2000. That will allow us for spent fuel capacity through the end of the current license period.

In 2006, we performed a full structural overlay of all our pressurizer nozzles. Two thousand eight, which is our last outage, we performed a thick modification of the main steam and feedwater isolation valves actuators. The control will be the second phase. We're changing the controls out.

The valves and actuators were changed out due to equipment reliability reasons. And the controls will be changed out to take care of a large number of obsolescence issues and some major single point vulnerabilities with that system.

CHAIRMAN SHACK: What type of strainer did you install when you did your upgrade, sump strainer?

MR. GARRETT: Well, the sump strainer, we did not change it. It was just changed in 2006.

MR. DINGLER: But, to answer your question, we used PCI for the sump strainer, for the container sump strainer.

MR. GARRETT: But it was not due to the rerate.

In 2011, we will be changing our turbine rotors, all three low-pressure and high-pressure rotors, changing out primarily due to equipment reliability. But we also experienced, realized approximately a 38-megawatt electric increase in power at that time.

We operate on approximately 18-month fuel cycles. We have started our current cycle at the end of our refuel 16 on May 14th, 2008. Currently our station is operating at 100 percent power. And we have operated near continuous 100 percent power since the start-up of this cycle. Our next refueling outage is scheduled for the Fall of 2009.

Now I would like to move into the discussion on the license renewal project and the way we went about preparing this application. Wolf Creek, as I mentioned, used the STARS Alliance plant aging management project team for development of our license renewal application.

There are other STARS member stations that are also utilizing it. And the STARS contractor, Worley Parsons, also will be providing a consistent way of preparing applications as the other stations decide and proceed with that.

The STARS plant aging management project team was established in March of 2004. Plant aging management project team utilized a combined utility and contractor staff at Wolf Creek.

There were six personnel assigned to watch the project dedicated: Project Manager Lori Bell, one electrical lead, one civil structural lead, two mechanical leads, and one document services lead. These six then served as interface between the Wolf Creek and the STARS project team.

There were approximately 25 utility and contractor personnel located at the STARS project team office also. Personnel members have actually gradually increased at the STARS project office.

Other STARS utilities began their license renewal studies in process.

Prime responsibility for our Wolf Creek project team, then, was to facilitate good communication between the plant aging management project team and the Wolf Creek subject matter experts.

And we did involve the Wolf Creek program owners from the onset in order to ensure and develop license renewal deliverables that had been reviewed, owned, and will be managed by our Wolf Creek personnel.

In terms of application of the GALL, there are 39 aging management programs established. This includes the three time-limiting aging analysis, aging management programs, metal fatigue, equipment qualification, and the containment tendon pre-stress. Of the 39 programs, 13 have enhancements, 15 have exceptions. And we are developing six new programs, including a severance program, the reactor coolant system supplement for reactor vessel internals.

As far as GALL consistency, we had a 95.6 percent consistent with GALL using GALL standard notes alpha through echo. We had one plant-specific program, the nickel alloy aging management program.

And also the RCS supplement for reactor internals is listed as a plant-specific program in our safety evaluation report.

The next area we would like to discuss, then, is the resolution of the draft SER open item. Before I go on, do you have any questions?

(No response.)

MR. GARRETT: Our draft SER was issued in February 2008, had five open items for the Wolf Creek submittal and no confirmatory items. A lot of this discussion did occur at the subcommittee meeting on those open items.

The final SER was issued in July 2008 with no open items now. The discussion today, then, can be focused now. We closed each one of those items out and resolved the issue between Wolf Creek and NRC staff.

So the first two items I will talk about will be tied to the station blackout equipment for license renewal and how we scope that. And the other three items will be the metal fatigue-related issues.

The first open item, then, on station blackout is on the recovery plat and the actual scoping boundary for license renewal. The NRC has proposed license renewal interim staff guidance regarding the station blackout rules associated for license renewal applications was issued on March 5th, 2008. And it stated that the station blackout recovery path should be included in the license renewal and the scoping boundaries should be a circuit breaker at transmission system voltage.

Wolf Creek has scoped into our license renewal switchyard into the license renewal. Our switchyard breakers at transmission system voltage for each recovery path: one on the east bus and one on the west bus. The changes to the licensure scope have also been submitted as an amendment to our license renewal application, and this closes that open item.

Okay. The next one. The second open item was also tied to station blackout scoping boundary, more specifically to an underground cable in the Wolf Creek switchyard. The open item, then, was that the underground cable should include within its scope license renewal and then managed by the inaccessible meeting voltage cable aging management program.

For the resolution of that open item, Wolf Creek has included a switchyard and accessible meeting voltage cable where station blackout restoration of off-site power and the scope of license renewal.

The aging management program related to

inaccessible meeting voltage cable is not subject to Part 50.49, applies to this cable. And the changes to the license renewal scope have been submitted as an amendment to the license renewal application. And this closes that open item.

The next one.

MEMBER BROWN: Are we finished with the SBO thing? I wanted to ask a question on that if you don't mind.

MEMBER SIEBER: No. Go ahead.

MEMBER BROWN: When I was reading your scoping and screening documents in your license application, you talk about the station blackout. And, by the way, my name is Charlie Brown. I'm new. So that's why I'm asking these questions, because I wasn't here in March. Okay?

You referred to a four-hour coping duration, did you all determine, for your SBO recovery requirements and made the statement that it was based on frequency and expected frequency off loss of off-site power and the probable time needed for its restoration.

But, yet, after going through all of the documents, the entire application plus some of the other supporting docs, I couldn't find how you arrived at the expected frequency of off-site and the probable recovery times.

Now, that might have been discussed in the previous meeting, but that was what I was interested in. Did you use actual data, loss of off-site power data, and the time that it took to recover? I would have expected a little stronger language if it had been an analysis, as opposed just an engineering judgment. So that's my question, how you arrived at that.

MEMBER SIEBER: The staff did issue some station blackout requirements a number of years ago where this was defined. So you won't find it in the application. Licensee certainly knows what the basis of their coping time is, though.

MR. GARRETT: That's correct. That was actually part of the existing current licensing basis. I actually was involved in some of that. I can't remember all of the details of that.

But that basically was never challenged. It is part of the current licensing basis. It's still consistent with the original analysis that was done.

MEMBER BROWN: So it's no change from your past 20 years of operations?

MR. GARRETT: That's correct.

MEMBER BROWN: Okay.

MR. GARRETT: We could find that information out and give it to you.

MEMBER BROWN: No. That's all right. That's fine. I am not asking for something new or different, just that that would have been a nice --

VICE CHAIRMAN BONACA: Why isn't it different?

MEMBER BROWN: Pardon?

VICE CHAIRMAN BONACA: Why isn't it different?

MEMBER BROWN: Well, that is a good question, but I haven't been around here long enough to really know whether I could understand the answer to it.

MEMBER SIEBER: The thing is that --

MEMBER BROWN: It seems kind of short. That's --

MEMBER SIEBER: If my memory is correct, a four-hour coping time is relatively conservative compared to other plants that had eight-hour coping times. And a lot of it depends on how much battery capacity you have.

MEMBER BROWN: Well, eight hours is longer than dealing with that. So it's less conservative. I thought I understood you to say four hours is more conservative than eight.

MEMBER SIEBER: Four is because you have to -- the judgment that it is four hours is more conservative than a judgment that it is eight hours. On the other hand, the plant might be more conservative. It has coping equipment that will hold it for eight hours.

MEMBER BROWN: I guess I am missing something there.

MEMBER SIEBER: That's a good question.

MEMBER BROWN: If you have to do without power for eight hours, that would seem to be more difficult to deal with than if you only have to deal without power for four hours.

MEMBER SIEBER: Right.

MEMBER BROWN: Is that intuition right or wrong? And so I would have thought four was a little shorter than -- you say other plants are eight.

MEMBER SIEBER: Some are.

MEMBER BROWN: There's got to be some basis for saying -- I'm not going to go challenge the previous basis if that has been previously agreed to. But I just wanted to make sure I understood the metric there relative to that. So I would have viewed it as in my own mind you've got a break because you don't have to last as long.

MR. GARRETT: Basically you have to demonstrate that you could cope for four hours and --

MEMBER BROWN: Right. Other plants have to do it for eight.

MR. GARRETT: Yes.

MEMBER BROWN: So you get some bennies then somehow.

MR. GARRETT: But you have to demonstrate you can cope for four hours.

MEMBER BROWN: Yes.

MR. GARRETT: Once you do that, that establishes your criteria going forward.

MEMBER BROWN: All right. I'll quit on that one.

MEMBER POWERS: My perception is that -- this is a rough measure -- outage times now, good outage times, are going up. Frequencies aren't changing very much, but the time to recover from an outage is going up. That's my perception. I don't know whether that's factual or not, but that's my perception.

MEMBER MAYNARD: You have to look at that on a case-by-case basis because it really does depend on how many lines do you have coming in and the priorities and lots of things I think on a case-by-case basis.

In a lot of these areas, there have been a lot of improvements made to the reliability and even additional electrical sources that are --

MEMBER POWERS: It appears to me that we have not done that here.

MEMBER MAYNARD: We haven't done what where?

MEMBER POWERS: We said a 20-year-old analysis said 4 hours. So it's four hours. Well, it's not clear to me that a 20-year-old analysis is applicable today.

MEMBER MAYNARD: I agree with you you have to do it on a case-by-case basis. I don't know how else you would do it. But you've got to do it.

MEMBER BROWN: Does the staff have any amplification of that or did you all look at it in any other detail or rejustify the four hours from --

MR. MATTHEW: This is Roy Matthew from Electrical Branch.

On the license renewal, the only thing they need to do is scope whatever the original commitment is under 50.63. 50.63 when they submitted the amendment, we reviewed it. We looked at the coping analysis and duration for the coping. And we approved that. There is no need to go back and revisit that.

The station blackout rule complies with that. The only thing they have to do, part of the license renewal is the scope, whatever are recorded as part of the station blackout. So questioning the adequacy of the coping analysis is not within the scope of the license renewal.

MEMBER BROWN: Even though there was a power uprate involved if the plant is not operating at higher power, which requires higher load to maintain it?

MR. MATTHEW: Yes. Those are all reviewed under -- if it is a power uprate, we would look at the electrical system due to power uprate.

MEMBER BROWN: Okay.

MR. HOLIAN: And this is Brian Holian again.

The staff might want to comment, though. I believe it was Electrical Branch. I don't know if Research was involved, but following the East Coast blackout from a few years ago, I know there was a paper done by the staff to go back and look at station blackout assumptions and whether they are still conservative, which I think is the gist of this question. You know, was there any need to change that?

And I believe other than looking at some of the frequencies that are more up to date now, that there was no movement to change anything or cause another change for the assumptions for a station blackout rule. Is that correct?

MR. MATTHEW: Actually, everybody is aware of the blackout that we had in 2003. Is that correct? Part of that, we viewed the off-site power frequency and loss of off-site power. The frequency has decreased, although the duration has increased.

So these are all documented in NUREG. The staff is still looking at the adequacy of the existing regulation. So we are still reviewing it.

MEMBER BROWN: Just as a newbie, is that the prevailing way, even though their situations may have changed from those periods of time, making the statement durations have increased over the period of time? Yet, they're not required to do it based on the renewal, I guess, plan, whatever steps scoping is supposed to do?

Therefore, you can't go and ask for

information relative to things that may be a problem, even though they're not covered or they've been superseded by other circumstances. That's an information question. I'm not challenging --

MEMBER MAYNARD: Under the legal process, you have a licensing basis. And if you --

MEMBER BROWN: I understand that.

MEMBER MAYNARD: There is a process available to the Commission and they have exercised that --

MEMBER BROWN: Yes. I am not disagreeing with that. I am not disagreeing with that.

MEMBER MAYNARD: -- to go and --

MEMBER BROWN: I am not disagreeing with that.

MEMBER MAYNARD: -- get information if it's deemed --

MEMBER SIEBER: You can't arbitrarily hang --

MEMBER BROWN: I didn't say "arbitrarily."

MEMBER SIEBER: -- preexisting conditions --

MEMBER BROWN: I understand that. I didn't say "arbitrarily." I said --

MEMBER SIEBER: -- onto a new application.

CHAIRMAN SHACK: I think the answer to your question specifically, license renewal covers a certain number of things, you know. In particular, the life expectancy of passive components that are not normally tested in some --

MEMBER BROWN: I got that out of the renewal application.

CHAIRMAN SHACK: You don't address the whole licensing basis in the license renewal application. You address that part of it. You know, the questions about the station blackout would be raised in another area. It's sort of a different analysis but not as part of the license renewal.

MR. GARRETT: If I could add, Charlie, Diane just pointed out that under 10 CFR 50.59, 10 CFR 50.71-8, that any environmental or physical change we would make to the plant, we would have to look at those effects and include an evaluation of that.

So if we make a physical change or an environmental change to our station, then we would have to factor those into that and evaluate at that time.

MEMBER BROWN: I got it. I understand that.

MEMBER SIEBER: Just to perhaps close out the subject, the rules for license renewal are Title X, Code of Federal Regulations, Part 54.25. That tells you what is in there, what the scope is, and what things you have to do. And the current licensing basis, however, remains the same unless the licensee by application changes it.

MEMBER BROWN: That's fine.

MEMBER SIEBER: Okay.

VICE CHAIRMAN BONACA: Or the staff raises an issue.

MEMBER SIEBER: Right, yes.

VICE CHAIRMAN BONACA: And then it --

MEMBER SIEBER: But it's not part of this.

VICE CHAIRMAN BONACA: Not part of this.

MEMBER SIEBER: It's not part of that.

MEMBER BROWN: I will have a couple of questions later after they have finished the rest of this, which you can shoot at me also.

MR. GARRETT: So now to move into the metal fatigue open item discussions, let's talk about an overview of the Wolf Creek generating station metal fatigue pressure boundary aging managing program.

And at this point I would like to turn it over to our senior engineer, Mo Dingler, who is also our fatigue program owner.

And he will lead us through this metal fatigue discussion. So Mo?

MR. DINGLER: Thank you, Terry.

As Terry says, I want to give you an overview. Our metal fatigue AMP program is in accordance with 10 CFR 50.21(c)(1)(iii). Metal fatigue AMP will track events to assure: one, that the operating cycles of the events remain within the cycles of analyzed design allowable events; or, two, that appropriate reevaluation or other corrective action is taken if an analyzed number of events is exceeded.

As part of the existing metal fatigue AMP, Wolf Creek is committed to two items. One is include consideration of environmental effects per NUREG CR-6260 locations and update our baseline accumulative usage factor CUF calculations for surge line hot leg nozzles and the charging nozzles.

These open items in the area of metal fatigue and each one of these open items have been resolved. Now I would like to go through more detail with these open items.

The first open item, 4.3-1, is related to the stress analysis methodology used in our fatigue monitoring program at two locations: charging nozzle and the hot leg surge nozzle.

For the resolution of these open items, we performed ASME NB-3200 analysis for both locations: the surge line hot leg nozzle and the charging nozzle locations. These analyses provide an input in setting a corrective action level for the CUF to assure that sufficient margin exists to allow the highest fatigue usage per cycle to occur without exceeding a CUF equal to one.

The charging nozzle, a 3D dimensional model was developing using or including the following locations. Local portion of the cold leg piping, cold leg to charging nozzle well, charging nozzle, charging nozzle to piping well, portions of the attached piping. And at this time we did the analysis based on thermal sleeve.

The finite element model was developed using ANSYS finite element analysis software. As I said before, a design assumption, analysis assumption was that the charging nuzzle had a thermal sleeve configuration. During our May 1st, 2008 meeting with the NRC staff, the question was raised if a thermal sleeve was present in our charging nozzle design.

Wolf Creek made a commitment as part of the metal fatigue of the reactor coolant pressure boundary program to confirm the presence or absence of a thermal sleeve and update the fatigue calculation and supporting confirmation analysis appropriate. That was license renewal commitment number 40, as Jack said.

Substantially we have determined that Wolf Creek design does not have a thermal sleeve. We have completed -- and are going through final verification now -- the confirmation modern-day analysis without the thermal sleeves. That's in the final review cycle as we speak today.

MEMBER ARMIJO: How did you conclude that you did not have a thermal sleeve? Did you X-ray them or do something?

MR. DINGLER: We were thinking about we had to X-ray. We found the actual fabrication, the ASME NPP reports, and actually pulled those up. And they indicated there were no thermal sleeves on those.

MEMBER ARMIJO: So you had to do an additional analysis assuming a more aggressive --

MR. DINGLER: More aggressive base with no thermal sleeve, yes.

MEMBER MAYNARD: Could you explain why there was some confusion as to whether there was or was not a thermal sleeve there?

MR. DINGLER: Yes. In the early '90s, when we made the decision to go to the fatigue monitoring program, we researched. And we were working with a vendor that had three plants going on: Calloway, Vogtle, and us.

And at that time during our construction, there was a short period of time we found out during our investigation in a root cause of the issue that our NSSS vendor had thermal sleeves. In a couple of years, they decided no thermal sleeves was better. Then they decided to go back to thermal sleeves.

And we fell into the gap of no thermal sleeves. And some of the documentation was vague at that point. And during 1990, when we developed our fatigue monitoring program, whoever was in charge there, based on the documentation we had made an assumption that we had the thermal sleeve.

MEMBER SIEBER: You have reconstructed the thermal cycle, various elements of the plant. You did hot functionals up until the day that you adopted the thermal fatigue monitoring.

MR. DINGLER: Right. That's the next open item closure is we made a commitment to baseline everything that we've had. And we're in the process of doing that.

MEMBER SIEBER: It seems to me that what you initially did was there was an analysis that was done as a matter of record for the initial construction and licensing of the plant. And you looked at that and said, "This is very conservative. It assumes a lot of cycles."

So this ought to be good for 60 years and not 40 years. You ought to be able to use this analysis to go beyond that. And maybe that's a correct assumption or maybe it's not, but the fact that it's an assumption, rather than a fact, actually requires you to go back and look at these items and to do the calculation based on history, as opposed to based on you can't do any more cycles than this.

MR. DINGLER: As I said, our AMP, one, is to track the cycles to make sure we are staying with the allowables. There are some out there that we can multiply 1.5 times the cycles. And we're still under one.

There are others that are very close to one that we're tracking in cycles, others if you have what the design cycles are and the stress reports, we'll push you over the one. So we enter best item 2, corrective action program to reevaluate and make sure that we have sufficient margin for one cycle to give us time to reevaluate if we have to.

MEMBER SIEBER: How far in advance will you have notice that you're getting into a problem there? One cycle?

MR. DINGLER: I think it's the commitment. We're still in evaluation at this point of changing our procedure. At least there will be one cycle, and we're thinking about maybe two. We haven't decided on that yet.

MEMBER SIEBER: Yes because you're going to have to do a corrective action that is going to require mods.

MR. DINGLER: Maybe or we do an --

MEMBER SIEBER: Maybe or a conditional analysis.

MR. DINGLER: -- NB-3200 analysis. There are some ways to refine like the charging nozzle at the two charging nozzles --

MEMBER SIEBER: Right.

MR. DINGLER: -- so I can alternate between the two and stuff like that. So there is some opportunity in that area.

MEMBER SIEBER: Okay.

MR. DINGLER: On the surge line nozzle, the same issue was there for that. It's the charging location. Analysis was performed using ASME NB-3200.

Additional transients were included for the pressurizer in surge how surge effects that count for both the pre-modified operating procedure, what we call the mop and the post-mop operation. This is when we have our sprays and heaters on during heat-up and cool-down to keep the out-surge minimized. These actions and commitments close this open item.

MEMBER SIEBER: We, let me ask you this question. You have a recent history of finding cracks in basically the pressure boundary of the reactor cooling system. Those were in pressurizer safety valve nozzles.

MR. DINGLER: Yes and at the pressurizer.

MEMBER SIEBER: That is unlikely to have been caused by thermal cycling. What do you attribute the cause of that to?

MR. DINGLER: That was part of our Alloy 600 as the industry is working on to minimize the Alloy 600.

MEMBER SIEBER: So it is a transition well?

MR. DINGLER: It is a transition well with a cracked list --

MEMBER SIEBER: Do you find --

MR. DINGLER: -- or the indication, I should say.

MEMBER SIEBER: Yes. You found indications in more than one nozzle, right?

MR. DINGLER: Yes. We found them in three nozzles.

MEMBER SIEBER: Okay. Could you tell us which ones?

MR. DINGLER: I can't remember off the top of my head. I think Mr. Turner can.

MR. GARRETT: It was in the surge line, one safety and one relief valve.

MEMBER SIEBER: Okay. That is how I remember, too, but I don't know for sure. And you did a weld repair on those?

MR. DINGLER: We did a weld --

MEMBER SIEBER: Okay.

MEMBER ARMIJO: After you did that, now, when you do your fatigue analysis, what is your assumption as far as the starting? Do you assume that the weld overlay, that there is a crack already there? Certainly for the ones that you inspected and found there were some indication or very large indication, how does that affect your fatigue analysis for that?

MR. DINGLER: Right now for those ones

that have indications, they're monitored per periodic inspections per the code, ASME code. And we monitor if there is any growth or anything to those so that it's crack flaw tolerance evaluation is more than a fatigue monitoring for those locations.

MEMBER ARMIJO: Yes. I understand that, but I'm just saying when you're going to do a fatigue analysis, if you've got a component that's presumably halfway through cracked and then this weld overlay, which is uncracked, how do you treat that in your fatigue analysis?

MR. DINGLER: Well, what the full structural overlay takes is that is the new pressure boundary in a sense. So the original pressure boundary is not assumed there at that point.

MEMBER ARMIJO: Okay. You just assume it doesn't even exist. And it's starting with no crack or anything.

CHAIRMAN SHACK: Well, he has to do a crack analysis for the crack components.

MEMBER ARMIJO: Right.

MR. DINGLER: Yes.

CHAIRMAN SHACK: The fatigue analysis is to prevent initiation of the crack.

MEMBER ARMIJO: But if there's one already there.

CHAIRMAN SHACK: Once the crack is there, you're not doing a fatigue analysis anymore. You're dealing with a crack, a flaw tolerance analysis.

MEMBER SIEBER: Well, the interesting thing about it is the pressurizer nozzle. I can see why those aren't cyclic fatigue because the pressurize retains a given pressure. And that requires a given steam temperature to do it.

On the other hand, there are in-surges and out-surges. And regardless of the composition of a weld, to me that is cycling. And so I'm not convinced or I'm not sure. That's a better word. I'm not sure that you can't attribute some elements of the surge line cracks to cyclic fatigue.

MR. DINGLER: Based on the NDE person level 3 indication, it looked like it was PWSCC on that. So that was inconsistent with --

MEMBER SIEBER: You didn't cut it apart?

MR. DINGLER: We didn't cut it apart. We were investigating. And were going to mitigate with a full structural overlay anyhow. So when we did the original analysis to install that, we assumed. We postulated a crack. So it was below that postulation. So we went in and overlaid.

MEMBER SIEBER: You based your characterization of that crack on a UT analysis or I'm sure it's that, rather than radiography, correct?

MR. DINGLER: Yes, UT.

MEMBER ARMIJO: I still have not gotten my point across. You have a pressurizer nozzle that has to be analyzed, obviously, for best corrosion cracking. But you also have some fatigue component, maybe small. I don't know.

But the component now is double wall. And you have to assume, at least in three of those nozzles, that there are preexisting cracks there caused by another mechanism.

The question is, how did you treat that in your analysis?

MEMBER SIEBER: Right.

MR. DINGLER: Our fatigue analysis, as Dr. Shack said, we don't treat that in fatigue analysis. That is treated in a separate program as fault tolerance and stuff like that.

Our monitoring program is designed to not have any thermal cracks or fatigue cracks initiate. And if you have one, a crack indication or a flaw, you go into a different program.

MEMBER ARMIJO: Okay. So those are just

going to be monitored, and you're just assuming that you'll catch that by periodic inspection?

MR. DINGLER: That's in our ISI program as special inspections.

MEMBER MAYNARD: That's part of the flaw tolerance calculations is to assure that your inspections are going to be done well in advance of it.

MEMBER ARMIJO: Right. If I recall, those were pretty big indications, though.

CHAIRMAN SHACK: He has got the full structural overlay.

MEMBER ARMIJO: Right, right. So he's just saying okay.

CHAIRMAN SHACK: You can lose the whole original wall.

MEMBER ARMIJO: You could say the original didn't exist, but that's unrealistic. You've got a pre-cracked, welded component with potentially a big crack there. And so I would think that the fatigue analysis would say, "Hey, I've got a big starting crack halfway through my component." Granted, the remaining half is full structural, but I just don't know how you analyze it.

CHAIRMAN SHACK: It's a fatigue crack

growth analysis versus a fatigue initiation analysis --

MEMBER SIEBER: Right.

CHAIRMAN SHACK: -- is what is confusing the terminology here. Whenever they say, "fatigue analysis," they mean the initiation, the CUF kind of thing. But, as Otto says, you are already --

MEMBER SIEBER: That has already been initiated.

CHAIRMAN SHACK: It's definitely been initiated.

MEMBER SIEBER: And you're treating it as that's initiated and now we're just going to monitor by inspection.

MR. DINGLER: Yes. And that's in another program.

MEMBER SIEBER: In a surge line crack that you had, what is the critical flaw size?

MR. DINGLER: I can't say.

MEMBER SIEBER: And how close were you?

MR. DINGLER: I can't say.

MEMBER SIEBER: Does anybody know?

MR. DINGLER: I don't think we have that information available.

CHAIRMAN SHACK: Well, you did. I mean,

those were analyzed.

MR. DINGLER: Those were analyzed at that point and --

CHAIRMAN SHACK: They're large.

MEMBER SIEBER: Yes, sir? Come to a microphone.

MR. TURNER: Art Turner from Wolf Creek.

The flaws were relatively large in terms of circumferential extent, not necessarily in depth. And the way the overlay works is that it puts the entire original pressure boundary in the compression so that that helps to keep the special corrosion cracking and material that is done for the overlay is resistant to structural corrosion cracking. So you basically turn off the stress corrosion cracking growth mechanism.

The fatigue analysis then assumes you have a crack. And it's actually assumed to be as big as the depth that we can't inspect after the overlay is there. We can't inspect the inner portion of the original pressure boundary walls.

So the assumption is made that a crack is there that's to the full extent of what can't be inspected. And then a T crack growth analysis using the thermal cycling is done to show that you won't propagate that crack into the material you're giving credit for for the pressure boundary.

MEMBER ARMIJO: Okay. That answers my question.

MEMBER SIEBER: And you found your existing cracks through an aging management program that is already in place?

MR. DINGLER: As part of the NEI material initiative of MRP-139.

MEMBER SIEBER: So it wasn't an aging management program? It was an initiative that --

MR. DINGLER: That's correct. That's correct.

MEMBER SIEBER: Okay. Thank you.

MR. DINGLER: The second open item is related to the calculation. As Jack said, we committed to re-baseline or fatigue usage for periods before implementation or fatigue monitoring program.

For this open item, Wolf Creek has made a commitment to update the baseline to CUF calculation for the charging and the surge line nozzle as part of the existing metal fatigue AMP, license commitment number 41.

We committed to update the baseline CUF for the pressurizer hot leg nozzle based on the actual pre-modified operating procedures environment. We also committed to update the fatigue monitoring baseline CUF for the charging to consider different contributions for each category of charging events. These items or these commitments close this open item.

The third and final open item is related to the validation of the fatigue usage calculations, reactor pressure internals and the reactor coolant system sample lines for a period of extended operation.

On this open item, the NRC staff has completed their audit of supporting calculations analysis. The staff has verified: one, that the Wolf Creek approach that indicates, one, the vibratory stresses for reactor vessel internals are very small compared to thermal transient cycles and the usage of high cycle fatigue effects is negligible.

The NRC staff also verified that Wolf Creek stress calculations and assumptions for the reactor coolant sample lines are valid for the period of extended operation in accordance with CFR 54.21(c)(1)(iii).

The staff verified a required stress reduction or stress range reduction factor of 0.9 is incorporated in the analysis. These actions close this open item.

If there are no other questions -- Charlie?

MEMBER BROWN: Were instrument, reactor coolant system instrument, lines, included in this evaluation or scoping of thermal stress, cyclic stress, pressure differential, pressure detectors, things of that nature? I presume you have those: pressure differential to right level sensors.

Are they bellows type? I presume you have bellows type flow and level sensors. Those are always flushing water in and out as the plant operates. So you have cold water --

MR. DINGLER: It's my understanding that that's an active component and wouldn't be. That would not be handled as a passive unit and in this area would be changed down through --

MEMBER BROWN: Well, the instrument lines connects into the reactor coolant system. That is a point of thermal cycling, stress, thermal stress, if you build up on those, similar to sample sync lines or stuff like that, where you are taking hot coolant and moving it from point A to point B.

MR. DINGLER: In those areas for those, you have constant temperatures. And that, where the sample lines is, you take a sample. So you flush cold water in --

MEMBER BROWN: I understand that. But in a differential pressure type, a bellows-type detector, it's got to move and expand. So water comes in and out of it all the time. It's not a static. It's not like a board and tube pressure detector, where --

MEMBER SIEBER: But the amount of fluid that is in place is minuscule when the bellows moves.

MR. DINGLER: It depends on the bellows movement. A half-inch of movement depends on the size of the bellows and everything else. I mean, it is an area that --

MEMBER SIEBER: High-pressure valves aren't very big.

MR. DINGLER: I have no idea. They weren't included. Is that the point?

MEMBER SIEBER: They are --

MR. BLOCHER: Part of the TLA analysis for fatigue did look at instrument nozzles on systems, both for instrument lines and on the large vessel, any mounted instrumentation in the pressure.

MEMBER BROWN: Okay. And the conclusion was that the cycling was within any particular analysis that had been --

MR. BLOCHER: Risk factors were typically low on instrument nozzles.

MEMBER BROWN: Okay.

MEMBER SIEBER: They code for each small lines differently than the large lines. I think six inches is the point. Somebody can correct me if I'm wrong.

MR. DINGLER: I can't remember off the top of my head.

MEMBER BROWN: Okay. That's the only question. I'm done with that one, but I did have -- just on the commitment system, you have -- and maybe the staff can answer. I know it's in one of the tables.

You listed when the commitments were due to be completed. And several of them were out in 2025. It's 18 years from now. Is that kind of an acceptable practice to wait another 18 years to have a CUF or something like that?

MEMBER SIEBER: You can do it in advance.

MEMBER BROWN: Pardon?

MEMBER SIEBER: You can do it in advance.

MR. DINGLER: Let me speak to the metal fatigue.

MEMBER BROWN: That's largely looking at

--

MR. DINGLER: Where the process, as I said, the reanalysis, NB-3200 analysis, is ongoing. It's in the final verification right now. The baseline will occur right after I get my charging nozzle verified. And we will do the baseline right way. So we're in the process of completing both of those two commitments as we apeak.

MEMBER BROWN: Okay. Were there any other ones out that far that you are really going to get done earlier?

MR. DINGLER: Not in the metal fatigue.

MEMBER BROWN: Not in the metal fatigue area?

MR. DINGLER: The third one has already been closed out by the audit.

MEMBER BROWN: Okay.

MR. DINGLER: The 40 and 41, we are in the process of completing those now.

MEMBER BROWN: Okay. My other question had to do with your -- I want to get the right document. Wrong table. Scoping again, section 2.5. No. That's the wrong section also. No. Here it is. Table 2.2.1 in your scoping section relative to electrical and I&C system components.

You noted that the class 1E 125-volt DCs fell within the scoping document. You said, "Yes" under this.

MR. DINGLER: I'm going to have to refer it over to here.

MEMBER BROWN: That's fine. I didn't mean to eyeball you explicitly. I'm eyeballing all of you here.

MR. DINGLER: I try to stay away from electrical as much as possible.

MEMBER BROWN: That's why I like this job. Nobody else knows what it is.

There was a whole list of items that says yes. Then I get down to instrument systems, and it says no. They're not under the scoping requirements of the license renewal, like reactor, your reactor control system, your reactor instrument system, ad nauseam. They're all kinds listed in there.

MEMBER SIEBER: They're active.

MEMBER BROWN: Yes, I understand they're active, but they also age. Is there some methodology you used to see that you're getting stable, long-term performance?

I noticed you covered it under this thing called the spaces approach, which I presume if a cabinet sits in a nice air-conditioned space, then you have kind of covered with this -- and there are no environmental factors that affect it but, in fact, instrumentation control equipment does not last for 60 years typically.

It drifts. It becomes more susceptible to drift as it ages. And the only way to really know that is to have some idea if you have an extended calibration, not extended but a more frequent calibration cycle when you're doing your checks and things like that.

Is there a reason? Is there a basis for that or are you going to upgrade it every 15 years or put new stuff in or is this still the original stuff from 1986 or what?

MEMBER SIEBER: Well, it's not a passive component. So it doesn't fit under the rule. It's not required to be addressed in --

MEMBER BROWN: All right. Just a minute. Okay? I understand that, Jack, but, I mean, the point is the stuff ages.

MEMBER SIEBER: Well, that is what we are reviewing.

MEMBER BROWN: And if you're not watching it -- I mean, I had a direct experience with this from my previous past life, where we had a significant problem with a particular very high-value aircraft carrier asset that was, unbeknownst to us at headquarters, beating the life out of their people because of the efforts that they had to put in to keep the stuff in service. We found out about it through a back door.

And once you start looking at it, we then had to change our thought process in terms of how you deal with instrumentation control equipment, at least in naval vessels, far more critical environmental circumstances than what you have at Wolf Creek. But, yet, we were dealing with a 10-year time frame relative to its degradation, as opposed to a potential 60-year time frame, which you're really granting.

So I'm just asking a question. Do you all have a process of evaluating this stuff or do you have a plan in place to upgrade it periodically or do you just kind of let it sit there?

MR. GARRETT: Well, I can't speak specifically to those particular components, but in general we have a number of predictive maintenance and preventive maintenance programs. We use operating experience and other mechanisms to identify comparative equipment and make changes before they go on and perform their function.

So those are generally reactor components. So we have ongoing resisting monitoring programs to observe and detect and monitor and take action as necessary.

MEMBER BROWN: Does someone try to say, "Gee, we fail alignment checks," for instance? I presume you have some periodicity to alignment checks, three months, six months, annually, whatever the circumstances are. Does that get tracked?

I do a weekly or a biweekly or a monthly or whatever calibration check, and now I start seeing, gee, every three or four, five, six months, or twice a year I have to realign, where I used to never have to do it. I mean, do you have a tracking or is it just in here?

MR. GARRETT: No. In this sense, when our maintenance people go out, our I&C people go out, they do any type of an activity, a maintenance activity, PM or whatever, they also have a feedback form that they will capture information relative to the as-found condition or maybe their response to that equipment. And that will then capture any trends by our systems engineering program. So there are other ways to catch the onset of degradation.

MEMBER BROWN: So you have an ongoing feedback-type system when people are actually out doing maintenance or other type of functions on this type of a --

MR. GARRETT: When you get on, actually, to the worker crest package and called feedback, that would be captured and reviewed by the appropriate program or system engineer.

MEMBER MAYNARD: One of the reasons the safety-related components are included in the license renewal process is essentially all safety-related components have regulatory requirements, surveillance requirements, periodicity and feedback.

And with the maintenance rule, if failures are identified or if unusual situations, it's not just based on a mechanic or an I&C tech deciding what they want to do. There's a regulatory process and a required process for dealing with these and taking care of them, replacing them, whatever has to be done to people.

And so it's not really an age of the plant issue as much as it is some components may have a two-year life. Some components may have a 30-year life. You know, there are change-outs for various components of the vessel reactor components throughout. So there is a program and process that deals with those.

MEMBER BROWN: All right. I just --

MEMBER MAYNARD: Hopefully the I&C and the instrumentation --

MEMBER BROWN: We had a system like that also. Unfortunately, the I&C guys just every time it went -- when they failed a calibration check, they just went and realigned it.

And it's in the logs. There was feedback, but nobody picked up on the fact that now they were doing every plant every week or every two weeks or every three weeks, whatever it was, as opposed to every six months or every year.

That's the kind of circumstance. When it starts increasing, you have to deal with it. And when I looked at a plant extension, I know this is probably analog equipment that was put in back in those days. And analog equipment tends to operate a little bit hotter in some circumstances. And it tends to drift a little bit more because you've got more amplifiers and systems that you have to deal with that can drift.

I'm not advocating replacing it with digital stuff. That's not --

MR. GARRETT: We are.

MEMBER BROWN: What?

MR. GARRETT: We are.

MEMBER BROWN: You are?

(Laughter.)

MEMBER BROWN: Yes. I'm not saying you shouldn't, but that's a different issue. It's just it's how you deal with it. You know, there are some pluses and minuses on both sides of it.

I'll stop right there. It's just that that is the thought process that I was looking for to try to figure out how you would address that.

And I will satisfy everybody and quit throwing those out and about now. I'm done.

MR. DINGLER: Turn it back over to Terry, then.

MR. GARRETT: Thanks, Mo. And we had nothing else to talk about today unless there are any further questions.

MEMBER SIEBER: If not, thank you very much.

I would like to call on the staff now for their portion of the agenda. Are we ready to begin?

MR. TRAN: Yes.

MEMBER SIEBER: Okay. Go ahead.

MR. TRAN: Good morning. My name is Tam

Tran. I am the Project Manager for the Wolf Creek generation station license renewal review project. I, along with other members of the project, will discuss the staff review of the Wolf Creek license renewal application, a document, and the safety evaluation report.

The SER was issued for the applicant on July 29th, 2008. I have here the main contributing review for both the station blackout open item and metal fatigue open item.

And I also have Mr. Greg Pick, who is the lead inspector for license renewal for Wolf Creek.

Next slide. Okay. I will begin with a brief review of the Wolf Creek license renewal review. Audit inspection will be discussed then. I then will continue with the discussion of SER audits and results, section 2 to 4 of the SER and associate closure of the open items.

Next slide. The license renewal application was submitted in September 2008. The LRA was discussed by the applicant this morning. So I will just skip that.

For the safety evaluation report, the staff was aided with audit review and additional information provided by the applicant in response to the request for additional information items. The information collected from audit and RAI responses was used to develop the SER with the open item, and it was issued on February the 1st, 2008. The SER will contain five open items and no open confirmatory items.

Okay. Next slide. With the issuance of the SER with open items, the applicant provided responses for closure of open items. The staff reviewed the responses for acceptability and issued a finding of no open items. And the final SER dated July 29th, 2008 was issued.

Next slide. Next I will discuss the audit and inspections. NRC review team has conducted four audits and two inspections at the Wolf Creek plant. The staff started the on-site review with the scoping and screening methodology. And that followed with a series of audits and inspections that ended in October 2007.

Region IV conducted two inspections in September and October 2007. And that inspection was for Wolf Creek scoping and screening and aging management programs.

Next, Mr. Greg Pick, who is the lead inspector, will discuss the inspections.

MR. PICK: Good morning, everyone. Our first on-site week had five inspectors, and our second on-site week had six inspectors. We reviewed 21 of their 39 aging management programs.

At the end of the inspection, the team concluded that the screening and the scoping of the non-safety-related systems, structures, and components was implemented, as required by the rule. And aging management portions of the license renewal activities were conducted as described in the application for the programs that we reviewed.

The regional administrator letter was issued on January 28th, 2008 and recommended that the license renewal be granted for this applicant.

Their current performance, other performance indicators, and their findings are in the licensee response band there, green. Their corrective action program, the corrective action program identified that the applicant had some challenges to implementing appropriate and timely corrective actions, including correcting deficiencies related to non-cited violations that we had issued over the assessment period.

Further, the applicant had deficiencies that had aspects related to processing operating experience information. There was also a special inspection in January and February of this year in response to emergency core cooling system voiding that identified several deficiencies that included failure to properly process operating experience information and also identified inadequate corrective actions by the licensee.

On September 2nd, we issued the mid-cycle letter. And it closed one human performance cross-cutting issue, substantive cross-cutting issue, related to human error, prevention techniques. And it expresses that NRC remains concerned with human performance in the area of resources since five of seven findings in human performance had components related to a lack of accurate or up-to-date procedures.

MEMBER SIEBER: I take it this is a Region III plant?

MR. PICK: No, sir. Region IV.

MEMBER SIEBER: Region IV?

MR. PICK: Yes, yes.

MEMBER SIEBER: Okay. Must be close to the border of two regions.

MEMBER BLEY: Those are maintenance procedures here?

MR. PICK: All types.

MEMBER BLEY: All types. Emergency procedures?

MR. PICK: There were no emergency procedures. They were the routine daily procedures.

MEMBER BLEY: Okay. Thank you.

MEMBER ABDEL-KHALIK: What were the applicant's actions in response to ECCS voiding? And why were they judged to be inadequate?

MR. PICK: They had received the industry information. They reviewed it, thought they had an appropriate system and didn't. We concluded during our inspection that they didn't take the right actions.

MEMBER ABDEL-KHALIK: Could you elaborate?

MR. PICK: There was a calculation from a vendor that talked about whether the voiding fraction for the voids in the system would be okay. They didn't do an independent review. We concluded it was not okay.

MEMBER CORRADINI: The vendor analysis?

MR. PICK: Correct and that the licensee should have done a more thorough job. That is one example of one of the engineering findings. The processing of the OE would have been an opportunity for them to catch it and take action, and they didn't.

Another one was we asked them whether they were going to evaluate four voids on the suction side of the pump. They said it wasn't necessary. We looked and decided it was necessary and they were, again, incorrect.

So they had several findings out of that inspection. They also had several findings out of the corrective action inspection that occurred last October. Those findings are going to go into what I'm about to talk about.

Our mid-cycle letter also has identified that they have three areas that have substantive cross-cutting issues related to their corrective action program. Those findings accumulated from those big inspections.

And the licensee has a process to correct it, and they have a corrective action program ongoing. And they have had that for some time. And we will get an update in October.

MEMBER ABDEL-KHALIK: What was the applicant's response to your finding, not the follow-up response following your finding of --

MR. PICK: As I just said, they issued a big root cause analysis. And they're taking corrective actions to address them. And that work is still ongoing.

MEMBER ABDEL-KHALIK: Okay. Thank you.

MEMBER SIEBER: But that is a serious issue.

MR. PICK: And we view it as serious, but, again, it is still in the licensee response band.

MEMBER SIEBER: Right.

MR. PICK: Nothing was significant enough where we as the regulator have to have any more involvement than letting them self-police.

VICE CHAIRMAN BONACA: They are listed in the green PIs.

MR. PICK: Correct.

MEMBER BLEY: This might be related, but you used a phrase I've heard before. And I'm not sure exactly what it means, "non-cited violations." Would these be non-cited violations?

MR. PICK: The tech specs, the rules, the regulations. If they don't comply, it's a violation.

MEMBER BLEY: Okay.

MR. PICK: If they enter it in their corrective action program and take actions to correct it, then we don't cite it because they have a corrective action program that will fix things.

MEMBER SIEBER: Yes, but I thought that they had to find it, as opposed to you having to find it to be non-cited.

MR. PICK: No, sir.

MEMBER MAYNARD: It also depends on the significance of the finding, too.

MR. PICK: Correct. These 15 years ago would be security level IV-type violations. Did I answer your question?

MEMBER BLEY: Yes. When you cite it, you're saying this is really serious and it gets --

MR. PICK: Well, in our enforcement policy, we can cite for other things, but if we chose to cite a violation and have them formally respond, you're correct. We are saying, "We don't have confidence that you are going to police it yourself."

MEMBER SIEBER: Right.

MEMBER BLEY: That's good. Thanks.

MEMBER ABDEL-KHALIK: Perhaps I should ask the applicant. Are there any physical modifications being done right now to address the ECCS voiding issues; for example, addition of vents, et cetera?

MR. CARD: I am Tim Card. I am system engineering supervisor. Yes. We put in 27 additional vent valves during our last refueling outage. And, as a result of our review of those procedures, we're putting in 23 more during the next outage to facilitate partial drains of the system. In addition, we had to go in and fix some of the valves that we found leaking. So yes, we have made several modifications.

MEMBER ABDEL-KHALIK: Thank you.

MR. PICK: Well, that would have been part of their improvement plan. And, as I said, their corrective actions are in the early stages of development.

Our inspection in September and October of '07, in reality, the big picture, it was a very clean inspection. We did not as a team find very much in the programs we selected. But we did find some minor drawing errors under scoping and screening and in their switchyard on the 3.45 kV tower and the electrical disconnect. That didn't include vaulting and scoping for an inspection of the vaulting.

We found minor issues with 3 of the 21 aging management programs evaluated. And the one-time inspection program, they had referred to a new reg. And it implied in their SER that they would use the whole new reg and, in reality, wanted to just use the 90 sampling methodology. They submitted an amendment to fix that.

Under the accessible meeting voltage cables, that was a new program. We felt that they couldn't determine the adverse temperatures in the center of a conduct for the cable. So they added a safety factor. And they didn't have a real criteria for what cables will be included in scope. They added a criteria for that.

MEMBER SIEBER: Let me ask a question about the station blackout line, the 4 kV line. That was an issue that you folks found, right?

MR. PICK: I don't --

MEMBER SIEBER: Licensee --

MR. PICK: The submerged cables is the issue we found. The 4 kV that is going up to the switchyard now?

MEMBER SIEBER: Yes. The issue was the vaulting that holds the circuit breaker and I think it disconnects the switch to the ground to the concrete pad was not in an aging management program.

MR. PICK: Correct.

MEMBER SIEBER: And that was something you found because my impression was the licensee intentionally didn't include that because they didn't believe that that was part of the boundary. Is that correct or not correct?

MR. TRAN: The open items, there was one issue associated with cable submerged when they opened up the manhole and so on.

MEMBER SIEBER: Right.

MR. TRAN: The open item associated with the meeting voltage cable, the underground meeting voltage cable is --

MEMBER SIEBER: Is a different issue.

MR. TRAN: Yes, right.

MEMBER SIEBER: That's different than the question I am asking.

MR. TRAN: Okay.

MR. PICK: I do not recall. The inspector on the team went out in the switchyard, the power was, the vaulting wasn't and just challenged them. And they agreed and added it.

MEMBER SIEBER: Right. Because that became an issue at our subcommittee meeting, the fact that it wasn't resolved at that time, --

MR. PICK: Yes.

MEMBER SIEBER: -- the fact that it wasn't resolved at that time. That was one of the five open items. So I'm just curious as to how that got originated.

MR. TRAN: Yes. We have a reviewer who has the open item here.

MEMBER SIEBER: Yes?

MR. NGUYEN: My name is Duc Nguyen. I am the team member doing the audit. What we found was, actually, the scoping, that they did not include underground cable. This is the 13.8 kV from the transformer to the switchgear. This cable is very long. And we have a concern because this cable could be subject to the significant moisture underground.

As a result of that, we addressed this open item during the audit. And we also addressed it in the SER, the open item.

MEMBER SIEBER: But subsequently the applicant has agreed to include these items and address them?

MR. PICK: Yes.

MEMBER SIEBER: So they are no longer open items. Okay.

MR. PICK: Did we answer your question, sir?

MEMBER SIEBER: Yes.

MR. PICK: Okay.

MEMBER SIEBER: I would still be talking if you hadn't.

(Laughter.)

MR. PICK: The inaccessible meeting voltage cables were also a new program. We identified concerns with submerged cables during our inspection. When they do their inspections, their periodic inspections that they do perform in response to our inspection, they will pump the manhole dry, increase the inspection frequency, and if they find water during their increased frequency of review, they will implement additional corrective actions.

Prior to the period of extended operation, they committed to, of course, getting the manholes dry. And that was the license renewal aging management part of the inspection. Anything that we identified that needed to be addressed in the SER was addressed through amendment 5.

The current license basis issue related to the submerged cables. When they were initially identified because my experience as a resident seemed -- I was involved in the operability evaluation and consultation with the Electrical Branch -- we called them. What we concluded was we didn't have enough information to show that the components were not inoperable at the time.

MEMBER SIEBER: Right.

MR. PICK: And then the license renewal inspection and the inspector left site. And now it's in the hands of the Electrical Branch if you have any more questions on that topic.

MEMBER SIEBER: Okay.

MR. PICK: And I am going to turn it back over to Tam Tran unless you do have questions.

MEMBER ABDEL-KHALIK: Do any of the manholes have sump pumps or are they all just sort of accumulating water and you inspect them and you drain them whenever --

MR. PICK: If I recall, they do not have sump pumps.

MEMBER ABDEL-KHALIK: None of them? Is that correct?

MEMBER SIEBER: It's not typical.

MEMBER ABDEL-KHALIK: It's not typical, no.

MEMBER SIEBER: I don't know of any plant that has a --

MR. WILSON: Yes. There are plants that have sump pumps built in. My name is George Wilson, Electrical Engineering Branch Chief.

There are a lot of plants that have sump pumps with a toilet bowl switch that automatically pump the water out of their manholes for --

MEMBER SIEBER: Oh, really?

MR. WILSON: Yes, that is correct.

MEMBER SIEBER: Okay.

MEMBER RAY: Well, let me ask a question. In listening to this discussion of the inspection, there were a couple of times when you said something that was approximately corrective actions are in the early stages of development.

But it's not clear to me what the connection is between the corrective action, if any, and the application that is before us here.

MR. PICK: I was talking about current plant performance.

MEMBER RAY: Okay. But does any of that corrective action have anything to do with --

MEMBER SIEBER: No.

MR. PICK: No, sir.

MEMBER RAY: Why are we talking about it?

MEMBER SIEBER: Matter of information.

MR. PICK: I was informed that the Committee liked to know about the current plant performance. Mid-cycle letter went out on September 2nd. That's current plant performance.

MEMBER SIEBER: Right.

MEMBER RAY: I see. So this doesn't have anything to do with the application in --

MR. PICK: No. The license renewal application inspection was very clean. I had a Region I inspector that had participated in several when it was my first. That is the feedback I got.

MR. TRAN: And we did document the results of the inspection in our SER.

MEMBER RAY: Well, okay. But still when you say something is in the early stages of development, it sort of leads a question of, well, does it need to be completed? Do we care?

MR. PICK: The only relation to license renewal is the inspections were finding problems with them processing some pieces of operating experience information.

MEMBER RAY: Well, but that can have a generic implication --

MR. PICK: Yes, it could.

MEMBER RAY: -- is what I am trying to get at.

MR. PICK: Yes, it could. And in October, the applicant in this meeting will be describing to Region IV the actions they have been taking to improve their operating experience program.

MEMBER RAY: And you don't feel that needs to be coupled with the application, processing of the application.

MR. PICK: No, sir, because the 21 programs we reviewed and the operating experience we reviewed, we found everything satisfactory.

MEMBER RAY: Okay.

MR. TRAN: Any other questions?

MEMBER SIEBER: Go ahead.

MR. TRAN: Okay. Thanks, Greg.

I will now begin a discussion of the result of the safety evaluation report and the closure of the open items. Section 2 discussed structure and components subject to aging management review. The staff concluded that the license renewal application meets the review criteria in the standard review plan and in accordance with the rules.

Next slide. Relative to mechanical systems, the staff identified a number of components that related work within the scope of the application. These components provided support functionally to a needed mechanical system intended functions according to 10 CFR 54.4(a)(2) and 10 CFR 54.4(a)(3). The function of the components were not obvious at the time the applicant performed scoping and screening activities.

Consistent with 10 CFR 54.4(a) and 10 CFR 54.21(a)(1), the staff concludes no omission of the mechanical component and structure within the scope of license renewal after license renewal application amended subsequent to the staff review.

Next slide. Section 2.5, scoping and screening of electrical instrumentation and control systems, the staff identified one open item, which was open item 2.5-1 associated with the station blackout recovery path to the off-site sources. For this open item, the staff determined that the recovery path should be included within the scope of license renewal.

The expanded review plan is the guideline that outlined the component that should be subject to an aging management review. The guideline indicates that the path from the on-site distribution system to the switchyard circuit vectors should be included within the scope of license renewal.

The staff accepted the applicant's amendment to review the circuit breaker within the scope of license renewal for closure of open item 2.5-1.

CHAIRMAN SHACK: I know we already covered this at the subcommittee meeting, but I can't recall. Why did this issue arise now? I mean, we have been through a number of license renewals. This seemed to be a contentious issue. I mean, it wasn't just Wolf Creek. There was a whole sort of industry push-back on this. Had all the other plants up until now included these breakers without any discussion or has this been a contentious issue all along and we just didn't notice it?

MR. MATTHEW: This is Roy Matthew from Electrical Branch.

We had an issue I would refer to as an open item starting at Wolf Creek. That's where some of the licensees were misinterpreting our guidance.

And we issued a revised interim staff guidance. That is going to be issued or it's in the process, actually. It's still under review. It clarified the instance of the original staff guidance.

So there was some misinterpretation, but the majority of the licensees or the applicants were correctly scoping those. In the Wolf Creek case, we found out that they were misinterpreting the guidance. So we feel that we need to issue additional staff guidance.

CHAIRMAN SHACK: Okay. So this isn't a

new requirement. I mean, every other license renewal applicant has included comparable --

MR. MATTHEW: Right.

MEMBER SIEBER: Right.

MR. TRAN: Yes. That is the basic internal review plan.

Okay. Next slide. Any other questions?

(No response.)

MR. TRAN: The section 3 is called "Aging Management Review." This slide provides an overview of all the aging management programs that were reviewed in the safety advisory report.

The review of the aging management programs was performed mostly by the license renewal audit teams documented in the SER. And the summary is listed on this list.

The audit team reviewed 39 aging management programs. Of the 39, 2 are plant-specific programs. Twelve programs are consistent with generic aging lessons learned report to go. Twelve have exceptions. And ten have enhancements. Three programs have both exception and enhancements. There were also other reviews performed by Management Engineering Division and contribution to the development of the SER.

Next slide.

MR. WILSON: My name is George Wilson. I am going to clarify your point.

Wolf Creek has stated two precedents that they stated that they were going back and re-looking at that the staff when we did the SEs that we did not make them go out to the first breakers of transmission voltage. That is the correct answer to your question that you asked.

We are going to go back and re-look at those plants. We're also redoing the ISG. That's actually I think the answer that you were hunting for because I think Wolf Creek did state precedence. And we'll go back and look at that.

MEMBER MAYNARD: I appreciate you bringing that up because I don't think it was just Wolf Creek. I know at the time we had our subcommittee meeting there was a lot of industry interest in that. NEI was involved. And so I don't think it was just one plant that was --

MEMBER SIEBER: Well, the STARS plants seem to --

CHAIRMAN SHACK: There are other plants outside of precedent.

MR. HOLIAN: That's right. This is Brian

Holian. We are still working with NEI on this. NEI still does have some issues with, does the station blackout really require up to this circuit breaker in the switchyard?

So the previous ISG did say typically it should. And so some plants said that word "typically" back in 2000 or 2001 was put into that guidance because even when that interim staff guidance was put out, I think the industry was pushing back above, "Hey, we have other ways, you know, the transmission network. And that will protect that. We would like to keep the boundary closer to our plant output.

And so it is still a current issue that we're working with NEI on and the industry.

MR. TRAN: As a result the staff review, one open item was identified related to station blackout, recovery, and associated aging management programs.

For this open item, which is related to the open item 2.5-1, the staff found that in accessible medium voltage cables, aging management program did not include the underground medium voltage cable from the 13.8 kV switchgear to the transformer connecting the switchyard.

These inaccessible medium voltage cables provide connections for the station blackout restorations of the off-site power path to on-site distribution systems if the underground cables are not managed. Significant moisture can affect the cable's intended functions.

The staff accepted the applicant's amendment to include these cables as a part of the medium voltage cable aging management programs. And, therefore, this open item is closed.

Okay. Next slide. As shown in this slide, at the time of the application submitted, the latest Wolf Creek sampling data from June 2005 to May 2006 indicate that below-grade environment is not aggressive. This represents the baseline data of the below-grade environment for the license renewal. Fluctuation in the 2005 and 2006 measured data is comparable with other plants.

There is also the future commitment described on the next slide. License renewal commitment 17 includes provision to ensure groundwater samples are evaluated periodically to assess the aggressiveness of groundwater through concrete. This consists of periodic testing, chemistry monitoring two times every five years, and visual inspection of very plant structures.

Next slide.

MEMBER SIEBER: Could you go back to two slides back, where you had the table?

MR. TRAN: Yes.

MEMBER SIEBER: And you looked at sulfates, the maximum. And you said, "Measured during winter." I presume that during the summer that number would increase.

MR. TRAN: Actually, I have the reviewer here who can answer you in more detail.

MR. HONG: Yes. My name is Dan Hong. And I am a structural engineer with the staff.

During the period of time of the outage, I did review the applicant's data. The applicant during that time frame, 2005-2006, they performed five total firewells monthly. But they take the credit for two every five years. And that particular data you see right there 717. They're located near the ECCS. We see about .2 miles away from the reactor building. During the winter, sir, yes, you are correct.

MEMBER SIEBER: Okay. I presume there's little chance that you would exceed the 1,500 ppm limit?

MR. HONG: According to the data they provided to me, that's the highest they ever got.

MEMBER SIEBER: Okay. Thank you.

MR. TRAN: Section 4, time limit aging analyses, section 4.2 of the SER covered reactor vessel analyses. There were three reviews performed to evaluate embrittlement, as documented in the SER. These were neutron effluents, upper shell energy, and adjusted reference temperature review, pressurized internal shock review, and pressure temperature limits review.

The staff concludes that the reactor neutron improvement analyses need to review criteria in the standard review plan and in the form of the rules.

As indicated on this slide relative to reactor vessel, neutron embrittlement analyses, Wolf Creek has large margins with respect to pressurized internal shock, both for 40-year operation and for 60-year operation. The 270-degree F is the current 10 CFR 50.61 limit for plates and actual wells.

Next slide.

MEMBER SIEBER: So you would conclude that that is a good vessel?

MR. TRAN: We conclude that that is an acceptable vessel.

MEMBER SIEBER: All right. Lots of

margin.

MR. TRAN: Lots of margin, right.

This slide shows the upper shell energy data at 69-foot panels for the limiting material and 54 effective full power years. Projected upper shell energy meets the acceptance criteria.

Next slide. There are three open items related to metal fatigue analysis. The main contributing reviewers out here were Mr. Alexander Tsirigotis from the Electrical Branch and Mr. John Fair. And I will turn over the presentation to them at this point.

MR. TSIRIGOTIS: Hello. My name is Alexander Tsirigotis from the Electrical Branch.

Open item 4.3 is a two-part item. The first part deals with the vessel internals. And the second part deals with plus two and plus three piping.

In the vessel internals issue came at some locations and basically eight locations. The particular usage factor, the cumulative usage factor, came to be above .66. And that's how the whole thing started.

When I reviewed the stress report for the vessel internals, it is an evaluation report basically, where it contains a summary of the calculations for these internals, for the vessel internals.

And this somewhat shows these eight locations, but the cumulative usage factor shown in there, it is not explained what part of it is due to vibration fatigue and which part is due to the thermal fatigue.

The licensee went into individual calculations and determined that in three of those eight locations, the calculations were performed and the usage factor used for fatigue was so negligible that it was reported as zero.

MEMBER SIEBER: Right.

MR. TSIRIGOTIS: The main five locations were determined that the stresses due to the fatigue due to the vibration fatigue if you want to use vibration, basically fatigue, were so low that they wouldn't be able to account anything for the fatigue.

MEMBER SIEBER: Right.

MR. TSIRIGOTIS: And that's how they were explained.

MEMBER SIEBER: Okay.

MR. TSIRIGOTIS: And I agree with that. That's acceptable.

MEMBER SIEBER: Good.

MR. TSIRIGOTIS: The second part of the open item, which deals with the plus two and plus three piping, it deals with a stress reduction factor. If this line cycles more than, let's say, 7,000 cycles, then they have to introduce a reduction factor for the thermal extension stresses.

And the licensee determined there were three locations. Initially they determined there were three locations where it was thought that the reduction factor, that these lines will cycle less than 11,000 cycles.

It was told that the reduction factor was not accounted for in the beginning, but then when they looked more into it, they submitted calculations. And I ordered them. And I found out that they did use a .9 factor for the allowable, which is acceptable because if it's from 7,000 to 14,000 cycles, it's .9. And they claim that it's less than 11,000. So that's acceptable to us. That closed that.

MR. TRAN: Next Mr. John Fair will talk about the next open item.

MR. FAIR: Next slide, please. Now, this issue had to do with two of the locations that were evaluated for environmental fatigue. On these two locations, the applicant uses what is called a stress-based monitoring, where they're monitoring the actual fatigue usage at these locations. So they need a detailed stress analysis to compute the fatigue usage for each cycle of our operation or transient that goes on.

The way that this is done is there is a program which monitors the fatigue usage based on the thermal transients and use the thermal transients to go directly to the thermal stress to add into the other stresses associated with bending and pressure.

This particular procedure uses one component of stress to track. And the question was whether the tracking of this one component of stress was conservative or not conservative. If you're going to do a full-blown detailed stress analysis, you need to look at all of the components of the stress analysis, --

MEMBER SIEBER: Which are six.

MR. FAIR: -- which are six independent. There are actually nine, but three of the sheer stresses are symmetric in the stress sensor. So there are six independent.

MEMBER SIEBER: Right.

MR. FAIR: Anyway, the applicant did a confirmatory analysis using a full ASME procedure calculating the stresses and determined that their original monitoring calculation was conservative. However, in the submittal here, as they indicated this morning, one of the locations, which was the charging system, they did an analysis with a thermal sleeve in place.

And we were not sure at that time whether they actually had the thermal sleeve. Now I found out this morning they don't have a thermal sleeve. So they have to redo that particular calculation.

As far as the stress monitoring goes, they demonstrated that they were conservative with their original technique with the confirmatory analysis.

CHAIRMAN SHACK: That was sort of interesting. You know, that shows you how difficult it is to be consistently conservative because they were conservative because they over-predicted the strains, but that gave them non-conservative values of the fatigue enhancement factor because they got too high a strain rate. But overall they ended up conservative.

MR. FAIR: Yes. That situation has come about in other locations when they have taken another look at it. When you do the analysis, of course, if you do a conservative analysis, you're going to calculate a high strain rate. And the environmental factors for a high strain rate are lower. So there's a kind of a trade-off on the calculation. If you get an under-prediction of the actual strains and less strain rates, you'll over-predict the FEN factor.

CHAIRMAN SHACK: But I thought in the Vermont Yankee case, they actually under-predicted the strains with the 1D model or is it, again, the overall calculation was non-conservative in that case because the enhancement factor overwhelmed the strain factor?

MR. FAIR: Well, in that case, the reason this became an issue was when they went back and looked at the calculation of the non-environmentally enhanced stresses and strains, the 1D calculation was not conservative.

CHAIRMAN SHACK: Conservative. Okay. But you can always count on the 1D calculation of the original strain being conservative?

MR. FAIR: That's right. But in that particular case, they used a one FEN factor to account for all the transients. And then when they did the confirmatory analysis, then they broke down each transient and calculated as separate FEN for each transient. It turned out the overall value was lower than the moderate value.

So yes, it's very difficult. One of the problems we're having in evaluating these cases where the 1D assumption was used was that most of the confirmatory analyses that come in, they do some subtle twist in the confirmatory analysis to reduce the conservatism. And it makes it difficult to make a judgment as to whether everybody has the same level of conservatism or not. That is an issue that we're grappling with right now.

CHAIRMAN SHACK: Yes. It would be sort of nice to know you were consistently conservative or --

MR. FAIR: Yes, it would be.

MEMBER SIEBER: Well, this is an issue for this plant. And it's also potentially an issue for a lot of plants.

MR. FAIR: Yes.

MEMBER SIEBER: And this is why on May 1st of this year, it appeared in the Federal Register that there was a regulatory information summary that is out for public comment now that will be sent to licensees to put forth the staff's position of the interpretation of the ASME code, which the staff since they are the regulating authority, they determine what the code says and what it means, so as to make sure that this is done consistently conservative in all applications.

And so I think that this is an important outcome that came out of this plant.

MR. FAIR: Yes. I think the status of that right now is that we issued a draft regulatory info summary for comment. And we have comments from about five different commenters on that. And right now we are evaluating the comments. We haven't come out with a final position.

But the other thing that was going on is we have asked a number of license renewal facilities to give us a confirmatory analysis in cases where this technique was used.

In all cases thus far -- and I think there are four of them -- the ultimate confirmatory analysis came out with a lower number, a CUF. Therefore, the original values were conservative but, again, --

MEMBER SIEBER: You don't know.

MR. FAIR: -- each one of these cases had some additional conservatism in the analysis when they did the confirmatory analysis they were able to take out. And so we can't make an overall judgment at this time.

MEMBER SIEBER: I would say that if the members would like a copy of the regulatory information summary, I have it here and would be happy to provide it.

MEMBER RAY: Well, Jack, in talking about generic or broader implications of this particular issue, it seems to me that this question of the question of the presence of the thermal sleeve cries out for some generic reflection as well.

I mean, is this simply a -- I guess the outcome was that we finally found the paper that we're going to believe tells us that there isn't a thermal sleeve in place. We didn't do anything to verify that directly.

MEMBER SIEBER: Well, I think there is a difference. One of them in one case, the licensee doesn't know for sure how his plant was built. And they're supposed to know that.

And it's not a matter of analysis or techniques. It's a matter of having the right information. In the other case, it's the application of an analysis and whether it is conservative or not.

I see them as different things, but they're similar from the standpoint that there may be other plants out there that don't have a thermal sleeve.

MEMBER RAY: Well, yes, but, I mean, I am thinking even more broadly than that. I mean, to me this is a significant example of the fact that we put a microscope of something and analyze the hell out of it without really knowing whether we're looking at something that is in the real world or not.

And it's that issue that I'm more -- I don't want to quiz the group here or attempt to pursue the issue now, but I would sure like to know a lot more about whether the staff thinks this is a rare exception or an anomaly or this is, "Oh, well, this is what happens all the time. After all, these rare plants, God knows how they're actually built. But, nevertheless, we're going to analyze the heck out of what we think it is."

MEMBER SIEBER: Well, I can let the staff answer that question.

MR. FAIR: Well, for this particular case, I think the applicant was using some data from other plants.

MEMBER RAY: I understand what happened. I don't want you to take the time to repeat it. I am just trying to figure out what is the broader implication.

If you've got an opinion about that, I would be happy to hear it, but I don't have an answer.

If somebody does, that would be -- it just seems to me like, for example, one would say, "Well, maybe we ought to do something to verify things that are particularly critical that we're assuming to be true when we consider a renewal application." That's just an example.

MR. FAIR: Well, this in my opinion is an unusual case. And as I was going to say that in the early '80s, there were a couple of cases of loose thermal sleeves, where they came detached and --

MEMBER RAY: Oh, I know.

MR. FAIR: And in the early '80s, there was a decision. All these nozzles originally had thermal sleeves. And there was a decision that they could take the thermal sleeves out of some of the locations --

MEMBER SIEBER: And it would be okay.

MR. FAIR: -- and demonstrate that they were okay by analysis. So there is a particular reason why this occurred in this particular case.

MEMBER RAY: Okay. Well, maybe there is a rationale that says this is a rare anomaly, as they say, but it does raise a broader question, I think, because we all spend a lot of time focused on minute details. And I sometimes wonder, do we really know what the real world is like? That's enough.

MEMBER SIEBER: Well, this particular issue I'm pleased that the staff identified it and the licensee was able to do an analysis that turned out okay.

At the time that the SER was issued, there was uncertainty as to whether there was a thermal sleeve or not. And the analysis had not been done.

MEMBER BLEY: I have a real simple procedural question, if I may. This one is a closed item, as I understand it, but subject to verification.

MEMBER SIEBER: Right.

MEMBER BLEY: And now it's subject to another verification.

MEMBER SIEBER: Right.

MEMBER BLEY: And I'm just curious why we call them closed if there is still something open on them. Do we do that routinely?

MEMBER SIEBER: It's a matter of the law. You can close out an item as far as compliance with the law regarding the application with a commitment that it will be completed and examined by the staff -- well, the law says completed -- prior to the new term of the license.

So you can close out an issue of renewed license based on a commitment to do something in the future but before the time of license extension. So that has happened here in a couple of cases.

MEMBER BROWN: But that's the comment I made earlier about several of the commitments had commitment completion dates in March 2025. I mean, I can barely remember.

MEMBER BLEY: Somewhere there is a tally list.

MEMBER BROWN: Yes, there's got to be, but tally lists get lost. I mean --

MR. MEDUFF: This is Jim Meduff of the staff, in the Division of License Renewal.

The applicability period for commitments really depends on the nature of the commitment. If it's something where we have an issue where we need the applicant to commit to something and get it in before the period of extended operation, the period of applicability will be before they enter that period.

If it's a type of commitment where they may need to do some sort of activity to get some sort of verification during the period of extended operation, then what happens is there may be specified time frames in the period of extended operation we specify that we want them to get them completed by.

MR. HOLIAN: And just to add, -- this is Brian Holian -- the other question on the table is, you know, will the staff be able to adequately track those commitments?

And between the operating reactor projects, license renewal, and the inspections in the regions, we will have these commitments tracked to completion.

MEMBER SIEBER: Well, it's important to me that the staff review the commitments that have been made in this case and in every case for your perusing, rather than just have the licensee say, "I completed this reanalysis. Here is the paperwork" and everybody say, "Yes, it's done" and that's the end of it. I don't think that's the right way to close out the commitment.

MR. HOLIAN: Well, with respect to that, that can be done one of two ways. If it's something where we have to look at it for review and approval, it will come into the staff before the period and go down to the appropriate technical staff for review.

MEMBER SIEBER: Right.

MR. HOLIAN: If it's something where they're going to do something during the period of extended operation, then we need to verify it will be done through a regional inspection.

MEMBER SIEBER: It doesn't require a new approval because it's not a new analysis. But in this case, you're using the analysis. I might point out in your slide 4, which was an introductory slide, there are no new confirmatory items. That may have been true because the draft SER that came out last February -- there are actually 41 confirmatory items in the current SER.

And so let us not be misleading. I think it's not accurate, but it's not accurate with regard to the latest version of the SER.

MEMBER BROWN: Did you actually confirm that you don't have the -- there's a little bit of an ambiguous -- I wasn't quite sure that I heard the absolute positive.

MEMBER BLEY: Confirm that the paper said there's no -- that's my understanding. Is that correct?

MEMBER SIEBER: Well, the confirmation is the reanalysis.

MEMBER BROWN: No, no. But there is actually a sleeve or there is not a sleeve. They said they fell into this window of change by the NSSS vendor about what he did or what he didn't do. So you all fell into that intermediate window.

MR. DINGLER: Yes. This is Mo Dingler.

We actually pulled up the ASME NB fabrication reports that indicated there was no thermal sleeve. So that is the actual fabrication documentation.

MEMBER BROWN: Okay. So that's a certified report?

MR. DINGLER: That's the certified report, yes.

MEMBER BROWN: Somebody has to sign, put their Betty Crocker Good Housekeeping seal of approval on it?

MR. DINGLER: By the in-stamp person, yes.

MEMBER BROWN: Okay.

MEMBER SIEBER: Okay. I guess we're ready for the summary or last slide.

MR. FAIR: I had one more quick slide, but the applicant went over that. And that had to do with the transients that were put into the baseline system. There was concern on the pressurizer surge line that they had tracked transients after they had made an operating procedure change and that the ones before the operational procedure change were more severe and the applicant committed to update the baseline to account for those three changes to the operating procedure.

And another one was with the charging line on a number of types of charging events that they were tracking that some of the events may have been more severe on the earlier period of time before they used the tracking period to monitor them.

Actually, I think the applicant came in and said that the monitoring uses more conservative transients for the original operating period of time, but they're going to go back and re-baseline anyway with what they have determined. So that is the resolution of that issue.

MEMBER SIEBER: Okay. Thank you.

MR. TRAN: Next slide. In conclusion, the staff found that with the closure of the open items, the requirement of 10 CFR 54.29(a) have been met for the license renewal of Wolf Creek generating station.

MEMBER SIEBER: And that means that you can close an item to a future commitment. Some of these items were closed that way. That doesn't represent an impediment to planning your license.

MR. TRAN: Correct.

MR. LEE: Yes. This is Sam Lee from License Renewal Division.

I just want to add that the commitment documented in the appendix of the SER, when we issued the license, we issued license condition that points to that commitment list.

MEMBER SIEBER: Right.

MR. LEE: And then on top of that, for the region, we have a post-license renewal inspection procedure, 71 over 3. So when the plant enters year 40, the region will conduct an inspection just to work out if its commitments are being fulfilled.

MEMBER SIEBER: Are there any other comments or questions?

MEMBER BROWN: That's kind of late, isn't it?

MEMBER SIEBER: Mr. Chairman, are you --

MEMBER BROWN: Eighteen years from now? I guess he just closed me out.

(Laughter.)

MEMBER BROWN: What if they find a commitment is not done and this is like the date of the license extension? They just don't put the extension? They shut down? All right. Okay.

MR. PICK: The 71.003 inspection, unlike this -- this is not our typical regional inspection. If I have an issue, I have to consult with the Program

Office. And I have to I'm going to use the word negotiate with the licensee if I think something isn't right as an inspector.

When I do my 71.003 inspection, it will be against the SER, which it is a record. And if they don't follow it, I now have legal authority to cite them. And there is no negotiation. They said they didn't, and they didn't do it. And I'm in more familiar territory when I know what I can do.

MR. HOLIAN: And this is Brian Holian.

Just one final comment on that. You know, we have done the first of those inspections at a significant plant. And we even do it prior to the 40-year period to ensure that they're entering the extended period with the commitments met. So we have already done the initial one at the outage prior to GNAY.

MEMBER SIEBER: Mr. Chairman?

MR. PICK: The first one is in 2013. So we will have experience.

CHAIRMAN SHACK: With a two-minute head start, you are only three minutes over schedule. We will take a break now until 10:45. Thank the staff and the licensee again for very good presentations.

(Whereupon, the foregoing matter went off the record at 10:34 a.m. and resumed at 10:47 a.m.)

CHAIRMAN SHACK: We're back into session.

3) DRAFT FINAL REVISION 1 TO REGULATORY GUIDE 1.131, "QUALIFICATION OF SAFETY-RELATED CABLES AND FIELD SPLICES FOR NUCLEAR POWER PLANTS"

CHAIRMAN SHACK: Our next topic is the draft revision to Reg Guide 1.131, "Qualification of Safety-Related Cables and Field Splices for Nuclear Power Plants." And Otto will take us through that.

MEMBER MAYNARD: Thank you, Mr. Chairman.

3.1) REMARKS BY THE SUBCOMMITTEE CHAIRMAN

MEMBER MAYNARD: I know the agenda says, "Draft Reg Guide, Rev. 1.131."

CHAIRMAN SHACK: I had three different numbers for this reg guide.

MEMBER MAYNARD: It's actually going to be coming out as Reg Guide 1.211. And I believe they are going to go through this. There has been some history.

The original Reg Guide 1.131 was issued as a draft rev. 0 for comment back in I think 1977 and had extensive comments and was never issued or published. So there's never been a rev. 0 of 1.131 published. I think they're going to be going back over --

CHAIRMAN SHACK: There was another draft Reg Guide 1.132, then -- well, okay.

MEMBER MAYNARD: Anyway, the bottom line, it's the same subject, but it's a different number. And they will be going over a little bit of the history of that.

Basically this reg guide endorses IEEE standard 3-83.2003 with several exceptions and clarifying staff position. And it's relative to the qualification of safety-related cables and field splices.

Originally we got a copy of this. And the intent was for us to review this today and potentially put a letter out, either saying, "Issue it" or "Not issue it" or whatever comments that we may have.

It is my understanding that there are some changes that are being made and being presented today that are some different regulatory positions than what we have seen in the document that was provided to us.

So we'll have a decision to make as to whether or not we need to see a final copy or whether we have enough information today to go ahead and make any recommendations.

So at the end of the discussion today, I'll be going around and just seeing if we believe that, with the information provided, that we have enough or whether we need to see something a little more finalized. And also we need to get to the finalization, whether these are final or whether these are things still working in progress here.

So, with that, I will go ahead and turn it over to Satish Aggarwal and lead through the presentation here and Reg Guide 1.211.

MR. AGGARWAL: Thank you very much.

3.2) BRIEFING BY AND DISCUSSIONS WITH REPRESENTATIVES OF THE NRC STAFF

MR. AGGARWAL: Mr. Chairman, we are here today to present -- and I will not mention the number of the reg guide for the qualification of safety-related cables. I hope that you concur with the staff position and send us a letter after the meeting.

Essentially I want to tell you some background. I would like to tell you about the public comments which we received, how we resolved them. And at the outset, let me point out that there is a total agreement with industry and the staff, there are no outstanding comments except the issue of condition monitoring. There is a group that's on --

CHAIRMAN SHACK: That's a big except.

MEMBER MAYNARD: And I apologize. I should have mentioned at the end of the presentation, we are going to have some public comments at the end of this session.

MR. AGGARWAL: Yes, sir. And, as I said earlier, we are very open. We wanted to give a fair chance to industry to go back and look at where the staff is coming from. We had no legal obligation to release this document to the public, but we went the extra mile. Copies were provided to all commenters.

So there was enough time to review for the kind of a challenge to them that, hey, we are looking at the comments very objectively and we believe we have it.

In summary, they sent us a letter, which was received yesterday. Again, from a system development practice, we looked at those comments very objectively. And where we found that we should make changes, we will. And I will point out that. And that is a part of the slides 9, 10, and 11.

Further, as I said earlier when there was some chuckle when I made the comment, except, we will deal with condition monitoring quite at length. I will also explain to you about IEEE standard 3-23, which is a mother document on qualifications. IEEE standard 3-83 is a daughter standard. I will try to explain the relationship between these standards.

MEMBER BROWN: Say that again. One of them is what, and the other one is?

MR. AGGARWAL: One is called as a mother document.

MEMBER BROWN: Which is the mother document?

MR. AGGARWAL: Three twenty-three.

MEMBER BROWN: Oh, 3-23. I'm sorry.

MR. AGGARWAL: It is not the topic on the agenda.

MEMBER BROWN: That's fine. I just lost the bubble on the numbers.

MR. AGGARWAL: Right. I will briefly describe about that. Three eighty-three is considered to be a daughter standard. Similarly, we have two separate reg guides. 1.89 covers the qualification of the plant overall. And this reg guide is coupled to cover the broader standard about the reg guide. We don't call it but in that sense.

Okay. You are aware that IEEE standard 3-83, which is on cable, was issued in 1974. And nothing was done over 30 years within the IEEE, as you know. And one of the reasons was that we had problems with the original standard.

There are many, many comments. And we were saying that IEEE standard 3-23, which is a mother document, which is endorsed by regulation 10 CFR 50.55(a) and also regulatory guide 1.89. They should be followed for qualification of all safety-related equipment, and cables are one of them.

So we worked diligently with the IEEE. And it took some time that this standard was ultimately revised in June 2004 and the issue of the IEEE standard 3-83.

Now, what we have done in the regulatory analysis or activities is that we issued this reg guide 1.131, which is one of the very particular kind of situations of issues of comments in August 1977. And it did endorse IEEE 3-83 `74 with multiple exceptions. It remained always a draft guide that was never issued.

The funny thing is that if we go to NRC website, we find that a rev 1 was also issued for comment as a draft. But nowhere we can find a copy of that one.

MEMBER MAYNARD: This is 13? This is --

MR. AGGARWAL: 1.131. Okay? And, I mean, I have been too long with the NRC. I don't have a copy. We cannot find a copy anywhere in the world.

The bottom line is there was a lot of confusion beside the topic of basic subject matter has changed between the old guide and the new guide.

MS. ANTONESCU: Satish, I am sorry. There is a copy on the Web site for the old record.

MR. AGGARWAL: Rev 1 is not available. Rev 0 is available. Okay? So now, going back to the basic issue, we have clarity. We are going to issue. As I was saying, the subject matter has changed. The connectors are no longer part of this proposed new guide. In the old guide, connectors were included. So we will issue this as a reg guide 1.211, as a new reg guide.

The Committee should also note that when we issued the draft guide, DG-1132, at that time the guide was issued under the exemption, which is not a revision of the old guide, but it will be new guide. So I think that clarifies. And our hope is that once we issue 1.211, we will withdraw 1.131 so we are clean, have a clean plate.

Now, the DG-1132 adds, I mentioned several times, was issued for public comment in June 2007, wherein we took ten exceptions. And, again, I must stress that nine out of those ten exceptions are more like clarifications, nothing significant, nothing technically different. And the ten, which will be major topics on my discussion with you today, will be on condition monitoring. Okay?

We received five comment letters, which you have as a package, resolution of public comments. And names of all of the organizations are highlighted. And, just for information, I'll repeat, they were from IEEE, a group NUGEQ, Duke Power, Exelon, and Westinghouse. Staff looked at those comments. And, as I said earlier, we are going to discuss quite at length.

The scope of this guide is very plain and simple. It covers all safety-related cable, whether they are in power instrumentation and control and communication cables.

MEMBER BROWN: Can I ask a question? You talk about ten exceptions. And Christina sent out a bunch of stuff, you know, a copy that was labeled 1.131 and all kinds of other documents.

I went through every one. I could never find ten exceptions. The only document I ever saw had seven. So when I went through the public comment and took a look at the public comments, I couldn't even correlate the comments to something that was --

CHAIRMAN SHACK: You had to go to the Web site and get DG-1132, where they were --

MEMBER BROWN: That I did not have. So that --

CHAIRMAN SHACK: -- and it made sense then.

MEMBER BROWN: Then it makes? Okay. Well, all right. I quit again.

MS. ANTONESCU: There was another copy that was sent out in July. And that is the one Satish is referring to, another version of the final draft.

MR. AGGARWAL: On these documents, which is available to the public in DG-1132.

MEMBER BROWN: Okay.

MR. AGGARWAL: And we had those comments. These exceptions, there are ten of them. And we have to address them according to those numbers.

MEMBER BROWN: I figured you all got rid of three. You have said that somebody had something on three of them, and you would --

CHAIRMAN SHACK: It was advertised as a redlined strikeout version, but there was never any record that it was ten and that it had become seven in our redlined strikeout version.

MR. AGGARWAL: I am going to explain to

you. Before I am done with, you will have no questions in your mind. I can assure you of that.

All right. Let's go back to the basic issues that include splices but does not include fiber optic cables and connectors. NRC has accepted reg guide on connectors, reg guide 1.156, which was viewed separately. And there is an IEEE standard, 5-72 2006 on the topic. It's that plant that goes there sometime in the near future.

And let's talk about the daughter standard, IEEE 3-83 2003. What does it cover? Essentially to write the general requirement, directions, and matters, how do you qualify especially the cable and splicing?

Now I am going to pause for a moment. And I know there are several new members on the Committee now. And they didn't have the benefit from my presentation here on the cables. So I just very briefly want to explain to you how do we do the testing of cable or safety-related equipment, in general.

At the outside I must point out that we take only one prototype, one sample. Sometime in the real testing, they may go with six, seven, or more samples, but the bottom line is that the standard only requires one prototype.

They tried to bring what they call preconditioning. Preconditioning means re-aging. They wanted to bring that cable to 40 years of life in terms of the radiation and --

MEMBER BROWN: Is that IEEE that wanted to do this?

MR. AGGARWAL: Yes.

MEMBER BROWN: In 3-83? I mean, they have a bunch of tests like that that they --

MR. AGGARWAL: That's right.

MEMBER BROWN: -- for the qualification?

MR. AGGARWAL: This is what I was involved. So what they will do there that -- you will age the cable. In all probability, what the industry has done is two different labs. One, they will do the thermal aging, which means aggravated temperature. In the other one, they will do the radiation. That takes care of the normal radiation as well as the accidental radiation.

Once this is done, which involved pre-age, then they will throw the cables in a test chamber.

MEMBER BROWN: In a what?

MR. AGGARWAL: Test chamber.

MEMBER BROWN: Oh, okay. A chamber. Yes.

Okay.

MR. AGGARWAL: And normally most of the testing had been done at the Wiley Lab. Some other companies also have done, but mostly cable testing was done at Wiley Lab.

MEMBER BROWN: Is this the temperature?

MR. AGGARWAL: Aging, thermal and --

MEMBER BROWN: Thermal aging? Okay. Do they include humidity in that?

MR. AGGARWAL: They assigned it to some other radiation lab. They bring it back. And then they put in a LOCA. LOCA test chamber is a large chamber. The cable samples are put in. And you have the monitors outside. Cables are energized. And you have this thing at the standard for in the test chamber.

MEMBER BROWN: I am familiar with that. I did that.

MR. AGGARWAL: They want to see whether the cable will survive or not. And, again, I want to stress that in a nuclear power plant, we use different kinds of cables for different applications.

For a given application, when we are testing, the requirement is only one prototype, one single sample.

MEMBER APOSTOLAKIS: You seem to emphasize that a lot. Do you think it's not enough?

MR. AGGARWAL: Well, when I come to condition monitoring, you will know why I am stressing that point.

MEMBER APOSTOLAKIS: Okay. You are setting the stage.

MEMBER BROWN: But one thing --

MR. AGGARWAL: I am trying to precondition your minds.

MEMBER APOSTOLAKIS: And you are aging my mind.

(Laughter.)

MEMBER BROWN: George, that's not unusual. I mean, right now in one of the programs I'm involved in, they've got brand new 13.8 kV cable being used in an ADC application. We have gone through this exact same process, some of the IEEE, some other ASME testing. You know, you wrap it around mandrels and you age it for so long in certain things. You do these. But it's only one. You only do this --

MEMBER APOSTOLAKIS: Are these expensive tests?

MEMBER BROWN: They are time-consuming because you have to stick them in someplace and run it thermally at some temperatures for some period. It's the Arhennius-type stuff. If you want to believe that, you can, but you do it. And then you wrap it around mandrels afterwards. And you run insulation resistance tests, characteristics tests, et cetera. So this is not uncommon.

The issue of whether you use one cable and that's it, one prototype, for a type of cable or multiple ones has always been up there, but it gets very expensive if you go do that.

So there's a push-back all the time. If somebody builds a type, they label it something. They go out and they test their sections. Everybody walks away. Here is the test report. They're happy. And you pray that the guy makes it the same way for the next 15 years, because you just don't know. There's almost no ability to confirm that they maintain their manufacturing and quality standards unless you have something contractually to hold them to. It's very difficult.

MR. KOSHY: We expect them to adhere to those same quality assurance programs through which the original product was produced.

MEMBER BROWN: Yes.

MR. KOSHY: And we, in turn, ask for a

certificate of conformance confirming that they have, in fact, produced to those standards and we do spot audits from the industrial side as well as from the analyses side on selective occasions to make sure that the quality is for --

MEMBER BROWN: Yes. And that's what we've tried to do in the Navy program. When somebody goes back out and tries to buy this five years later for the next ship, the vendor has to certify that he has changed nothing. If he has, then you have to reassess does it need to be requalified or not?

And that is tough to keep track of, probably better here than it is in some of the -- I hate to say this but in some of the -- because it's done on the non-nuclear side. So it can kind of get frittered away if you're not careful.

MEMBER MAYNARD: Why don't we move on because I think --

MEMBER BROWN: Yes.

MEMBER MAYNARD: -- this is leading into more of the other things that need to be done to maintain the quality.

MEMBER BROWN: I just wanted to provide the calibration because we haven't even talked about the connectors having to be on this stuff yet, which is another wrinkle.

MEMBER POWERS: To prevent Otto from realizing his hope, let me ask a question. We have been entertained in this Committee several times by a set of experiments looking at fires and the effect of various cable insulations on the propensity to have hot shorts.

Is this kind of information being factored into the development of standards for splices? In particular, the experiments being conducted by the staff show that thermal plastic kinds of insulation have higher propensity, whether for hot shorts, than do thermal set types of insulations.

MR. AGGARWAL: The standard simply tells you how to qualify a cable in the test path. In a very brief, prescribed procedure, it does not address any of these factors. Remember, you do pre-aging. You do the LOCA testing and the mandrel tests. And that is it.

MS. UHLE: This is Jennifer Uhle from Research.

Dr. Powers, your question there I think is pertaining to the fire protection program and the work that is done there. We can ask that question. That's not in this division. It's in another division. So we can go back and ask that question to the fire protection experts there. I think you're talking about the CAROLFIRE program. And we can get that answer to you through Christina.

MEMBER POWERS: That's good. The question I'm asking is, gentlemen -- because here you are formulating a regular tour guide on handling splices. You address one class of accidents. But we know from risk assessment that another class of accidents where it is threatening is those that you're considering.

And I'm asking you, in formulating your position and in adopting the standard, with all of your comments and exceptions, have you borne in mind that there is another component to the risk profile of nuclear plants that deserves consideration? And if you have not, then at what point does that information and that threat to the safety of plants get its own reg guide?

MR. AGGARWAL: Well, that is not addressed in the reg guide at this time.

MEMBER MAYNARD: Should it be?

MEMBER BROWN: You mean the splice issue?

MEMBER MAYNARD: Yes.

MEMBER BROWN: The IEEE standard covers splices to be qualified. I mean, it has, but I don't know --

MR. AGGARWAL: As a part of the cable, yes.

MEMBER BROWN: Pardon?

MR. AGGARWAL: As a part of the cable.

MEMBER BROWN: Yes.

MR. AGGARWAL: Splices must be qualified.

MEMBER BROWN: Yes, but --

MEMBER MAYNARD: But not with respect to fire.

MEMBER POWERS: IEEE does whatever IEEE does.

MEMBER BROWN: I am not arguing. I am not arguing with your point. I'm just saying there is stuff in there. It's just whether it's complete enough to meet your thought process. I don't know.

MS. UHLE: Well, I think the way the agency has handled this is that there is the design basis condition testing here. And then the fire protection aspect is handled in a way separately, through endorsement, NFP PA standards.

And I think so the way this all works together to make sure that there is no loophole there or regulatory concern or a safety concern, we'll get that answer back to you.

MEMBER MAYNARD: I believe that this is for environmental qualification, design basis accident, T temperature aging, and stuff. If the licensee wants to use this, take credit for it as a fire barrier or for fire, that there is a different set of criteria, this is just qualifying it for the radiation, heat, temperature, steam environment but not necessarily qualifying it to be credited as a fire barrier.

MEMBER POWERS: You stated it correctly. I am asking you, why are we doing this? This seems like an unnecessary and perhaps unwise stovepiping of our thinking. The advantage to having a tool like risk assessment is to integrate all of these things together.

MEMBER BROWN: There's a partial answer to that. I mean, you've got to have a cable that's qualified for the environment in which it is going to be applied. That is number one. Put everything else aside. I mean, if it's going to be in a hot, chemically aggressive environment, you have to qualify it.

If it's going to have bends and a lot of bends, then you've got to run those bends. And they've got to be aged. And you've got to make sure they can withstand it. So there is a basis for just a fundamental qualification of a cable.

If you then want to extend it to become a safety -- a severe accident barrier to something, that is a different circumstance.

MEMBER POWERS: It is by definition a safety-related cable.

MEMBER BROWN: Well, let me finish. No, no. Let me finish. If you look at the way the plants are designed -- and I've got two months of whole experience on these commercial plants here. So I am really talking about something -- that will fix me, I'm sure. I keep seeing it. They put all the stuff in different rooms, in different compartments now, at least on the new plants.

So whether a cable is suitable for a DBA-type severe accident environment, we are already assuming that that is only in some spaces and not in other spaces. So that other diverse or redundant instrumentation or controls are still available, or monitoring systems.

So I'm not so sure. I haven't gone through this in ultimate detail. But I'm not so sure you would need to qualify the cable and the splice to a severe accident consideration.

That's just my initial thought process. Whether that is right or wrong, I don't know. It's just that was my going-in thought process when I started going through this.

MR. KOSHY: Minor factors. The cable manufacturers have currently done it. They have improved their product such that it is self-extinguishing in the sense it will not propagate a fire, you know, in the conditions of internal fault or external fault.

And for design purposes, what we assume is if you really did have a fire in a zone, you know, separated into rooms and compartments with fireproof doors and containing devices, it will be restricted to that area so that it will not negatively spread over and affect others.

And even for existing plants, what we have done is we have gone back and protected a channel or, rather, a train of systems necessary for shutdown. And we protected it such that, in spite of the fire, those channels necessary would remain intact.

So, to summarize, in this qualification process, what we are doing is -- this will not actually cause a problem in a sense, cause a fire and allow it to propagate. That part is done through chemically. And now we are confirming through this qualification process it can, in fact, withstand the harsh environment that will be a consequence to an accident.

So either of the strains remaining available will serve our ultimate purpose in mitigating an accident. So any of these claims remaining intact post the power condition that you are referring to. We will be able to mitigate the effects of an accident.

MEMBER ARMIJO: Within the scope of this standard -- and this is a question in clarification -- there must be more than one way to make a splice, I'm guessing.

MEMBER BROWN: There are dozens of ways to make splices.

MEMBER ARMIJO: So in this qualification, are these dozens of different splicing techniques part of the qualification program? Each one of these different splicing methodologies, techniques are qualified individually?

MR. AGGARWAL: Correct. The manufacturers normally will qualify the methodology used for splicing. They will qualify the people making qualifications, how to make splices. And the bottom line is that it is a separate process.

MEMBER ARMIJO: If there's a field of splices done at the plant by different people than the manufacturer, --

MR. AGGARWAL: Qualified people.

MEMBER ARMIJO: -- they are qualified? Okay.

MEMBER ABDEL-KHALIK: In many of the applications we have heard so far, it appears that outdoor cable vaults tend to flood. And the issue that is in my mind, how is that issue addressed here?

MR. AGGARWAL: We want to address that briefly. As I go through, I will detail that issue.

MEMBER ABDEL-KHALIK: Thank you.

MR. AGGARWAL: Can you wait for a few minutes?

MEMBER ABDEL-KHALIK: Sure.

MR. AGGARWAL: Continuing, these standards require the quality assurance program. It is implemented everywhere. I think under the next viewgraph, you will see we want to make sure that no failure mechanism exists, which is a cause in common cause failure under the postulated in DBA or DBE and the service conditions.

And naturally in order to do this, you

have to have a qualified life. Based upon the techniques available, you may designate that my cable is good for 40 years and, therefore, that is the qualified life. And you will create the cable for 40 years and do the testing.

MR. KOSHY: Qualified life in the sense that, up to that life, it can stay intact and still work through an accident. That is what you are qualifying for: brought to the end of life, and then it can withstand the effects of an accident and do its function.

MR. AGGARWAL: Yes. Because the accident can take place at 39 years and 360 days, you have to qualify that way that you create for the 40 years. And an accident will take place at that time.

MEMBER ABDEL-KHALIK: My concern is that some of these cables, the connective cables, may be submerged for --

MR. KOSHY: We are coming to that.

MR. AGGARWAL: We are coming to that.

MEMBER ABDEL-KHALIK: -- for a considerable length of time.

MR. AGGARWAL: We will answer. As I promised you, you will not have any questions.

MEMBER ABDEL-KHALIK: All right.

(Laughter.)

MEMBER MAYNARD: Let's move ahead.

MEMBER RYAN: I just want to add one question. Maybe you will answer this one, too, down the line. I am always interested when I hear 40-year life and we do accelerated testing. If you can address how accelerated testing is going to represent long-term condition in this case? I don't know anything about cables.

MEMBER BROWN: You'll have to ask all the Ph.D.'s why Arrhenius supposedly works. Some of this necessarily I understand it.

MEMBER RYAN: It is -- you need a boundary. You have a conservative case. I would just like to learn a little bit about that.

MR. KOSHY: The best technique that we have so far used the Arrhenius technology. And what we are doing is, you know, we are elevating the temperature for a shorter duration, which should reflect its life at the longer period in the plant.

MEMBER RYAN: Should is the word I am worried about.

MR. KOSHY: So far we find that to be the best available technique. And over the years, certain other countries, like Japanese and I think in Belgium, they have done some slow rating in the sense, not elevating the temperature, like 120 degrees or 140 degrees. They left it at a lower temperature. In that case, the test duration gets much longer. And those appear to relate pretty well.

But what we have done is we have added a substantial margin in spite of that to make sure that for the covered period, we would still remain on the conservative side.

MEMBER RYAN: Okay. Let me just ask you maybe to give us the details. That would be helpful.

MR. KOSHY: I can provide you later with some specific details.

MEMBER RYAN: Okay.

MR. KOSHY: In fact, we have some NUREG reports that has been addressed through our labs.

MEMBER RYAN: Thank you.

MR. KOSHY: And I can provide that to you, yes.

MEMBER ARMIJO: When you do these aging experiments at elevated temperatures, do you do them under load or are they --

MR. KOSHY: You have to monitor the function of the cable, yes.

MEMBER ARMIJO: Are they energized 15

maybe --

MEMBER BROWN: Not necessarily. A cable that's good for 700 amps and 13.8 kV may not necessarily be at 13.8 kV and 700 amps. It will be energized.

MR. AGGARWAL: That's right.

MEMBER BROWN: But in a test chamber, you've got to have feed-throughs to do that. So there is considerable hand-wringing over the validity.

MR. KOSHY: And they will monitor the leakage current also so that --

MEMBER BROWN: Right.

MR. KOSHY: -- we have an understanding of --

MEMBER ARMIJO: It's not really fully energized.

MEMBER BROWN: It depends on the level of -- I mean, if it's a 120/200-volt cable, something like that, you can do that. But at 13.8, it's much more difficult when you try to do that in a --

MEMBER ARMIJO: That's why I asked the question.

MEMBER BLEY: I am sure it's much more difficult, but maybe these gentlemen could tell us about the tests they are talking about and how they are done, the specific -- are they done at --

MEMBER BROWN: I am not trying to tell them. I was just trying to go back.

MEMBER BLEY: I understand, Charlie. And I understand where you're coming from. It's the same. Is it the same the labs doing it or do you have the same? Are they tested at the power they're actually going to run at: the voltage and current?

MR. KOSHY: Full load current, like it goes two ways, is practically difficult. So what they do in those cases is you have reasonable loading and monitor any leakage current so that we get a clear picture of the status of the insulation.

And also the tests that are done after this, you know, to verify that the insulation stayed intact give us the added assurance that insulations did not fail through the accident reading.

MEMBER BROWN: I mean, for example, some of the 13.8 kV cables that may be in your safety, coming off your buses and everything else, when you do periodic insulation testing of those. Not everybody does that at 13.8 or 15 kV. They do it at 4,160 or 5,000. And you are making the assumption that that is okay. Big arguments on --

MR. KOSHY: Well, plus in plants, you

know, the safety cables are in the tight area range.

MEMBER BROWN: Right.

MR. KOSHY: 13.8 has been in a likely reactor coolant pump and some pumps which are not subject to a harsh environment, just safety-related and hot harsh environment.

MEMBER MAYNARD: I would like to go ahead and move on here.

MR. AGGARWAL: Testing for different methods of qualifications. The qualification testing is the preferred method of the staff. And we would like to have the documentation, which should be on the table.

With that background of these standards and discussion --

MEMBER MAYNARD: Can I ask you a question? It's on the slide. I do think it's important to note that qualification by analysis alone is not --

MR. AGGARWAL: Acceptable.

MEMBER MAYNARD: I think that's key.

MR. AGGARWAL: Okay. Now --

MEMBER BLEY: When people submit their test results of the successful test, do they have to tell you if they had done a previous test that had failed?

MR. AGGARWAL: There is no such requirement, but there is a, you know, moral obligation. But it is not normally done.

MEMBER BLEY: Thank you.

MR. AGGARWAL: Let me also point out when you read that issue, NRC, under its own research program, they came in first over the last decade, they did test all the cables independently just to see what level of confidence we had. And, you know, by statistics, you know the more samples you do, they will fail. There's nothing like 100 surety.

In that case, some of these samples did fail. But the industry said, we can explain those failures. And this is where it ended. And this also studies our point, why we ask condition monitoring now so that we continue and we address that issue.

MEMBER BLEY: Thank you.

MR. AGGARWAL: At this time I would like to turn over to the exceptions. There are about ten exceptions. The new guide has only seven. And why we are not talking about the others, they were resolved and staff agreed with the public comments; there is no use wasting time.

MEMBER MAYNARD: As you go through these, can you be clear as to if any of these are different from what we had seen in the --

MR. AGGARWAL: I will. Actually, with viewgraphs 9, 10, 11, I will explicitly address what they were and what happened.

MEMBER MAYNARD: Good.

MR. AGGARWAL: In the exception 1, essentially the industry was saying, you are asking too much information. And we agreed that some of the information is required by the standard, but we wanted to know the definition which was in this standard, clause 3.3, that is specified whether the conductor is round, what specification it is, strain information, as well as the information about whether what kind of a shielding it had. Okay?

And the reason is that if someone ten years from now wants to use that cable tap for a different kind of cable, he ought to know what the cable is. So we were simply stating the point, document it. Nothing more was required by the industry but just document so at a later date you can use it.

MEMBER BROWN: This is just a configuration issue, what the cable looks like physically?

MR. AGGARWAL: Exactly, exactly.

MEMBER BROWN: And during the test conditions?

MR. AGGARWAL: That's right, so representative cable, quote and un-quote which is being tested. The exception 2 was with regard to qualifying the specific cable with connectors.

The industry had problems. We are giving the reason why we were doing it. And this is modified based on the number third letter, which I will discuss letter. So I am going to move on.

Exception 3. Again we wanted to know, document the standing configuration, you know, what it is, no testing done, just simply noted.

Again, exception 4 is document manufacturing standards and data manufacturer so we know when the testing was done or was it not done.

The exception 5 is the test to include testing of this cable for electrical performance characteristic. You should tell in your specification how the cable will be used.

Exception 6 was again very simple that you have a manufacturer's inspection and maintenance requirements. You should document. And that should be level in EQ files.

The exception 7, here we have concern or, rather, the staff had no concern, the industry had concerns. The exception 7 addresses the monitoring of the environmental conditions.

What we are saying is very plain and simple. You ought to know where your hardest parts are. You must have radiation monitors. You must have temperature monitors. And you are well-aware of what environment you are dealing with. That is number one.

Number two, we are saying that the cable, which is risk-significant, namely which are connected to this significant equipment, you must make sure that they will perform. Therefore, you must have some kind of inspections such as walk-through, visual indication, or anything you do, in addition to one technique for condition monitoring of your choice.

Bottom line is that you cannot simply test a cable today and then say in 40, 60, or 80 years, I am not going to do anything. I qualified forever. It is forever. And that is no longer acceptable.

Our maintenance rules require that you preserve your basis at the time of qualification, that you have to do something about it. And, again, we are focusing only on risk-significant cable. Okay? Go ahead.

MEMBER BLEY: Some of those cables in

older plants, you know where they start and you know where they end, but you don't know quite where they go in between. Is there an exception here for those?

MR. AGGARWAL: I am aware in some cases they run into -- I am not suggesting to the industry to break that to do something. I'm saying to the extent it is possible and practicable, they should.

MEMBER BLEY: Okay.

MR. AGGARWAL: But just don't sit in my classic example, which I have given before. You buy a car and say, okay. I'm not going to do anything. It drove on the first day. You can drive it 40 years, you know.

MEMBER BROWN: You said any appropriate technique supplemented with walk-throughs, which I take that to mean visual inspections down the cable link.

MR. AGGARWAL: That's correct.

MEMBER BROWN: And Dennis' comment is right to the point. I mean, you can't even find the way these things wind around through various cable trays or open up cable trays to be able --

MEMBER BLEY: In the older plants. In the new plants, you know exactly --

MEMBER BROWN: It's better.

MEMBER BLEY: No. You know exactly where they are.

MEMBER BROWN: They have a -- I mean, the way we call it in the Navy programs, you have to build it exactly according to the plan. In other words, you specify the location of every cable hanger. You specify what tray it's in, where the cable is within the bundle that's in there.

MEMBER BLEY: For the last 20 years.

MEMBER BROWN: And that's the way the commercial plants are built now in the last 20 years?

MEMBER BLEY: About the last 20 years.

MEMBER RAY: Well, wait a minute. You made a transition from safety-related to risk-significant somewhere along the way. And I didn't catch when you made that change. And it's relevant to what Dennis is talking about.

MR. AGGARWAL: They are risk-significant safety-related cables. They are all safety-related cables. And we are saying don't do it for all of the cables in the plant, just which is connected to risk-significant equipment.

MEMBER BLEY: But you are just talking about exception 7.

MR. AGGARWAL: The calculation in review, what industry has to do.

MEMBER RAY: You are defining risk-significant as a subset of safety-related, --

MR. AGGARWAL: That's right.

MEMBER RAY: -- as opposed to the other way around?

MR. AGGARWAL: That's right.

MS. UHLE: I think, actually, we're using it there as an adjective because we're saying of all the safety-related --

MEMBER RAY: This is --

MS. UHLE: Can I please finish?

MEMBER RAY: Yes, you may.

MS. UHLE: Okay.

-- of all the safety-related cabling, focus on those that are most risk-significant. So it's a bit of an adjective because obviously there are some cables that are not safety that are also risk-significant.

MEMBER RAY: That's correct.

MS. UHLE: So this guide here is focused on safety-related cables?

MEMBER RAY: Right, right.

MS. UHLE: So this --

MEMBER RAY: You've got to have your

terminology straight here.

MS. UHLE: No, I don't --

MEMBER RAY: Don't need to?

MS. UHLE: No. I think we do have our terminology straight. This guide is focused on safety cables. So now we are asking them to do monitoring. And we want them to go and focus this extra effort on those safety-related cables that are the most risk-significant. So it's a --

MEMBER RAY: Now you've inserted the word most. Isn't risk-significant a defined set?

MR. AGGARWAL: Yes.

MEMBER RAY: Okay. Now, if risk-significant is a defined set, is it a subset of safety-related or is it greater than safety-related?

MS. UHLE: It's a subset. And it can also include non-safety cables as well.

MEMBER RAY: It's not a subset. It's greater than safety-related.

MS. UHLE: Depends on what you mean by greater. It's not --

MEMBER RAY: I'm trying to find out what you're talking about.

MR. AGGARWAL: If you will --

MEMBER MAYNARD: The population here, it's risk-significant. You don't have to include the non-safety-related, risk-significant in this particular --

MEMBER RAY: That's not what she said.

MS. UHLE: No. That's what I said.

MEMBER RAY: She said you do have to.

MEMBER BROWN: Well, no. This reg guide is only for safety-related cables.

MEMBER RAY: Well, now, that's a problem, isn't it?

MEMBER MAYNARD: So this is kind of a new subset.

MEMBER RAY: Yes. It is new, I claim, to say that I'm dealing with things that are risk-significant unless they're not safety-related. Then I'm not dealing with them.

MS. UHLE: Our regulations, I mean, it goes back to the fact that our regulations have defined in classified things that are safety-related and non-safety. And then as we learned more about PRA and its application, we gained some insight here and --

MEMBER RAY: But he mentioned the maintenance rule. The maintenance rule deals with more than safety-related items.

MS. UHLE: Exactly.

MEMBER RAY: Okay.

MS. UHLE: But this particular guide here and the requirements in 50.55(a) are focused here on safety-related components. Now, the licensees, of course, if they're looking at trying to, I would say, use risk-informed arguments to change their licensing basis, it behooves them, obviously, to pay more attention to those things that are non-safety that are risk-significant. But at this point in time --

MEMBER RAY: You're using terms like more and most. I'm going to give up because I don't want to continue the argument, but I don't know what exactly he's talking about.

MS. UHLE: He's talking about safety-related components. Okay? So that --

MEMBER RAY: All of them?

MS. UHLE: At this point, yes. This guide --

MEMBER RAY: You let them answer. Can I, please?

MR. AGGARWAL: Regulation 50.49 -- incidentally, before we go further, Jennifer is my division director. She has the oversight on all the --

MEMBER RAY: I don't care who is in charge here.

MR. AGGARWAL: No. I just wanted to clarify.

MEMBER RAY: I am just trying to find out what you are talking about.

MR. AGGARWAL: Okay. I will. I will. I said every answer will be answered. Our regulation 50.49 defines what this safety-related equipment is. It goes further, that non-safety-related equipment with failure that keeps this safety-related equipment from performing its sole safety function is also covered under 50.49.

MEMBER RAY: I know that.

MR. AGGARWAL: But what we are saying to you is that you have that group of cables, safety-related, subset of this. And you have post-accident monitoring.

MEMBER RAY: Okay. Stop right there.

MR. AGGARWAL: Okay.

MEMBER RAY: Because everything you said up to the last sentence would say to me you've got safety-related and then you've got other steps that meet this definition.

MR. AGGARWAL: Right.

MEMBER RAY: Okay. You just stop right there.

MR. AGGARWAL: Okay.

MEMBER RAY: Then you're not defining anything within the subset of the set called safety-related as being excluded. Everything is included.

MR. AGGARWAL: Correct.

MEMBER RAY: Right.

MR. AGGARWAL: Now --

MEMBER RAY: That's not what she said.

MR. AGGARWAL: I think she's consistent with what I said. I hope.

MEMBER RAY: Fine. So you're talking about safety-related plus things that are not safety-related but that are safety-significant?

MR. AGGARWAL: I won't use the word safety-significant because we never used that in the regulations. But we are saying that with failure, it can prevent a safety-related equipment from performing.

MEMBER RAY: Yes. That's the classical definition of safety-significant. I just don't know how you're excluding things that are safety-related because they don't satisfy the need I think, to use your term, as being most safety-significant.

MEMBER MAYNARD: Well, okay. I am getting confused here now. And I agree with you, Harold. Can we kind of go back and see? I have heard two different things here. Does this include non-safety-related or not? Are there any non-safety-related cables that fall into this monitoring?

MR. AGGARWAL: As I stated previously, regulation 50.49 defines what is covered by qualification of safety. They use the term in those days important to safety. And they had those categories.

MS. UHLE: This only covers safety-related cables.

MR. AGGARWAL: Right.

MS. UHLE: And there's a definition in the regulation about what is safety-related. And safety-related is a deterministic argument. There is no input from PRA at all.

MEMBER RAY: Correct.

MR. AGGARWAL: Exactly.

MEMBER MAYNARD: All of that is right.

MS. UHLE: Okay.

MEMBER MAYNARD: We are trying to get the scope. We say --

MEMBER ARMIJO: The introductory sentence here says, this is regulation qualification of safety-related cables and field splices for nuclear power plants, period. That's it.

MEMBER RAY: That's simple.

MEMBER ARMIJO: I believe that is what you said.

MEMBER MAYNARD: I think what we are really getting into here -- and this is a contentious issue with the industry we will be hearing from them -- is on the condition monitoring part.

And so there are really two questions here. Number one, should condition monitoring be put as a requirement? And if so, what is the population that would be put into that?

MR. AGGARWAL: Exactly.

MEMBER MAYNARD: And so maybe we should address a little bit on the condition monitoring first as to whether that should or should not be imposed as a requirement. And what is meant by it?

One of the issues that I have with the reg guide is it doesn't provide any guide. This says, any appropriate means. I could write a reg guide that says, you can comply with the regulations by any appropriate means. It doesn't really provide any guidance.

I would like to know what you are talking about for appropriate means for condition monitoring. What are we really expecting of that?

MR. AGGARWAL: We intend to. Let me close a loop. Earlier we talked about the 41 cable outside the manholes in standing water. The requirement we see here is that you will have inspection testing and monitoring program to detect degradation of cable, of cable installation, which is submerged in water.

MEMBER RAY: Which are what?

MR. AGGARWAL: Submerged in water, usually ten feet of water in a manhole, situation like that. And there is no factory demand with the industry. They agree such a full count will be over if needed.

Now, if we turn over to viewgraph now on 9, slide 9, 10 are 2 minor changes we have made. And 11 is the conditioning monitoring where I will focus the rest of the time.

MEMBER MAYNARD: Okay. Now, this is on 9. Let's just --

MR. AGGARWAL: Yes. The other one --

MEMBER MAYNARD: From a process standpoint here --

MR. AGGARWAL: On slide 9, this is in response to the letter which we received on September 3rd, 2008 from the nuclear industry, which a copy is provided. Actually, the letter is addressed to you.

MEMBER MAYNARD: I'm asking more a process question here right now than challenging it. This is different from what was provided to us earlier in the reg guide.

MR. AGGARWAL: Correct.

MEMBER MAYNARD: So this is going --

MR. AGGARWAL: I am going to tell you explicitly what changes we --

MEMBER MAYNARD: I understand. But what I am asking here now is, this was a fairly recent, last-minute change. So this is a new staff position. Is it an approved staff position? I don't know what the coordination is within the staff on these.

We have three new staff positions here. Are these approved, been through the process of whatever it takes to make it an official staff position?

MR. AGGARWAL: That's correct. What we are representing to you is the staff position, the staff. All appropriate coordination has taken place.

MEMBER MAYNARD: Good. And also I might

add we are not covering any other ground. They have already stated in response to the public comment. Simply, we have taken that out and put in the discussion part around the reg guide, and not only that. This letter was suggesting we do.

So, in other words, their comment stated two points. The one point goes away. The next point, in there they are condition monitoring, which I said I would discuss.

So on the viewgraph 9, slide 9 --

MEMBER ARMIJO: On your chart, when you put the word representative in quotations, that means it means something other than representative to me. It's got some sort of special connotation.

MR. AGGARWAL: No. It is just simply telling you that if you go to the clause 3.3 of IEEE standard 3-83 2003, there's a definition given. We're talking about representative with cable having --

MEMBER ARMIJO: So it is representative as defined in that document?

MR. AGGARWAL: Of course.

MEMBER ARMIJO: Okay.

MR. AGGARWAL: And, again, there is nothing unusual with this. We are just simply saying a plant will provide all of that documented information and document it.

Next. This was the problem which industry read in their letter of September 3rd, 2008. They were saying the position as it existed in the guide, which we have a previous version here. It will apply to all coaxial, triaxial, and twin axial cables.

It's too broad. The staff is correct in pointing out their concern, which is there in response to the public comment, that they want to simply clarify -- and the staff agreed -- that this should be supplemented to include approved connectors for those test specimens where we have a problem of concern regarding the differential cable extension.

So, again, this was what the industry requested. We agreed.

MEMBER BROWN: Position 3?

MR. AGGARWAL: Yes. This will replace --

MEMBER BROWN: The coax cable in this position 5 in the letter I've got. Position 3 is conductor should include stranding.

CHAIRMAN SHACK: It's better to look at the handout they just gave us.

MEMBER BROWN: That's what I'm looking at. They handed me this. I threw away all my other stuff. I've decided that is useless. I have no idea what it is.

MR. AGGARWAL: I stand corrected. That is the position 5.

CHAIRMAN SHACK: Position 2.

MR. AGGARWAL: I am so sorry. This is the regulatory position 2. The staff can stand corrected. We are seeing here the 3, section 3, regulatory position 2.

MEMBER BROWN: Position 2. Okay. Yes. That's another --

MR. AGGARWAL: And we take that out.

MEMBER BROWN: It's not three.

MR. AGGARWAL: Yes. It's an oversight. See, with these computers these days, I cannot say it is a typographical error. Those days are gone.

Anyway, the bottom line is take that position out and replace with this. And this is what exactly the industry requested.

MEMBER BROWN: Okay. I've got this redlined doohickus that was just handed to us along with this package. Does that look like this or do we now have to mentally --

MR. AGGARWAL: If you take two, it's the other --

MEMBER BROWN: The redlined?

CHAIRMAN SHACK: The redlined.

MR. AGGARWAL: Yes.

MEMBER BROWN: I've got two redlines over here. I'm not even sure which redline is correct.

MEMBER MAYNARD: We need to make sure that what is being put up on the board is the exact wording that you're talking about.

MR. AGGARWAL: That's right, exactly, except you will replace that 3-22 borderline five lines will be exactly the same as you see in this slide.

MEMBER BROWN: Okay. So this redlined thing reflects your viewgraph?

MR. AGGARWAL: Correct.

MEMBER BROWN: Is that correct?

MR. AGGARWAL: Yes.

MEMBER BROWN: For all of these items?

MR. AGGARWAL: Yes. Moving on, if we may, to the slide 11. This is again on the same issue which we just discussed. And the staff is giving the information why we think those connectors should be included. This is the way the industry wanted us to do it. And we agree there is a point.

This information is already there in response to the public comment. And this document will disappear so we decided to put it in the discussion portion.

This item will be added. Instead of the last paragraph which you have, we have that connectors should be included. That will be deleted. And we will have a different paragraph.

Now, the last item --

MEMBER BROWN: No, no. Don't leave this one yet. I am totally --

MR. AGGARWAL: Oh, I'm sorry.

MEMBER BROWN: I'm back to, you put something in under discussion relative to -- and I see on the little redlined job. I see this thing that says, further clause 6.1 requires that suitable test specimen links, et cetera, et cetera.

Okay. All right. So that complies or they're the same. If I go read this word for word, they're going to be identical.

MR. AGGARWAL: A hundred percent. You have my assurance.

MEMBER BROWN: Christina, you just said there were a couple of more tweaks and one of the --

MS. ANTONESCU: You can see it right on the redline.

MEMBER BROWN: So it's not 100 percent the same?

MS. ANTONESCU: A little bit, yes.

MR. AGGARWAL: I did provide to the ACRS, the staff copy of the new reg guide. They took correction and copied it.

MEMBER BROWN: Yes, but they are all labeled September, rev 1 without --

MR. AGGARWAL: Is that a number for the reg guide on the top 1.211?

MEMBER BROWN: Yes. I saw that.

MEMBER MAYNARD: Let me just call a timeout here for just a minute because this is unusual. In fact, yesterday I wondered if we should even cancel this presentation and reschedule it because we've got so many last-minute changes.

There's a lot of confusion. It may not be confusing to you, but it is to us getting a lot of things at the last minute. What are we really being asked to approve and look at here?

I'm wondering if what we really need to do is to look at to get all of these consolidated, get one document that we all look at and visit this at another meeting or whether we believe we're going to be able to work through this and know at the end of this what we're really going to be approving here.

MR. AGGARWAL: Mr. Chairman, may I answer that part of the question?

CHAIRMAN SHACK: Okay. You can have your comment on it.

MEMBER MAYNARD: This question is for the members, not for the staff. I know what your --

MR. AGGARWAL: I am just trying to get some input to help you to make a decision.

MEMBER APOSTOLAKIS: So let me understand the situation first.

MEMBER MAYNARD: Do we even know what we're approving here?

MEMBER APOSTOLAKIS: So changes were made until when?

MEMBER BROWN: Yesterday. This morning.

MEMBER APOSTOLAKIS: Yesterday.

MEMBER BROWN: Or this morning, I guess.

MEMBER APOSTOLAKIS: Isn't it the policy of this Committee to receive the document three weeks?

MS. ANTONESCU: About four weeks, but we had two final drafts. One was received in July and one in August and tagged as September. Yesterday we had no new changes that you were told based on the NUREG letter. So the comparison that you have is the latest version of the changes that the staff would like to make.

MEMBER ARMIJO: So the redlined are the latest changes. And all the previous ones are okay?

MEMBER BROWN: Almost.

MEMBER APOSTOLAKIS: I think what is really --

MEMBER MAYNARD: My concern is that some of the changes I'm not sure what is being shown to us are things that they sent us or whether it's our interpretation of what is changed.

And it's a little bit confusing to me at this point. And I have been looking to these as to what are we really approving or reviewing here. And so I am a little bit confused.

MEMBER RAY: Well, on the issue of scope, it seems clear to me that there is unresolved ambiguity. I don't see how you could say it differently. We're getting different inputs here as to what we're talking about scope-wise.

CHAIRMAN SHACK: That one I disagree with you on, but I --

MEMBER ARMIJO: I don't see that, Harold. The data is right there in the document.

MEMBER RAY: Well, let me refer you over to page 3 here, where it talks about monitoring and says that we're talking about controlled cables whose failures could disable risk-significant equipment. That doesn't say anything about being safety-related.

CHAIRMAN SHACK: That is because the whole guide starts out saying safety-related.

MEMBER ARMIJO: Risk-significant within the safety-related.

MEMBER RAY: Okay. If that's the way the way you're going to read it, this is safety-related cables whose failure could disable risk-significant equipment. I guess I have to ponder that a little bit, Bill, to figure out how something becomes safety-related, even though its failure would not disable risk-significant equipment.

But laying that aside for a minute, I understood it to be said here that we were also reaching outside of safety-related with the understanding that you gave us as well. So that's what I mean about ambiguity.

The use of the term risk-significant is being introduced in a deterministic environment, which is defined by things being safety-related or not safety-related.

I dealt with that an awful lot in my life. And let me tell you that it's very confusing for somebody to use this damn thing, for us as a reviewer of it, to not know exactly how and to what it applies. I'll stop there.

MEMBER BROWN: No. I agree with you. The shifting terminology just drives me nuts when I read documents that then have different words meaning kind of the same but they're not exactly the same.

MEMBER MAYNARD: Let me suggest to the Committee here that, what I think might be more meaningful with the rest of our time here on this, is I think it would be better if we ended up with a finalized document or with wording so we're all looking at the same thing and identify some areas that we want to have more detailed discussion/presentations on.

I think the scope is extremely important. I think it is important to talk about what are we really talking about condition monitoring and if there is something else and have them come back and talk to us about that.

I am concerned that if we try to write a letter right now on this, it's --

MEMBER ARMIJO: Will add to the confusion.

MEMBER MAYNARD: We're going to add to the confusion and might even be misquoting what we're even talking about here. So this is an unusual procedural thing here, but that is kind of where I am seeing things right now.

CHAIRMAN SHACK: Okay. You don't think it's worthwhile pursuing the discussion. you know, leaving aside exactly what we're condition monitoring and exactly how we're going to do condition monitoring, what the objections to condition monitoring are at all.

MEMBER MAYNARD: No. I think we just talked about that.

CHAIRMAN SHACK: That's some discussion that we should understand perhaps and then not write the letter but at least examine that issue --

MEMBER MAYNARD: Yes. That's fine.

CHAIRMAN SHACK: -- for our information and understanding and that --

MEMBER MAYNARD: I think that would be worthwhile.

MEMBER APOSTOLAKIS: So the letter would be --

CHAIRMAN SHACK: Yes, sometime, when it can be rescheduled.

MEMBER BROWN: I mean, I don't want my comments to be taken as objecting to qualification.

Cables ought to be qualified. And if we have not, if the NRC has not, established some reg, new reg or reg guide, however they're framed, for defining that and using the IEEE, some standard for what that qualification means, there ought to be one. I agree with that.

Condition monitoring, adding connectors in is another issue. Now you're matching stuff up. I've got this guy's connector. Now he doesn't make that connector anymore but three years later you've got to replace the cable. Now you've got another guy's connector. Do I have to redo that qualification? That's the way I would read it. Yes, you have to redo that qualification.

As being a user similar to Harold and some others in my other, my old job, that became a real judgment issue as to when you requalified or not. And having an absolute statement like that is very difficult for industry or anybody else to deal with. There has to be some room for judgment in my own opinion.

Now, I don't know who makes the final, you know, puts the Betty Crocker Good Housekeeping seal of approval on it, but it's got to be done.

And the third thing there are some

technical things. The Navy does condition monitoring in a way. They run insulation resistance tests periodically on cables, main cable, all kinds of cables for the exact reasons they're talking about. You inspect what you can, but you don't rip cable ways apart.

So I don't know whether there's a -- saying there will be a walkdown is another bit of a hard spot.

CHAIRMAN SHACK: I mean, I guess the question is always, should we just move forward? And then we can make the decision as to whether we want to write a letter or not.

MEMBER BROWN: We ought to talk about it. I mean, we ought to get everybody's opinion. But, I mean, it's just --

CHAIRMAN SHACK: Well, I would like to try to move forward to the substance, especially for the condition monitoring.

MEMBER BROWN: Yes, exactly.

CHAIRMAN SHACK: You know, I think we have raised some other problems that we can talk about in our letter and that they may want to address in a final final draft.

But I think to me the big issue that we

haven't gotten to yet is condition monitoring.

MEMBER BROWN: I think there are two of them: Condition monitoring and a qualification of cables and connectors together with absolutes written down the line. I'm not against it necessarily, but I am trying to look downstream at an execution when you're building a series of plants or something a little ways away.

CHAIRMAN SHACK: We are down to 20 minutes here.

MEMBER MAYNARD: Let's go. Let's get into the condition monitoring as to --

MR. KOSHY: I can I just provide just two points of clarification? The attempt to give you an update yesterday was just to avoid another meeting to incorporate the comments from the industry. So from those three changes that you saw, it was just trying to help out and see if you have to meet again for another --

CHAIRMAN SHACK: Unfortunately, the problem isn't with the changes. The scope issue is in the original.

MEMBER MAYNARD: In the original, yes.

MR. KOSHY: Okay. And the next point, I guess you have a lingering question on what are we addressing as risk-significant. See, what we attempted to do here is this regulatory guide is dwelling on what is deterministically classified as safety-related.

So what we are saying, narrowing our discussion to given that you have safety-related cables according to a certain regulation, rather than telling industry, "You should do a monitoring program of all of those safety-related cables," what we have learned over the years is we can identify some of them to be very predictable for accident mitigation. And if you focus on those cables to have this extra of affirming that it can do --

CHAIRMAN SHACK: I think Harold's point is that is true in the maintenance rule. However, when we define risk-significant, we give you a criterion for what risk-significant means. If you told me risk-significant meant, you know, I had a risk achievement worth of X, that would define it. This one doesn't do that.

MR. KOSHY: This one does this. Within that classification, whatever is deterministically classified as safety-related falls into that group. And what Jennifer was clarifying is there is still another body of cables outside the scope of this reg guide that may need --

CHAIRMAN SHACK: What is a risk-significant safety-related cable? I know what a safety-related cable is. What is a risk-significant safety-related cable?

MR. KOSHY: That will be a plant and assigned specific evaluation. Watch the stem scan contribute so that there will be scan deminimized.

MR. WILSON: Their comment is valid, Tom. You need to go back.

MR. KOSHY: Comment is valid, yes.

MR. WILSON: You've got to go back. And we're going to have to define clearly what the risk significance is. That's what they're bringing up.

MR. AGGARWAL: Yes.

MR. WILSON: All right. Their comment is valid. We're going to have to do that.

MR. AGGARWAL: I would like to define now the risk-significant term is defined in 10 CFR 50.65 in regulatory guide 1.174. But that definition is defined. And the industry commented over this. And we provided that response in resolution of public comment.

MEMBER APOSTOLAKIS: 50.65 is which regulation?

CHAIRMAN SHACK: Okay. If you mean risk-significant in the same terms as the maintenance rule, doesn't that clarify? That solves problems.

MR. AGGARWAL: Exactly. And we have it stated. If you look at the document on page 18 of that response to the public comment, it clearly states --

MEMBER APOSTOLAKIS: How do you get the risk-significant failures?

MEMBER RAY: Well, it says here failures could disable, but the point is if that is the definition of risk-significant you're talking about, fine. But now you're going to say, well, we only want to look at the safety-related ones within that larger set.

MR. AGGARWAL: Correct. You've got it right.

MEMBER RAY: Yes. Now, does this make sense?

MR. AGGARWAL: To me, it does.

MEMBER RAY: It does? Okay. It doesn't to me, period.

MEMBER BROWN: I am so simple-minded. I need a big circle that says what is risk-significant and what defines that and then another small circle inside that says, "What about what it does?" I can't think --

MEMBER SIEBER: The circle is safety-related

MEMBER APOSTOLAKIS: The risk achievement work is greater than two. And the fossil vessel is greater than .005. Another question in my mind is, how on Earth do you determine those for --

CHAIRMAN SHACK: You look at the table. You look at the equipment that has been --

MEMBER APOSTOLAKIS: You are going back. That was quite an adventure in --

CHAIRMAN SHACK: The point that Harold is making is we need to somehow be able to define what risk-significant means, which we clearly haven't done.

MEMBER APOSTOLAKIS: Well, that was the main argument, the main argument, in that whole -- I don't remember a number.

CHAIRMAN SHACK: 50.69. But they're not trying to cover. You know, that would be a different approach is to cover all the risk-significant cables. This is safety.

And I agree with Harold. There are reasons why that doesn't make sense. But since you've got a regulation that deals with safety-related cables and you want some way to prioritize the safety-related cables, risk significance is a sensible way to do it.

MEMBER BROWN: Okay. So risk-significant, then, is a bigger ball --

CHAIRMAN SHACK: No, no.

MEMBER BROWN: -- then the safety-related ball.

CHAIRMAN SHACK: Those are two balls. They overlap.

MEMBER RAY: That's right, exactly what's been said just now. It's not clear here, and I didn't think it was clear in the presentation.

MEMBER BROWN: Words are not working.

MEMBER MAYNARD: I would like to move forward, talk about condition monitoring and what is really being proposed here for that. That is one of the issues that -- well, the industry doesn't believe that should be put into the Reg Guide.

And so I would like to have the staff address for me what types of condition monitoring things are you talking about because you say, "any appropriate means."

MR. AGGARWAL: Okay. Essentially what the staff is telling you is that if you look at the maintenance rules, it is our submission that the techniques, again what is -- I will talk about it -- for condition monitoring for the cable should be incorporated in the maintenance core plan in a nuclear power plant to maintain and demonstrate qualification through the qualified life.

You heard from me before one thing of prototype, probably ten times, the staff is saying that we need to do something. And we are not describing any particular technique. What they should choose, we are aware and not see as many, many new regs on that issue. IEEE had two standards, 400.8 and 400.2, which describe a different process.

We also know that one single condition monitoring technique cannot be applied to all kind of cables. Therefore, we are leaving it up to the licensees that they can pick up any of the known techniques for their given plant for given cables.

MEMBER SIEBER: Okay.

MR. AGGARWAL: Okay? Now, it can be a simple thing, such as IER. It can be elongation at break. It can be partial discharge, any of those known techniques.

MEMBER BROWN: Go back to the first one you said again. I heard you say about elongation?

MR. AGGARWAL: Elongation at --

MEMBER BROWN: You're going to cut some cable out and test it for elongation again?

MR. AGGARWAL: No. You check the elongation, the different interval of aging. It is a known procedure, process, which some of the countries and companies have used it.

What that simply means, that you take a cable which is working. You see the elongation. Then you do it 5 years, then 10, 15, and 20.

MEMBER ARMIJO: So you have got to have a surveillance program, --

MR. AGGARWAL: Right.

MEMBER ARMIJO: -- clean out the operating cable?

MR. AGGARWAL: That's right.

MEMBER BROWN: So you have another cable that you sit down there that's parasitic?

MR. AGGARWAL: This is not the place for me to define different techniques of the condition monitoring at this time. All the staff is saying, hey, licensee, you pick one of them which you think will fit your plant.

I am not accepting the argument, do nothing.

MEMBER ARMIJO: I don't think we are

either. The problem is we don't know what would be acceptable, you know.

MR. AGGARWAL: We will accept any technique.

CHAIRMAN SHACK: One at a time. Let's let the staff speak on this one.

MR. KOSHY: The reason that we haven't specified a particular technique is based on the cable design; for example, shielded type, EPR, CSB, all those materials and its physical configuration. You need to take an appropriate technique suitable for like cable design to make sure that insulation is intact.

What you referred to was one of the techniques that is used that is good only if you have sample cables planted in the plant in that location to take a sample and test something. European plants are extensively using that technique. They are putting samples in there so that they can continue to evaluate its life.

In my knowledge, I work in an international cable database group with NEA. We counted about 23 techniques so far. All of these things came about because of the design uniqueness.

The reason we are not specifying is

looking forward as well as backward, there are 70-plus types of cables. These two IEEE standards have made an effort to identify what techniques are suitable for certain types of cables in certain configurations. And they are continuing to work on it to improve it and use other supplementary directions.

In summary, what we are saying is we are staying away from specifying a technique because the industry hasn't narrowed down to uprate techniques which can be suitable for all kinds.

In fact, at our project, they have developed a new technique that appears to be very promising. In fact, EPRI conducted some tests on it and found that to be suitable for about half the types of cables that they had looked into.

So industry is advancing in that area. So at this time, we feel very uneasy about going into specifying a technique. That's the reason we left it open, so that they can choose an appropriate technique that would verify that the insulation has not degraded.

MEMBER APOSTOLAKIS: And you will have to approve it after they selected it?

MR. KOSHY: No. We are leaving it to the investigator to make it appropriate. In fact, there are some such facilities, like Oconee. They used a technique through which they were able to defer their cable replacement to another outage. And they successfully replaced those cables.

And I have ordered those examples in the generic letter 2007-01. And I came to this group for presenting that generic letter. That letter went out to incorporate the industry programs that are in place. And that's where we found out there are about 260-plus failures that have happened in the operating cycle of the plants.

So we are not worrying about cables that are in place. There is operational failure of that number. But we are also worrying about, can those cables also withstand an accident environment. In other words, these cables haven't seen accident environment and have failed.

So we are imposing this requirement for risk significance. Sorry if you didn't like the use of that term. The significant cables need to be inspected with an appropriate technique suitable for the design and application and confirmed that it is continuing to be capable of that function. So that is the expectation.

CHAIRMAN SHACK: Yes, but the industry,

one, argues that the condition monitoring can't tell you that it is capable of performing in the accident situation.

MEMBER SIEBER: That's right.

MR. KOSHY: I see that to be a very, you know, not well-informed answer. They should be pursuing techniques that are appropriate for their cables. I told you that's about 20-plus techniques available.

MEMBER SIEBER: But how can they do that? Then you can evaluate the condition of the cable in the environment that it is in. But how are you going to evaluate its condition in the accident environment?

MR. KOSHY: Okay. Let me highlight this. When you are trying to qualify a cable, we bring it to an end-of-life condition and then expose it to accident environment.

So we have an understanding of how far it will degrade during the preconditioning process. So when I make a measurement now, if it appears greater than my preconditioned end-of-life condition, that gives me an indication it can survive the accident or not.

MEMBER ARMIJO: Are those electrical measurements that you're talking about, some sort of electrical property degradation or --

MR. KOSHY: Yes. There are whether you --

MEMBER ARMIJO: Okay. So if you had a cable that was 20 years old and you did this test and you found out it is behaving like a 40-year-old cable, that would be an indication that something has gone on.

MR. KOSHY: In that case, you plan so that you can replace the cable through the winter.

MEMBER MAYNARD: Well, you answered my question on what pipes. And I agree it would be difficult to put guidance on exactly what to do for each cable and stuff like that.

It wasn't clear to me, though, as to who was going to pick what was appropriate or not and whether we are setting ourselves up for arguments in the past.

So I think this is appropriate, and I don't. But you said the industry picked any appropriate methods behind --

MR. KOSHY: They're going to have to --

MEMBER MAYNARD: -- the industry standards or the NRC --

MR. WILSON: And use operating experience as they have failures that come on and modify those testing criteria because there was a cable failure at Point Beach, where they were using a methodology. And that methodology that they used didn't even show them that there were faults there.

So we already know that some of the testing capability out there, there is better testing capability than what they are doing. And that was a very significant failure at Point Beach in their off-site power system.

So not only are they going to have to pick it, but they are also going to have to use their own operating experience as stuff comes to make sure that they are using the right methodology that is out there because Point Beach learned the hard way that the methodology that they are using is not there.

The industry's main point when we wrote generic letter 2007-01 is that there is not a predictive maintenance tool. And we agree with them. There is nothing that says, "This cable is going to fail in three months" or "This cable is going to fail in 18 months." There is nothing out there.

But they have to give us some sort of a reasonable assurance that the cable is going to be able to perform its function. They have to do some sort of monitoring to say, "Hey, this cable is here" because we are having cables just fail, even though there are no indications they are going to fail. They are just failing. And some of them are very risk-significant.

MEMBER MAYNARD: Well, we are close on time. We do have industry comments. I would like to get to those and that we could decide where we go with what we do with our next step.

I did have just before you leave one last procedural question. You changed some staff positions from what went out earlier for public comment. Do you intend to send this document out again for public comment?

MR. AGGARWAL: No, sir. Sir, before you I would like to take 30 seconds of the time. I have been with the agency for 32 years. And I have made presentations before this Committee dozens of times.

And all of a sudden it has happened that some comments have been provided during the meeting, and the staff has agreed upon that we would incorporate those changes. We were simply going the extra mile out of our way to address the comments which were given to you yesterday. We could have simply kept quiet and made no changes and come here and just answered your questions.

The bottom line is that the staff put a lot of effort in bringing a good technical document. And I believe it behooves this Committee -- again, it is my opinion.

MS. UHLE: Okay. Satish, we've got it. We need to move on here. I think that we didn't follow the process. I think that we should have followed the process personally. And I think it has caused some confusion.

We understand what you were trying to accomplish, but I do think it caused some confusion. So Ed Hackett and I will talk about that.

MEMBER MAYNARD: Can we move now, then, to the industry comments? Do you have any slides or anything?

MR. HORIN: No, no. I just have the letter that we sent in yesterday. Good afternoon. My name is Bill Horin. I am the counsel to the Nuclear Utility Group on Equipment Qualification.

By way of background, this group has been in existence since 1981. We represent over 90 nuclear power plants in the United States as well as 2 of the 3 nuclear power plant owners in Canada.

We have by a combination of both legal and technical expertise provided comments, have been interacting with the staff since prior to the time that the equipment qualification rule was approved in 1983.

Our technical consultant is Phil Holzman. He has been involved in this area for over 30 years or 30 years, close. I began my involvement in this area of equipment qualification in 1988.

We submitted comments yesterday as a result of having had the opportunity to review some of the staff's resolution of prior comments. I would like to say first -- I mean, we seem to be going after Mr. Aggarwal here -- the process that was used in providing this draft guide for comment and then also to reaching out to those who had commented already on the guide to provide them with proposed resolutions to those comments I think is exemplary. And to suggest that this was not a good process I think misses the point because we know that there are iterations that take place on the resolution of comments.

Satish is correct. They could have ignored those who had made comments, come out with their proposed guide, met with the ACRS, and be done with it. But I think, you know, the staff should be commended on the process that they used.

I also want to point out that, even though we provided these comments just yesterday to the ACRS, two of the three, condition monitoring is the one that remains. The staff has looked at, they have considered. They have determined that it is appropriate for the suggested language that we had that we all are actually in agreement, I think, in two of those three areas.

I don't think that those were significant changes that would suggest that there needs to be additional public comment. The staff reached out again, as I say, to all of those who had previously demonstrated an interest in this guide to get further input. And I think the process has worked. If you want to talk to me about some cases where the process hasn't worked, I'll talk to you about those later.

I would like to in the time that we have here reiterate that the two of the three comments that we made, one dealing with the characterization of representative cable and the other dealing with whether it was mandatory to include the connectors on the specific cable for differential expansion may be an issue, we believe that the language that we have agreed on and which is reflected on the slides is consistent with what our concerns were.

One was simply the clarification. The

other was to also provide consistent with 3-83 the flexibility of licensees to address the differential expansion issue, including connectors in a means that is most appropriate for the particular application of the cable, the type of the connector, et cetera.

With respect to condition monitoring, let me give you a little background on the question of condition monitoring in cables. Over the years, there have been a number of different methods that have been proposed for condition monitoring of cables.

This is an area that has seen extensive research. It continues to see extensive research. Industry, it is fully aware of what has been done in the past. They're fully aware of what is going on in the present.

Our concern here is that we have language in this guide that suggests that a utility should use a condition monitoring technique. It could be whatever we may want, you know, whatever the utility might decide upon is best.

But the problem is that that establishes an expectation that one of the set of condition monitoring techniques that have been examined and researched over the years has to be used at a plant.

And, yet, as Satish pointed out, no one of those techniques has been shown to provide the type of information and all the different applications for all the different types of cable and that a utility would be faced with a situation of for given all the types of cable and the conditions that they see in the plant, being unable to select this one or that one or they would end up having to select dozens of them for different applications.

In reality, the combination of environmental monitoring, the use of walkdowns, the use of operational experience -- and when we say, "operational experience," we don't just mean, "Oh. We had a failure over here. We'll go fix it."

If we find a situation that reflects that there is a problem with this type of cable and its application, a licensee just doesn't say, "Well, let's put in a new cable."

As part of the quality assurance program that we have at all of these plants, we look at every failure as a nonconforming condition that requires evaluation, both for root cause and extended condition. We need to go back and analyze, why did that happen, how can we make it so that it doesn't happen again. So to suggest that, you know, we don't do anything with these cables after they have been installed in the plant isn't correct.

Licensees monitor the environments in the areas in which the cables are located. If it turns out that we find areas that are hotter, we know that for qualification purposes, we need to adjust the qualified lives of those cables.

If we find hot spots -- and oftentimes we have, and you can go and look in the literature. And there are many cases where licensees have identified hot spots. They may have because of the nature of the connections that were made -- perhaps some insulation was left off of a hot pipe below some of the cables. They have exposed certain segments of cable to hotter temperatures. We may find hotter radiation levels than what we had originally assumed when he analyzed the qualification.

But we have identified those. And we go in to look at them. And we take whatever corrective actions are appropriate and again look at the root cause, look at the extent of condition, and address those.

Let me step back a second on the condition monitoring issue. It is interesting that we have now spent basically an hour or whatever it is talking about condition monitoring and not once -- and many of the Committee members here are new, but not once was it brought up that beginning in about 1996 through 2002, the very question of the adequacy of qualification standards for safety-related cable and, important to safety cable, nuclear power plants and including condition monitoring was subject to an extensive NRC research program.

Millions of dollars were spent to evaluate issues such as the adequacy of Arrhenius, the appropriateness of that for estimating the qualified lives of cable. That program included extensive analysis of the condition monitoring techniques that were available at the time.

And with the possible exception of the EPRI, there haven't been any significant changes in that since the conclusion of that research in the 2002 time frame.

The staff's conclusion, the Commission's conclusion was that there are no specific condition monitoring techniques that can be used in all applications that would provide information that would be useful to assess the ability of the cable to perform its function down the road.

There are extensive reports on this. This was all involved in the resolution of generic safety issue 168. Following that research and following additional analyses with issues related to risk significance were also evaluated, as we point out in our letter.

It was concluded that it was not appropriate to impose an expectation of specific condition monitoring techniques for all of the reasons we mentioned in the letter. And there has been nothing since that time that suggests that there needs to be a change in that position.

I mean, the staff spent -- and, Satish, you can probably help me. I heard numbers in the seven million range in doing research on all of these different areas related to cable qualification. The results said, "Condition monitoring is not appropriate to be applied at this point in time."

It may be at some point in the future, but when you look at the combination of the uncertainty that would be involved in that as well as the relative risk significance given the extensive conservatism and margin that we have in our testing, given the fact that we address conditions that we find regularly and thoroughly so that we don't end up having those conditions creating problems in other parts of the plant, it was concluded, and I think rightly so. I think the staff got it right then that we should not impose expectations regarding specific condition monitoring techniques.

I know we're saying here, well, we're just leaving it open. You know, you can choose, pick and choose. But it's not that simple. You could say that this technique might work under these specific conditions, but that may only be a little bit of the cable. You are going to end up. And none of them are necessarily themselves foolproof.

We have a number of the electrical methods that are used for condition monitoring or proposed for condition monitoring that will look at the bulk length of the cable, but they're not going to tell you where somewhere in that 100-foot length or 200-foot length if there is a problem, there is a problem.

Other techniques, such as the elongation to break issue, that requires cable samples. So we can go in, and we can look at -- and there have been plants that have found hot spots. And they have gone in and actually scraped off pieces of the cable and gone out and tested it and compared it to data regarding the new cable of that same type. That would be focused on a specific area that you know that there is a problem.

What our point is is that the Commission spent a heck of a lot of effort and a lot of research. I mean, this high associated with the resolution of generic safety issue 168 that reaches in support of the conclusion that we shouldn't impose condition monitoring expectations now.

MEMBER MAYNARD: Not reliable.

MR. HORIN: Not reliable, not applicable and across the board. And from the standpoint of risk given the nature of the design of the plants and the nature of our testing again, I think the staff's words quoted in here in our comments were "No" or -- I forget the exact word now. I have to go look. You know, there's very little, if any, safety benefit that would be gained by trying to apply condition monitoring techniques.

So that's our point. This has been an issue that we have been debating with the staff for years. We would all like to have a magic bullet in terms of condition monitoring, but there isn't a bullet.

And so what we're saying is that if the language goes into a reg guide, even though it's a reg guide, that says we expect that you will utilize a condition monitoring technique, we know that inspectors will be out there that will say, "Well, what is your condition monitoring technique?"

Well, I disagree with that. I don't think that is the right one. I think you should be using this. So we would be setting up a regime immediately again in guidance but a regime that practically could not be implemented. Licensee would be at a loss knowing what to do.

And I'll repeat. Given the multiple layers of conservatism and margin in every aspect of the qualification and the implementation of the qualification requirements in the plant, it hasn't been demonstrated that it's worth saying that we need to do that now.

And nothing has changed since the resolution of generic safety issue 168 that would suggest to --

MEMBER MAYNARD: I am sorry, but is that your close? Can you bring it out to a close here?

MR. HORIN: Yes.

MEMBER MAYNARD: I apologize, but we have allotted so much time here. Okay. Thank you very much for your comments.

MEMBER ARMIJO: Could I ask just a quick question?

MEMBER MAYNARD: Okay.

MEMBER ARMIJO: The issue of walkdowns -- I'm not a cable guy. I would expect the only thing you would see was some gross damage to the cable. Does your find that as unnecessary or --

MR. HORIN: No. What we have found is that when you go down and you look at configurations, you look at cables that are exposed, you will identify areas where there may be issues. Many utilities utilize. There would be more gross issues. You're not going to find a little slice on a cable that is buried inside a tray.

MEMBER ARMIJO: Somebody dropped a big piece of --

MR. HORIN: Right. But many utilities utilize temperature guns, where they will test along the trays at different points in the plant. And if they identify hot spots, they'll say, "We'd better take a look at this."

And then you find situations where it's so obvious somebody left off a piece of insulation on a hot pipe and all the cable that's three feet above it is toast. And so you go in and you say, "Well, one, we have to fix whatever our process is to assuring that the insulation remains on." But then let's evaluate the cable. Let's see what needs to be replaced, et cetera, et cetera.

Walkdowns are beneficial, though.

MEMBER MAYNARD: We need to be bringing this to a close. And I really appreciate everybody's input. This is one that, in retrospect, we probably needed a subcommittee meeting on. I think it is very difficult in the time frame that we had to get into the depth and discuss some of the things.

So to the staff, it's just that we have a number of questions in a number of areas. We would have probably been better off ourselves to have escaped to the subcommittee meeting to have aired some of those things out.

CHAIRMAN SHACK: Can we give them five minutes to see if they want to say anything to respond?

MEMBER MAYNARD: Okay.

MR. KOSHY: What we have attempted to with this reg guide is address a narrow spectrum of cable, which we call safety-related. And the title speaks to that effect, the safety-related cables.

And the only part that we have added in relation to the previous portions and the draft portions is to include a testing and monitoring requirement for risk-significant cables. The staff's reasoning is operating experience and the generic letter that we put out, which basically collected 250-plus cable failures.

We look continuously at the operating experience to see if our existing regulations and requirements are adequate. And we make timely adjustments and make decisions appropriately so that we can make sure the operational readiness of this can be affirmed.

So initially the industry at that point also stated that the cable failures are random because we have this extensive qualification program. Cables are failing because of maybe some manufacturing defect of some of the problems of that nature.

What we find is the numbers that we see for a limited duration of the bar, 10 to 15 years, operational failures, we see that as risk-significant because if the cable is suitably sized and suitably selected for the environment, it will very surely last for much longer than 40 years with no problem. And the new product line would, in fact, be much better.

So it is in light of this operating experience that we have chosen to include this added requirement so that the risk-significant cables could get --

MS. UHLE: The risk-significant --

MR. KOSHY: -- and safety-related --

MS. UHLE: -- and safety-related.

MR. KOSHY: -- cables will get this attention so that they are very sure that they remain available and operable for an accident mitigation.

We recognize that there could be a group of cables outside of this that may need our attention that we may have to address through a different process, through a different reg guide, or maybe through another method, but for the purposes of qualifying the cable and saying how this qualified cable subsection should have an added attention, we have thought this would be the appropriate vehicle to convey that message.

MR. AGGARWAL: I may add two points. The term safety-related is there defined in our regulations. The rule was issued somewhere in 1981. Since then we have issued at least a dozen reg guides using the same term, safety-related. For all of our deliberation and all reg guides they use it consistently.

Finally, the term risk-significant is well-defined in our regulation and regulatory guide.

And it doesn't need any further definition. We were just trying to agree with the industry that you cannot take all cable -- it's in some plants maybe a million feet -- to monitor all the cable that now only a few selected cables. We take and see if they are in the hardest part and are risk-significant.

MEMBER MAYNARD: Okay.

MR. GILL: If I may just add a point about condition monitoring? My name is Paul Gill. I am electrical engineering staff. I'm also author of a book called *Electrical Equipment Testing and Maintenance*. It's a 950-page book that talks strictly about electrical testing.

I would just like to update the Committee on condition monitoring of cables. If you go to IEEE 400, 400.1, 400.2, 400.3, the Committee since the last 5 years has published these 3 standards to specifically talk about and address condition monitoring of power cables. And when I say, "Power cables," these cables are 600 volts and above.

And I think that is one of the big issues that the staff is concerned about. They are inaccessible. You cannot do a walkdown. So, therefore, you don't know the condition of these cables.

So these methods are now available. And the general industry, the transmission and distribution side of the electrical power systems, they are implementing these procedures as well as industrials and commercial facilities to test their cables on a periodic basis every maybe two years to five years, whatever the period they select, to look at the condition of what is going on in the cable itself and to determine the conditions in there that basically say that this cable will not last another, you know, cycle. So, therefore, they have to do corrective actions, either replace or whatever.

But there are condition monitoring methods now available in the market that industry is using. So to say that there is no method, nothing has been developed since 2002 I think is not correct.

So I would refer the Committee if they want to look into that to go to the IEEE standards that talk about these various condition monitoring methods.

MR. HORIN: And if I might just say one thing? I know we need --

MEMBER MAYNARD: One more minute.

MR. HORIN: One more thing. And there are going to be evolutions in condition monitoring. We're not suggesting that there are not. But to impose an expectation on NRC licensees of condition monitoring by the insertion of some words into a regulatory guide without having a full analysis of what else might be available or what needs to be done when we spent millions of dollars looking at this issue just years ago, a few years ago is not the way to handle it from a regulatory standpoint.

CHAIRMAN SHACK: Thank you very much for an interesting discussion and contribution. And we'll break for lunch. Back at 1:30.

(Whereupon, a luncheon recess was taken at 12:35 p.m.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

1:33 p.m.

CHAIRMAN SHACK: On the record. We're back into session. Our next topic is TRACE Peer Review and, Sanjoy, I guess you're going to be leading us through that.

MEMBER BANERJEE: Right. Well, it's a little bit more than just a peer review.

CHAIRMAN SHACK: Okay.

MEMBER BANERJEE: We discussed this. So let me for the new members or members who were not here, let me give you a little background because I think you might find it useful.

(Off the record comments.)

You know though this has been in front of us for the last few years TRACE --

MEMBER SIEBER: Two?

MEMBER BANERJEE: Few I said. Yes. TRACE is a code which does calculations or heat transfer and flow during postulated accidents if you would like which involves steam and water in this case. Okay, and it sort arises out of a long history. Back in the late `50s and `60s, these calculations were done with some sort of a model which homogenized these two things and this lead to NRC developing amongst other things sort of suite of codes to be able to do this.

But in the early `70s, people started to realize that phenomena were the vapor and the liquid could disengage and perhaps go counter current to each other were important.

This lead to a series of developments where the fluids, the vapor and the liquid, were treated separately and they were formulated in something which is called a multi-field model and TRACE has become the two-field model and this lead to NRC developing a series of codes called TRAC. And there was a sort of a splinter group which went and developed this code called RELAP 5. TRAC was mainly done at Los Alamos and RELAP 5 at Idaho.

Now what happened was that these had various incarnations and lives of their own and versions. So in the early `90s, it was realized that NRC couldn't maintain all of these things. There were other things which I don't want to get into behind all this, but we decided to develop one single code which could handle a broad range of calculations of heat transfer and flow basically and this led to TRAC being selected as the code on which this should be based and consequently this code TRACE is an evolution of TRAC and RELAP 5 took on somewhat a life of its own and there was a group of people in the world that continued to use RELAP 5 including NRR here happily.

(Off the record comments.)

And various vendors. I mean, you've seen as RELAP in front of you all this sort of stuff, whereas NRC kept plugging away at TRACE. And ultimately we said, "Well, maybe with all this effort and validation this should be really the tool to be used for our confirmatory analysis." And ACRS has in its review of this long saga always come out and supported the NRC decision to go forward with a code such as TRACE and we've really urged that it be accelerated in terms of its development and incorporation into the regulatory process.

So last year in March, we wrote a letter after consultation with staff and I think they agreed with the letter which was that we wanted to see the schedule for documentation of this code, its validation and peer review accelerated and we wanted to see also a renewed effort on trying to get incorporated into the regulatory process and that meant, making it more user friendly, preparing plant access required, whatever it took. We wanted to get it in so that we had some independent confirmatory analysis that we supported at the NRC and that we weren't just randomly doing stuff which was being developed elsewhere or using versions of RELAP or whatever.

Anyway, so what happened then is they started, the staff, really responded to this very positively and they conducted a peer review. They got it going which you'll hear about now and they also started to accelerate the process of getting adopted for confirmatory analysis which you will hear about today.

So we need to write a letter at the end of this and after you've heard from staff and let the Commission know whether we like the progress, whether we don't like the progress, what we plan to do in the longer term with it, what should we recommend, not that -- The only recommendation I would suggest we don't make is to kill it.

(Laughter.)

All right. So with that, I think I'll turn it over to Chris Hoxie who is in charge of this and as Farouk Eltawila, we love Chris Hoxie's super -- and Farouk has been behind TRACE for a long time and without him, of course, this thing would not have gone anywhere.

All right. So go ahead, Chris.

MR. HOXIE: Thank you.

I just wanted to start by introducing. That was an excellent introduction. You did most of what I was going to do. So let me just introduce the speakers. We have four today. Bill Krotiuk will be followed by Mirela. Then I have a small piece of it and then Dr. Steve Bajorek has the final section and, with that, I'm going to go ahead and just turn it over to you, Bill, so you can get started.

(Off the record comments.)

MR. KROTIUK: I am Bill Krotiuk. I'm in the Office of Research and what I would like to discuss is the peer review process for the TRACE code and I will also at the end of the presentation make a summary of some of the findings of the peer review group.

The TRACE code, this peer review process, was initiated to look at specific tasks. One was to review the TRACE code and documentation and produce reports that summarize the code strengths, deficiencies and provide recommendations for changes or improvements.

The priority objectives of the review was to identify deficiencies that would preclude the use of TRACE for any analyses or that would introduce significant errors into the calculations. Ultimately, we would want the peer review group to provide recommendations for the improvements to the code.

In order to do this, we organized a group of experts to review the code. These are individuals who have international reputations in thermohydraulics, models and methods and the applications. One of the peer review members was Dominique Bestion. He is the research director of CEA Grenoble and one of the primary developers of the CATHARE computer code. Another member was Peter Griffith. He is a retired professor at MIT, has a lot of experience in the nuclear area. Marv Thurgood was brought in because of his expertise in numerical applications and he is one of the principal developers of the COBRA code and George Yadiagaroglu, he was a professor emeritus of nuclear engineering in the Swiss Institute of Technology in Zurich.

In order to start this process, we decided that it would be appropriate to give the -- proof documentation to review. So the documentation was completed in August of 2007 and copies of the theory manual which explains the code models and the derivations of the correlations and models within the TRACE code was distributed to the peer review members. We also gave them copies of the assessment manual that compared predictions, TRACE predictions, to test results and we had over 550 calculations of experimental facilities. We also gave them copies of the user guide which include Volume I and Volume II which I was just describing the input description, provide the input description and the other provided modeling guidelines.

We also did give to the group copies of the source code and the executable would sample inputs and outputs. But they were not required or it was not expected that they would run the code. But it was there for their information or use if they wanted it.

MEMBER APOSTOLAKIS: Did anyone do that?

MR. KROTIUK: No. What had happened is that I ended up at the request in some cases.

MEMBER APOSTOLAKIS: I understand that these reviewers are act independent. Is that correct?

MR. KROTIUK: They did act independent.

MEMBER APOSTOLAKIS: Independent of you, but also independent of each other. Right?

MR. KROTIUK: Well, let me go through that because they did act independently, but there were also meetings in which there was a lot of cooperation also.

MEMBER APOSTOLAKIS: Okay. You're going

to address that.

MR. KROTIUK: I'll address that. The peer reviews were given general review topics regarding the capabilities and limitations of the code and to provide information regarding the numerical solution techniques and also to review the fundamental equations, models and correlations. Specifically, were the models appropriate for application to a nuclear power plant and was the documentation sufficient that it gave appropriate references that the source of the correlation and any supporting data and then just general information regarding the quality of the documentation itself, whether it was useable and understandable.

It was recognized that the amount of documentation that was distributed was quite extensive and it was really an overwhelming task for individuals to review, for one individual to review. So we asked the reviewers to look at the code documentation as a whole, but also we assigned based on the reviewer's expertise specific focus areas that they would give more detailed review on and these areas are listed here. They are areas of the conservation equations, the thermal-hydraulic closure relations and models, the numerical solution, the nuclear system components, features, models, in other words, how to model different nuclear components within the code itself and the test assessment and matrix.

We identified at least one individual for each of these topic areas and this supplies the names of the individuals that were assigned a responsibility to review in more detail these specific focus areas.

MEMBER APOSTOLAKIS: Could you tell me what the test assessment matrix and results, the last one?

MR. KROTIUK: That consisted of a report that included a grounding plus appendices and what that entitled was there was the 550 sample test problems that the TRACE code was used to analyze.

MEMBER BANERJEE: Well, they were not just test problems, usually experiments, results.

MR. KROTIUK: Yes, that's right. Experimental results. Sorry.

MEMBER APOSTOLAKIS: So you are comparing the results.

MR. KROTIUK: We are comparing the predictions of the code to experimental results and also to some theoretical calculations that there are a lot of thermal hydraulic calculations that have close formed solutions. So we did some of those also to compare the predictions of the close formed predictions and to experimental results. And as I said, there was about 550 in the assessment basis. So that was quite a large report. It included principal volume and then I think there were three additional appendices or four additional appendices that presented all the comparisons of the predictions versus the experimental data.

MEMBER BANERJEE: There is one question which came up. Somebody asked me actually and you can clarify this that if any changes -- Now this is a frozen version obviously. But when changes are made, what fraction of this matrix was activated to check that the changes are fair? Is it the whole 550 or do you take some subset of it?

MR. KROTIUK: I think we should address that -- One of the other speakers will address that.

MEMBER BANERJEE: Okay.

MR. KROTIUK: I think, Steve, are you doing that?

MEMBER BANERJEE: Somebody asked me this question. I didn't know that answer.

MR. BAJOREK: When we're making just minor changes to the code, we'll do a subset of those cases. For example, if we're changing a heat transfer model, we'll look at FLAC to maybe LOFT and those places where we'd expect it. However, our plans are when we make a sufficient number of changes to the code or make major changes we would reissue that assessment report and redo all the 550 some calculations.

MEMBER BANERJEE: So is this system in some way that this is called 5.0? Okay, so if you do 5.1, you would go through all 550. I mean, if there is any change and you issue a new version, it would be all reassessed.

MR. HOXIE: It's actually maybe something in between those. I would say when we do 6.0 we would redo the full 550. We're going to have a 5.1 that's just like Steve said that would be a subset and part of the reason for that is that it's just the extreme amount. The industry is booming and we have to keep up and we think that we can pick a good subset that will cover the assessment range that we need.

MEMBER POWERS: But that's pretty consistent with what most folks are doing. A 0.1 version is some limited amount of focused recalculation. Part of the decimal point version you'd expect to have the whole --

SPECIAL AGENT HAYDEN: There were some concerns raised regarding the manner in which the momentum equation is implemented in the code. Would correction of the manner in which the momentum equation is implemented in the code qualify as a measure modification that would sort of force you to issue a version 6.0 or 7.0 in which this assessment report would have to be entirely repeated?

MR. HOXIE: I'll try and then you can add. Something like -- Your point is very well taken that it depends on the nature of the changes. The 5.1 that I was referring to are more like I would call bug fixes, things to help. They're not open heart surgery on the code like what you're referring to if you, for example, put in a fully conservative form of the momentum equation. In my mind, you're right. That would take more assessment and would require maybe the entire 550 problem sweep.

MEMBER BANERJEE: So I think what we'll do is we'll wait because the peer review will bring up some of these issues. They're going to say how they're going to respond to that and when they say how they're going to respond to that, I think we'll try to understand whether it's the 6.0 or the 5.1. Okay. So we will revisit this at that point.

Go ahead.

MR. KROTIUK: What I want to do now is

just review the activity that the peer review panel had. The contracts were awarded to the reviewers in August of last year and we had a kick-off meeting at the end of August and at that meeting basically the co-developers presented a summary of the code over the two day period summarizing what the code did and the correlations and the assessments and then followed by discussions between the peer reviewers and the co-developers themselves.

After that meeting, we asked the reviewers to then really start the real work of reviewing the code and they supplied us with draft reports, individual draft reports. Each reviewer completed his own draft report at this point for his assigned area that concentrated on his focus areas and they were received in January and then we followed that with a working meeting in February where we had discussions between the co-developers and the reviewers on the draft reports and at the request of the reviewers we did include some additional presentations on specific areas that the reviewers wanted some further information on and we did do at their request some actual TRACE calculations looking at certain geometries that they wanted to see the results of and they specifically related to the problem that you said with the momentum equation.

MEMBER CORRADINI: Can I just ask a clarification? I was reading -- You don't have to go back, but I was reading some previous slides just to catch up. They primarily looked at documentation, but they did not look any calculations within the documentation. Although they were provided the code, none of them ran.

MR. KROTIUK: That's correct.

MEMBER CORRADINI: Okay.

MR. KROTIUK: We received the final individual reports from the peer reviewers in May. We presented this to the subcommittee, ACRS Thermohydraulics Subcommittee, in July and we are making this presentation now.

What we will do and I'm in the process of completing is a final report that will present the individual reports from the peer reviewers and we'll also address the NRC co-developers' responses and courses of actions, things of that nature.

MEMBER BANERJEE: Let me ask you, Bill. In the Thermal Hydraulic Subcommittee meeting, several questions came up which were important but hadn't come up in the peer review. One of them, for example, was to show the "conserved mass and energy" for each of the individual phases. I hope you're going to say something about that today because Mohaffi said that he was going -- had done some calculations if you look at the record and that he was going to send them. But we've never seen those. So that would be something important for us to know.

Secondly, there was an issue which was outside. The peer reviewers didn't raise it but the subcommittee members did which was how much effort would be required to do an uncertainty analysis. Again, if you look at the record, you'll see. You were going to say something about that.

Now I hope you'll address those issues today?

MR. KROTIUK: I personally will not be addressing those issues. But that is on the schedule for the follow-on presenters to address.

MEMBER CORRADINI: So somebody else is going to get to it.

MEMBER BANERJEE: Yes. We don't want you to forget the subcommittee.

MEMBER APOSTOLAKIS: There is no -- Is there a single report from the panel or did you get four separate?

MR. KROTIUK: Okay. We have four separate reports.

MEMBER APOSTOLAKIS: So they never did it together.

MR. KROTIUK: No, and we did -- And this was brought up at the subcommittee meeting and what the panel members ended up doing is write a summary report which I'll go into. That's the next thing I'll get to.

MEMBER APOSTOLAKIS: So they did?

MR. KROTIUK: They did complete a summary report and I will -- That is the document, the two-page document, that was handed out to you.

MEMBER CORRADINI: Yes, I have it.

MR. KROTIUK: That is the summary report and I'll just review that a little bit.

MEMBER CORRADINI: But during this working meeting in February the actions were primarily between the reviewers and the staff.

MR. KROTIUK: That's correct.

MEMBER CORRADINI: Did they have any time to talk among themselves?

MR. KROTIUK: They -- I mean --

MEMBER CORRADINI: Probably at dinner.

MR. KROTIUK: Probably at dinner or something. I know they got to dinner. But additionally, I mean, there was a lot of email correspondence and, in fact, I know a lot of phone calls between the peer reviewers and email correspondence I would generally be copied. So I know what was going on and they included me for information. I never really commented on them. I let them discuss things especially when they were developing the summary statement. They again included me on distribution, but I never provided them with any comments on what was in that summary statement.

MEMBER CORRADINI: Okay.

MEMBER BANERJEE: But going back to your first, second, slide, you wrote down what the priority objectives were. Now in the individual statements which we've seen, of course, the reviewers didn't seem to address those.

MR. KROTIUK: They have addressed that in the summary statement.

MEMBER BANERJEE: Oh, they have?

MR. KROTIUK: Yes.

MEMBER BANERJEE: This is news to us.

MEMBER CORRADINI: I was going to say Sanjoy is going down a path that I remember distinctly from their oral presentations is they -- I thought I heard they say. So you correct me if I'm wrong. I thought I heard they say they weren't -- They didn't feel like they had enough time to give you top box answers -- answers to your top box questions. That's what I remember.

MR. KROTIUK: Well, from the summer --

(Simultaneous conversations.)

MEMBER BANERJEE: There were three things that identified. They said one was time. The second resources. The third interactions with the staff. They did not have sufficient all of those three in order to be able to address those questions. That's my recollection and I think it's in the record.

MEMBER POWERS: Sanjoy, let me ask you a question. Did you ever hear of a peer review panel that didn't say that?

MEMBER BANERJEE: Probably not.

MEMBER POWERS: This peer review panel said, "We didn't have enough time to do everything here."

MEMBER BANERJEE: At least, they should answer the questions.

MEMBER ABDEL-KHALIK: I guess in the summary they have albeit sort of they hedged on the answers.

MEMBER BANERJEE: They had to in the

subcommittee meeting.

MEMBER ABDEL-KHALIK: But you'll talk about that.

MEMBER POWERS: It seems to me that you asked a prestigious group like this to look at these things and you give them all this material that you send them to see if you really just had a blind spot and missed something that everybody knew or should have known or something like that. I mean, they're not going to tell you about the coding error down in the seventh sub-routine on the left module of the code or something like that.

MR. KROTIUK: To continue, what I'm going to do now is I took the summary report which you all have and I just picked which I thought would be important points and I'm going to just review that right now and I have to say again that report was completed independent of any interaction with the staff at all. And there will be couple of items that were obviously brought up by the peer reviewers and what I'm going to -- what I'd like to say is that the staff responses will be discussed in more detail by the following presenters.

I'm kind of -- I think what I'd like to do is just read this so not to insert any of my comments into this. So I'll just -- This is a statement from the peer review panel. "The summary opinions of the panel regarding the adequacy of TRACE should be viewed in light of the evident time and resource limitations that precluded a full and detailed review of the models, the absence of full information regarding the developmental validation of the models used and the limitations of the code validation work.

MEMBER APOSTOLAKIS: Can you explain the last two?

MEMBER CORRADINI: That's called a disclaimer.

MEMBER POWERS: That's a disclaimer.

MEMBER APOSTOLAKIS: No, "the absence of full information regarding the developmental validation of the model." What do they mean?

MEMBER BANERJEE: They actually say it more specifically after that.

MEMBER APOSTOLAKIS: So I have to tell you what it is. Everybody is asking you to read it.

(Laughter.)

(Off the record comments.)

MEMBER BANERJEE: There it is, George.

MEMBER APOSTOLAKIS: Okay.

MR. KROTIUK: Continuing the statement,

"A very large number of models and correlations have been carefully assembled to reduce a code that can covet a phenomena of interest. The manual describes the models and correlations clearly and in specific detail. It was not possible within the limits of this review and the absence of full information to verify the adequacy and implementation of all the models."

MEMBER APOSTOLAKIS: Again, "full information." What does that mean? You withheld something from them?

MR. KROTIUK: We did not withhold anything from them.

MEMBER APOSTOLAKIS: So why are they complaining about full information?

MEMBER BANERJEE: Maybe it was not in the documentation.

MR. KROTIUK: There was some information.

MEMBER BANERJEE: Let's say when they here in front of us. We quizzed them on this and sometimes it seemed that they wanted more information and they got in touch with the staff and I'm just repeating what they said. They did not get a response. Perhaps the staff was busy or whatever to come up with the questions they have. So they did not get full information which was information that they needed that was not in the documentation. That's how I interpret that from what they said.

MR. BAJOREK: Sanjoy, this is Steve Bajorek. One of the issues that arose in a lot of the comments were why did you choose one particular model versus another model and a lot of why did you change from this one and why didn't you use that one.

We sort of look at that as we had to make a decision as part of the development. We put the models that we thought were most appropriate. Some of them could have been better documented. We agree with that and we're going to say that we are going to try and clarify that. But we felt the need that at some point we had to select the models, put them in the code and do that assessment and we really --

MEMBER BANERJEE: Did you tell them that in those words?

MR. BAJOREK: Probably not.

MEMBER BANERJEE: I think they would have bought that. If you would tell me that, I'd say, "Well, yes, I do the same thing." I mean there's an infinite number of things. I mean, I don't have the time to do an exhaustive thing. I pull the one that I think is the best and stick it in. It's a judgment call.

MR. BAJOREK: In some cases, the models came across as ad hoc. There were parts of them that were developed in-house and I think we could have done a better job of documenting them. They were criticized for that. But we think that the real proof in the pudding is how does the code compare with the experimental data in those 500 some assessments and that's why I think --

MEMBER BANERJEE: Well, Steve, the problem is tricky because there can be as you know cancelling errors and I think what they were trying to do is look at each component and when you put them altogether they might work in some cases. But then if you're in a situation where have a possibly cooled system where the pressure drops matter a lot and if you get those wrong it can be different.

MEMBER APOSTOLAKIS: And also when you select --

MEMBER BANERJEE: Momentum, sorry.

MEMBER APOSTOLAKIS: -- one model out of a number of models that could be used don't you have to have some criteria how you do that? I mean, it's one thing to say we select the one we think is best and quite another to say and we went with the conservative model or the best estimate model or maybe even in some cases speaking of uncertainty you might want to say, "These two models we just picked them one, but one could use another" and then in your uncertainty analysis, people would at least be aware of it.

You know there is a story that has to go with it and I mean --

MEMBER BANERJEE: Perhaps what you're saying, George, is you are saying the right thing. But it couldn't be that during this process, the process of thought, was not necessarily documented. Somebody thought about it.

MEMBER APOSTOLAKIS: And I understand that.

MEMBER BANERJEE: And probably made certain decisions. Why they made that decision might not have been documented. That's probably the issue that they were dealing with. They might have made a perfectly good decision but it wasn't -- Because you have to use judgment at the end in some of these things.

MEMBER APOSTOLAKIS: Absolutely.

MR. KROTIUK: Everyone is specifically going through some discussions where the peer reviewers did say that some models were -- the history of why the model that was chosen was not sufficiently documented and they did comment that some others were over documented.

MEMBER APOSTOLAKIS: Which is something that doesn't surprise me in major research projects.

MEMBER ABDEL-KHALIK: I was going to ask about adequacy of implementation. Does that mean that line by line review of the code? I mean, that was not in their charter.

MR. KROTIUK: I would assume that that's what they're referring to. That would be my impression.

MEMBER BANERJEE: You know, say they were given the source code. If they had decided and when we originally discussed this I had suggested to the staff that they actually be able to run the codes and do that and actually look at it in some areas in pretty great detail.

MEMBER ABDEL-KHALIK: You know, just standing 10,000 feet away from this, if you read the statement, it would imply line by line verification of the code that these models are correctly implemented.

MR. KROTIUK: You know, I think that one thing we have to realize is that this peer review process is only a part of the whole process of verifying the code. I mean this is one step of the process. The comparison and assessments with test data is another part of it and additionally within --

MEMBER ABDEL-KHALIK: I think you're confusing verification and validation. Verification means you're doing things the way you intended to do them. Validation means that the way you've done actually is correct. Now the word here is verify the adequacy and implementation of the models means that I'm not sure you wanted these four people to verify that the models are correctly implemented.

MEMBER BANERJEE: But that's where we are deferring. I thought that the original idea was that they would do some spot checks. That's why they were provided the source code. You know, I personally had thought that they would look at whatever they were interested in, just make sure that they got it reported right.

MS. GRAVRILAS: This is Mirela Gravrilas from Research. We never asked the peer reviewers to verify. So if there was a request along those lines, it was never formally presented to any reviewers.

MEMBER BANERJEE: So why did you give them the source code then?

MS. GRAVRILAS: So they can check. If they would like to check something, they have it available. We gave them everything we had, all the documentation, the source code so that they can go to the depths to which they are comfortable. But we did not ask them to verify.

MEMBER BANERJEE: Perhaps you did not ask them for it.

MS. GRAVRILAS: We did not.

MEMBER BANERJEE: Yes.

MEMBER SIEBER: In my experience --

MEMBER APOSTOLAKIS: What did you ask?

MEMBER SIEBER: The language that the code is in.

MR. KROTIUK: I'm sorry. Fortran.

MEMBER SIEBER: That's common -- or just straight Fortran.

MR. KROTIUK: You know, I'm not one of the code developers. I am a code analyst.

MEMBER BANERJEE: Do you have an internal verification process at least?

(Simultaneous conversations.)

It would be internally at least. Right?

MR. MURRAY: This is Chris Murray. Yes, we do have an extensive verification process. We actually run 1600. Actually it's up to 1700 test cases now every single code version we create. That's designed purely to verify the correctness of the models as they're implemented and test out, you know, that aspect of functionality and that it's also portable that those cases run across different platforms and what not. So we do have a pretty extensive V&V process and the subcommittee has been briefed on that several times.

MEMBER BANERJEE: Okay. Continue.

MR. KROTIUK: The second statement and I'll just read it here, "The TRACE documentation lists the physical phenomena that are important in large break and small break loss of coolant accident analyses. The phenomena identified as important on the basis of phenomena identification in ranking tables, PIRTs, appear in the assessment manual. However, a cross reference table should be provided showing how the code capability was assessed for each phenomena consistent."

And the last statement --

MEMBER APOSTOLAKIS: Give me an example of a phenomena that could be shown, you know, how the code capability is assessed. Pick one example, just one example, and tell me about all these things.

MEMBER BANERJEE: The reflux on the --

MR. KROTIUK: I was going to say

condensation.

MEMBER BANERJEE: Say reflux on this.

MEMBER APOSTOLAKIS: Okay.

MR. KROTIUK: Basically, when you're ending in the code manual, they recommend that a table be put in, say, for condensation that has a reference that says "This correlation was used and that correlation could be verified using this, this and this test data." And that table, a cross reference table, was not included in the manual as something that has to be addressed.

MR. BAJOREK: Well, but -- I think we -- I'm sorry.

MEMBER APOSTOLAKIS: Sorry. Go ahead.

MR. BRACH: I think we want to point out, however, what we did in the report is we did have a PIRT table that looked at things like break flow, re-flood heat transfer and cross index those to the tests in the assessment matrix that exercise that model package. Break flow, for example, we would have checked off things like Marvican, Moby Dick, Super Moby Dick, re-flood heat transfer, FLECHT, FLECHT C-set, RBHT, LOFT, SCTF and tests like that.

What the committee really wanted was us to break that down into more detail. For example, if we had a model in the code for nucleoid boiling, what tests did we use to test out nucleoid boiling or transition boiling or the transition? So it's getting down into a lot more detail than what we had originally intended and what has been put into comparable theory manuals for other codes like RELAP or TRAC or COBRA TRAC.

MEMBER BANERJEE: Though I think their comment was a good one, it simply would mean quite a lot of work. Though it would certainly improve the quality of the documentation if you did what they wanted.

MR. BAJOREK: We agree on both points. Yes, it would help things out but it is a fair amount of work.

MEMBER APOSTOLAKIS: But you are going to tell us how you respond to these.

MR. KROTIUK: That is in the responses.

MEMBER BANERJEE: Yes, Steve will tell us. Right?

MR. KROTIUK: Yes, Steve has it.

MEMBER POWERS: Steve covers everything.

(Off the record comments.)

And he's proved eminently capable of doing so.

MR. KROTIUK: Finally, the manuals indicate that some important changes will need to be done in the future. Some of these may make critical remarks made like the review is obsolete. However, this review was limited to the TRACE 5.0 version of the code.

MEMBER APOSTOLAKIS: This is familiar. PRA Rev. 3 that was there, too.

MEMBER BANERJEE: You could have taken your peer review and put it here.

MEMBER APOSTOLAKIS: It has nothing to do with you.

MR. KROTIUK: This statement really comes from the fact that there were --

MEMBER BANERJEE: Keep going, but don't get sidetracked.

MEMBER APOSTOLAKIS: When we smile, keep going.

MR. KROTIUK: Okay. These to me are the important statements made by peer reviewers. One is "No major deficiency was evident in the physical models nor revealed by the assessed test cases. That would be preclude the use of TRACE for confirmatory thermal hydraulic calculations of large break LOCAs and small break LOCAs of PWRs and BWRs. However, additional assessments covering more systematically the entire range of conditions expected are recommended."

MEMBER ABDEL-KHALIK: Is that the intended sort of application space for TRACE, just mall break LOCAs and large break LOCAs?

MR. KROTIUK: That are the guidelines that were given to the peer reviewers that was the primary application right now.

MEMBER BANERJEE: But we commented on that in the subcommittee meeting. We said that in EPUs obviously we want to see this being used and for new reactors way beyond just these two things. So it's a common good stance. But that's what they were given. They're just responding to that.

MEMBER APOSTOLAKIS: When they talk about range of conditions, they mean, for example, medium LOCA or the conditions within the large break LOCAs? What do they mean by "entire range of conditions"?

MR. KROTIUK: Typically, that would mean a range of large breaks or small breaks. So it's a range for large breaks to small breaks.

MEMBER APOSTOLAKIS: How about the medium LOCA? Is that part of the --

MR. KROTIUK: That's part of it. It's

from large break to small break.

MEMBER BANERJEE: But, for example, if we want to use it for ATWS and stability which --

MEMBER CORRADINI: Which is not appropriate at this point in time.

MEMBER SIEBER: Right.

MEMBER BANERJEE: Well, we would like to see it.

MEMBER CORRADINI: I understand that. But given the rules of the game --

MEMBER BANERJEE: They didn't look at issues like that.

MR. KROTIUK: They did not look at that.

MEMBER BANERJEE: So one of the things, George, that may come out of this meeting is that we see this peer review as a work-in-progress. We say that it's good. Do what they said. But this is not the end of the line. So keep that in mind.

(Off the record comment.)

MEMBER ABDEL-KHALIK: If I may just go back to the comment I made earlier about the expected range of applicability of the code, now your priority objectives did not constrain the peer reviewers as to the applicability of the code to small break LOCAs and large break LOCAs. It just simply says, "Identify major deficiencies that preclude the use of TRACE for confirmatory thermal hydraulic calculations." It didn't say, "Confirmatory small break and large break LOCAs."

MR. KROTIUK: Maybe you're a little confused about "in the statement of work." LOCAs were specifically identified as the primary focus area.

MEMBER ABDEL-KHALIK: Focus. Okay.

MEMBER CORRADINI: We want to go through all your statements, but I guess I have a question to ask which is if a licensee were to come in for small break LOCAs and large break LOCAs and they would give you TRACE with sort of peer review and this sort of documentation, would it be acceptable? Don't answer now. But what I'm kind of asking is would you hold up the same level of scrutiny or a different level of scrutiny for this if it came from a licensee than if it came from another part of NRC.

MEMBER SIEBER: Be an approved code.

MEMBER CORRADINI: Be an approved code for these things. Forget about the other things that we might want. For these things. That's what I'm -- What I'm struggling within my head is is this enough to say this has been blessed by NRC even though it's one part of NRC blessed it by the other part?

MEMBER BANERJEE: I think, Mike, you're asking him to answer, but --

MEMBER CORRADINI: Not now, but eventually.

MEMBER BANERJEE: But I think in some way what they've already told us is they have a very large assessment matrix. They have a very large verification procedure in place which is probably more than we've ever asked any licensee to do when we blessed their codes. I mean, I've blessed codes with one-billionth of that information worth it.

MEMBER SIEBER: Wow. Pretty --

MEMBER BANERJEE: Yes. When you take the --

MEMBER CORRADINI: Don't let him off the hook. You're giving the answer. I want to know what their answer is.

MR. BAJOREK: The mission of this code is to be used as an audit tool for the vendors' codes and that can range from codes like RELAP, TRAC, COBRA TRAC, NO TRUMP, some of the other Appendix K evaluation models. It is not in itself the licensing tool. So the standard for TRACE is really a little bit below what you would hold as a standard for a licensing tool.

MEMBER CORRADINI: The reason for that logic is what?

MR. BAJOREK: That the analysis of record is with the applicant.

MEMBER CORRADINI: So the burden of proof is on them.

MR. BAJOREK: Yes.

MEMBER CORRADINI: For you to know that they did it right, would you not need a tool that at least is of the same or greater level of specificity and excellence that you could actually know that something's amiss?

MR. BAJOREK: We want it to be very comparable but what we use this code for is to help us ask good questions of the applicant.

MEMBER BANERJEE: But, Steve, let me -- You've sort of taken the wind out of the sails I think.

(Laughter.)

But I think that if you look at the standards of V&V you have for this code, they seem to me quite a bit higher than what we ask of the licensee's code before we approve it. So why do you keep saying that it has to be a little less and a little below what you ask of a licensee. We have approved licensee code with much less V&V.

CHAIRMAN SHACK: Okay. A real regulator.

MEMBER BANERJEE: Okay. Here is a regulator. Tell us.

MR. LANDRY: Ralph Landry from the Office of New Reactors.

MEMBER BANERJEE: Now.

MR. LANDRY: Right now. The use of an NRC code as Steve has said is to provide us confirmation of material which has been submitted by an applicant or a licensee. We are not doing a design analysis with that code. We are not doing a licensing analysis with the code. We are using the code to determine what we have had submitted to us, is it reasonable, does it appear to be valid or is it completely wrong.

We are not trying to reproduce the results of the applicant or the licensee. We simply want to see are they getting results that are reasonable, the right phenomena occurring at the right times, do they have peak cladding temperature that's above or below what we predict, is it significantly above or below. If it's significantly off, then we'll want to know why and don't box me into what is significant and what isn't.

MEMBER CORRADINI: Fine.

MR. LANDRY: But is the number we see reasonable. That's all we're interested in and then we might use our own codes to do what ifs to see if we can find a cliff where everything falls apart. Our codes are not used for a licensing purpose. The proof is on the -- The burden of proof is on the applicant or the licensee to come in and justify their licensing basis. All we're trying to do is get a warm, fuzzy feeling for what they're showing us.

Now all of that said, when we look at the work that has been done to date on TRACE, the verification, validation and assessment, and, Said, I'm taking it further than you did, this is way back from the early `80s. People were misusing these terms terribly and one day Vic Granson and I decided we're going to sit down and we're going to define these terms and since that time it's now gone into misuse again.

But the verification, validation and assessment that has been done on this code is more extensive than we have seen in licensing basis codes. This has had an extensive verification, validation and assessment performed on it. More is being done and more will continue to be done.

But what we have seen with the licensing tools that have been submitted has been really more of a subset of what we are seeing with TRACE today. Now that doesn't say TRACE is above or below the licensing tools. All I'm saying is that this has had a very good assessment done on it.

Part of that is the growth. Now we've all grown from the days of RELAP 5, from the days of S-RELAP taken over by AREVA, from WCOBRA TRAC days, from the TRAC-G days. Those codes relied on assessments that were done by the NRC in the development of the base codes which they then modified and then they had to do additional assessments as required by licensing statements. This code is not being verified and assessed against licensing basis but against scientific bases. With the engineering models, what needs to be done to assess those engineering models? Now that's a little bit different than we looked at when we do a review of a licensing basis tool.

MEMBER CORRADINI: So can I --

MEMBER BANERJEE: I think let me --

CHAIRMAN SHACK: Gentlemen, we're one hour into this, halfway through.

MEMBER BANERJEE: Yes. Just make one -- Thank you, Ralph. I think --

MR. LANDRY: I'm sorry. I didn't mean to

take all your time, but --

CHAIRMAN SHACK: You're not the problem, Ralph.

(Laughter.)

MEMBER BANERJEE: When, say, GE comes and wants to use TRAC-G for ATWS or whatever, they produce a set of things which make it applicable, show its applicability to ATWS or whatever; whereas, our code TRACE that we have is going to have a broad range of applicability and we don't demonstrate applicability to each separate use as the vendors do.

MEMBER CORRADINI: But if I may just -- I'm not -- Don't take this as a criticism as much as I'm trying to make sure you refine your answer. Because what I heard you say is, I almost had you there for a minute as I understood it. But then you said you want to have a scientific calculation. I guess I'm old-fashioned enough to believe that you're going to have to tune this for the application and what I heard from the peer reviewers when we had the subcommittee meeting was, this is what I heard, I may have misheard and Sanjoy was listening much more carefully than I, in some sense you have a broad tool. These are the current applications. What's the road map that one has to use if I need to tune this tool for this application? What's the road map if I had to tune this tool for that application because you have a lot of models, a lot of switches and dials that I can turn on and off and manipulate and when all is said and done because I have such a nonlinear system I'm going to eventually have to make it work for a small regime and guidance for the user, that is the agency, and potentially guidance for others is probably the most important thing, not that you haven't had the models because I think in the eight hours that I was there I was convinced you have a lot of models.

(Laughter.)

But you see where I'm going with this and that's why I think --

MEMBER BANERJEE: That's why he's asking whether it was just SB LOCA and LB LOCA and focusing on that.

MEMBER CORRADINI: Right.

MR. LANDRY: I agree, Mike, and Sanjoy was giving part of the answer there and that's part of the answer of why this has had such an extensive assessment because this is a tool to be used for all transients, all accidents, in all reactors; whereas when we look at TRAC-G it's being reviewed for application to a particular type of transient whether it's AOO or whether it's a LOCA in either the OP FLEET BWR or the ES BWR.

It's been reviewed for that specific application so that the assessment cases are specific to that application of the code. The assessments are to TRACE applied to the operating BWRs, the operating PWRs, the new design PWRs, the new design BWRs. Did I get them all? Anyway --

MEMBER BANERJEE: First approximation.

MR. LANDRY: But this is going to be applicable to transients, small breaks, large breaks, which means as we've been talking about when you get into some plants that are using things like reflux cooling and that didn't model reflux cooling with this; whereas vendor XYZ that doesn't have a plant using reflux cooling doesn't have to model it and we don't review it.

MEMBER BANERJEE: But I think what these people said and the reviewers said that we need clear user guidelines. So it can be that while the code is fairly general the way you use it to look at a specific problem requires one set of user guidelines and when you want to look at a different problem, you might need a different set of them because the way you nodalize the problem may be different. The way you exercise the code may be different.

MR. LANDRY: And that, Sanjoy, is going to be Mirela's presentation.

MEMBER BANERJEE: Right.

MR. LANDRY: A lot of what Mirela is going to present is stuff that's come out of working between NRR and Research and our rolling research and what we've asked Research to provide to us and she's going to talk about a lot of that.

MEMBER BANERJEE: Great. All right. I think what our Chairman is saying is that we need to expedite this process. So keep going, man.

CHAIRMAN SHACK: Keep trying, Bill.

MR. KROTIUK: Keep trying. All right.

The third item was the development that the code appears to have partially at least selected a strategic approach to modeling. Although much work was done into the selection of the best available models and correlations, top level guidelines and strategy employed in selecting full regimes, phenomena, situations, to be simulated and the selection of methods and models for these regimes are not clear. So this is really a comment on the --

MEMBER BANERJEE: On the framework.

MR. KROTIUK: -- on the framework and on

the theory manual itself.

MEMBER BANERJEE: Yes, I think in some way what they're saying is why did you choose TRAC. So let's not worry about it. Keep going.

MEMBER ABDEL-KHALIK: If I were to read this, the review panel then essentially classified any concerns about the validity of the momentum equation in the code as being a deficiency rather than in other words under Category 2 rather than a measure deficiency. Is that correct?

MR. KROTIUK: I don't think they really classified it as major or minor, but they did identify specific items which they said are necessary to be addressed and the momentum problem was something that was classified as a necessary item to be addressed. So in that respect I guess you would consider it measure.

MEMBER BANERJEE: Well, you know one other thing is that --

MEMBER ABDEL-KHALIK: But they say there is no measure deficiency.

MEMBER ARMIJO: So this must be minor.

MEMBER BANERJEE: No.

MR. KROTIUK: I see what you're saying. Yes.

MEMBER APOSTOLAKIS: Or medium.

(Off the record comments.)

MEMBER POWERS: I hesitate to read this as a legal document.

MEMBER ABDEL-KHALIK: I'm not reading it as a legal document. You know, as someone who --

MEMBER POWERS: If I had one of my codes get this kind of a peer review, I'd be dancing the streets.

MR. BAJOREK: Bill, one of the things when we talked about the momentum equation is I think we demonstrated that the deficiency related to that momentum equation problem small compared to the uncertainties and how you model things like flow patterns and heat transfer, what you get out of the closure models.

They also identified what we've interpreted as an error in our treatment of the momentum equation. We have fixed that, okay, and we have completed some additional testing and I think that we can take this momentum equation issue, meet with Professor Wallis, meet with the subcommittee and I think we can close it out at this point and I think we can demonstrate --

MEMBER BANERJEE: I think the concern is

not so much for when you have pumps pushing the stuff around, but in the passive cooled systems where you have a much more delicate balance of pressure losses.

MR. BAJOREK: And unknowingly you actually helped us on that. If you look at the flow through a loop as you would scale in the AP600 we set up some models that look at these very low velocity situations in order to characterize how much of a deficiency and how important it is. But I think we can address that now.

MEMBER BANERJEE: Fine. I guess we need to move. How much time do we have, Bill?

CHAIRMAN SHACK: On the schedule, you have another hour.

MEMBER BANERJEE: Please conclude it as soon as possible.

MR. KROTIUK: Okay.

MEMBER BANERJEE: We want Mirela to say things as well.

MR. KROTIUK: There is no assurance that the closer the issue is performed adequately over the entire range of the change claimed, the systematic evaluation or set of correlations implemented by the code against the best available relevant range of basics data sets would have been necessary.

Okay. I'm going to just at this point just briefly go through the specific items that were identified by the peer reviewers in their individual reports according to the topics that I previously identified.

Regarding the thermal-hydraulic closure relations and models, they did say that improvements were needed for some of the physical models, that they recommended inclusion of validation matrix for the physical models and that the interface tracker model which was included in the code there was a lack of user guidance in it and some user guidance had to be included.

MEMBER BANERJEE: But they liked it.

MR. KROTIUK: They liked it. They liked the model. They just lacked the guidance.

The conservative equations and it's interesting. But anyway, the momentum of flux term is incorrect specifically for side connections and 3-D vessel flow direction changes. They wanted some additional guidance for using the non-conservative form of the momentum equation and they considered the water packing model in the code as overly restrictive.

MEMBER BANERJEE: We got to this. We got very extensive moments from our consultants. I -- You know our DFO. I don't know if Dave Bessette who has been absent for a while now passed these comments onto you or not. I asked this be checked, but did you receive the comments that our consultants made with regard to the momentum equations?

MR. KROTIUK: I think there were two letters.

MEMBER BANERJEE: Yes. Did you get Wallis' letter as well as Kress' letter?

MR. KROTIUK: Yes.

MEMBER BANERJEE: Okay. So you got them. I just wanted to be sure you had them.

MR. KROTIUK: Regarding the numerical solutions techniques, the SET matrix is a method that's used to do the numerical solution in TRACE and it allows the delta Ts to exceed the material limit. They basically said that this was a methodology that was previously used in TRAC and they had no major problems with it.

MEMBER BANERJEE: Not the greatest.

MR. KROTIUK: Yes. Regarding the assessment matrix and results, they recommended additional assessments or extensions to cover all physical models and phenomena, recommended some additional referencing to the SET matrix and PIRT tables and they wanted the assessment manual to specifically address how TRAC predicts licensing limits such as peak clad temperature.

This is really the user's guidance. It was commented basically that the user's manual needed a lot of work to make it completely useable to a new user who is using the code. They recommended that the whole manual be rewritten and that references could be provided to connect the guidelines to assessment modeling and then they did comment about the inclusion of code uncertainties into PWR and BWR transients.

The final slide, I tried to identify the major items which had to be addressed. So the modification and improvements that were recommended were to rewrite the user's manual, correct the momentum term.

MEMBER POWERS: I take it that had some Freudian thing on that term.

MR. KROTIUK: That's Bill Gates.

PARTICIPANT: That's not a happy face.

MEMBER BANERJEE: It coincides his opinion with Graham Wallis.

MEMBER POWERS: I just think it's Freudian.

(Laughter.)

MR. KROTIUK: They recommended as previously said that the closure relations, the physical models, include a validation matrix and to continue the expanded code assessment.

The only thing they recommended was the addition of a liquid droplet field into the code and to modify trace to solve the conservative form within the momentum measure.

MEMBER BANERJEE: I think they went -- One reviewer said that, but they went a little bit beyond that. They suggested that if you wanted to add something you really add disbursed full fields both for droplets and bobbles, a full field model.

MR. KROTIUK: Yes, that was --

MEMBER BANERJEE: That was the comment.

MR. KROTIUK: Yes.

MEMBER BANERJEE: At least, the droplet field exists and then the codes, some vendor codes. So you should probably do that. But if you do that, you may as well do the other. That's what they said.

MR. KROTIUK: Yes, but the specific comment that I was referring to addressed the droplet fields.

Okay. I finished with my part of this presentation. Any other comments or questions?

MEMBER BANERJEE: Thanks, Bill. I know you did this under duress. So maybe you could -- Thanks a lot and let's have the next.

MR. KROTIUK: Yes, Mirela Gavrilas will present applications of the TRACE code to actual --

MEMBER BANERJEE: And her story is a happy story since she's done a lot or this group has on this. So I hope we go a little faster on this.

MS. GRAVRILAS: We hope.

MEMBER POWERS: Mirela will do her best.

MEMBER BANERJEE: Yes. Mirela keep going.

MS. GRAVRILAS: Ignore everybody and just keep going. Right?

MEMBER BANERJEE: Right.

MS. GRAVRILAS: I'm Mirela Gavrilas. I'm the Branch Chief in Reactor Systems Application. The way the TRACE work is set up, there's a branch that does the development of the code and a branch that has the users of the code. I'm the Branch Chief of the users branch.

The last meeting we had with the committee was in March 2007 and I believe Professor Banerjee said there were recommendations the committee made at that time. One was have the code peer reviewed. Two was accelerated introduction into the regulatory process.

Since that time, we can report the following accomplishments as far as regulatory activities are concerned. The ESBWR as far as the code, the TRACE code is used the ESBWR DCD confirmatory calculations, that the LOCA work is largely completed subject to any design modifications that are still pending.

We have an applicability report that accompanies those calculations. Our applicability reports compliment the assessment manual. In other words, the special models that are needed to account for phenomena unique to that design are captured in the applicability report. For example, the passive containment cooling system in the ESBWR would be. But the model development, the testing for the model development, is described in the applicability report.

We've also ran the large break LOCA for the EPR to inform the first round of RAIs. The code was used to compliment RELAP in the SER for the Browns Ferry EPU and basically over the past few years we had several locations to provide calculations, scoping analyses, to GSI-191.

MEMBER BANERJEE: This is mainly the core blockage issue. Right?

MS. GRAVRILAS: Yes.

After a few early deliverables to NRR in April this year, we formalized what NRR would like us to produce over the next two fiscal years and they've requested that we prepare plant techs to support our upcoming EPU reviews and these will cover BWRs 3, 4 and 5s, Westinghouse's 2, 3 and 4 loops CE as well as B&W lowered loop.

We have now a final or nearly final NRO user need that's coming to us and in that we've already mentioned a couple of times about the ESBWR as well as the AOOs. We're going to start applying the code to AOOs. EPR topical review is going to include again the TRACE code confirmatory calculations. We're working on an applicability report for the EPR. The US APWR again will TRACE calculations for LOCAs and transients and we're working on an applicability report primarily focused on the advanced accumulator.

MEMBER BANERJEE: For the EPR, are you doing refluxing?

MS. GRAVRILAS: We're doing reflux condensation as a big portion of the EPR applicability report, yes.

MEMBER ABDEL-KHALIK: Does the applicability report for the ESBWR examine the issue of noncondensable gas entrapment within the piping?

MS. GRAVRILAS: I'm not sure if it establishes entrapment. Joe, can you answer that?

JOE: I don't know what the specific issues of entrapment within the piping. I think to really examine that you'd have to have actual piping diagrams and I don't think any of them have been submitted for real. But I mean we have assessment with noncondensable gases and condensation with noncondensable gases present.

MEMBER BANERJEE: I guess at elbows and you know the issue is --

JOE: Right. I mean usually that type of thing is something like a high point trap or something like that and for that you really need real piping diagrams for how the plant is actually laid out. We have essentially piping diagrams as they exist in whatever the design is now which may or may not be how the plant is built and as far as that is we haven't really seen any issues where it's caused a real problem. But I know of instances where it could cause a problem if it wasn't laid out right like in the piping from the PCCS drain over to the GDCS where it dumps in the water. There is a possibility of putting a high point trap into something like that if the loop seal isn't deep enough in the GDCS tank or things like that. But I'm not aware of any specific issue or questions that have been raised with respect to that yet.

MEMBER BANERJEE: I guess this committee raised some questions related to that. Now whether this can be assessed with the code or this should be assessed in some other way, we don't know. But certainly we ask whether TRACE had the capability to do such an assessment provided you had the detailed piping diagram obviously because what you get are problems like counter-current flows near elbows of noncondensables and entrapping and things and I think the answer we got back is it did have the capability but maybe that's not part of that applicability document that you are dealing with here.

MR. BAJOREK: Yes, the purpose of those applicability documents is really twofold. It's to look at those unique design features and in an ESPWR those would be looking at the chimney where you want to model flow through a very large diameter pipe and to assess how well the code does for passive flow conditions which is why we model things like puma, panda, giraffe, separate effects tests to look at the PRHR heat exchangers. EPR because of the importance of reflux condensation, that's where we have additional tests to look at that specific phenomena because it's important to that design.

The other reason we take that information, we put those, into applicability reports is because a lot of that is proprietary and that's a good place for us to put that where we're able to protect it; whereas, everything that the peer reviewers were looking is more what we would refer to as the generic assessment. It's public. It's applicable to virtually all plants because even the passive plants have to make use of those models and correlations.

MEMBER BANERJEE: Would there be any problem with the peer reviewers on the appropriate direction also reviewing these applicability documents? I mean, you would restrict -- put them under whatever.

MS. GRAVRILAS: Generically, there isn't a problem. We have consultants who are helping us with the review of ESPWRs. So generically there isn't a problem, but we can't answer with a specific reviewer.

MEMBER BANERJEE: You're saying you can't answer for this specific peer review group that you have at the moment.

MS. GRAVRILAS: We don't have a peer

review group anymore. I just want to -- There was talk. We heard your advice during the subcommittee meeting. We took it back and we all agree that a continual peer review process is a wise thing. But as far as this peer review panel is concerned, they had a limited scope. They finished. The contract has ended. They're not under contract to us anymore. Let me put it that way.

MEMBER BANERJEE: So, in that sense, the peer review is finished.

MS. GRAVRILAS: In that sense, the peer review -- But we did hear you and you will hear more about our vision of continuing the peer review process.

MEMBER POWERS: I'm not sure you're the one to ask, but I'll ask anyway and maybe somebody can answer. I think who you picked for the peer review I know everyone of them. They are very high level people, but they're not going to run the code. They're not going to delve into the details. Don't you want for an ongoing peer review out of what I'll call the assistant professors rather the full professors, the guys that will delve into the details and try to make that reputation at your expense rather than the people that already have it and are way too busy to delve into the details?

MS. GRAVRILAS: The first answer is --

MEMBER POWERS: When I have hired peer reviewers for my own group I always go after the assistant professors. I don't want the full professors because they read the documents on airplanes. The assistant professor doesn't have anything. He has no life anyway.

(Laughter.)

He might as well not have a life working on most -- something else.

MEMBER BANERJEE: I think there are some --

MEMBER POWERS: And they're cheaper.

MS. GRAVRILAS: Once again, there is no reason for us not to do exactly what you're saying. None. And again, we don't have a standing peer review panel. So we're open to what we're going to do.

MEMBER POWERS: I think you do a tremendous thing here.

MS. GRAVRILAS: The other thing but what we do get as far as dwelling under the hood there is about five users in my branch and there are a few others spread in the other offices.

MEMBER POWERS: Which are like assistant

professors.

MS. GRAVRILAS: I mean these are people who are continuously --

(Laughter.)

MEMBER POWERS: And Ralph has no life at all. I know for sure he has no life.

MS. GRAVRILAS: So as you can see, basically any PWR and BWR advanced plant that's coming under the horizon we're going to prepare techs for. This is a summary table. Examine it at leisure. What you'll see here is the issue was how are you going to use given that this code has so many models and so many tweaks and so many options. We anticipate that in the couple of years we will actually have a plant model that represents all the types of plants that are in operation right now and we'll also have as I told you models for the new reactors that we anticipate coming online in the not-too-distant future. So, in other words, all the selections of models will be done in these pilot plants that then can be used as sister plants to model all the 100 some plants that are in operation today.

There used to be one of the -- I shouldn't call it a complaint, but no better word comes to mind right now that we kept hearing from users both inside

Research and outside was one time and with these models, with the plant models, that we have created we have also set some target times in terms of execution and set up times and this table summarizes how robust we'd like the code to be for the models that we're dealing with and --

MEMBER POWERS: What's the one mobilized to? Real time?

MS. GRAVRILAS: Execution time to problem time to real transient times.

MEMBER POWERS: Real time.

MS. GRAVRILAS: Real time. Two hundred seconds of a large break LOCA should take no more than 2,000 seconds of computer time on an agency PC. Those are the target objectives. They're ambitious. We are. These are target times.

MEMBER POWERS: How close are you to target?

(Simultaneous conversations.)

MS. GRAVRILAS: Actually, we're okay to the target.

MEMBER POWERS: But it's not sophisticated enough obviously.

(Laughter.)

MEMBER BANERJEE: Don't get sidetracked,

Mirela. Tell us quickly.

MS. GRAVRILAS: As I mentioned already, we are going to have the decks of every type within the next couple of years and let's see how close we are to the target time. We have very good BWR decks for Brown's Ferry and despite the assumption that it's a very simple model it's not. It's one that has a vessel with 17 levels and two radial cells. And it takes a large break LOCA in 20 minutes and it does a small break LOCA in 40 minutes on just the standalone machine. Those are very good results for a system code.

MEMBER POWERS: And you're mobilizing fine enough. I can tell that right here.

MS. GRAVRILAS: As I said, but it's not coarse either. It's two channels and about 30 some nodes in the vessels. That's what we need. We need more.

MEMBER POWERS: And you're way too coarse.

MS. GRAVRILAS: Okay. But we need to add more.

So what was raised in terms of as preparing models in addition to working on our models, we're also working very hard as we're developing these models to improve user guidance. So we basically have the users improve the user guidance.

MEMBER BANERJEE: So let me get this clear. What you've done is you've done -- You have some decks which will run screening deck calculations. Then you have -- But can you do very detailed calculations?

MS. GRAVRILAS: These are good enough to run large break LOCA and small break LOCA according to assessment standards. These are not screening calculations because we have --

MEMBER BANERJEE: That's clarification. So you have sufficiently fine nodulization --

MS. GRAVRILAS: Absolutely.

MEMBER BANERJEE: -- in the core for example to be able to get good results and reflux.

MS. GRAVRILAS: This would be the nodulization that we recognize for any PWR 3 Mark I. I mean this is it.

MEMBER POWERS: It isn't fine enough.

(Simultaneous conversations.)

MEMBER POWERS: Until those minutes become hours, you're not fine enough.

MS. GRAVRILAS: In BWR we are on the order of hours, but our conciliation is so is CATHARE. So we're close. We're in the same ball park as CATHARE.

MEMBER BANERJEE: Sorry. I was actually surprised with the PWRs. That's what I was referring to.

MS. GRAVRILAS: Okay. PWR, we're still working on a sample and that one is going to be -- Those are on the order of hours. We're talking eight, nine hours right now. But again, that's on the order of what CATHARE does too.

MR. BAJOREK: The other aspect of these decks too to keep in mind is we've upgraded these. Rather than using the decks that were produced in the mid `80s, these have been brought up so that the conditions in these decks are very comparable to the plant as it is today and that's one of the things that has taken a bit of time in order to do those upgrades.

MEMBER BANERJEE: All right.

MS. GRAVRILAS: I think that's it. I think those were the conclusions.

MEMBER BANERJEE: Thank you.

MS. GRAVRILAS: So I held my --

MEMBER BANERJEE: Now, Steve, you should be just as disciplined as this.

(Off the record comments.)

I'm going to make sure that we get that done by 3:30 p.m., guys.

(Off the record comments.)

MR. HOXIE: So onward and upward then. Again, I'm Chris Hoxie, Branch Chief, Co-Development. Steve is here.

I wanted to start by just giving you a little bit of information. A lot of the peer review comments now that they have been conducted are going to end up in my branch for resolution and so I wanted to give you a little bit of more details about that and then Steve will get into even additional details.

This slide we've basically covered. So in the interest of time, here's what I wanted to talk to you about in a little bit more detail. Basically, the peer review reports if you look at them is we've made a first pass through them now. They actually made 262 separate comments that we've now put in and we're tracking them. Here you see a general characterization. I wanted to give you some flavor in nature of the comments of these 262.

Basically what I want to say is that almost 60 percent of the items are related to documentation. So we clearly have to improve in documenting things more clearly and I think Steve will talk a little bit more. We already have efforts underway to improve that situation I think.

The other thing that's here, the next largest category after the 60 percent, are peer review comments on field equations and closure models. They're about 21 percent of the 262 comments that fall in there. The field equation comments include items such as adding a droplet field or end fields, treatment of side junctions and other issues. The field equation comments represent about two percent of the 262 comments.

There were 42 peer review comments that were suggested improvements on closure model write-ups. That represents 16 percent of the 262. The remaining closure model comments include consideration for improving the models and adding new models and these represent about three percent of all comments.

To position this properly, I'd like to recall one of the reviewer's comments, Dr. Bestion. His overall comment was that "TRACE on TRACE closure models was that an impressive work has been done to revisit all closure models considering recent published work to improve some old correlations of the previous generations of code, RELAP and TRAC, implementing many improvements and finally providing a coherent and rather simple set of models."

That being said, now it's me again, there is only room for continuing improvement and we will give serious considerations to the reviewers' comments on both the field models and the closure models. We want to keep moving forward and keep improving the code.

The last category are modeling approach and assessment related comments, and I think we've already touched on some of that. They wanted a top down strategy approach and Steve covered that.

So how do you prioritize all this work on the 262 comments? Work packages that emerge from this review will have to be prioritized along with all of our other NRC needs. The highest priority will be given to items that enhance the readiness of TRACE for regulatory use. Our peer review reports, however, identified several areas of low-hanging fruit and on these things we took action. For example, several code errors were identified. We have already implemented fixes for those code errors and have made a version of the code available for the staff use that has those fixes. So I hope this gives you some sort of overview in more detail of what the code was about, the peer review was about.

And with that I'd like to move it on over to Steve to get into a little bit more detail on some of the issues.

MR. BAJOREK: Okay. Thank you, Chris.

What I'm going to do is to try to summarize the findings and issues that were brought up from the peer review and try to describe how we're going to prioritize and how we're going to try to go through these here probably over the next couple of years as we deal with all of these.

Probably the best way of looking at how quickly we're going to be able to do some of these is to look at the first in terms of the documentation, the validation and assessment, the models and correlations and then talk about long-term development. As Chris pointed out, there are some things that they pointed out which we think are low-hanging fruit. We can get a lot of ground quickly and get a lot of that accomplished.

The other aspect of this is what does it take to get TRACE into regular regulatory use and a couple of the comments that the peer review had and we've had from our own users is that we need better guidance on how to set up some of these models. How do we tie those back to the assessment that was done and how do we select nodulization when there is user choice involved. So fixing those aspects of the documentation, improving the clarity, we're treating those as --

MEMBER BANERJEE: I think they asked for user guidelines. Now are you going to actually incorporate those in the documentation or will you do it in the applicability reports or what's going to happen?

MR. BAJOREK: Actually, it will be a bit in both of those. But we are going to put those into what we'll talk about a Volume 2 of the user guide. I'm jumping ahead here, but the idea here is to put content into that volume that might be described as a BE LOCA cookbook. In a way, that's one of the ways we described it when I worked somewhere else and we had the same type of a problem.

The user has several tools that are described in Volume 1 that he can use to analyze a problem. I can use a pipe component. I can use a vessel. I could be 3-D. I could node it down to the drop size or I could make it very coarse as in some of those BWR models that we just got accused of skimping on. But what we want to do is to give the user guidance so that when he sets up a core for a BWR he does it like this and we tie it back to how we did the assessment and our knowledge of how those models would work and we have been doing that in the core models that have been set up.

For the plants that Mirela talked about, if you look at the core for each of those PWRs and you go take a look at how they were assessed in CCTF and SCTF, they all start to look alike. So the user has firm guidelines on how to set those things up and we know how it's going to behave because we can point back, directly back, to the assessment for a lot of those.

First, let's talk a little bit about the documentation. The issue that was raised and I'm jumping down to the second bullet is that each of the reviewers had a lot of difficulty with this. The two things that jumped out from the 262 comments related to their comments and those which go back to the documentation was this lack of specific guidance and Peter Griffith did a very nice job in helping to point out that, hey, there's --

MEMBER BANERJEE: You're dealing with the second point there.

MR. BAJOREK: I'm down here at the second.

MEMBER BANERJEE: Right. But before you skip through the first point, several comments were made in the theory manual where you sort of wrote down pictorial partial differential equations and then made a jump to control volumes, that those steps were very poorly presented, indeed if they were correct at all. Whereas, if you wrote them directly in the form of control volumes they might have been more believable and you know that thing is a mess, the theory manual, and probably if you do anything with it you really need somebody else to write it than the writer you had.

MR. BAJOREK: Clarity in the theory manual is clearly an issue.

MEMBER BANERJEE: Yes, and if you need some help on that --

MEMBER POWERS: You're available.

MEMBER BANERJEE: No, I'm not available.

(Laughter.)

But I can suggest people who might do a much better job in making that connection including Graham Wallis. Perhaps you might want to get his help.

MR. BAJOREK: That message came very clear in the peer review.

MEMBER BANERJEE: It's really a shamble and it detracts from the whole credibility of TRACE.

MR. BAJOREK: It has to be improved, not

only the clarity and going from the differential equations. We want to fix that, but another issue that's very important is you need to know which model the code is using and in some places it's difficult to sort that out.

MEMBER BANERJEE: It reminds me of the old TRAC documentation which was a piece of whatever.

MR. BAJOREK: The model that we are going to try to go to is one where the initial part of the theory manual will describe the model and be very clear as to what the code is using. Details will either appear in an appendix, through an electronic link or in an appendix where somebody can go and get details of why that model is the best one available --

MEMBER BANERJEE: No, it's not the model. It's when you're going from these PDs to the 1D forms and the control volume forms. What you're really done there is you can't hide it behind slight of hand. Either you write it as a control volume stuff or if you do the PDs do it properly. But it's a mess right now and people should just read Bird, Stewart and Lightfoot.

(Laughter.)

Then proceed from there. That should be required reading for anybody doing the theory manual.

MEMBER POWERS: I would hunger for you to do the peer review on Bird, Stewart and Lightfoot and see how clear you think his documentation is.

MEMBER BANERJEE: I was brought on it.

(Off the record comments.)

MR. BAJOREK: Bird, Stewart and Lightfoot is an excellent text. What we have been --

MEMBER POWERS: It's geriatric. It has poor nomenclature. It is incomplete in its explanations. It drops terms willy-nilly.

MEMBER BANERJEE: We love it because we were brought up on it.

MEMBER SIEBER: So, in general, how do you like it?

(Laughter.)

MEMBER POWERS: I love it actually.

MR. BAJOREK: Sanjoy, but I think what you're really pointing to in the section that talks about the differential equations is what's needed is a treatment I think much like was done in COBRA TF where you start with the conservation equation and you step through to see each step of the process in going from that original conservation equation to the finite difference form that's actually applied and where you have to take exceptions, the top and bottom of vessels, bins and places where the finite differencing gives the complications.

MEMBER BANERJEE: We believe that there are regions where you have multi-dimensional effects which cannot be banished by slight of hand and you may as well acknowledge that and make a model for it or something that you have to without trying to do these fancy looking vectors which only work in straight pipes or you do CFD.

MR. BAJOREK: Clarity is something that we have to address. I do want to point out however that we feel that for the first time in some 10 to 15 years the staff now has a complete set of documentation, a theory manual with its flaws and deficiencies but an assessment report and a user manual which are all consistent and up-to-date.

MEMBER BANERJEE: We commend you for that. You've done what we've wanted last March. Now we are saying improve it.

(Laughter.)

MR. BAJOREK: This is like the pole vault exhibition. Next slide.

So our resolution and I think we've talked about this. We've already started working on what had been Volume 2 of the user guide. We're going to put in specific recommendations on how you model a plant, region by region and that's not only to address the peer reviewers' concerns. But if you look at the use of other codes one of the biggest uncertainties is this user effect.

If you give five people the code and five user manuals and say, "Go off and do it," you'll get five sometimes very different answers. We're trying to protect against that. We've already started that work.

The theory manual will be restructured. I don't know if it's going to be a volume 1 versus a volume 2, but we've heard the criticism, the comment. We want to make it a more concise description of what's in the code and make it clear on how you go from one step in those sections where that has to be accounted for and maybe make use of a little bit more modern technology so you can link different parts and go to the related information when you need to go ahead and do that.

We're also going to respond to the comments about parts of the theory manual that should be added in order to make it a little bit more readable. That's something up front to define what flow patterns you're modeling, how they relate to one another. That's sort of lost in the documentation at this point.

Assessment report, we think we can do a better job of relating PIRT-related phenomena to where they're assessed.

MEMBER BANERJEE: But also maybe you could go some direction towards what the peer review wants which is to relate this correlation to these experiments or something. You may not have to go all the way but at least some way towards it.

MR. BAJOREK: We think we've done that partially at this point, but, yes, we think we can go and find perhaps a happy medium between doing it for everything and correlations which may not be that important but taking it the next step.

MEMBER BANERJEE: You really don't have to do it for a smooth pipe friction factor. That's fine.

MR. BAJOREK: Okay. Scratch that off the list then.

And we also want to consolidate because we've done a lot of the validation part of this in the theory manual comparing with the code and the correlation to separate bits and pieces of data. We'll probably move that into the assessment just to keep it altogether.

Assessment is an ongoing effort. As was pointed out earlier, we use some 550 cases for the generic part of the code. But when a version of the NRC's RELAP code is put out, they do 43 cases. My understanding or my recollection COBRA TRAC used something like 250. TRAC had 60 or 70. So we think on a generic basis we have exceeded what the NRC has done in the past for these comparable types of codes and that does not include the additional assessment that goes in to look at ESBWR, AP-1000 and those things.

MEMBER BANERJEE: Right, because obviously you have different issues than these issues which the reviewers identified here.

MR. BAJOREK: Right.

MEMBER BANERJEE: Noncondensables will be much more important for ESBWRs.

MR. BAJOREK: Each one has their own PIRT and what may not have appeared on the conventional PIRTs may appear or visa versa. So we have to look at that from a PIRT related.

MEMBER BANERJEE: Is that treated in your applicability reports that you have --

MR. BAJOREK: Yes.

MEMBER BANERJEE: So you got the specific extensions to this matrix or whatever modifications for those specific cases like ESBWR or EPR or whatever.

MR. BAJOREK: I can't speak for each of the applicability reports. Some are in production. ESBWR I haven't really looked at closely. But the idea is to do a review of the code versus the PIRT for that plant and ask the question, "Do I need better models for condensation?"

MEMBER BANERJEE: You might need to add more experiments in the assessment matrix for those.

MR. BAJOREK: And that's where those occur. For ESBWR, for example, there is about a dozen experiments that show up in that report but not in the generic report. So if you need to understand how the ESBWR, how the code would perform for tests that model or mimic the ESBWR, you would find them there.

MEMBER BANERJEE: Let's move on, Steve, unless you have something important.

MR. BAJOREK: Generic assessment, let me -- I think I've covered this. Applicability reports. Assessment is an ongoing process. The things in the green on the right-hand column are things that the peer reviewers have pointed out. We've either added ir or emphasized it on the list of assessments that we would still like to add at this point and we would like to put some others on there as well and usually that's going to be driven by whatever the regulatory issues are. Achilles, for example, is more important because one of the newer plants seems to cool on that nitrogen discharge. So that will probably get a little bit more of the attention early on. But in the long run, we hope to address these other issues.

By the way, they aren't completely ignored. If we go back and look at a lot of the integral tests, there are aspects of those tests that do have reflux condensation, direct contact condensation.

MEMBER BANERJEE: I don't see LOBI there anywhere. Is it too old, the data? I mean, there were some reflux in LOBI and semi-scale. There was some --

MR. BAJOREK: Semi-scale.

MEMBER BANERJEE: -- interesting reflux condensation.

MR. BAJOREK: We have tried to skew things towards tests which are a little bit more modern and also at larger scale. We do have semi-scale in there, but we've tried to make better use of that --

MEMBER BANERJEE: But you know if you're

doing reflux condensation --

MR. BAJOREK: ROSA has some tests there.

MEMBER BANERJEE: Yes, ROSA has some.

MEMBER ABDEL-KHALIK: Where in your time line do you think you'd be able to use TRACE for BWR stability calculations?

MR. BAJOREK: Right now, we would say that we could do BWR stability. We've had some projects at, I think, Penn State. We've been doing some work in-house in order to assess and examine how TRACE does for stability. We have not found anything that would preclude it from doing stability. We should complete an applicability report and document those cases.

MEMBER ABDEL-KHALIK: Do your 550 comparison cases include stability data from plant transients?

MR. BAJOREK: No, not like Ringles or some of those. We have done work assessing against those transients, but that does not appear in this set of documentation.

MEMBER BANERJEE: If you did a plant applicability, I mean, a stability applicability report, they would appear there. Right?

MR. BAJOREK: It would appear. That's where we would put that in.

MEMBER BANERJEE: I think Said makes a very important point and I don't think that you can ignore stability and, in particular, its connection with the reactor physics code like PARKs.

MR. BAJOREK: It's important. But as we have been directed, we have focused on large break, small break and the advanced plans.

MEMBER BANERJEE: We're telling you that some of the major problems that we are seeing in EPUs have to do with stability. We see the big picture and we're going to see it with MELA Plus and the extended domain as well.

MR. BAJOREK: We intend to move into that area, but it has lagged because we have not had a user need to say they would like to use TRACE for that purpose yet.

MEMBER BANERJEE: Do you want us to put it in that letter that it be a user need?

(Off the record comments.)

MR. BAJOREK: With regards to the physical models and conservation equations, the peer reviewers sort of found three different categories here. They found some things which were errors and we're treating those as the highest priority. I believe at this point we have actually fixed them all. In the most recent patch version of the code that we're using, I think they are all in there or they're in very, very late stages of testing at this point.

Some of the examples have been incorrect treatment of the VgradV. So I learned from the earlier one and the Bill Gates' trap on this.

MEMBER BANERJEE: Yes, you've still forgotten a dot.

(Laughter.)

MR. BAJOREK: But we've corrected that in the code. We have also made some other changes to the code in order to help resolve this momentum issue and that's something that perhaps a separate meeting with the Thermal Hydraulic Subcommittee might be the way of going through and discussing what those changes were and where the code really stands in terms of treating that as a deficiency anymore.

Improvements, we had a lot of comments from the peer reviewers that this model may be inadequate. There are alternate choices. In some cases, what you have in there is overly complex. We will take those review comments into account as part of our long-term development. We think that the models that are in there are adequate for the most part. As we look at any one of these individuals, there will be an uncertainty associated with those. We are going to move towards an uncertainty methodology. But we would not remove any of these overly sophisticated models unless something told us they were becoming a problem.

MEMBER BANERJEE: Steve, you have four more slides and you have five more minutes. I want one minute per slide.

MR. BAJOREK: Okay. I thought one minute for questions.

MEMBER BANERJEE: No questions. Questions will be after.

MEMBER SIEBER: There's a reward if you finish early.

MR. BAJOREK: Okay. But we will take that as part of our long-term development.

Error corrections, this might be easy because I think we've talked about a lot of this. That's been our highest priority. I think we fixed all of those.

Long-term development, we got some comments. Bill went through those. Right now, our plans are to activate that third droplet field. But if you look down below, it may be the right time to go ahead and activate the fourth field to get like the small bubble field.

MEMBER BANERJEE: I think you should assess this in a little bit depth with the long-term development before you go forward with that.

MR. BAJOREK: Okay.

MEMBER BANERJEE: But the ideas are good anyway.

MR. BAJOREK: That's why it's down in the possible, thinking about that. But we have not taken a lot of the steps towards that. We are looking at putting in spacer group models because we think that the deficiencies in the code right now which cause it to over predict some of the cladding temperatures are due to the lack of the spacer grid and having that third droplet field interacting with the spacer grid I think would collect a lot of the problems we see right now.

Summary conclusions, we think the peer review is valuable and those comments have helped us out and it's going to help us improve the code. We think the important aspect is that the peer reviewers, they, did not find major deficiencies. They had a lot of comments, but they didn't find anything that was truly significant and would preclude the use of this code for large and small break LOCA for the plants that we typically analyzed.

We have some high priority items. We think that those would have corrected errors and ease the code into the regulatory mainframe and as we move toward long-term development, this is where we can use those comments to improve and refine what's in the code presently.

And our bottom line conclusion is that we feel TRACE is ready at this point to be incorporated into the regulatory framework. Mirela pointed out some cases where it has been used. We're preparing the input decks. We're aware of what deficiencies are there and we think at this point we can use TRACE to help us ask better questions of the vendors and get these confirmatory questions not only for power uprates but also for the advanced plants considering the work of that has to go into these applicability reports.

MEMBER BANERJEE: I should add a comment that at the subcommittee meeting we had some of the users in NRR and NRO make comments, a comment that it was getting incorporated into the process. People who had not used it before are now using it and they are relatively happy with it and that's a very positive thing I think.

MEMBER SIEBER: Yes.

MEMBER POWERS: I think Steve's highlighted this conclusion and I think we should highlight this conclusion as well.

CHAIRMAN SHACK: You think that's highlighting?

(Laughter.)

The glare is killing my eyes.

MEMBER POWERS: It caught my attention. That's all.

MEMBER BANERJEE: One of the things, Steve, is you haven't answered a couple of the questions that we thought you were going to answer which came up in the subcommittee meeting. One was what plans for the uncertainty because at the end it's sort of a best estimate course or how do we know what the uncertainties are and what methodology are you suggesting for that?

MR. BAJOREK: We hope to be starting on that fairly soon.

MEMBER BANERJEE: What is involved really in doing this?

MR. BAJOREK: The very first step is to get some reliable plant models that we can begin to exercise. Secondly, it's to break down the types of uncertainties that we need to incorporate into that methodology. Some come from models. Some come from plant. Some come from the boundary conditions, uncertainties in pumps and things like that. I think we actually have a fairly good handle on those.

MEMBER BANERJEE: What about intrinsic uncertainties arising from, say, the models themselves? I don't know what George would call these.

MEMBER APOSTOLAKIS: Model uncertainties.

MEMBER BANERJEE: Model uncertainties.

CHAIRMAN SHACK: It's a very technical term.

MR. BAJOREK: In the assessment report, we have attempted to characterize the performance of several model packages in terms of scatter plots for heat transfer coefficients, break flow, some other, ECCS bypass, to set us up to the situation that if we decide that reflood heat transfers is a major contributor to uncertainty which it is it needs to be arranged in these calculations by plus 10 percent and minus 40 percent just to grab a couple of numbers. We've set ourselves up purposefully so that we know approximately what those ranges are.

Now we haven't done that for all of the

models yet. There are some that it's going to have to be done for.

MEMBER APOSTOLAKIS: Steve, when you have this statement of the board (Cough) do you mean it's also ready to be used, say, for the ESBWR?

MR. BAJOREK: Yes. We've been using it for ESBWR.

MEMBER CORRADINI: And we'll see those audit calculations when?

MR. BAJOREK: I don't know when that is scheduled really.

MEMBER APOSTOLAKIS: But you haven't done an uncertainty analysis.

MR. BAJOREK: We haven't done uncertainty calculations. So that is unfortunate and more of a best estimate calculation of here's what we think the ESBWR is going to do and we compare that with the TRAC-G calculations.

MEMBER APOSTOLAKIS: So that I understand. There is a plan to do something about the uncertainties. Is that the conclusion?

MEMBER BANERJEE: No, that's the question you're asking.

MEMBER APOSTOLAKIS: What is the answer?

MEMBER BANERJEE: We haven't gotten it

yet.

MR. BAJOREK: We haven't started it. Our plan is to begin that.

MEMBER APOSTOLAKIS: Okay.

MEMBER BLEY: Steve, you have suggested that --

MEMBER ARMIJO: Is the uncertainty a TRACE 6.0 or 5.X?

MR. BAJOREK: No, it would be with the 5.X, whatever we'd be working with at the time. There are some changes you have to make in the code, but it's not to models and correlations. It's more of an convenience to allow a user to arrange things. We really don't want people going in and making an update and coming up with 20 different code versions.

MEMBER APOSTOLAKIS: No.

MEMBER BLEY: But when you said you've been organizing have you actually been documenting where you think these uncertainties ought to be or is it just you're thinking about them at this point?

MR. BAJOREK: We've been thinking about them, but we would start with the CSAU.

MEMBER BLEY: What's that?

MR. BAJOREK: Code Scaling Applicability Uncertainty report that was done in 1989.

MEMBER BLEY: Yes, I know.

MR. BAJOREK: They basically went through the PIRT and they said, "For models you should be ranging these." My personal opinion is that's probably the best starting point for extending this and instead of using a response surface methodology which is difficult to apply we will likely go to something that might be more the non-parametric ranking, what I refer to as the GRS method or Wilkes method as a way of getting the uncertainty for a particular calculation.

MEMBER BANERJEE: Mike was telling me there are ways that this is done in some other codes. Right?

MEMBER CORRADINI: I was going to ask Dana. I mean the thing that pops in my head is MELCOR. You have an in-house tool that has whatever George says put on top. There is a structure and a methodology in how I thought containment system calculation is done in MELCOR and I'm curious if staff is going just look and you've already paid for it just replicate it from another one of your system's codes.

MEMBER POWERS: My off-hand suspicion is that their code has been written in a fashion for that should be applicable.

MEMBER CORRADINI: Right. That's what I was getting at.

MEMBER POWERS: There are challenges. First, they have to do exactly what Steve said. First they have to put bins in all the things that I want to look at. Then you have to think about ranges and you have to think about what the nature of those distributions are over those ranges and then comes one of the really difficult things that I think we've looked in some respects and that's correlations. Some uncertainties are just not independent and that takes a lot of puzzling to think about and stuff like that.

But those Monte Carlo methods are now so powerful and easy to do that it's Latin hyper q methods are essentially -- They're too much of a burden, the Monte Carlo methods, and you can reduce the data now with nonparametric methods and develop distributions. It's so easy. Why wouldn't you do it?

MR. BAJOREK: But our biggest obstacle --

MEMBER POWERS: Within minutes.

MEMBER BANERJEE: PWRs take longer.

MEMBER APOSTOLAKIS: If it's involvement of minutes you're okay.

MEMBER POWERS: If it's on the order of hours.

MEMBER APOSTOLAKIS: It depends. You have -- the hours.

MR. BAJOREK: Just as a way of reference --

MEMBER APOSTOLAKIS: Some idea must have --

MEMBER BANERJEE: Then you have 500 runs to do.

MEMBER SIEBER: Yes.

MEMBER ABDEL-KHALIK: You don't need 500 runs for a 9595 calculation.

MEMBER BANERJEE: It depends what you're trying to do.

MR. BAJOREK: I'll reference a paper by one of our peer reviewers that for CATHARE they would use an uncertainty methodology that would use a couple of hundred peak PWR runs eight hours and they would do it over a weekend.

MEMBER APOSTOLAKIS: We can discuss this when --

MR. BAJOREK: They used multiple nodes to run it.

MEMBER BANERJEE: Yes. I think you should come back to us.

MEMBER APOSTOLAKIS: Come to the

subcommittee meeting.

MEMBER BANERJEE: Yes. Okay. You should come back to us on that and then you still haven't answer the mass and energy conservation. I would love to see that, Mahaffi's famous claim that it conserves things. There's no evidence at the moment.

MR. STODMEYER: This is Joe Stodmeyer from the staff. The calculations have been done and we'll document them and submit them to you.

MEMBER BANERJEE: Okay.

(Off the record comments.)

MEMBER BANERJEE: Thank you very much. That was an excellent set of presentations. Thank you to the staff and I'll hand it back to you, Mr. Chairman.

CHAIRMAN SHACK: And the staff got us through it and almost on schedule. I'm amazed.

(Off the record comments.)

MEMBER BANERJEE: The staff should hang around for the letter at some point.

CHAIRMAN SHACK: We'll take a break until 3:45 p.m. Off the record.

(Whereupon, a short recess was taken.)

CHAIRMAN SHACK: On the record. We're back in sessions. Mike, it's over to you.

MEMBER CORRADINI: Okay. Thank you, Mr. Chairman. Let me give everybody a little bit of background as to why we're here for the next hour.

Originally, we had scheduled in this time slot to talk about the advanced reactor research plan and associated needs. That was modified due to a number of things. So instead of going into the whys and wherefores, let me give you a little bit of three or four minute history and then we have staff here that will essentially provide us with information as we have a discussion. The whole point of this is that we have scheduled two, I'm looking at -- so I don't get it wrong, plus days of subcommittee meetings on the advanced reactor research plan over the next few months.

We have some time. I won't even get to the dates. We'll do that tomorrow in planning and procedures. We have some time in the end of this calendar year once it starts getting chilly and then when it gets nice and cold we have a couple more days or a day and a half scheduled.

So the point of those subcommittee meetings are to look at not the licensing strategy which I'll remind you what we did but rather the long-term research plan, R&D plan, that has to go and be in synced with and paralleled to and synchronized with the licensing strategy as well as what DOE is doing for the next generation nuclear power plant.

So with that as the ending, that's what we're supposed to be done with at the end which is what should I suggest to the staff in terms of topics and maybe even a prioritization of topics for the subcommittee meetings for advanced reactor research. Let me remind you where we are.

So I'm going to go back a bit. Let me take the DOE side to begin with. So back in 2000, the GEN IV roadmap was started. This was two year effort to identify advanced reactor concepts beyond light water reactors that one might want to deploy in the three decades from 2000 time frame. All right. One of those reactors that was identified was a gas cooled thermal spectrum reactor. It was termed the VHTR, very high temperature reactor. The reason at the time it was termed that is the point design was focused on about 1,000 degrees Centigrade as the outlet gas temperature for this gas cooled reactor and the reason that temperature was shot at as a target goal was that it could be used for high temperature process heat as well as for electricity production.

Roll forward about three years. DOE

finished the roadmap, started a research plan with that as one of its reactor concepts and target goals for doing R&D and there was a review report termed the ITRG report, interim technical review group document, which was essentially a group of folks that were brought together. Some of you might know Phil Hildebrand, Ron Ballinger, a number of people in materials and reactor technologies that reviewed the VHTR program back in 2003 and asked was it on track from an R&D standpoint and if it wasn't, what were th things they worried about.

Their key finding was it was going too slow and it was being too -- The stretch goals were a bit too stretched. They were very concerned about the high temperature and how it would be affecting fuels and materials and their major conclusion was back off, do something more reasonable and continue with the R&D with that as a more reasonable target.

Roll forward two more years, in 2005 Harold was part of a subcommittee that I was on for the NERAC and we did another review and the status of that review was essentially look at the R&D that was done for the -- At this time now, it changed its name. It now became the NGNP primarily because in 2005 Congress in the Energy Policy Act of 2005 gave it a name, NGNP, and then set up a series of deliverables that had to be done to get this into essentially a demonstration reactor by 2021 at the latest.

One of the things was to review it, to review the R&D, which I'll mentioned and the second thing was to then deliver a year later which just has occurred a licensing strategy to Congress for the NGNP. So in 2005 this review was done. To cut to the chase, the result two years later was not a whole lot different from the ITRG report which was you're moving awful slow and your target shot at 1,000 degrees Centigrade gas outlet temperature is such a stretch goal you have a high potential for failure or shall we say goals could not be met and again it was suggested to back off on the temperature and a lot of the worries relative to materials and fuel reliability and associated thermal hydraulic, etc., would be ameliorated.

MEMBER RAY: May I make one comment?

MEMBER CORRADINI: Sure. I'm sorry.

MEMBER RAY: No.

MEMBER CORRADINI: Go ahead.

MEMBER RAY: But one of the reasons why this was happening from standpoint was they were being driven by absolutely crazy metrics that were causing them to get that high. For example, I remember arguing with Bill Magwood about the effort to make the hydrogen produced equivalent in cost to gasoline at that time assuming they were going to substitute hydrogen for gasoline in transportation. So the idea was we have to get the yield to the point where we can claim that it would be cheaper than gasoline. This is back as -- a few years ago.

But the point is it was crazy and they were talking out 30 years with these kinds of objectives that were being set by to me totally irrelevant metrics that had been dreamed up and it was driving them into things like ceramic pressure vessels and so on and so forth.

MEMBER ARMIJO: So what would the temperature be today at $4.00 a gallon?

MEMBER RAY: It would be less than it was.

MEMBER CORRADINI: It might be higher.

MEMBER BANERJEE: Make electricity directly.

MEMBER POWERS: The reason is that the efficiency of the thermal chemical cycle is almost a set point. That's what I mean. It has some slope to it. Instead of 1,000, it drops down to 850 but you need an extra delta to get across the heat exchanger.

So maybe it's 900.

MEMBER RAY: Well, 850 was -- I interrupted.

MEMBER CORRADINI: No, this is fine.

MEMBER RAY: But the point was I think, Dana, that they were being driven by things that just weren't relevant to the program.

MEMBER CORRADINI: Yes, they had -- I'll say they had stretch goals that were really stretched. So stop --

MEMBER BANERJEE: Using hydrogen for transportation is the goofiest idea I've ever heard.

MEMBER RAY: I'm just pointing out that was the rationale at the time.

(Off the record comments.)

MEMBER CORRADINI: Stipulating that, we'll stop talking about DOE and now we'll move over to the NRC. So about the end of 2006-2007, there was an advanced reactor research plan that had been put together. We have a copy of it. We've all gotten a very large CD with a lot of information on it which I'm sure you've all read. Right? Chapter and verse which had an advanced research plan.

At that time, given the timing and what was happening with the NGNP and the request for all of these steps in terms of licensing and research, the agency and the staff because of the 2005 Policy Act which said thou shalt work together jointly put together a PIRT process. The first PIRT process was TRISO-coated particle fuel for the NGNP. It was NUREG 6844. I think Dana was a member of that PIRT panel.

Subsequently, in spring of 2007, a series of four, Sud, five?

MR. ELTAWILA: Six actually including the men before.

MEMBER CORRADINI: Six other panels were put together on accident analysis, on hydrogen production, on materials, on graphite and something else which I've probably forgotten, fission products, source terms, of course.

Dana was part of the source term. I was part of the accident analysis. The result of all that was as you have in any PIRT process phenomena were identified. Phenomena were ranked into what was more important than other and that essentially gave a construct from which one might take what the advanced reactor research point was and start prioritizing what I'm going to do first, what I'm going to do second.

More importantly, it got DOE into the conversation as to what they're going to do relative to their fuels program and their materials program and what NRC may choose not to do because DOE is doing it. So what we have is a --

MR. ELTAWILA: Mike, can I add something?

MEMBER CORRADINI: Feel free.

MR. ELTAWILA: In addition to the PIRTs that you mentioned because I was asked that question last time, we have identified --

MEMBER APOSTOLAKIS: Identify yourself please.

MR. ELTAWILA: Farouk Eltawila from Research. We have identified, we have conducted a PIRT on human factor issue and that will be published and will be linked to all the other PIRTs. Human factors issue, yes.

MEMBER ARMIJO: Is that unique to gas reactors or just in general?

MR. ELTAWILA: Some of the issues related to the modular reactor might not be applied directly to the NGNP because it would be a single unit. But there are issues related when you have to have multi-unit or modular reactors.

MS. BANERJEE: Is this available now?

MR. ELTAWILA: It is in publication and it just should be available shortly.

MS. BANERJEE: I've been tracking it for the last four months.

MR. ELTAWILA: I will give you the exact date for that.

MS. BANERJEE: Thank you.

MEMBER CORRADINI: Okay. To finish off, we're at a point now entering in 2008 that we have a PIRT analysis. We have an advanced reactor research plan which is being redone. We have yet to see that because staff is still working on essentially changing it a bit based on the PIRT results. The licensing strategy which we have seen a few months ago has been delivered to the Congress. So now it's public. We've already reviewed that. And so we're kind of changing now in terms of emphasis from the licensing strategy which we're not going to talk about, but to the R&D that needs to be done within the construct of the agency in collaboration with or maybe I should in coordination with DOE and that's kind of what we want to talk about today.

The reason we backed away from a presentation is the main staff from the agency were having fun in South Africa for the last ten days. So they just came back two days ago, three days ago.

MEMBER APOSTOLAKIS: They don't want to

have any more fun.

MEMBER CORRADINI: And they don't want to have any more fun in two days.

CHAIRMAN SHACK: But we got their slides. They're ready.

MEMBER CORRADINI: And we have the slides from their topic. So I guess that's the context. What I wanted to talk about is and maybe ask Stu Rubin to say a couple things is in what way do we want to organize the next set of subcommittee meetings to walk through a prioritization of the research that needs to be done in this fiscal year and in the subsequent fiscal years, in support of NGNP licensing.

MEMBER APOSTOLAKIS: Let me ask something. I know we reviewed what the staff was proposing for the licensing process. Can you remind us what the actual final result was? I mean did they really raise the level of PRA utilization or are they following the standard Part 50 or 52 for the prototype and then the next one we'll think about it?

MEMBER CORRADINI: So are you asking about what was delivered to Congress?

MEMBER APOSTOLAKIS: Yes. I should have known, but can someone remind us very quickly?

MR. BASU: Sud Basu from Office of

Research. The report that was delivered to Congress identified various options, technical requirements options, if you recall, that included risk informed performance based options. It doesn't say partial -- Am I responding to your question?

MEMBER APOSTOLAKIS: No, but did you offer options to Congress or you said this --

MR. BASU: No, we said it's Part 52 licensing process with risk informed performance based Part 50 technical requirements. That's what we said.

MEMBER APOSTOLAKIS: That's the first time I heard it.

MEMBER CORRADINI: No, this is not.

MR. BASU: It was one of the options.

MEMBER APOSTOLAKIS: Risk informed technique requirements. Give me an example of it.

MR. RUBIN: This is Stu Rubin, Office of Research. The approach is to use the current body of regulations, Part 50, Part 100, etc. We're not creating a new body of regulations. But in applying those regulations we're going to develop a licensing basis which utilizes a plant PRA to help us sort out events to populate the AOOs, the DBAs, beyond the design basis accidents and also conservatively developed events in those categories. So we are using the PRA, for example, for event selection and categorization.

MEMBER CORRADINI: But can I try it my way? We agreed. We wrote a letter that agreed with their approach which was a blending of deterministic and risk informed and we kind of debated and got all torn up about option 2, option 3. Let's just say a midrange option which was deterministic as well as risk informed efforts that identify as Stu suggested the accidents or transients and AOO design basis and beyond design basis. Do I have it right?

MR. RUBIN: Yes.

MEMBER APOSTOLAKIS: So how would this be different, say, from what we're doing now with design conditions?

MR. RUBIN: We will use the PRA to pick AOOs, DBAs now.

MEMBER APOSTOLAKIS: I thought you were going to say that. So that's good.

CHAIRMAN SHACK: That's what we recommended, George.

MEMBER CORRADINI: That's what we recommended.

MEMBER APOSTOLAKIS: No, we didn't talk about the AOOs.

CHAIRMAN SHACK: We talked about using PRAs to choose licensing basis events.

MR. RUBIN: So we took your recommendation. That's what's --

MEMBER CORRADINI: But wait. Can I --

MEMBER APOSTOLAKIS: The licensing basis events in the technology of their framework means something else. It's a whole sequence.

CHAIRMAN SHACK: It's everything.

MEMBER CORRADINI: Be careful what we -- Can I just try one more time?

MEMBER APOSTOLAKIS: Yes.

MEMBER CORRADINI: So the staff listened to us and in what came on into the license strategy is for the NGNP, and Stu said it better, I'll get this wrong, but essentially used the current body of regulations but using the risk informed approach to identify where potential accidents and transients fit within those three categories.

MEMBER APOSTOLAKIS: Okay.

MEMBER CORRADINI: In difference to what I think you want to do which is essentially for some commercial plant use a totally technology neutral frock. I'm just guessing.

MEMBER APOSTOLAKIS: It's not me. That's

what the law says. We quoted the law.

MEMBER CORRADINI: But that's where the commercial --

MR. BASU: For the commercial that's a correct statement. That's the commercial review.

MEMBER APOSTOLAKIS: But at that time we'll find another way to bring Part 52 into it. Don't worry.

MEMBER CORRADINI: Are you satisfied?

MEMBER APOSTOLAKIS: No. This is then it seems to me one of the very first things that the subcommittee meeting should address because it flows directly from the licensing process. How are we going to do all these things? That's why it's important to know --

MEMBER CORRADINI: So can I anticipate you? I would agree that -- I would hope that -- I guess my only worry is we have limited number of slots for subcommittee meetings. If we do that, I would ask them to do that shortly and then launch into what's the research they need to do to help answer those to help identify.

MEMBER APOSTOLAKIS: That's what I meant.

MEMBER CORRADINI: Okay.

MEMBER APOSTOLAKIS: I mean, what is the

research that will be required to be able to say, "Yes, we are using PRA this way. This is what we're going to do" rather than say "For certification purposes it's good enough."

MR. RUBIN: I would envision one of these meetings at the subcommittee level would talk about what are the quality requirements for the PRA to apply a PRA in this manner and then what are the rules or the logic that you would apply that PRA to event selection.

MEMBER APOSTOLAKIS: And anything else.

MR. RUBIN: Exactly. Maybe other things. I think that will be in my mind a topic --

MR. ELTAWILA: Can I -- I think we agree --

MEMBER APOSTOLAKIS: I think Dr. Shack is smiling. Why are you smiling, Mr. Chairman?

CHAIRMAN SHACK: Because I agree with you, George.

(Simultaneous conversations.)

MR. ELTAWILA: I would like to work with the ACRS staff here and try to establish the details presentation that the staff wants to make. Just keep in mind that there are a lot of policy issues that we need to write a policy paper for the Commission which we want to be discussing with you. So I don't want to start talking about the specific meeting at a specific time before we develop these policy issues where we have the benefit the staff thinking about the policy that we are addressing.

MEMBER APOSTOLAKIS: The question was how do you prioritize what we're going to do.

MR. ELTAWILA: Okay.

MEMBER APOSTOLAKIS: The high priority item is this issue of how do you use risk information licensing. Right?

MR. ELTAWILA: Okay.

MS. BANERJEE: This is Maitri again. I just wanted to mention that right now we only have a day and a half of subcommittee meetings scheduled that after the end of this meeting hopefully we will --

MEMBER APOSTOLAKIS: Tomorrow I thought during the P&P the chairman of the subcommittee will propose that I expect.

MEMBER CORRADINI: We have some in mind.

MEMBER APOSTOLAKIS: Yes.

MEMBER CORRADINI: Okay. So can I -- I would like to turn to Stu to give us some construct of this because the way I see it at least if you guys remember when we had the licensing strategy we had a half of a day during the license strategy where Dave Petty came in and folks from I&L came in and went through their R&D and in some sense if you look at it from the DOE side, they attack the problem relative to performance of the machine during normal operation as their key item and if you looked at their research plan relative to fuels and materials, graphite, etc., thermal hydraulic codes, etc., it starts with steady state operation and then moves its way down to off normal events and to essentially what I'll call accident events.

MR. ELTAWILA: Mike with all due respect, we are not prepared to make any presentations today.

MEMBER CORRADINI: I understand.

MR. ELTAWILA: I really prefer. We are not prepared to make any presentations.

MEMBER CORRADINI: I don't want a presentation. I just --

MR. ELTAWILA: Or even discussion. I think these are issues that we discussed internally and we have to vet with our management and things like that before discussing it.

MEMBER APOSTOLAKIS: Are you saying the discussion should be among the members only?

MR. ELTAWILA: That's what the meeting

was. The discussion among the members, yes.

MEMBER APOSTOLAKIS: But don't ask the staff anything.

MEMBER CORRADINI: Okay. Fine. But they can volunteer.

(Laughter.)

So let me just finish the way I was going to frame this, so at least we can go down the path. When we last got together DOE essentially started with steady state operation and identified all their research. Where I see it going relative to how we might want to hear for things relative from the staff in our subcommittee meetings is to reverse the paradigm and talk about first of all as George -- I'll pick George's theme. How does one identify the AOOs, the DBAs and the beyond design basis events, what are the source term consequences from them and then what sort of safety systems and associated criteria would we have to come up with so that those safety systems have to perform so that we don't get beyond a release based on 10 CFR 100, 10 CFR, based on current regulations.

CHAIRMAN SHACK: That sounds like you want to design a reactor.

MEMBER CORRADINI: No, just the opposite.

I'm trying to avoid talking about research for steady state operation. I want to understand the research the staff wants to do relative to radiological consequences, first, determining what the LBEs are, the radiological consequences given a set of LBEs and then what are the safety systems and the performance criteria for those safety systems it seems to me.

MEMBER ARMIJO: So, Mike, these are things that you would address independent to the reactor design.

MEMBER CORRADINI: Independent of the reactor design because at this point DOE has not picked. They have two point designs that they have yet to pick.

MEMBER ARMIJO: Right.

MEMBER CORRADINI: One is the pebble bed and one is the prismatic.

MEMBER ARMIJO: And they haven't picked the fuel either.

MEMBER CORRADINI: And they have not picked the fuel although they have a lead fuel which is the UCO and a backup fuel which is the UO2 kernel.

MEMBER ABDEL-KHALIK: Isn't there a missing step in this logic where you feedback to the design?

MEMBER CORRADINI: In some sense that's kind of not our job. That's kind of we would have to tell DOE. Staff would have to discuss it with DOE and DOE would have to think, "Oh, that's the requirements that are going to be put upon us for licensing. Will the design meet those requirements?"

MEMBER BLEY: Yes, we. It's almost a natural --

MEMBER ABDEL-KHALIK: They should have that information long ago, Mike, to take you seriously and go back and change the design. Then we have to go work the bottom and dig in ourselves.

MEMBER APOSTOLAKIS: No, we are second -- not we, the staff ultimately --

(Simultaneous conversations.)

So we are commenting on the rules of the game and in order to develop the rules you had to do some research to understand why you are setting the rules. That's the way I see it.

By the way, is this NGNP supposed to be part of the hydrogen production?

MEMBER BLEY: Yes, by the law.

MEMBER CORRADINI: It's supposed to produce at least 10 percent -- use 10 percent of its process heat for hydrogen production.

MEMBER APOSTOLAKIS: Because I also hear there process heat will be used forever in -- it's not just hydrogen.

MEMBER CORRADINI: They have to develop a process heat plant and they want to demonstrate hydrogen production as the end stage of where the process heat is.

MEMBER APOSTOLAKIS: And we understand what kind of accidents may be caused by these --

MEMBER BLEY: We raised that issue.

MEMBER ARMIJO: We're not evaluating where the boundary is.

MEMBER APOSTOLAKIS: What?

MEMBER ARMIJO: The plant is a black box the way I understand it.

MEMBER APOSTOLAKIS: But which plant is a black box?

MEMBER BLEY: I'm sorry. Hydrogen.

MEMBER ARMIJO: It's out of our scope.

MEMBER BLEY: It is except we raised the issue of is there any way it can feed back to cause a problem at the reactor side and they agreed they had to do that was my understanding.

MEMBER APOSTOLAKIS: From the nuclear side, they have to worry about it.

MEMBER ARMIJO: Agreed. But that's not the way it started out.

MEMBER BLEY: No.

MEMBER APOSTOLAKIS: Is that understood?

CHAIRMAN SHACK: That's well understood.

MEMBER BLEY: It was complete black box in the beginning, yes.

MEMBER CORRADINI: So my strawman to consider for the subcommittees is to start with what the staff is thinking about relative to how it's going to determine LBEs using this deterministic risk informed combined approach. Secondly, what the radiological consequences are? How that drives things relative to research they need to do? And then what are the performance criteria they're going to put upon the safety systems?

Just so we're clear. You guys are worried about the hydrogen plant. The thing that I'm still struggling with is in the steady state normal point design that DOE is putting out there is no containment.

MEMBER ARMIJO: Yes, I know. That's the key issue.

MEMBER CORRADINI: So the first question that would come to my mind is what is the containment, we'll use the term in a general fashion, system. What are the requirements of that containment system relative to being a safety system that has to keep in a source term to meet 10 CFR 100 links? And what are accidents, going back to my first thing, they are going to challenge? So that's my suggested strawman. Work from LBEs to radiological consequences from those LBEs to essentially safety systems that have to be there as part of the design.

MEMBER APOSTOLAKIS: Not that we use risk information. We go to defense-in-depth and go back to Part 50 with the containment. Right?

MEMBER ARMIJO: All of this goes back to the quality of that fuel.

MEMBER POWERS: Absolutely, George, except we'll leave out the risk assessment stuff. Do that first and then we'll do the risk assessment.

MEMBER APOSTOLAKIS: No, I think it should be the other way. It's more provocative.

(Laughter.)

MEMBER POWERS: Also a waste of time.

JOHN: Mike, can I just add something to what you just said?

MEMBER CORRADINI: Sure.

JOHN: Certainly it's right on. I think

there was an important point brought out in the committee's report on this back in 2004, or was it 2003, 2003, where it said that it's important to distinguish what would be done by the staff versus what would be done by the applicant and that would be in this context. This is what it said. In general, a research document does not specifically distinguish between the information that should be developed by the applicant and the information to be developed by the NRC. So I think to draw that line on where who does what would be important to the research program and understand what they would need to do versus what the applicant would need to do as part of it.

MEMBER APOSTOLAKIS: Something that the ACRS should worry about?

JOHN: I think where the line is drawn might be. I think that's something that --

MEMBER APOSTOLAKIS: They don't get involved in things like that.

MEMBER CORRADINI: No, but I think what John is asking is there are two other things I wanted to ask where we do this in the subcommittee meetings which is what research is really in the court of DOE and what research is in the court of the NRC staff. That's kind of --

JOHN: That's exactly right.

MEMBER CORRADINI: That's what John is saying. And the second question at least in my mind is now that they have a PIRT, now that staff has done their PIRT in all the areas including the one Farouk mentioned, and we have the old advanced research plan what's now the priority of once we know who does what, what should be first, what should be second, right, in terms of his graphite. I'll pick a crazy example. Is the fact that this thing is going to undergoing a non-isotropic graphite growth and bypass flows which will affect hot spots something that DOE should do or is it something the staff is going to do? And if staff is going to do it, where does it fit into their 2009-2010 plan relative to the research?

MEMBER APOSTOLAKIS: I'm not sure we can --

MEMBER CORRADINI: I know that. I'm just saying we should at least know what the plan is.

MEMBER APOSTOLAKIS: Yes.

MEMBER BLEY: Got to make sure it's being done somewhere.

MEMBER ARMIJO: The staff should have the tools to evaluate it.

CHAIRMAN SHACK: Yes, isn't the

first order of business is to make sure they have the tools they need to do any of this?

MEMBER APOSTOLAKIS: Is there a -- in TRACE that can be used?

CHAIRMAN SHACK: I would think that's almost the first order of business is develop the tools, one of which is a code.

MEMBER APOSTOLAKIS: Yes.

CHAIRMAN SHACK: I don't think they have simulator codes for gas reactors yet. I don't know. I would think that those codes are the first things that you need to worry about if you want the NRC to have an independent analysis capability which I think you probably do.

MEMBER CORRADINI: So do you think tools are first versus determining what experiments that -- Let me just back up. So one thing that was I brought into this about who does what, I'm curious if staff thinks that given what DOE's plans are there is no obvious experimental research that needs to be done by staff. It's all going to be done by DOE and by the appropriate questions that they might ask of DOE as the applicant and all that NRC is going to do is develop the appropriate computational analysis tools.

CHAIRMAN SHACK: But those computational

analysis tools need verification and validation. So I mean the experiments are part and parcel of what you need to do to develop that analysis capability.

MEMBER SIEBER: That's right.

MEMBER ABDEL-KHALIK: But the fact that DOE would run the experiments does not preclude the possibility of NRC taking the raw data and using that to validate whatever codes they develop.

MEMBER CORRADINI: Correct.

MEMBER BLEY: I think also even if they haven't a PRA or might not have all the tools for doing a PRA understanding how it would be used to select these events is something that they certainly can think about at this time. They'll need tools to be able to do it later. But I think the way Mike phrased it was how would you go about using a PRA to extract these things.

MEMBER APOSTOLAKIS: Certain things can be done in power uprate. So the obvious tools that you will need, yes, and then you do other things as well. For example, the issue of uncertainty associated with a tool like TRACE. In this case, it seems to me it's going to be very important to have that ready because you're talking about the new system, gas coolant. It's not something that you can do as an afterthought four years down the line. I mean you have to think about --

MEMBER BLEY: Decide to do bounding calculations.

MEMBER CORRADINI: Can I get to the bounding calculations?

MEMBER APOSTOLAKIS: Then you are not using PRA. Okay. These are the issues and concerns.

(Simultaneous conversations.)

MEMBER CORRADINI: Dana has been kind of quiet and he was on the original PIRT relative to fuels and on the source term. The one thing that I guess I'm thinking and how I'm thinking about it is I'm not so thrilled about fancy tools unless I need the fancy tools. I'm curious. Are there already available tools that the staff has that they can turn to the problem to, I don't want to say bound, but at least scope it like MELCOR calculations that will say with some other analysis that decides what the LBEs are and if I run through a serious of calculations, "Gee, this is the accident that really concerns me and under this point design conditions I'm going to have a problem with, I don't know what, release of metallic source term fission products into containment or trapped on the dust that goes launching its way for a depressurization accident." That's why I hesitate on the need to develop tools. There might already be tools that can just be, I don't want to say shifted over, but immediately utilized to kind of bound the problem. Can you give us some insight as to what some concerns you have relative to fuels and source term, sir?

MEMBER POWERS: We have some substantial experience with gas cooled reactors. I mean, it's not the first time we've ever looked at them and I mean the one thing we absolutely know is that because of the graphite there's a lot of dust and things that one has to think about depressurization of plants either due to pipe breaks or deliberately done and the resuspension of that gas or that dust which is always contaminated with radionuclides.

Now the magnitude of that contamination is a source of discussion right now and we've recently been treated to newer information about just how extensive it's contaminated that dust and what particular it gets on.

MEMBER CORRADINI: So can I just remind folks that in your CD you got from Maitri there's a paper specifically on this, a draft paper, that's going to be coming in a conference by Moorman. Is that the name of the --

MEMBER POWERS: Roger Moorman, yes.

MEMBER CORRADINI: Roger Moorman.

MEMBER POWERS: So you have something that looks very equivalent to what they call a gap release that is almost anything I do that changes, that creates a hole in the reactor coolant system. I get a release of radioactivity in the containment roughly equivalent to the gap release.

MEMBER ARMIJO: This is independent of the quality of the fuel or fuel failure. This is just activation.

MEMBER POWERS: Much of the containment issue actually is fission product. You have a certain amount of fuel failure all the time. You will undoubtedly have some contamination in the fuel just in manufacturing it. You will have some activation products. I mean, there's a variety of ways this stuff gets contaminated.

What the Moorman paper suggests is there are other ways to get it contaminated that may go beyond natural fuel failures and the fact that many of the tracer kinds of design of fuel protocols like silicon carbide, pressure boundary within the fuel particle itself which is pretty good at retaining noble gases and maybe not retaining what he calls metallic fission products.

Now when you get to going more, thinking about more, severe accidents than just a depressurization which you wouldn't have to count as an anticipated operational event. I mean, in the lifetime of a plant it's hard to preclude there being a depressurization of a reactor coolant system. I don't know how you would go about arguing that sometime in the 40 year lifetime of a plant you would not ever get a depressurization. Think of that as an operational event.

Then you think about more severe accidents. The one that people automatically think about is I get water intrusion into it because some place I'm going to have an interface between my gas coolant and water to drive a turbine probably. It's not absolutely required, but most of the designs have it and there have been water intrusion events for instances in the AVR plant itself has water intrusion and the hot water and hot graphite have a propensity to produce hydrogen and hydrogen has a propensity to degrade. So it causes an interesting accident.

More sophisticated in that is you have a water intrusion event or a depressurization event and you get air into the thing and air and graphite are an uncomfortable mixture when one of them is warm and produces degradation. You have degradation in the fuel during normal operations and at higher temperatures. So if you have over temperature that you're going to get a degradation in the fuel.

Typically in this subject of a water discussion right now on when fuel starts to degrade in these reactors it's not nearly as sharp an event as it is with metal clad fuel. Now roughly if you get to the cladding melting point you're going degrading the fuel. Here it's more of a continuum in which things accelerate over time.

Some of the fuels have a really marvelously peculiar fact. It's called an amoeba effect, whereas when you have an oxide kernel within all this graphite and whatnot a kernel appears to move through the pressure boundary. It's actually the pressure boundary moving across the kernel, but it looks like the kernel is moving across the pressure boundary and there is some hope of fixing that by going to carbide fuel.

One of the interesting effects that you get that Moorman reports is that some of the inherent radionuclide retention capabilities are lost when you go to carbide fuels and particularly notes that strontium retention which is pretty high in oxide fuels is pretty low in carbide fuels. So you get some enhanced fission product release.

Are there codes available for predicting this? Well, the folks at GA and I&L think they have codes for calculating fission product release from these product of fuels. I think I fall into a camp that says, "Well, you may have code, but you don't have good data" because nearly all the data has been taken isothermal circumstances and, in fact, you always have thermal gradients in these systems and the peculiarity of the fine particulate fuel is that you get some very, very sharp thermal gradients. The delta T, the change of temperatures, across the various barriers are only a couple of degrees but the barrier is only a few microns wide. So you get 10,000 degrees per centimeter types of temperature gradients and they drive thermal defusion. That thermal defusion terms in the release are not reflected in the codes because they've always done isothermal experiments and it is the thermal defusion that is the biggest problem we had in fast reactor fuels as far as where the fission products went and the thermal gradients there were only like 1,000 degree per centimeter. Here we have 10,000 degree per centimeter gradients.

So I question the reliability of the fuels. A lot of the I&L program is now devoted toward doing experiments to validate their tools. But again, I think the experiments are the wrong experiments.

MEMBER CORRADINI: So I was taking notes as you were commenting. To put it in a context of what might be important in a subcommittee meeting to hear from staff, I wrote down source term research.

MEMBER POWERS: Yes, I think in the area of source term research the first order of business is can we understand the resuspension and subsequent deposition of dust from the core, maybe even understanding how much dust there is but certainly understanding in a blowdown, in a depressurization event, how much are we going to resuspend and how long is it going to remain suspended in the atmosphere and how fast is it going to leak out of what I hope is a containment building but right now is a confinement building.

We'd always anticipated there would be a lot of dust, but we'd hoped there wouldn't be much radionuclide contamination. Moorman comes back and says, "Gee, in the AVR which operate at high temperatures for only a period of four years they got percentages of the coring inventory up on the dust," you know, three, four, five percent like a gap release. It adds about two orders of magnitude more than I thought we would have on the dust.

Now the AVR reactors are particle bed reactors and so produces inherently a lot of dust because little balls bang against each other and things like that.

MEMBER CORRADINI: It's really -- fuel. Right? AVR results with pebble bed.

MEMBER POWERS: Yes. AVR with pebble bed. Yes, and so when you think about a fixed block fuel maybe you don't have so much dust, but you're going to always have dust with a graphite moderated reactor. It's just unavoidable. The neutrons slamming through in and of itself is going to create a dust pool. That's the first order of business.

The second order of business is can you predict the fission product release in normal operations and accidents where you had a loss of inventory and in accidents where you've had either water intrusion or air intrusion.

MEMBER CORRADINI: Can I just ask about that? I mean, that's one that I guess I expect DOE that ought to have in their grouping to worry about and NRC would do more of a QA check than a total development project for example, or am I off base?

MEMBER POWERS: You would think they would. I'll tell you some of the sad history there when you get done posing your question.

MEMBER CORRADINI: That's fine. What I'm trying to do is we have a few minutes left. I'm trying to get down from all of you questions and then I'll order them and get comments so that I can get back to staff on what sort of things we want to cover in three days of subcommittees on the NGNP plant.

MEMBER BLEY: Okay. In that context -- you're not done. I'm sorry.

MEMBER POWERS: Well, for some reason people that work in gas cooled reactors resist the idea of an air intrusion accident with a blind passion and that's because they're disasters that would ordinarily be made into movies. The approach to looking at air intrusion accidents has a history of they said, "The graphite is hot. So all of the air will react right in the inlet and will never get up to where the coolant is." That's not really the way graphite behaves. Graphite reacts with air under chemical control, chemical kinetic control, up to about 1,000, maybe 1,200, degrees Centigrade. Above that temperature, it's strictly mass transport control.

Lower temperatures it reacts by chemical kinetic control and so it doesn't react all that immediately. It gets everywhere around and it's not a uniform reaction. It tends to do pinhole and any kind of metal on the surface of the graphite will catalyze the reaction and you'll get the little bore holes into the graphite. They're called worm holes because it looks like worms have attacked your graphite and it's just because it's catalyzing the oxidation of the graphite. So it's much more pandemic than just a localized attack and I think I&L has now done calculations that recognize that getting air into these cores is really, really a bad idea.

Do they have codes that address it? I really don't know what the status is. What I do know is in connection with the N reactor and even before that the B reactor up at Hanford General Electric did some really nice large scale experiments on graphite components exposed to air and so we have databases if we cared to ever validate those and I mean these were well done, well instrumented, well thought out experiments looking at Bouchard reactions in kinetics and things like that.

Now what I also know is those experiments were done with nuclear graphites of the day and the nuclear graphite vendors today really get upset at me when I bring these subjects up because they assure me that the nuclear graphites today are vastly better, essentially impervious to all known forms of energy and reaction. They stand up to bullets, speeding trains, more powerful than a locomotive and we can't transfer that information forward. I simply don't know. I have no experience with the current day graphites.

(Off the record comments.)

MEMBER RAY: In this presentation here that we were given, I was glad to see that there was emphasis placed on graphite component analysis and I'm thinking in the accident environment now and DE&R site requirements I think are -- they may not rise to the top of people's agenda sitting around this table here but they're going to be a problem I believe and therefore if I were thinking about R&D as this slide talks about, I would certainly include them.

MEMBER POWERS: One of the troublesome issues with graphite as a material is because you accumulate radiation damage in there and there's the wild belief that this is all Wigner energy that gets dissipated in normal operating temperatures. It's not true. You accumulate radiation damage some of which doesn't really -- until you get up about 2,500 degrees Centigrade. So when you get a exothermic reaction going on in graphite it has a tendency to self propagate because the reaction is now reacting to something that is not graphite. It's graphite excited by being displaced out of its normal lattice position. So it gets hotter faster than --

MEMBER RAY: That may be a why but my concern is the assurance that you have for whatever reason the thing will withstand a DBE or a blowdown without it.

(Simultaneous conversation.)

-- configuration. That's what I worry about.

MEMBER POWERS: You bring up a good point that these blocks of graphite on the drawings they look all uniform. They don't stay put in the irradiation. They move around and grow.

MEMBER CORRADINI: I was going to say. That's the one thing I thought you guys were going towards which is more of a steady state aging problem which is as these things undergo irradiation where you thought the flow was going is not where the flow ends up and you start having bypass and you start moving hot spots because of dimensional changes.

MEMBER RAY: Or the supports can't withstand the loading in a design basis accident.

MEMBER ARMIJO: Mike, there's another issue. Yesterday we had a fuel subcommittee meeting with all the water reactors guys and they were telling us about their fuel performance and it's really very good. They're down to five leakers in a million rods in operation per year. Pretty good. We're talking with this fuel millions of particles which are the fuel elements and the enormously high quality required and they're near uninspectable. I think they are totally uninspectable. So it's all batch process control and they're going to say we have batch process control that can assure that this fuel will perform in certain ways under steady state and more importantly under high temperature transients. I don't believe it.

But if you're going to justify operation without a containment you're going to have to assure that that fuel is essentially perfect and the numbers are mind-boggling. So that's an area that I would look to the staff to really probe and we certainly will. So I would sure like to know what they're going to do about that, how they address that. They have challenges.

MS. BANERJEE: I was going to point out, this is Maitri again, that there are several policy issues that staff has identified and the top four include this source term for an NGNP condition and which their use can be justified in licensing and their functional requirements -- four and use of selective risk matrix and criteria.

MEMBER CORRADINI: Can you say that one again please? Can you repeat the third one?

MS. BANERJEE: The third one is the basis for and use of selective risk matrix and criteria and the quality and scope of an NGNP PRA relicensing process and then actually the top one is defense-in-depth measures. So somehow all these are going to play into how much they are going to do in terms of that in establishing criteria.

MEMBER CORRADINI: Other comments? We're at our hour of time.

MEMBER APOSTOLAKIS: Don't the Chinese have a running reactor mode?

MEMBER CORRADINI: Yes, they do and a lot of people come look at it. But it's alpha temperature is 700 degrees C.

MEMBER APOSTOLAKIS: But I mean its tools.

MEMBER ARMIJO: Far less challenging.

MEMBER CORRADINI: Far less challenging. It's a 10 megawatt thermal pebble bed reactor. I'm pretty sure that's what it is. Right?

MEMBER APOSTOLAKIS: So it's not what has been -- what kind of tools they have developed.

MEMBER CORRADINI: I don't know that. You're talking about analytical tools for it.

MEMBER APOSTOLAKIS: Yes.

MEMBER ARMIJO: The Germans license the SNR which was a 300 megawatt or something.

MEMBER APOSTOLAKIS: That was quite an experience. Is there such a thing?

MEMBER ARMIJO: And they didn't operate very long. They had control rod problems. But they licensed it and they asked lots of questions and they use these particle fuel and it was a pebble bed.

MEMBER CORRADINI: So this is an appropriate time. I'm looking at Dr. Eltawila and I ask any offhand if it's allowed insights from the staff after their jaunt to the Southern Hemisphere. I'm curious if they found things there that interested or surprised them. I'm curious about that.

MR. ELTAWILA: Okay. I think I'll let John talk about that.

MEMBER CORRADINI: Okay.

MR. JOLICOEUR: John Jolicoeur from Research. Let me make sure I understand the question. You're asking if we have any new insights.

MEMBER CORRADINI: Yes. When you went down there, did something surprise you to the positive? To the negative? The staff went down to South Africa to see the SCOM and the PBMR project just a few days came back.

MR. JOLICOEUR: Well, I can say we went down there and we did look at about three or four different research facilities they have down there that are in pretty good shape that are providing some good data for them down there and an opportunity for us to do some cooperative research with them down in South Africa. In terms of big surprises in our discussion with NRR, I can't say there were any new issues that I heard from them are things that we weren't already beginning to look at here.

MEMBER CORRADINI: Or nothing on the list that we're generating or something that we're missing off our list.

MR. JOLICOEUR: I don't remember anything new. The guys were there sitting at the other table. I don't remember any other issues here that we haven't already discussed today.

MR. BAKER: Mike, Ed Baker from NRR. I would like to add one thing though when you're talking about temperatures. The latest discussions with both AREVA and the PDMR folks and DOE is considering this as part of their proposals is that they would come in at 750 degrees to start with. They're looking at, both the companies are looking at, not only NGNP but also a commercial heat process market and they've told us they can meet two-thirds of what they see as the process heat market at 750 degrees. So both companies have said that publicly and they're proposing that to DOE as a first step for the NGNP.

(Simultaneous conversations.)

MEMBER CORRADINI: Any other members' comments before I essentially take all and write this up. Our point of this is to give staff some idea of what sorts of things we'd be interested in. They're going to come back and suggest how they'll roll out their R&D plan to us over two and a half days of meetings.

MEMBER APOSTOLAKIS: Just one meeting?

MEMBER CORRADINI: No, two two and a half days. We'll discuss it tomorrow. We'll have these there for all of them.

Any other comments?

(No verbal response.)

Mr. Chairman.

CHAIRMAN SHACK: Thank you very much. We can end the recorded portion of the meeting. Off the record.

(Whereupon, at 4:48 p.m., the above-entitled matter was concluded.)

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Advisory Committee on Reactor Safeguards (ACRS) License Renewal Subcommittee

Wolf Creek Generating Station (WCGS)

Safety Evaluation Report (SER)

September 4, 2008

Tam Tran, Project Manager
Office of Nuclear Reactor Regulation

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Presentation Outline

- Overview of WCGS license renewal review
- License renewal Audit and Inspection
- SER Section 2: Scoping and Screening review results
- SER Section 3: Aging Management review results
- SER Section 4: Time-Limited Aging Analyses (TLAAs)

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Overview (LRA)

- License Renewal Application (LRA) submitted September 2006
  - Located 3.5 miles northeast of the town of Burlington, in Coffey County, Kansas
  - Westinghouse PWR, carbon steel-lined concrete (DRYAMB) containment
  - 3565 megawatt thermal, 1228 megawatt electric
  - Facility Operating License Number NPF-42 expires March 11, 2025

Overview (SER)

- Safety Evaluation Report (SER) with Open Items issued to the applicant February 1, 2008
  - 95 RAI items issued
  - 5 Open Items (OIs)
  - No Confirmatory Items

Overview (SER) – con’t

- Final Safety Evaluation Report (SER) issued to the applicant July 29, 2008
  - Closure of 2 SBO related OIs
  - Closure of 3 metal fatigue analysis related OIs

Audit and Inspection

- Scoping and Screening Methodology Audit
  1/8 – 1/12, 2007
- Aging Management Program (AMP) Audit
  3/26 – 3/30, 2007
- Aging Management Review (AMR) Audit
  5/7 – 5/11, 2007
- Time-Limited Aging Analysis (TLAA) Audit
  7/9 – 7/11, 2007
- Region IV Inspection (Scoping and Screening & AMP)
  9/10 – 9/14, 2007 & 10/22 – 10/26, 2007
- Additional audit of metal fatigue for open item closure, 06/2008

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License Renewal Inspections

Gregory Pick

Region IV Inspection Team Leader

Current Performance

- Green PIs & Findings
- Corrective Action Program
- Special Inspection – ECCS Voiding
- Mid-Cycle Performance Review

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Inspection Results

- Scoping of nonsafety-related systems
- Aging Management Programs
- Amendment 5 corrected items
- Current License Basis Issue

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SER Section 2: Structures and Components Subject to Aging Management Review

Section 2.1 Scoping and Screening Methodology

- Staff's audit and review concluded that the applicant's methodology is consistent with the requirements of 10 CFR 54.4 and 54.21.

Section 2.2 Plant-Level Scoping Results

- Consistent with 10 CFR 54.4, the staff found no omission of plant-level scoping systems and structures within the scope of license renewal.

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Section 2.3 & 2.4 Scoping and Screening Results: Mechanical Systems and Structures

- As a result of staff review, the License Renewal Application was amended. The staff concludes no omission of mechanical components and structures within the scope of license renewal and subject to AMR, consistent with 10 CFR 54.4(a) and 10 CFR 54.21(a)(1).

Section 2.5 Scoping and Screening Results: Electrical and Instrumentation & Control Systems

- OI 2.5-1 is closed:
  - SBO recovery paths should be within the scope of license renewal to ensure offsite power can be restored to the plant.
  - The scoping boundary should be a circuit breaker for each path at transmission voltage.
  - Closure: Applicant submitted LRA amendment to include a circuit breaker for each path within the scope of LRA.

SER Section 3: Aging Management Review Results

Section 3.0.3 39 Aging Management Programs (AMPs) evaluated in the SER, consistent with GALL

	Plant specific	Consistent with GALL	With exception	With enhancement	With exception & enhancement
Existing	1	7	11	10	3
New	1	5	1		

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Section 3.0.3.1.10 Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

- OI 3.0.3.1.10-1 is closed:
  - Medium Voltage Cables AMP (E3 AMP) does not include the underground medium voltage cables from 13.8 kV switchgear to transformer connecting the switchyard.
  - Cable connections are for SBO restoration of offsite power path to onsite distribution systems.
  - Closure: Applicant submitted LRA amendment to include the underground cable as a part of E3 AMP.

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Section 3.5 Aging Management of In-Scope Inaccessible Concrete

Baseline information (* with future commitments on next slide) – data fluctuation is comparable with other plants (e.g., Pilgrim, Shearon Harris, etc.)

	Acceptance Criteria	WCGS (2005-2006)*	
		min	max
pH	>5.5	7.0	8.7
Chlorides	<500 ppm	5.0	41.2
Sulfates	<1500 ppm	30	717**

** measured during winter

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Section 3.5 Aging Management of In-Scope Inaccessible Concrete (con't)

- Future commitments
  - Periodic testing of ground water will be performed as part of the Structures Monitoring Program.
  - Monitor chemistry of ground water twice every five years
  - Visual inspections of buried plant structures are performed when opportunistic excavation occurs. However, more frequent inspections may be performed based on prior inspection results, industry experience, or exposure to a significant event.

SER Section 4: Time-Limited Aging Analyses

Section 4.2 Reactor Vessel Neutron Embrittlement Analyses

- Reviews were performed to evaluate reactor vessel neutron embrittlement in terms of adjusted reference temperature (ART).
  - Neutron fluence and ART
  - Upper-shelf energy
  - Pressurized thermal shock
  - Pressure-temperature limits
  - The staff concludes that the reactor vessel neutron embrittlement analyses meet the review criteria in the Standard Review Plan.

Reactor Vessel RT_{PTS}

	40 calendar years 35 EFPYs	60 calendar years 54 EFPYs	RT_{PTS} 10 CFR 50.61 screening
Fluence E > 1.0 MeV	2.23×10^{19} n/cm^2	3.51×10^{19} n/cm^2	--
Calculated RT_{PTS}	136^o F	**142^o F**	**$\leq$ 270 ^{o}F**
Measured RT_{PTS}	105^o F	**109^o F**	**$\leq$ 270 ^{o}F**

- Surveillance Capsule X was removed at 13.83 EFPYs with a lead factor of 4.3 for an equivalent exposure of 59.5 EFPYs.
- The limiting reactor vessel material is lower shell plate R2508-3.
- The projected peak fluence values for R2508-3 are 2.23×10^{19} n/cm^2 (35 EFPY/40 calendar years) and 3.51×10^{19} n/cm^2 (54 EFPY/60 calendar years).
- The calculational methodology adheres to the guidance of RG 1.190.

Upper Shelf Energy (USE) Decrease

Reactor vessel limiting material	Fluence $x10^{19}$ n/cm^2 (E>1.0 MeV)	Unirradiated USE (ft-lb)	Measured USE (ft-lb)	Measured USE Decrease (%)	Predicted USE Decrease (RG 1.99, Rev. 2, %)	54 EFPY Projected USE (ft-lb)	EOL USE Acceptance Criteria (ft-lb)
Lower Shell Plate R2508-3	3.49	94 transverse	88*	6.4	25	**69**	**$\geq$ 50**

* 88 ft-lb measured USE from Capsule V, fluence $2.22x10^{19}$ n/cm^2

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Section 4.3 Metal Fatigue Analyses

- OI 4.3: Staff was concerned with the applicant's:

  (1) accounting of high-cycle fatigue due to flow-induced vibration in total fatigue usage factor calculation for reactor pressure vessel internals

  (2) application of stress range reduction factor (SRRF) for cyclic conditions for reactor coolant sampling lines

- Closure: Staff's audit of supporting analyses confirmed

  (1) fatigue usage from high-cycle fatigue was negligible due to low vibratory stresses.

  (2) proper SRRF was used iaw the ASME Code Section III and SRP-LR Table 4.3-1.

Section 4.3 Metal Fatigue Analyses (con't)

- OI 4.3-1: Staff was concerned with the Applicant's use of the 1D transfer functions developed for the EAF fatigue evaluation of the charging and the surge line hot leg nozzles.
- Closure: Applicant performed confirmatory analyses of both nozzles using ASME Code Subsection NB-3200 procedure. Applicant committed to verify presence of charging nozzle thermal sleeve as part of its metal fatigue AMP in accordance with 10 CFR 54.21 (c)(1)(iii).

Section 4.3 Metal Fatigue Analyses (con't)

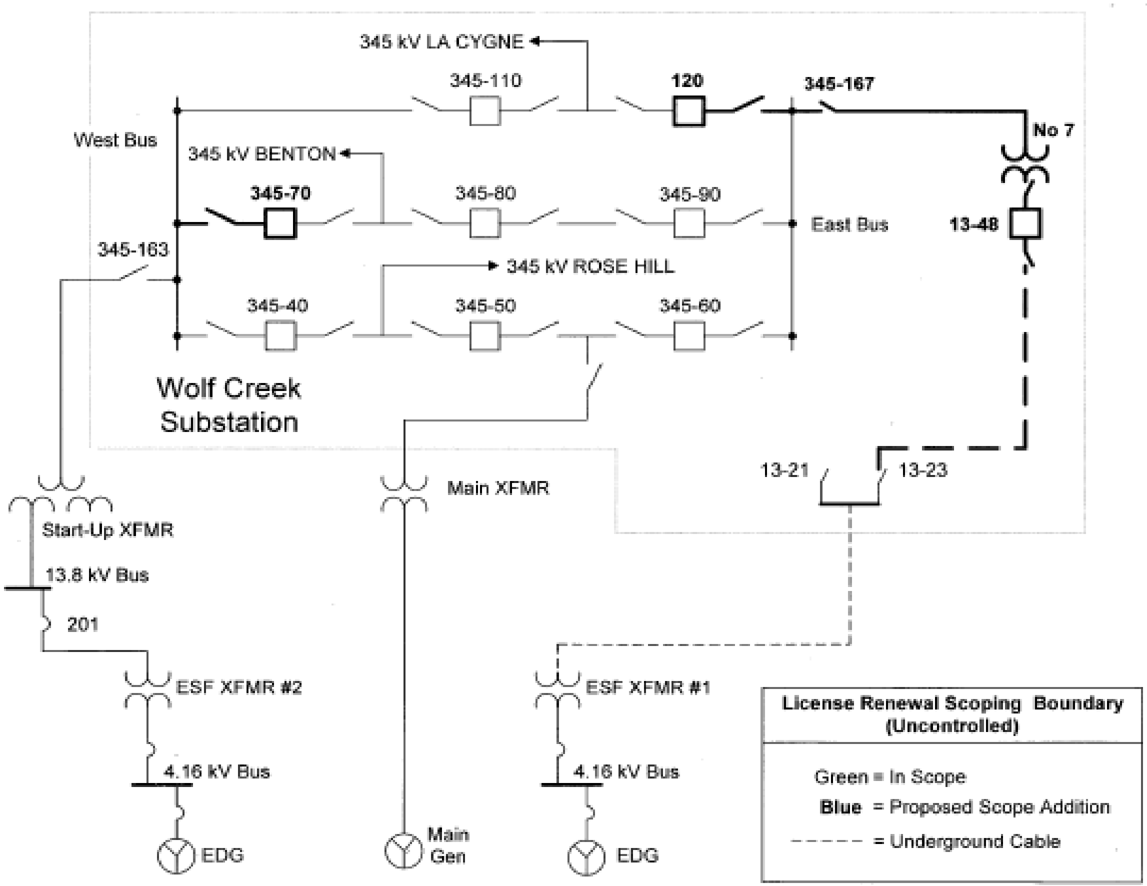
- OI 4.3-3: Staff was concerned with the Applicant's baseline fatigue calculations of the surge line hot leg nozzle for pre-MOP operation and of the charging nozzle based on the type of charging events.
- Closure: Applicant committed to update the fatigue baseline analyses as part of its metal fatigue AMP in accordance with 10 CFR 54.21 (c)(1)(iii).

Conclusion

On the basis of its review, the staff determines that the requirements of 10 CFR 54.29(a) have been met.

Backup Slides

OI 2.5-1 is closed:



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Extra Slides

Section 2.1 Scoping Screening

- WCNOC has formal agreement with the TSO, Westar Energy Transmission Services (WETS).
- GL 2006-02 discussed the use of protocols between the nuclear power plant and the transmission system operator.

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Section 2.2 Plant Level Scoping - EHC

- The Turbine Control Oil System has no intended function iaw 10 CFR 54.4(a).
- A portion of electrohydraulic control (EHC) system has intended function iaw 10 CFR 54.4(a)(3) via the electrical signal from AMSAC for activation of turbine trip under ATWS scenarios.
- The EHC cabinets that contain EHC components for receiving AMSAC signal and activating turbine trip are within scope.

SER Section 2: Structures and Components Subject to Aging Management Review (con't)

Section 2.3 Scoping and Screening Results: Mechanical Systems

- 10 Components added to the LRA subsequent to staff review

System	**Component**	**System**	**Component**
Fuel Pool Cooling	Strainer Spacer Ring	EDG Engine Jacket Clng	Vent Lines Flex Hoses Orifices
Compressed Air	Relief Valve Test Connections		
Main Steam	ADV Silencer		
Condensate Tank	CST Vent/Vacuum Relief		

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Section 2.3 and 2.4 Scoping and Screening Mechanical Systems and Structures

- Condensate Storage Tank (CST) is within scope as mechanical component in Section 2.3.
- CST supporting structures (foundation and valve housing) are within scope as civil structure in Section 2.4.

- OI 2.5-1 (Regulatory Basis):
  - 10 CFR 54.4(a)(3)
  - 10 CFR 50.63
  - GDC 17
  - SRP-LR
  - WC TS 3.8

AMP on Inaccessible Medium Voltage Cables (con't)

- Inspection of cables is being addressed under CLB.
- EEEB is looking at qualification of the cables.
- The applicant will keep these cables dry prior to entering the period of extended operation.

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SER Section 2: Structures and Components Subject to Aging Management Review

Summary

- The applicant’s scoping and screening methodology meets the requirements of 10 CFR 54.4 and 54.21.
- Scoping and screening results from the LRA as amended included all SSCs within the scope of license renewal and subject to AMR.

Section 3.6.2.2.3 Loss of Conduction Strength Due to Corrosion

- The staff has reviewed the testing program by Ontorio Hydroelectric for WCGS on the concern of loss of conduction strength due to corrosion of ACSR transmission conductor and found it acceptable.

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Leakage Monitoring for RPV Studs

- Stud preload not monitored – uncertainty in frictional forces renders monitoring of stud preload ineffective.
- Loss of preload is predominantly due to gasket creep because of thermal cycling
- Monitor of leakage detects loss of preload indirectly.

Monitoring of CCCW HX for Thermal Performance

- Combination of leading-indicator measures to ensure timely corrective action
  - Periodical testing of CCW heat transfer capability
  - Periodical testing of CCW pressure boundary via NDE
  - Proposed enhancement of ISI to inspect check valves internal surfaces
  - Chemistry program monitoring ensures detection of HX performance degradation.

Small Crack in Inaccessible Area of Turbine Building Wall

- 3-hour fire barrier masonry wall is for commercial (insurance) purpose only.
- There is no 10 CFR 54.4(a)(1) component in the building.
- The building 10 CFR 54.4(a)(2) intended functions is to resist wind-loads.

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Applicant's Operating History – inspection

- Fuel Oil Chemistry (interior coating failure) – latest 2006 result
- Buried piping corrosion – latest past-years result relative to decision to implement Buried Piping and Tanks Inspection AMP as possible CLB implementation.

Section 4.3 Metal Fatigue Analyses (3 OIs were identified related to metal fatigue analyses)

• WCGS SER with open items issued	2/01/2008
• Additional RAIs for closure of OIs issued	2/21/2008
• ACRS subcommittee review	3/05/2008
• Public meeting	5/01/2008
• Responses to RAIs provided	5/15/2008
• Additional supplemental information to comply with 10 CFR 54.21 (c)(1)(iii) provided	6/09/2008
• Staff accepted responses and issued Final SER	7/29/2008

<u>Section 4.3</u> Metal Fatigue Analyses

(revised by John Fair)

- <u>OI 4.3</u>: For the purpose of license renewal, staff is to verify the following through an additional audit:

  (1) Vibratory stresses are much less than thermal transient stresses.

  (2) High-cycle fatigue is insignificant.

- Closure: Staff's audit of supporting analyses confirmed positive.

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License Conditions

- The first license condition requires the applicant to include the UFSAR supplement required by 10 CFR 54.21(d) in the next UFSAR update, as required by 10 CFR 50.71(e), following the issuance of the renewed license.

- The second license condition requires future activities identified in the UFSAR supplement to be completed prior to the period of extended operation.

- The third license condition requires that all capsules in the reactor vessel that are removed and tested meet the requirements of American Society for Testing and Materials (ASTM) E 185-82 to the extent practicable for the configuration of the specimens in the capsule. Any changes to the capsule insertion and withdrawal schedule, including use of spare capsules, must be approved by the staff prior to implementation. All capsules placed in storage must be maintained for future insertion. Any changes to storage requirements must be approved by the staff, as required by 10 CFR Part 50, Appendix H.

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End of Presentation

Thank you for your time and attention

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Regulatory Guide 1. 211

Qualification of Safety-Related Cables and Field Splices

ACRS Meeting: September 4, 2008

Satish Aggarwal

Division of Engineering

Office of Nuclear Regulatory Research

301-415-6005

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Regulatory Guide 1. 211

BACKGROUND

Standards Activities: IEEE Std 383-1974

IEEE Std 383-2003 published in June 2004.

- Regulatory Activities: Regulatory Guide 1.131 was issued for comment in August 1977- endorsing IEEE Std 383-1974 with several exceptions. It remained a draft guide
- RG 1.131 was never finalized. It will be withdrawn following the issuance of RG 1.211
- DG-1132 was issued for public comment in June 2007 with 10 exceptions to IEEE Std 383-2003
- Received comment letters from 5 organizations

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Regulatory Guide 1. 211

Scope

Power, and Instrumentation & Control cables, including signal and communication cables

- Splices
- Not Included: (1) Fiber Optics Cables (2) Connectors

Regulatory Guide 1. 211

IEEE Std 383-2003

- Provides general requirements, directions, and methods for qualifying safety-related cables and splices
- Must meet or exceed specific performance requirements throughout its installed life
- Requires a quality assurance program

Regulatory Guide 1. 211

Objectives

- To ensure that safety-related cables (single, multi-conductor, multiplex, coaxial, triaxial, twinaxial) to perform during & following postulated design basis events
- To ensure that no failure mechanism exists leading to common-cause failures under postulated service conditions
- To establish “Qualified Life”

Regulatory Guide 1. 211

Methods of Qualification

- Type Testing
- Operating experience
- Analysis as supplement
- Ongoing Qualification
- Qualification by analysis alone is NOT acceptable
- Type Testing is the preferred qualification method
- Documentation must be available in an auditable form

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Regulatory Guide 1. 211

Revised Regulatory Position In Response To Public Comments

- Exception 1: Sufficient information should be available for future engineering extrapolations
- Exception 2: Qualify Specialty Cables with its connectors
- Exception 3: Document stranding configuration.
- Exception 4: Document Manufacturing standards & date of manufacturer

Regulatory Guide 1. 211

Revised Regulatory Position In Response To Public Comments

- Exception 5: Tests to include testing of specialty cables' electrical performance characteristics
- Exception 6: Manufacturer's inspection & maintenance requirements
- Exception 7: Monitoring of environmental conditions. Condition monitoring of risk-significant safety related power and I & C cables

  Inspection, testing & monitoring programs
  to detect degradation of cable insulation

Revised Regulatory Position In Response To Public Comments (September 3, 2008)

- Page 2 of RG, 4th para under Section “B. Discussion” is modified to read as follows:

  In Clause 3.3 of IEEE Std 383-2003, an exact description of the “representative” cable is required to ensure that sufficient information is available for the “representative” cable to allow future extrapolation of the conclusions from the results of the type tested cable to other cables reported to be “represented” by the type test.

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Revised Regulatory Position In Response To Public Comments (September 3, 2008)

- Page 3, Section C. REGULATORY POSITION (3) is modified to read as follows:

  Clause 6.1.2, “coaxial, triaxial, and twinaxial cables,” should be supplemented to include appropriate connections for those test specimens used to address the concerns regarding differential shrinkage or expansion.

Revised Regulatory Position In Response To Public Comments (September 3, 2008)

- Page 2, last para, Section B. Discussion: Substitute the last sentence with the following:

  Further, Clause 6.1.2 of IEEE Std 383-2003, requires that suitable test specimen lengths and configuration be included in the DBE test to evaluate the potential for conductor shorting or loss of critical dielectric characteristics due to differential shrinkage or expansion in coaxial and triaxial cables. The NRC staff has witnessed cables which have passed a qualification type test without connectors only to fail the test when the connectors were attached. The failure was traced to unequal thermal expansion of the different cable components fixed at both ends of the cable with connectors.

TRACE Regulatory Applications

555th Meeting of the ACRS

Mirela Gavrilas
Reactor Systems Applications Branch
Office of Nuclear Regulatory Research

September 4, 2008

TRACE uses in regulatory activities since the last ACRS review (March 2007)

- ESBWR DCD confirmatory calculations
  - LOCAs
  - *applicability report*
- EPR topical report review
  - LBLOCA methodology RAIs
- Brown's Ferry EPU SER
  - SB and LB LOCAs
- GSI-191
  - scoping analyses

NRR user need 2008-002 for FY2008 through FY2010

nine plant decks to support EPU reviews

– BWR/3, BWR/4, and BWR/5

– Westinghouse 2-, 3-, and 4-loop

– CE

– B&W lowered loop

NRO pending user need

- ESBWR DCD confirmatory calculations
  - AOOs and upper plenum instability (in progress)
- EPR topical report reviews and DCD confirmatory calculations
  - LOCA audit calculations and transients
  - applicability report
- US APWR DCD confirmatory calculations
  - LOCAs and transients
  - applicability report; advanced accumulator
- ABWR DCD confirmatory calculations
  - LOCAs, AOOs, ATWS
- AP-1000 COL confirmatory calculations
  - LOCAs and transients
  - applicability report

Plant	Type	Event	Availability
Operating Plants			
Monticello	BWR/3	SBLOCA, LBLOCA, SBO	2008
Browns Ferry 1, 2, 3	BWR/4	SBLOCA, LBLOCA, SBO	Available
Nine Mile Point 2	BWR/5	SBLOCA, LBLOCA, SBO	2008
Point Beach 1, 2	W 2 loop	SBLOCA	2008
Prairie Island 1, 2	W 2 loop	SBLOCA, LBLOCA	2009
HB Robinson	W 3 loop	SBLOCA, LBLOCA, locked rotor	Available
Turkey Point 3, 4	W 3 loop	SBLOCA, LBLOCA	2009
North Anna	W 3 loop	Feed and bleed	2008
Seabrook 1	W412, 4 loop	SBLOCA, LBLOCA, SGTR	Available
Oconee 1, 2, 3	B&W lowered loop	SBLOCA, LBLOCA	Available
Crystal River 3	B&W lowered loop	SBLOCA, LBLOCA	2009
Calvert Cliffs 1, 2	CE 2 loop	SBLOCA, LBLOCA, loss of FW	Available
St. Lucie 1 & 2	CE 2 loop	SBLOCA, LBLOCA	2009
Ft. Calhoun	CE 2 loop	SBLOCA, LBLOCA	2009
New Reactors			
ESBWR	BWR	MSLB, BDLB, GDLB, AOL	Available
EPR	PWR	LBLOCA	Available
AP-1000	PWR	LBLOCA	Available
USAPWR	PWR	SBLOCA, LBLOCA, Transient TBD	2009
ABWR	BWR/6	SBLOCA, LBLOCA, Transient TBD	2009

Target Execution Times

Event	One-Dimensional Model TRACE Execution Time[1, 2] / Problem Time	Three-Dimensional Vessel TRACE Execution Time[2] / Problem Time
Steady State Initialization	1	0.5 – 3
BWR LBLOCA	1 – 3	1 – 10
BWR SBLOCA	1	1 – 5
PWR LBLOCA	1 – 5	5 – 30
PWR SBLOCA	1	3 – 10

[1] The indicated execution times are goals for the TRACE one-dimensional vessel models.
[2] Typical execution times using an NRC agency PC with a Pentium 4 CPU at 2.80 GHz and 1.0 GB of RAM.

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Conclusions

- within the next couple of years, the staff will be developing decks that represent every family of operating plants
- steep learning curve
  - BWR “sample” deck
    - LBLOCA in 20 minutes
    - SBLOCA in 40 minutes
  - still working on PWR “sample” deck
- improving user guidance and development of templates to enhance the usability of TRACE are as important at this stage as code error corrections

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TRACE 5.0 Peer Review

Presentation to the ACRS Committee

William J. Krotiuk
Reactor Systems Analysis Branch
Office of Nuclear Regulatory Research
September 4, 2008

TRACE 5.0 Peer Review

- Tasks
  - Review TRACE code and documentation.
  - Produce reports that
    - summarize code strengths and deficiencies and
    - provide recommendations for code changes and improvements.
- Priority Objectives
  - Identify major deficiencies that preclude the use of TRACE for confirmatory thermal-hydraulic calculations.
  - Identify deficiencies that introduce significant errors in TRACE predictions.
  - Provide recommendations for substantive improvements.

TRACE 5.0 Peer Review – Panel Members

- International experts with extensive knowledge of thermal-hydraulic code models, methods and applications
  - Dominique Bestion

    Research Director, Commissariat à l’Energie Atomique, CEA-Grenoble
  - Peter Griffith

    Retired Professor of Mechanical Engineering, MIT
  - Marv Thurgood

    CEO/Project Manager, John Marvin, Inc.
  - George Yadigaroglu

    Professor Emeritus of Nuclear Engineering, Swiss Federal Institute of Technology in Zurich (ETHZ)

TRACE 5.0 Peer Review

- Material Supplied to Peer Reviewers
  - TRACE Documentation
    - Theory Manual
    - Assessment Manual and Appendices
    - User’s Guide
      - Volume 1 Input Description
      - Volume 2 Modeling Guidelines
  - TRACE Code*
    - TRACE Version 5.0
      - Executable
      - Source
    - Sample problem input and output files

* Provided for completeness; reviewers were not required to run the code or review source coding.

TRACE 5.0 Peer Review –
General Review Topics

- Capabilities and Limitations
  - Code mission, purpose, objectives, capabilities, limitations and range of applicability
- Numerical Solution Methods
  - Numerical solution scheme
  - Time and space averaging approaches
- Fundamental Equations, Models and Correlations
  - Are original published sources referenced along with supporting data?
  - Is the model or correlation applicable to, and accuracy appropriate for power reactor conditions?
  - Is the model or correlation implementation approach including any modifications sufficiently described?
- General Quality
  - Is the documentation well written, well organized and understandable?

TRACE 5.0 Peer Review – Specific Focus Areas

- Detailed review by one or more panel member
  - Conservation Equations Application
  - Thermal-Hydraulic Closure Relations and Physical Models
  - Numerical Solution Schemes
  - Nuclear System Components, Features and Models
    - Pumps, valves, fuel rod models and reactor kinetics
  - Test Assessment Matrix and Results
    - Sufficiency and completeness relative to other T/H codes

TRACE 5.0 Peer Review - Specific Focus Area Review Assignments

- Conservation Equations Application
  - M. Thurgood
  - G. Yadigaroglu
- Thermal-Hydraulic Closure Relations and Physical Models
  - D. Bestion
  - G. Yadigaroglu
- Numerical Solution Methods
  - M. Thurgood
- Nuclear System Components, Features and Physical Models
  - P. Griffith
- Test Assessment Matrix and Results
  - D. Bestion
  - P. Griffith

TRACE 5.0 Peer Review

- Activity Summary
  - Contract Award — Aug., 2007
  - Kick-off meeting — Aug. 28-29, 2007
    - Office of Research presentations
    - Discussions/questions by peer reviewers
  - Reviewers draft reports to NRC — Jan., 2008
  - Working meeting — Feb. 27-28, 2008
    - Discuss draft reports and findings with Office of Research staff
  - Reviewers final reports to NRC — May, 2008
  - Presentation to ACRS T/H Subcommittee — July 7, 2008
  - Presentation to ACRS Committee — Sept. 4, 2008
  - Final Report — In preparation

TRACE 5.0 Peer Review

- The following slides summarize the opinion statements which were requested by the ACRS T/H Subcommittee and independently developed by the peer reviewers.
- The speakers following me will present the NRC response to the opinion statements.

Summary Statement of the Review Panel

- *"The summary opinions of the Panel regarding the adequacy of TRACE should be viewed in light of*
  - *the evident time and resource limitations that precluded a full and detailed review of the models,*
  - *the absence of full information regarding the developmental validation of the models used, and*
  - *the limitations of the code validation work."*

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Summary Statement of the Review Panel

- *"A very large number of models and correlations have been carefully assembled to produce a code that can cover the phenomena of interest.*
  - *The manual describes the models and correlations clearly and in sufficient detail.*
  - *It was not possible within the limits of this review and in the absence of full information to verify the adequacy and implementation of all the models."*
- *"The TRACE documentation lists the physical phenomena that are important in large-break and small-break loss-of-coolant accident analyses.*
  - *Phenomena identified as important on the basis of phenomena identification and ranking tables (PIRTs) appear in the Assessment Manual.*
  - *A cross-reference table should be provided showing how the code capability was assessed for each phenomenon considered."*
- *"The manuals indicate that some important changes will be implemented in the future.*
  - *Some of these may make critical remarks made by the reviewers obsolete.*
  - *However, this review was limited to the TRACE 5.0 version of the code."*

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Summary Statement of the Review Panel

- *1. "No major deficiency was evident in the physical models, nor revealed by the assessed test cases, that would preclude the use of TRACE for confirmatory thermal-hydraulic calculations of LBLOCAs and SBLOCAs of PWRs and BWRs.*
  - *However, additional assessments covering more systematically the entire range of conditions expected are recommended."*
- *2. "A few deficiencies were identified in the physical models, and some inaccurate predictions or erroneous predictions are found in assessment calculations.*
  - *Although it is recommended to correct these deficiencies, there is no clear indication that they could introduce significant errors in TRACE predictions."*
- *3. "Development of the code appears to have (partly at least) lacked a strategic approach to modeling.*
  - *Although much work has gone into the selection of the best available models and correlations, the top-level guiding lines and strategy employed in selecting flow regimes, phenomena, and situations to be simulated, and the selection of methods and models for these regimes are not clear."*
- *4. "There is no assurance that the closure laws used perform adequately over the entire range of applicability claimed.*
  - *A systematic evaluation of the set of correlations implemented in the code against the best available relevant range of basic data sets would have been necessary."*

TRACE 5.0 Peer Review

- The following slides summarize the specific findings and recommendations for improvements found in the individual reviewers’ reports.
- The speakers following me will present the NRC response to the specific findings and recommendations.

Specific Findings in Reviewers' Reports

- Thermal-Hydraulic Closure Relations and Physical Models
  - Improvements needed for some physical (equations or closure) models.
    - Some physical models require further review, analysis and improvement.
  - Include validation matrix for physical models and phenomena.
  - The interface tracking model is innovative and efficient; but user guidance should be provided.
- Conservation Equations Application
  - The $V\nabla V$ momentum term is incorrect for side connections, and 3-D vessel flow direction changes.
  - Provide guidance for using the nonconservative form of the momentum equation.
  - Water packing is overly restrictive.
- Numerical Solution Methods
  - The SETS* numerical solution is innovative and allows Δts to exceed the material Courant limit.

* Note, the SETS method was previously developed and implemented in TRAC.

Specific Findings in Reviewers' Reports

- Test Assessment Matrix and Results
  - Additional assessments or extensions are needed to fully address each physical model and all important phenomena.
  - Assessments should be referenced to the SET matrix and PIRT tables.
  - The Assessment Manual should provide information on how well TRACE predicts important licensing limits (e.g. PCT).
- Nuclear System Components, Features and Physical Models Documentation
  - A good deal of work is needed to make the Users Manual easy to use.
  - The Users Manual should be rewritten to provide recommended modeling and guidelines for system components.
  - Better input modeling guidelines, with references to assessment modeling, are needed.
  - Include code uncertainties relative to PWR and BWR transients.

TRACE 5.0 Peer Review Summary

- Recommended Modifications/Improvements:
  - Items which should be addressed as soon as possible
    - Rewrite the Users Manual.
    - Correct V∇V momentum term.
    - Review indicated closure relations and physical models, and include a validation matrix.
    - Continue to expand the code assessments.
  - Longer term items
    - Add a liquid droplet field.
    - Modify TRACE to solve the conservative form of the momentum equation.

Backup Slides

Summary Statement of
the Peer Review Panel

Summary Statement of the Review Panel

Objective

The objective of the work of the peer review panel was to review the TRACE manuals, including the Theory Manual, the Assessment Manual, and the User's Guide, and to produce a report that summarizes the strengths and deficiencies of the code as documented and provides recommendations for code changes and improvements. In particular the Panel was asked to:

- Identify major deficiencies that preclude the use of TRACE for confirmatory thermal-hydraulic calculations
- Identify deficiencies that introduce significant errors in TRACE predictions
- Provide recommendation for substantive improvements.

The recommendations for improvements can be found in the reviewers' reports that follow. The summary comments of the next section address the other two top-level issues listed above.

Summary Opinion of the Panel

The following summary opinion of the Panel regarding the adequacy of TRACE should be viewed in light of the evident time and resource limitations that precluded a full and detailed review of the models, the absence of full information regarding the developmental validation of the models used, and the limitations of the code validation work that followed. More specifically:

A very large number of models and correlations have been carefully assembled to produce a code that can cover the phenomena of interest. The manual describes the models and correlations clearly and in sufficient detail and often includes the reasons or the history that led to their selection and the relevant references. In spite of this, it was not possible within the limits of this review and in the absence of full information on the developmental validation carried out to verify in detail the adequacy of all the models used and the ways they were implemented or coded.

The TRACE documentation lists the physical phenomena that are important in large-break (LB) and small-break (SB) loss-of-coolant accident (LOCA) analyses. Phenomena identified as important on the basis of phenomena identification and ranking tables (PIRTs) appear in the Assessment Manual that also summarizes the pressurized-water reactor (PWR) and boiling-water reactor (BWR) modeling requirements. To arrive at some certainty regarding the completeness of the code validation work, it would have been necessary to provide information such as a cross-reference table showing how the capability of the code was assessed for each phenomenon considered and where this information can be found.

Finally, the manual indicates that some important changes will be implemented in the future. Some of these may make critical remarks made by the reviewers obsolete. However, this review had to be limited to the TRACE 5.0 version of the code.

Keeping in mind the above limitations of the review process:

1. No major deficiency was evident in the physical models described in the Theory Manual, nor revealed by the cases reported in the Assessment Manual, that would preclude the use of TRACE for confirmatory thermal-hydraulic calculations of LBLOCAs and SBLOCAs of PWRs and BWRs. However, additional assessment covering more systematically the entire range of conditions expected would be required to fully demonstrate that all phenomena identified in the PIRT tables are correctly addressed (such as oscillatory reflooding, condensation at ECCS injection,...).
2. A few deficiencies were identified in the physical models described in the Theory Manual and some inaccurate predictions or erroneous predictions are found in assessment calculations. Although it is recommended to correct these

deficiencies, there is no clear indication that they could introduce significant errors in TRACE predictions of LBLOCAs and SBLOCAs of PWRs and BWRs.

3. Development of the code appears to have (partly at least) lacked a strategic approach to modeling. Although much work has gone into the selection of the best available models and correlations, the top-level guiding lines and strategy employed in selecting flow regimes, phenomena, and situations to be simulated and the selection of methods and models for these regimes are not clear. For example, a three- (or if necessary four-) field model should have been implemented before the modeling work was undertaken. The flow regimes should have been selected based on the physical situations and then applied to both hydraulics and heat transfer; this is apparently only partly the case now.

4. There is no assurance that the closure laws used perform adequately over the *entire* range of applicability claimed. A *systematic* evaluation of the set of correlations implemented in the code against the best available relevant range of basic data sets would have been necessary.

TRACE

STAFF PLANS TO ADDRESS PEER REVIEW
&
LONG TERM DEVELOPMENT

Stephen M. Bajorek, Ph.D.
Senior Technical Advisor for Thermal-Hydraulics
Office of Nuclear Regulatory Research
United States Nuclear Regulatory Commission
Ph.: (301) 415-7574 / Stephen.Bajorek@nrc.gov

Chris L. Hoxie, Ph.D.
Branch Chief, Code Development Branch
Office of Nuclear Regulatory Research
United States Nuclear Regulatory Commission
Ph.: (301) 415-5824 / Chris.Hoxie@nrc.gov

Presentation to the
Advisory Committee on Reactor Safeguards
September 4, 2008

TRACE

Purpose & Mission of TRACE Version 5.0

- TRACE is the NRC's consolidated thermal-hydraulics code for LBLOCA, SBLOCA, and transients. TRACE replaces TRAC-P, TRAC-B, RAMONA, and RELAP.

- Applicability is intended to include:
  - Conventional PWRs and BWRs
  - Advanced LWRs , with additional development to address new features and phenomena introduced by those unique designs.

- TRACE Version 5.0 is an audit tool and is intended to have capability and accuracy similar to vendor codes (RELAP, TRAC, WCOBRA/TRAC, etc.)

TRACE Review Comment Characterization

- PEER REVIEW REPORTS HAVE BEEN EXAMINED & 262 SEPARATE COMMENTS / ISSUES IDENTIFIED.

- GENERAL CHARACTERIZATION:
  - ➔ **21% FIELD EQUATIONS / CLOSURE MODEL ISSUES**
  - ➔ **32% THEORY MANUAL; CLARIFICATION & JUSTIFICATION**
  - ➔ **14% MODELING APPROACH**
  - ➔ **7% ASSESSMENT RELATED**
  - ➔ **26% ASSESSMENT REPORT DISCUSSION & DOCUMENTATION**

- HIGHEST PRIORITY: ITEMS / ISSUES THAT ENHANCE THE READINESS OF TRACE FOR REGULATORY USE.

- SEVERAL CODE ERRORS IDENTIFIED - *ALL ERRORS HAVE BEEN CORRECTED IN THE MOST RECENT CODE VERSION MADE AVAILABLE TO STAFF ANALYSTS.*

TRACE

Review Comment Resolution

- WE WILL DISCUSS PLANS TO ADDRESS PEER REVIEW COMMENTS & FINDINGS FOR:
  - DOCUMENTATION
  - VALIDATION & ASSESSMENT
  - MODELS & CORRELATIONS
  - LONG TERM DEVELOPMENT

Near Term

Long Term

09/10/2008
Stephen.Bajorek@nrc.gov

ISSUE: Documentation

- BACKGROUND: CURRENT DOCUMENTATION WAS ISSUED AS A SET (Aug. 2007) AND CONSISTS OF:
  - THEORY MANUAL
  - ASSESSMENT REPORT
  - USER MANUAL (VOLUMES 1 and 2)

- EACH OF THE PEER REVIEWERS HAD DIFFICULTIES WITH THE DOCUMENTATION. OF PARTICULAR NOTE WERE:
  - LACK OF SPECIFIC USER GUIDANCE FOR PLANT INPUT DECK DEVELOPMENT
  - DIFFICULTY IN IDENTIFYING THE SPECIFIC MODEL(S) ACTUALLY USED BY TRACE

TRACE RESOLUTION: Documentation

- **VOLUMES 2 OF THE USER GUIDE IS BEING SIGNIFICANTLY REVISED AND UPDATED.   NEW CONTENT WILL BE ADDED WITH SPECIFIC PLANT MODELING RECOMMENDATIONS.**
  - **Each region (core, UP, HL, SG, PZR, etc.) of the plant will have specific guidelines on which Components, nodalization, parameter settings, and identify the basis for the recommendations.**
  - **To minimize the “User Effect” in plant calculations.**
  - **A Technical Editor has been obtained to facilitate revision of the User Manual.**

- **THE THEORY MANUAL WILL BE RESTRUCTURED TO IMPROVE CLARITY & MAKE IT EASIER TO USE.**
  - **MORE CONCISE DESCRIPTION OF MODELS & CORRELATIONS.**
  - **“LINKS” TO PROVIDE DETAILS ON TECHNICAL DEVELOPMENT.**

TRACE RESOLUTION: Documentation

- MOST SUGGESTIONS WILL BE INCORPORATED INTO REVISIONS OF THE THEORY MANUAL TO MAKE IT MORE READABLE:
  - ➔ **ADD CONTENT TO OUTLINE MODELING STRATEGY**
  - ➔ **ADD CONTENT TO DEFINE FLOW AND HEAT TRANSFER REGIMES**
  - ➔ **USE MODERN TECHNOLOGY TO PROVIDE LINKS BETWEEN RELATED MODELS AND DIFFICULT TO OBTAIN REFERENCES**
  - ➔ **PROVIDE DETAILS TO ADDRESS SPECIFIC COMMENTS**

- ASSESSMENT REPORT WILL BE REVISED TO:
  - ➔ **RELATE EACH ASSESSMENT TO A PIRT AND PROVIDE A BETTER CROSS REFERENCE BETWEEN MODELS AND SETs.**
  - ➔ **IDENTIFY RANGE OVER WHICH MODELS ARE ASSESSED.**
  - ➔ **MOVE “MODEL DEVELOPMENT TESTS” FROM THEORY MANUAL TO ASSESSMENT REPORT.**

09/10/2008
Stephen.Bajorek@nrc.gov

TRACE ISSUE: Assessment

- Background: TRACE ASSESSMENT IS CURRENTLY ACCOMPLISHED BY APPROXIMATELY 550 TEST CASES COVERING A BROAD RANGE OF FACILITIES AND T/H CONDITIONS. ADDITIONAL ASSESSMENT AND REPORTS ARE PRODUCED FOR NEW & ADVANCED LWRs.

- Peer Review Panel Comment: Additional assessments are needed to fully address each physical model and all important phenomena. Specific phenomena pointed out were:
  - **Direct Contact Condensation**
  - **Upper Plenum Entrainment / De-entrainment**
  - **SBLOCA Loop Seal Clearance**
  - **CCFL**
  - **Blowdown Film Boiling**
  - **Downcomer Hot Wall (i.e. Downcomer Boiling)**
  - **Non-LOCA Integral Tests**

TRACE RESOLUTION: Assessment

- WHILE THE TRACE ASSESSMENT BASE IS LARGE & WE FEEL IS SUFFICIENT TO CHARACTERIZE PERFORMANCE, ADDITIONAL ASSESSMENT IS PLANNED.

- ASSESSMENT IS A CONTINUAL PROCESS - ADDITIONAL CASES AND NEW TESTS TO BE SIMULATED WILL DEPEND ON RESOURCES, IDENTIFIED CODE PROBLEMS, AND REGULATORY NEEDS.

- ADDITIONAL ASSESSMENT AVAILABLE IN:
  - **ESBWR CODE APPLICABILITY REPORT**
  - **EPR CODE APPLICABILITY REPORT**
  - **APWR CODE APPLICABILITY REPORT**
  - **AP1000 CODE APPLICABILITY REPORT**

- ADDITONAL “GENERIC” ASSESSMENT PLANNED IS LISTED ON THE FOLLOWING SLIDE. (Highlighted Phenomena denotes consistency with a Peer Review comment.

09/10/2008
Stephen.Bajorek@nrc.gov

TRACE RESOLUTION: Assessment

TEST	PHENOMENA
COSI or W/EPRI 1/3 MIXING	Direct Contact Condensation
NRU	Fuel Rod Models
CCTF 72, 76 and UPTF 10	UP De-entrainment
Achilles (ISP 25)	Nitrogen discharge / Oscillations
FLECHT Top-Skewed Power	Reflood (Power Shape Sens.)
UPTF and/or IVO Loop Seal	SBLOCA Loop Seal Clearance
Inlet Elbow Flooding (various)	CCFL
MIST	IET (B&W plants)
PKL	IET for LBLOCA
to be determined	Blowdown Film Boiling
UPTF	Downcomer Hot Wall
various	Non-LOCA Tests

ISSUE: Physical Models and Conservation Equations

- PEER REVIEW COMMENTS FELL INTO ONE OF THREE CATEGORIES:
  - ERRORS – Areas where the code is incorrect. Examples:
    - ➔ **Incorrect treatment of the V gradV term for side connections**
    - ➔ **Gas mixture properties (viscosity and thermal conductivity) are not calculated using an appropriate mixing rule.**
  - IMPROVEMENTS - Areas where the model may be inadequate, alternate choices may simplify the code, or may improve agreement between predictions & experimental results. Examples:
    - ➔ **A stratified-mist flow regime should be added for large pipes.**
    - ➔ **Model for nucleate boiling is overly complex and ad hoc**
  - CLARIFICATION - Areas where the model is probably acceptable, but documentation or assessment does not make it clear.

RESOLUTION: Physical Models and Conservation Equations

TRACE

- ERROR CORRECTIONS HAVE HIGHEST PRIORITY
  - **ALL CLOSURE MODEL ERRORS HAVE BEEN RESOLVED, AND A CODE VERSION IS AVAILABLE FOR STAFF ANALYSTS. (Effects on results appear to be small.)**
  - **MOMENTUM EQUATION ISSUE IS NEARING RESOLUTION. ERROR IN VgradV TERM CORRECTED. TEST CASES (in progress) ARE SHOWING DEFICIENCIES IN MOMENTUM EQUATION TO BE SMALL.**

- IMPROVEMENTS TO PHYSICAL MODELS WILL BE PART CONTINUING AND LONG TERM CODE DEVELOPMENT
  - **Overly complex models to be replaced when found to be inaccurate or cause of numerical instabilities.**

- CLARIFICATION TO BE INCORPORATED INTO THEORY MANUAL REVISIONS.

ISSUE: Long Term Development Recommendations

- Peer Review Panel comments included some recommendations for long term development:
  - Add a liquid droplet field.
  - Modify TRACE to solve the conservative form of the momentum equation.

09/10/2008
Stephen.Bajorek@nrc.gov

RESOLUTION: Long Term TRACE Development Recommendations

- ONLY LIMITED EFFORTS HAVE BEEN PLACED ON LONG-TERM DEVELOPMENT PENDING THE IMMEDIATE NEED TO MAKE TRACE MORE ROBUST & DEVELOP PLANT INPUT DECKS.

- PLANS FOR "TRACE VERSION 6.0" INCLUDE:
  - **ACTIVATION OF 3RD FIELD FOR DROPLETS**
  - **SPACER GRID MODELS FOR**
    - → **LOCAL CONVECTIVE HEAT TRANSFER ENHANCEMENT**
    - → **DROPLET BREAK UP**
    - → **GRID REWET**
  - **IMPROVEMENT OF T/H MODELS (INCLUDING PEER REVIEW COMMENTS)**
  - **INCORPORATION OF AN UNCERTAINY METHODOLOGY**
  - **(POSSIBLE) FULLY CONSERVATIVE MOMENTUM EQUATION**
  - **(POSSIBLE) ACTIVATION OF 4TH FIELD FOR BUBBLY/SLUG FLOWS AND INTERFACIAL AREA TRANSPORT**

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Summary & Conclusions

- THE PEER REVIEW WAS VALUABLE & THE COMMENTS WILL HELP THE STAFF TO IMPROVE THE CODE AND ITS APPLICATIONS.

- NO MAJOR DEFICIENCIES FOUND THAT INTRODUCE SIGNIFICANT ERRORS OR PRECLUDE USE OF TRACE FOR T/H CALCULATIONS.

- HIGH PRIORITY ITEMS TO BE ADDRESSED INCLUDE:
  - **CORRECTION OF IDENTIFIED ERRORS and RESOLUTION OF THE MOMENTUM EQUATION ISSUE**
  - **DEVELOPMENT OF USER GUIDELINES AND REVISION OF THE USER MANUAL**
  - **CONTINUATION OF ASSESSMENT WITH EMPHASIS ON THOSE AREA NOT WELL COVERED IN WORK TO DATE**

- LONG TERM EFFORTS WILL FOCUS ON MODEL & CORRELATION IMPROVEMENTS, IMPROVING & QUANTIFYING CODE ACCURACY and PRODUCTION OF ADDITIONAL PLANT MODELS.

Stephen.Bajorek@nrc.gov

TRACE Summary & Conclusions

TRACE IS NOW READY TO BE
FULLY INCORPORATED INTO THE NRC'S REGULATORY FRAMEWORK

Stephen.Bajorek@nrc.gov