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UNITED STATES NUCLEAR REGULATORY COMMISSION'S

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

October 25, 2001

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

THERMAL-HYDRAULIC PHENOMENA SUBCOMMITTEE MEETING

(ACRS)

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THURSDAY

OCTOBER 25, 2001

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ROCKVILLE, MARYLAND

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The ACRS Thermal Phenomena Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 1:00 p.m., Dr. Graham Wallis, Chairman, presiding.

COMMITTEE MEMBERS PRESENT:

DR. GRAHAM WALLIS, Chairman

DR. F. PETER FORD, Member

DR. THOMAS S. KRESS, Member

DR. WILLIAM SHACK, Member

DR. VIRGIL SCHROCK, ACRS Consultant

DR. JOHN D. SIEBER, Member

ACRS STAFF PRESENT:

PAUL A. BOEHNERT, ACRS Staff Engineer

I-N-D-E-X

P-R-O-C-E-E-D-I-N-G-S

(1:00 p.m.)

CHAIRMAN WALLIS: The meeting will now please come to order. This is a meeting of the ACRS Subcommittee on Thermal-Hydraulic Phenomena. I am Graham Wallis, Chairman of the Subcommittee.

Other ACRS Members in attendance are Peter Ford, Thomas Kress, William Shack, and Jack Sieber. The ACRS Consultant in attendance is Virgil Schrock.

The purpose of this meeting is for the subcommittee to review the license amendment request of the Exelon Generating Company for core power uprates for the Dresden Nuclear Power Station, Units 2 and 3; and the Quad Cities Nuclear Power Station, Units 1 and 2.

The subcommittee will gather information, and analyze relevant issues and facts, and formulate the proposed positions and actions as appropriate for deliberation by the full committee. Mr. Paul Boehnert is the Cognizant ACRS Staff Engineer for this meeting.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register on October 15, 2001.

Portions of this meeting may be closed to the public as necessary to discuss information considered proprietary to General Electric Nuclear Energy.

A transcript of this meeting is being kept, and the open portions of this transcript will be made available as stated in the Federal Register notice. It is requested that speakers first identify themselves, and speak with sufficient clarity and volume so that they can be readily heard.

We have received no written comments or requests for time to make oral statements from members of the public. I will say what I said before the last meeting that we had on power uprates, that this committee has received a large stack of papers, which amounted to over two feet high.

Some of my colleagues said that was an underestimate last time. I am really looking forward to your help in pointing us to the elements of that which are important for us to consider. So I will now proceed with the meeting, and I will call upon Mr. Bill Bohlke of the Exelon Generating Company after my colleague, Peter Ford, makes a statement.

DR. FORD: Yes. I am a GE retiree, and therefore I have a conflict of interest.

MR. BOHLKE: Thank you. Good afternoon,

Mr. Chairman, and Members of the ACRS. I am Bill Bohlke, senior vice president of nuclear services for the Exelon Corporation, and the executive sponsor for the extended power uprate project for Dresden and Quad Cities.

We have brought many members of our project team who have been working on this project for almost two years now, and that this team of engineers, and analysts, and operators, I think is pretty well positioned to answer the question that you may have from reading the material and anything that comes up from their presentation, which we hope will help clarify and distill all of the information that you have been asked to digest.

This is an important project for our company. As you are already aware, Dresden and Quad Cities are BWR-3s licensed for commercial operations from 1969 through 1972 or '73.

Recently, we have seen significant improvements in the reliability and safe operation of those plants, and in addition to this extended power uprate request, we are preparing a license renewal application for Dresden and Quad which will be submitted at the end of next year.

So we have got a substantial investment

going forward in these plants, and we are anxious to tell you how we plan to integrate this uprate into our operations, and why we believe that this uprate can be safely and reliably achieved.

We are also aware that you just went through similar material about a month ago on the Duane Arnold project. There are many, many similarities between what you heard a month ago, and what you will hear today.

But there are also some differences, because these are BWR3s, and a little bit older than a Duane Arnold plant. Nevertheless, let me summarize as I conclude what I think you are going to hear.

That we have followed the GE designed approach for an extended power uprate described in their EPU license topical report for a constant pressure upgrade. That is to say, the steam dome pressure doesn't change.

You will see that we have provided an extensive sweep of analyses using methodology that has been reviewed by the staff and you many times before to analyze these plants, and in several cases these methodologies.

We represent an upgrade from the previous sweep of methodologies and analyses that existed for the units, and we have benefited from that, and we will also be able to demonstrate that the inputs to the analyses are accurate and reasonably conservative in addition.

The results of all of this work that we have gone through, and the modifications which are ensuing on Dresden 2 as we speak, because Dresden 2 is in the outage during which the modifications required for an extended power uprate must be implemented.

And you will see that at the end of the day there are in fact no significant impacts on the way that the plant responds to initiating events or the way that the plant operates during transients.

And there are no challenges to system integrity that are of any concern for us in an engineering context. Near the end of the presentation, you will hear a rather extensive review of the risk assessment of this uprate.

And I think when you have seen what we have done and have heard the results, you will conclude as we have that there are minimal changes in plant risk.

Thus, from all aspects, we believe that the plant operation following the increase in power to the extended level will be acceptable and safe. At this time, pending any questions, I would like to turn it over to our project manager for this project, Mr. John Nosko. Thank you.

MR. NOSKO: Good afternoon. My name is John Nosko, and I am the project manager for the Dresden and Quad Cities extended power uprate projects.

Our presentation this afternoon has been constructed to generally follow the guidelines of the agenda provided by the subcommittee. It incorporates materials to address the questions received from the ACRS before the meeting.

And we expect to take just over two hours, Mr. Chairman, to cover all of the topics, which allows time for questions from the subcommittee. We have with us today members of our project team from Exelon, and from General Electric, Stone & Webster, and Aaron Engineering here, to support the presentation.

There is no proprietary information contained in our presentation, but it may turn out that responses to some of your questions would bring out proprietary information. If that is the case, we will ask to address the matters separately with you, or in a closed session.

So looking at the agenda, we propose to

cover our compliance with regulatory issues in the introduction and project overview. We will talk about selected analyses and evaluations as requested by the committee.

A separate presentation will focus on probablistic risk analyses, and including a discussion on open items identified in the draft safety evaluation report.

And finally we will talk about implementing the power uprates at the station from the perspective of an operating license holder. Our submittal is requesting a 17 percent increase in license power level.

The goals of our project are to safely use the excess capacity currently available at the stations to increase power production levels to leverage industry experience using a proven and accepted methodology to minimize the impact of that uprate on the plant by maintaining a constant reactor dome pressure.

And to make our analyses and designs for both stations as similar as possible to simplify reviews and configuration management going forward. Our submittal was prepared in accordance with the license topical reports for extended power uprates.

They are ELTRs 1 and 2.

And it demonstrates compliance with applicable regulations and safety limits. The analyses that we have done consider a variety of operating transients, postulated accidents, and operating conditions.

We have evaluated the radiological consequences and environmental impacts of the uprate, as well as the effect of the uprate on station programs.

Now, we have taken only one exception to the license topical reports, and that is for conducting major transient testing at uprated power levels.

Our presentation will address why we are taking that exception, and why we believe there is compelling data to support that position. The committee has also asked us to address the impact of the extended uprate on plant margins, and our approach this afternoon is to include that aspect in the presentation on the specific topics.

DR. SIEBER: The large transient testing, this is two tests, right?

MR. NOSKO: Yes, sir; MSIV closure, and generator load --

DR. SIEBER: And maybe you could just say a sentence or so as to why you don't want to do that, because that is still an open item.

MR. NOSKO: Yes, sir. We have a -- if I could ask that the question be held until a later point in time. We do have a separate session that deals with that directly.

DR. SIEBER: All right.

MR. NOSKO: Okay. Thank you.

DR. SCHROCK: I have a question. In reading these documents, I find that to a very great extent, and perhaps more than 95 percent, are verbatim for the two plants.

And yet some numbers come out different here and there. This is puzzling to me, and I don't understand the reasons for these differences. I think a better starting point for me would be to tell us what are the plant specific differences that have to be dealt with.

The scheme as I understand it is that you have the generic evaluation done in the G.E. reports, and that leaves plant specific considerations to be dealt with on a case by case basis.

And what I don't find in these reports is a clear delineation of what the plant specific considerations are for each of these plants.

MR. HAEGER: I think that probably the best way to answer that is --

MR. BOEHNERT: If you could introduce yourself.

MR. HAEGER: Yes, I am Allan Haeger, and I work for Exelon in the licensing area. We have in our presentation pointed out differences where we think that those are significant, and we are prepared to discuss the reasons for the differences at that time.

That might go to what you are asking. If you would prefer to wait as we go through the presentation, there are opportunities there.

DR. SCHROCK: I am simply pointing out that I have difficulty digesting the material and making sense of it for this reason and a few others, but it would be helpful I think if you could tell us what he plant specific considerations are. That does not seem like an onerous request I don't believe.

MR. NOSKO: Well, they are sister stations, and they are both BWR-3s. The Dresden station uses an isolation condenser, for example; whereas, Quad Cities is a little bit behind Dresden, uses a RCIC system, reactor core isolation cooling system.

There are differences in safe shutdown. They have a safe shutdown pump at the Quad Cities station, and a separate system to address that for fire protection areas. We don't have that in the Dresden station.

It is things like that. But I am sure that we will be able to clarify this in the presentation, and if we fail, please bring that to our attention, and we will make sure that we get that straight.

DR. SIEBER: In your list of things that you are going to talk about, some of the questions that I sent in had to do with the fuel design, and I recognized that the lead safety analysis are separate from the upgrade.

But I would be interested in knowing a little bit more about the details of the fuel design than currently appears in the SER. Can you address that or do you plan to address that?

MR. NOSKO: Well, since the application for G.E. 14 fuel was a separate licensing submittal, we were not intending to address any of the specifics about the G.E. 14 fuel.

But depending on the questions, and

depending on the proprietary nature, we might be able to.

MR. HAEGER: We certainly have personnel here who can speak and answer those questions.

DR. SIEBER: Well, it seems to me that when you extend the rating of the plant by 17 percent, other than a few balance of plant things and some new analysis that you have to do, everything depends on the fuel, and that is where you are getting the uprate from.

MR. HAEGER: That's right.

DR. SIEBER: And so to me I think it is part-and-parcel of it.

MR. HAEGER: Well, we will be covering the fuel's response to at risk to LOCA, and we talk about the general design to some degree. But I think there is enough points in the presentation that touch on that that is an appropriate place to answer questions.

DR. SIEBER: The ACRS doesn't get the opportunity to review safety reload, safety evaluations, and so we may miss out on the full understanding of just exactly what the uprate is all about, and how you achieve it, and everything that is affected.

Because you actually affect a lot of

things when you change the fuel parameters. It changes the results and the results virtually of all the safety analyses as I see it.

Well, let's see what you do, and to the extent that you miss the questions that I submitted, then I will ask them at the appropriate time.

MR. NOSKO: Okay. This next slide is a power-to-flow map, and you are very familiar with this. We have a chart over there that is not as visible as we had hoped that it would be and our apologies.

From this chart, you can identify the current hundred percent power level, and the power level for uprated conditions, the 2957, and that is the far upper right.

DR. FORD: Can I ask about this chart? I mean, this chart -- well, what does it depend on? It depends upon what?

MR. NOSKO: Core flow.

DR. FORD: It depends upon the fuel design, and the way the flux is flattened, and so on? Or is it something much more basic than that? Does this middle upper boundary move around as you change the way in which you fuel the reactor, or design your flux distribution and so on?

MR. NOSKO: Jens or Jason, would you help us with that.

MR. POST: Yes, this is Jason Post of G.E. The MELLLA upper boundary is a licensed limit, and that does not change. That is fixed in space, and that does not change from reload to reload.

There can be small variations in the load lines as a result of the core design, but the changes are pretty small, and we have equations that we use when we define those, and they basically don't change significantly from cycle to cycle.

DR. FORD: Thank you.

DR. SCHROCK: I saw those equations and they look like empirical relations. They don't seem to relate to any physical aspect of the plant. I think that I would like to ask the question that Graham just asked again. What is the basis of the line? How does it come to be where it is as a licensing limit?

MR. PAPPONE: This is Dan Pappone of G.E. The rod lines that are shown on the power flow map did have their origination back in the plant design plant response, but we have fixed those in licensing space.

So they approximate what the actual response would be, but we are treating these as licensing boundaries. So that helps.

MR. NOSKO: So you are right; they are empirical.

MR. POST: It is an empirical bounding fit to an original set of calculations, and having done that original fit, we are now drawing that line and saying this is our licensing boundary, and we will not allow a plant operation outside of that boundary.

DR. SCHROCK: But if I am not mistaken, that is one of the unexplained differences between Quad Cities and the Dresden plants. These power flow maps are not identical, and they differ significantly I think. Is that right?

MR. PAPPONE: I believe that we kept the power flow maps the same, or what we are counting as a licensed power flow map, and I believe that is the same.

MR. NOSKO: For the uprate, yes. That's correct.

MR. PAPPONE: For the uprate, yes.

MR. NOSKO: Today they have differences in their licensed power levels. Dresden is 27 (sic) megawatts thermal for their license level; and Quad Cities is 2511. So there are some differences there.

DR. SCHROCK: And that is an affirmed

power?

MR. NOSKO: Correct. And when we go to the uprate power, we are bringing those two together as part of maintaining a common configuration management.

DR. SCHROCK: Well, I will have to look again, but in searching for what are the differences between these two reports, two sets of reports, I was struck by the fact that here were different numbers, different positioning of various lines -- this little dashed line, which has something to do with natural circulation, was in a different place.

But the numbers in the table that characterize where the lines are seem to be different also in Quad Cities and in the Dresden reports, SERs. So we will have to look again to confirm if I am right or am I wrong.

MR. HAEGER: What we will do is we will look closely at those, and try to explain any minor differences, and I think they are probably minor, but any differences in those.

MR. NOSKO: Okay. And the purpose of this slide frankly was to demonstrate that MELLLA allows us to operate at higher power levels without changing core flows.

The next slide summarizes differences in key operating parameters between plants today and what we expect after the uprate in Dresden.

CHAIRMAN WALLIS: And you talked about flow rate just now. The flow rates on this diagram are not the same as they are either for Quad Cities or for Dresden on page 115 on the G.E. safety analysis report.

And I don't know what the differences are due to, and Quad Cities shows 105.8 for its full power core flow range maximum; and Dresden shows 98. I don't know why they are different, and yet Dresden shows 105.8 for its extended power uprate, which is not on yours either. And these are different numbers, and I just don't understand why they are so different.

MR. HAEGER: I think I can handle that. The full power expected core flow for both stations is going to be as shown here, 98 million pounds mass per hour.

Now, Quad Cities currently is licensed to achieve what they call increased core flow, which is to go beyond the right boundary of the power flow map into that increased core flow region. Dresden is not.

For the power uprate, we did some of the analysis, and it was stated that we did some of the analysis for Dresden at that increased core flow range to support future potential licensing actions. But the full power, 100 percent core flow for both stations will be the same at 98.

CHAIRMAN WALLIS: This is one of the things that is confusing when you see different numbers in different places for the same thing, and it needs some explanation.

MR. HAEGER: Well, we do analysis -- and you are going to see a few more differences.

CHAIRMAN WALLIS: So it is true then is it that you are not extending the core flow rate with this application, but that you would like to do so sometime in the future, which is why you have some higher numbers in some of these other places?

MR. HAEGER: That's correct.

CHAIRMAN WALLIS: Thank you.

MR. NOSKO: Quickly summarizing some of these high points, the Dresden station, I mentioned thermal power is increasing from 2527 to 2957 megawatts thermal, and Quad Cities is going from their current 2511 to their same uprated level.

Steam flow is increasing from about 9.8 million pounds per hour to just over 11.7 million pounds per hour. And as you saw in the power flow map, the range of core flow at full power decreases somewhat under uprated conditions, but maximum flow through the core is not changing.

And you can also see here that we are not changing dome pressure or --

CHAIRMAN WALLIS: The core flow rate has to have a range because of condenser temperature variations or something to get the same power; is that why it varies?

MR. NOSKO: The range on the -- you are talking about full power?

CHAIRMAN WALLIS: Why is there a range? Why isn't it just 98? Why is it 85 to 98?

MR. NOSKO: It is a function of the MELLLA line, where the MELLLA line intersects full power.

CHAIRMAN WALLIS: Oh, it is the flat part.

MR. NOSKO: Yes. Moving on, this uprate will be accomplished in one phase. Mr. Bohlke mentioned earlier in his presentation that plant modifications will be installed during the next refueling outage for each unit, and in the on-line period immediately preceding that refueling outage.

I mentioned earlier that we will be taking advantage of installed spare capacity at the stations. These spares are maintenance spares for the plant, and the most obvious example that we have is that we will be operating all four of our condensate booster pumps, and all three of our motor driven reactor feed pumps.

But I should say also that the use of all installed feed and condensate pumps is common in the industry, and it is just a difference for Exelon at this time.

Following the uprate, our units will be generator limited, which means that we will be varying reactor power seasonally to account for temperature differences so that we maintain maximum output from the generators.

And this slide also shows our schedule for implementing the uprates at the four units. Dresden-2 is in its outage now, and the remaining three units will undergo their outages for the uprate next year.

Turning now to the modifications that we will be making to the station. You will find that the power uprate generally requires the same modifications to be made at both stations. There are relatively few safety related modifications, and the majority of the changes are being made to the balance of plant systems.

CHAIRMAN WALLIS: I am going to ask you a question, because I don't see it in your presentation here. The method for increasing the power without raising the flow rates through core and the pressure and so on is flux flattening essentially.

So what we have seen is that you have a higher flux than you would have had before at the outside of the assemblies of the core. And yet I understand that the fluence, the vessel fluence, goes down with a power uprate. How do you achieve that?

MR. NOSKO: Well, we are prepared to discuss that.

CHAIRMAN WALLIS: Well, I didn't see it in your presentation.

MR. NOSKO: It is there.

CHAIRMAN WALLIS: It is there? Okay.

MR. HAEGER: It is slightly touched.

CHAIRMAN WALLIS: So you are going to answer that question later then?

MR. HAEGER: Yes, sir.

CHAIRMAN WALLIS: Thank you.

MR. NOSKO: I would like to talk about the more significant plant changes that we will be making for the uprate, using the chart behind Mr. Haeger as a rough guide.

That chart over there is a very simplified schematic of the steam and feed water cycles. I will begin in the upper left-hand corner with the changes to the reactor internals, and then follow that diagram in a clockwise manner through the turbine, the condenser, through the feed water system, and then back to the reactor.

So starting with the reactor. New G.E. 14 fuel assemblies will replace existing G.E. and Siemens's fuel. This will be done gradually over 3 to 4 operating cycles, and this new fuel type will allow us to reach the higher EPU power levels, while maintaining a 24 month operating cycle.

Mr. Bohlke mentioned that Dresden and Quad Cities are BWR-3 units. As such the steam dryers are smaller than those of the later designed BWR-4s, 5s, and 6s, and they are not able to handle the increased steam flow of an extended power uprate as well.

So to prevent the higher moisture carryover levels predicted for the uprate, we elected to modify the steam dryers to keep those levels to no greater than what they are today.

We are adding clamps to 8 of the 20 jet pump sensing lines to eliminate a concern for potential vibration induced failure of those lines caused by the vein passing frequency of the recirculation pumps.

A reactor recirculation system runback and the low SCRAM level set point change are being added to improve station availability. Today, only two of the three feed pumps and 3 of the 4 condensate pumps operate at rated power.

If one pump trips, the standby pump automatically starts. After the uprate, we won't have a standby pump, and so we are adding a run back feature and a SCRAM set point change to prevent low water level SCRAM on either a loss of a single feed pump or a single condensate pump.

Changes to the isolation condenser time delay relay at Dresden and to the low pressure coolant injection swing bus timer at both times are being made to reflect new accident analyses for the extended power uprate. And we are also making some changes to set points on nuclear instrumentation.

DR. SIEBER: Before you leave that, what is your guaranteed maximum moisture content at the reactor outlet right now? Is it one percent?

MR. NOSKO: Currently today?

DR. SIEBER: Yes.

MR. HAEGER: The acceptance test for the original steam dryers was less than .2 percent.

DR. SIEBER: So, .2?

MR. HAEGER: Yes.

DR. SIEBER: And what modifications are you making to the dryers?

MR. HAEGER: We have a couple of slides on that later in the presentation that show an insertion of a perforated plate.

DR. SIEBER: Is that going to change the pressure drop?

MR. HAEGER: That is going to change the pressure drop.

DR. SIEBER: Do you know by how much?

CHAIRMAN WALLIS: Well, the higher flow rate will change the pressure drop, too, right?

MR. NOSKO: Right.

CHAIRMAN WALLIS: So you actually have a lower pressure at your turbine than you would like or that you have now?

MR. NOSKO: Than we have now, yes. I don't have that specific piece of data, but I am sure that we will collect it.

DR. SIEBER: Right.

MR. NOSKO: Okay. So moving on to the turbine generator system modifications, we are making changes to our high pressure steam path by installing new high pressure turbines, and we are also changing the cross-around relief valve set points.

An additional steam line residence compensator card is being installed in our electro hydraulic control circuitry to handle the third level harmonic for the steam piping system.

And at Dresden, we found that the existing isolated phase bus up cooling system was not adequately sized to handle the uprate, and so we are making a change to improve the cooling capacity of that system.

DR. SIEBER: You are putting in a new return line?

MR. HAEGER: Yes, we are. We are putting in a new return line, and we are having all the cooling go down all three of the phases.

DR. SIEBER: And you aren't doing anything to the generator to improve cooling I take it or are you?

MR. HAEGER: We are increasing the flow of standard water cooling to the generator, but it is a small issue. I didn't include it int his presentation.

DR. SIEBER: And how are you doing that? You aren't changing anything. Does that take cooling water away from other components in the plant and make that system marginal? Is that just a turbine plant closed cooling water system?

MR. HAEGER: Yes, and that has been evaluated.

DR. SIEBER: And you have enough capacity?

MR. HAEGER: Actually, standard water cooling is service water.

DR. SIEBER: Service water?

MR. HAEGER: Yes.

DR. SIEBER: Well, that is still a closed cooling system, and you can't put service water there.

MR. NOSKO: You are correct. Standard cooling is the closest one. And I didn't mention, but Quad Cities doesn't have this problem. This is a Dresden-unique situation.

Continuing now with changes to the condensate and feed water systems. The increased flow from the uprate causes additional stresses on the condenser tubes, particularly in cold weather.

Several years ago, the Quad Cities station installed intermediate bracing for their condenser tubes to eliminate a concern that they had over tube vibration. Dresden did not at that time. So now we are making that change at the Dresden station as a part of this uprate.

DR. SIEBER: Have you noticed damage at the current levels to condenser tubes on expanded vibration?

MR. NOSKO: No, sir, not at the Dresden station, and Quad Cities, after they went through this.

DR. SIEBER: And what kind of tubes are they? Do you know?

MR. NOSKO: They are stainless.

DR. SIEBER: Stainless? Okay. But you are expecting that the potential for vibration due to the increased exhaust flow will cause damage?

MR. NOSKO: Well, we are expecting that if it is staked at the present station, and the stakes that we have at Quad have been evaluated for the increased steam flow and they are adequate.

DR. SIEBER: Right. That is a time consuming modification to put all of those things in there, and there are tons of them.

MR. NOSKO: Yes. The increased condensate and feed water flow also requires us to increase the capacities of the condensate demineralizer systems at both stations. Dresden and Quad Cities use four stages of feed water heating.

The uprate increases extraction steam flow from the low pressure turbines to the feed water heaters, and this raises the internal pressure of the heaters.

For our two lowest pressure feed water heaters, that pressure increase is small enough so that the heaters will continue to operate within their existing design rating.

This is not the case for our two highest pressure heaters, and so we are making modifications to allow us to increase the pressure ratings of those heaters.

We are increasing the capacity of the bravo heater and normal drain valves at the Dresden station to maintain heater normal water level control, and avoid the need to bias open our emergency spills.

Because of similar changes already made at the Quad Cities station that modification isn't needed there. A change that is being made at the Quad Cities station, but not at Dresden, is the staggered feed pump low suction pressure trips.

Right now at Quad Cities all the reactor feed pumps trip on a low suction pressure signal, and after the uprate, they will be staggered somewhat, depending on the duration of that low pressure signal.

And separately from the extended power

uprate project, a new digital feed water control system is being installed at the Quad Cities station. It of course will be tested and adjusted to support planned uprated conditions.

And then there are plant changes that don't neatly fit into any of the previous categories. The results of the piping analyses require us to make some changes to our main steam and torus-attached piping supports, as well as to some drywell support steel.

We are upgrading the interrupting capability of the non-safety related 4kV switchgear to handle the additional running loads. A feature to trip the delta condensate pump in the event of a loss of coolant accident is being added to retain the ability to make up with feed water.

And the Dresden station uses a cooling lake and supplemental cooling towers to cool the circulating water. We have plans to install new cooling towers at the Dresden station to install, or excuse me, to handle the additional heat load from the uprate.

But this is an economic decision driven primarily to avoid derating the plants in the summer months. Depending on the results of more recent economic evaluations, we may elect to defer installation of those additional cooling towers to a later date.

While we are prepared to go on to selected analyses and evaluations, I thought I would ask the committee if there are no further questions on the modifications?

DR. SIEBER: I have a couple of questions. Because you are now operating your installed spares as to provide sufficient pumping capacity, that creates a problem with your unit auxiliary transformer and its spare; where when you get a bus transfer, you end up with more load on the spare transformer than it is rated for.

And you have addressed that in a number of ways, one of which was to test the circuit breaker for interrupting capability. I presume that test is complete and satisfactory?

MR. NOSKO: Yes.

DR. SIEBER: And another thing that you did was to cut out the instantaneous over current protection so that you would end up with a six cycle delay or something like that?

MR. NOSKO: Yes.

DR. SIEBER: What was the basis of doing

that? Was it because the peak was too high?

MR. HAEGER: I believe that is the case, yes.

MR. NOSKO: Right now I am not sure whether it is the interrupting or the instantaneous.

DR. SIEBER: It is the instantaneous that was cut out, and the long term one is designed to allow you to start motors where the current one would go above the operating current, and as the motor starts to the normal operating current.

The instantaneous one is for short-circuit protection, which now if you have a bolt short in your system, you have no protection. So when you close on it --

MR. HAEGER: As I understand it, the equivalent protection is obtained by the other relay scheme in there that is maintained, but I am not an electrical expert. Is there anybody back there that can help with this?

MR. KLUGE: Yes, I am Mark Kluge from Exelon. The test that was performed actually used the short-circuit current and then with some modifications to the switch gear bracing, and the switch gear then proved capable of interrupting that, even with the six cycle delay.

DR. SIEBER: The question is not whether the circuit-breaker can interrupt it, but whether the transformer can take that fault, because the protection is gone.

MR. HAEGER: Yes, and I am pretty sure that the answer lies in the equivalent protections in the other features of the release scheme. Let us confirm that for you.

DR. SIEBER: Okay. Now, the other part of that is that you end up with a required manual operator action to eliminate or disable some of the loads on that transformer to bring it back to its current rating.

And I take it that the effect of the operator not doing some stripping on those buses would lead to damage to the core or to the windings of the transformer and cause overheating.

And you say if he does it within an hour everything is just perfect, and where did the one hour come from?

MR. NOSKO: We had a separate evaluation conducted.

DR. SIEBER: Yes, I have read that, and they said one hour, and the question is how did they come up with that? What was the basis?

MR. NOSKO: The basis? I need to --

DR. SIEBER: Or is that engineering judgment?

MR. NOSKO: No, sir, it was based on the test results.

DR. SIEBER: Well, it takes the life out of the transformer when you do that.

MR. HAEGER: That's correct. We understand that to be the case, but as far as the specific basis, I think we are going to have to get back to you on that.

CHAIRMAN WALLIS: One hour sounds like a rounded-off number in some way.

DR. SIEBER: It certainly does. It should have been 58 minutes, and then we would believe it and not ask the question.

MR. HANLEY: This is Tim Hanley from Exelon. I believe the one hour actually came from me. I am the operations representative and I had them evaluate it at one hour because I thought that was an acceptable time period for which the operators to take those actions.

So it was a backward calculation on would it be okay from an hour. So I believe that is why it is such a round number.

DR. SIEBER: Let me ask since you are the operating person, you probably know this. Does Exelon or its predecessor have a practice of looking at transformer gas composition?

MR. HANLEY: Absolutely.

DR. SIEBER: How often do you do it on that transformer; do you know?

MR. HANLEY: We take oil samples to measure the gas content I believe on a monthly basis on all of our large power transformers. So, in an event like this, if we knew that we had over duty on the transformer for some period of time, we would immediately go out and take another sample and check for gasing.

But we do have an analysis program that we do on a regular basis for all the large power transformers at the plant.

DR. SIEBER: And if somebody from your laboratory came back and said you have got high acetylene in this transformer, what would you do as an operator?

MR. HANLEY: It depends on the level at which it comes back at. We trend that. In fact, Dresden this past summer had a transformer that was gasing and they trended it over time, and did a control plant shutdown, and shut down, and went in and repaired the transformer and brought the unit back on-line.

DR. SIEBER: Why would it be a shutdown?

MR. HANLEY: You would have to with the unidox transformer, because it is tied directly to the generator. There is no way to separate it without taking the unit off-line.

DR. SIEBER: Thank you.

MR. NOSKO: Moving then to the selected analyses and evaluations. A full scope of the evaluations was performed in accordance with the ELTRs. These analyses were used to prove methods within previously accepted ranges and in all cases the results were within the acceptance criteria for the planned EPU configuration.

This next slide identifies the analyses and evaluations that we will be covering; the containment, the emergency core cooling system; and thermal-hydraulic stability. We will talk about the anticipated transient without SCRAM analogies, piping, and also we will look at the effects of the power uprate on reactor internals, and the flow accelerated corrosion programs at the stations.

These were selected for discussion based on a request from the committee and in the case of the reactor internals, because of recent industry operating experience. And with that, I will turn the discussion over to Mark Kluge, who will begin with the review of the containment analyses.

DR. SCHROCK: Excuse me, but before you leave, could you say what the current licensing basis for these plants is?

MR. NOSKO: In terms of what, sir?

MR. HAEGER: Yes, can you be more specific?

CHAIRMAN WALLIS: That's a pretty broad question.

DR. SCHROCK: Right. Well, in terms of the LOCA evaluation is what I am thinking of.

MR. NOSKO: Those are covered in this presentation. They are summarized along with the pre-EPU and the post.

MR. HAEGER: Are you asking for the methodology or the --

DR. SCHROCK: Well, I will ask the question subsequently.

MR. NOSKO: Okay. Very good. Thank you.

MR. KLUGE: Good afternoon. I am Mark Kluge from Exelon's EPU project engineering team, and

I will be discussing the containment analysis that we performed for the Dresden and Quad Cities power uprates.

I will cover the methodology that we used to perform these analyses, and we will look at the results for the design basis accident, and we will also look at the Mark I hydrodynamic loads, and I will summarize the conclusions of the containment analysis.

CHAIRMAN WALLIS: When you say design, there are several design basis accidents.

MR. KLUGE: The design basis accident that I am referring to is the maximum recirculation and suction line break.

CHAIRMAN WALLIS: The most critical one or something like that?

MR. KLUGE: It provides the limiting case for containment and--

CHAIRMAN WALLIS: Okay.

MR. KLUGE: A containment analysis is performed in two phases; a short-term phase, and a long-term phase. For the short-term analysis, we use the M3CPT and LAMB codes. LAMB models flow down and then M3CPT calculates the peak dry well pressure and temperature.

In the long term, we use the SHEX code, which then looks at the conditions in the suppression pool. And for the Mark I hydrodynamic loads, we use the methodologies that were defined during the Mark I long-term program.

In all cases our EPU license power is within the range for which these codes are applicable, and we analyzed a full spectrum of break sizes and locations, and we used conservative input parameters so that we would have conservative results.

Moving to the next slide, the results for the design basis accident. Peak drywell pressure, you can see that when we perform the calculation with the same methodology for current conditions and uprate conditions, here is approximately a one pound rise in peak containment pressure, which is still well below the acceptance limit for these containments.

For drywell air temperature, again when we perform the pre-EPU and the EPU case, we have a very nominal two degree rise in peak drywell air temperature.

CHAIRMAN WALLIS: Now, the drywell metal temperatures.

MR. KLUGE: The drywell metal is designed for a temperature of 281 degrees.

CHAIRMAN WALLIS: And you have to do some transient heat transfer analyses or something?

MR. KLUGE: That's correct, and in this case the design basis loss of coolant accident is not even limiting for the drywell metal temperature. The peak temperature that is given here, and the air temperature lasts less than 10 seconds and simply is not there long enough to eat up the drywell shell to its limit.

CHAIRMAN WALLIS: I read that, and I would be a little reassured if you had actually given a number to how hot it gets. How hot does it get in this 10 seconds?

MR. KLUGE: I believe the peak drywell temperature is in the 277 degree range.

CHAIRMAN WALLIS: So it is a few degrees off the limit.

MR. PAPPONE: This is Dan Pappone. That is a typical result that we have seen for recirculation line break analysis, and 5 to 10 degrees below the shell temperature has been 5 to 10 degrees below the design temperature.

MR. KLUGE: Going on to the next slide, here are the results for the suppression coolant --

CHAIRMAN WALLIS: Typically is it always

below?

MR. KLUGE: Well, the reason that I said typically is that last month we did have the shell temperature slightly above, but when they went and looked at the structural evaluation for that higher temperature in the case where it did come up higher on the shell temperature, the structural analysis was still acceptable.

And so occasionally we have seen the drywell shell come above the 281 limit by a handful of degrees, and if we go to the next step in the structural analysis. The structural analysis results were okay.

DR. SIEBER: So when you say last month, Dan, you were talking about?

MR. PAPPONE: The Duane Arnold analysis.

CHAIRMAN WALLIS: The calculation and not an event. So what is the regulation? The regulation says that if it is above 281, then you have to do a detailed structural analysis or something? What does the regulation say about this structural limit?

MR. HAEGER: I don't believe there is any direct regulation on this. I believe that the licensing process is to set the structural limit, and then ensure that you don't achieve it; or if you do, justify a new structural limit.

MR. PAPPONE: This is Dan Pappone. The containment for the drywell torus shells are ASME pressure vessels, and so at that point we are working within the ASME structural codes.

CHAIRMAN WALLIS: So there is nothing written in some CFR document which says that 281 is a limit?

MR. PAPPONE: No.

CHAIRMAN WALLIS: I guess we can ask the staff the same question and what they think about these when we get to them tomorrow.

MR. KLUGE: Moving on to the suppression pool analysis. When we did a limiting analysis using the most conservative inputs from the two sites, we saw that EPU resulted in approximately a 9 degree rise in suppression pool peak temperature.

We used that bounding analysis, 202 degrees, in the containment analysis and piping analysis. We also calculated plant specific heat suppression pool temperatures, and that was used in the ECCS and NPSH analysis, and as you can see those numbers are lower than the limiting analysis.

For the EPU wetwell pressure analysis, again we had a very nominal rise in peak wetwell pressure when we applied the same methodology to the pre-EPU and post-EPU case.

The Mark-I hydrodynamic loads, we looked at pool swell, and vent thrust, condensation oscillation, chugging, and SRV discharge loads. We ran all the limiting cases for EPU as John Nosko mentioned, and reactor pressure does not change for this uprate.

That is a primary driver in these hydrodynamic loads. So we found in all cases the current Mark-I load definitions remained bounding for these plants.

DR. SIEBER: That is for pressure and flow, as opposed to duration of the transient, right? Because there is additional energy in the extended --

MR. KLUGE: There is additional energy, but it was all within the original load definitions.

DR. SIEBER: Okay. Do you use some kind of a starter or something like that on your safety and relief help discharge lines?

MR. KLUGE: We have T-quenchers. In conclusion, the containment analyses we performed for EPU used accepted methods within the range for which those codes are applicable.

We chose conservative input parameters and all of our results were within acceptance criteria. Therefore, we conclude that containment performance is acceptable under EPU conditions.

If there are no questions, I would like to introduce John Freeman, of our nuclear fuels department, to talk about the ECCS-LOCA analysis.

CHAIRMAN WALLIS: Well, can we conclude that not only containment performance acceptable, but containment performance is not a feature which limits the amount of power uprate that you can have within the range you are considering.

And that you are not getting close to a limit in containment performance which is preventing you from going to, say, 3,000 megawatts?

MR. KLUGE: That is correct. As you observed, there is substantial margins in all of the containment acceptance criteria.

CHAIRMAN WALLIS: Thank you.

MR. FREEMAN: Good afternoon. My name is John Freeman, with Exelon Nuclear Fuel Management. I am going to discuss emergency core cooling analysis, along with Dan Pappone of General Electric.

Dan is going to go over the methodology and some of the acceptance criteria, and part of the approach that was used for the extended power uprate.

I will go over the results and some of the conclusions that we had reached, and with that, I will turn it over to Dan Pappone.

MR. PAPPONE: For the for the ECCS analysis methodology, we used the SAFER/GESTR-LOCA methodology for performing LOCA analysis. We applied it as it was outlined in the ELTR, and we did basically a full scope analysis, and I will get into a little more of the particulars, because we are moving from the previous version of the code for the way we had applied it for Quad Cities, and we are essentially changing the fuel vendor of the analysis for the Dresden plant.

DR. SCHROCK: My question earlier about the licensing basis. I had this specific thing in mind. The current basis is also -- rests on SAFER/GESTR calculations, using the provisions of SECY 83-472; is that right?

MR. PAPPONE: Right. Well, the current analysis for the G.E. fuel in Quad Cities.

MR. HAEGER: Right now Dresden uses Siemens fuel, and they have a Siemens analysis methodology.

DR. SCHROCK: Which is different.

MR. HAEGER: Yes.

MR. PAPPONE: And because we are bringing the Quad Cities analysis up to date, and we are bringing Dresden into the SAFER/GESTR methodology, we did do a full-scope analysis for the plants, and when we do that analysis, we analyze the break spectrum using a nominal set of assumptions to determine the limiting break location, and limiting break size, and the limiting single failure.

And once we establish that, we calculate a licensing basis peak clad temperature using the required models from Appendix K. This is the process that is outlined in SECY 83-482.

And in order to demonstrate that licensing basis PCT has sufficient conservatism, we also calculate an upper-bound peak clad temperature for limiting nominal case.

DR. SCHROCK: In all of these descriptions of many analyses that have been performed, the results seem to be given in sort of a simple narrative description that things are well within the existing range or increase only by insignificant amounts, as opposed to showing us quantitatively what the results are, and what the range of investigations span, and how many there were, and things of this nature.

I would think that we need to hear some of those details to have a better understanding of do we buy in or don't we. Do you follow me?

MR. PAPPONE: Yes, I understand.

MR. HAEGER: We actually have some of those comparisons in our upcoming slides, but as far as --

DR. SCHROCK: Well, my reading of the thing is that it is a pretty broad brush description of how you comply with an existing set of regulatory limits that are imposed on you, as opposed to a technical evaluation of how the thing performs under these new conditions.

MR. PAPPONE: We did perform that technical evaluation.

MR. FREEMAN: This is John Freeman. I think I can address that. What was great about this analysis was that it gave us a chance to do a complete new analysis to cover all four of those units, and we very carefully chose all the emergency core cooling performance inputs, and we ran it before the power uprate and after the power uprate.

And that's where the difference is very small. With the same fuel type, all the same inputs, and the only difference being the power level for the dba, and we are going to go over this here in a minute to talk about for the dba, the temperature doesn't change that much.

Most of the impact due to power uprate is in the small break analysis, and we will go over that in a little bit. But we will also talk a little bit about the fuel aspect, which is something that you wanted to be discussed.

When we are finished, maybe you could see if you have any more questions on this.

DR. SCHROCK: Sure.

MR. PAPPONE: The prime purpose of doing the analysis is to demonstrate that the plant is in compliance with 10 CFR 50.46, and acceptance criteria, and peak clad temperature, local oxidation for wide water reaction, coolable geometry, and long term cooling.

We do the plant specific analysis for the peak clad temperature, and local oxidation of the core wide metal-water reaction; and coolable geometry and long term cooling we have addressed generically in the SAFER/GESTR methodology.

The primary parameter of interest is the peak clad temperature, and we have to keep the peak clad temperature below 2200, which is the 50-46 acceptance criterion.

And out of the SECY methodology, and the SECY approach, we also have to demonstrate the licensing PCT is greater than the upper bound PCT, so that we have demonstrated that licensing PCT we calculated is sufficiently conservative.

And then as part of the SER conditions that were imposed on the SAFER methodology, as part of that approval, we have a limit on the upper bound peak clad temperature of 1600 degrees.

And that was based on the test data that was supplied for the code qualification and the application methodology calculations that we had in the generic LTR for the SAFER methodology.

CHAIRMAN WALLIS: You show here two different things for Appendix K and licensing basis. Aren't they the same thing?

MR. PAPPONE: The licensing basis PCT is essentially a statistical summation of the nominal Appendix K, plus some additional plant variable uncertainty terms.

So in the practical sense, it is the Appendix K temperature, plus a small ADS. That ADS picks up a few terms that aren't in the Appendix K calculations. So it ends up being slightly higher.

Now, back to the actual scope of analysis that we did. We did a full scope SAFER analysis for bringing the G.E. 9 fuel, the G.E. fuel that is in Quad Cities, and we are bringing that up to the current analysis process procedures and code.

We are also applying the SAFER methodology to the Siemens fuel that is in both Dresden and Quad Cities. So at the end of all of this, we have got one common analysis basis for both units, and for all the fuels in the units.

We did all of the analyses, the full break spectrum analyses, assuming G.E. 14 fuel, because that was the hottest fuel that we were looking at. That was fuel that was giving us the highest temperatures.

DR. SIEBER: That is 10 by 10 fuel?

MR. PAPPONE: That is a 10 by 10 fuel.

DR. SCHROCK: And that is an equilibrium cycle?

MR. PAPPONE: When we do the analysis, we are assuming an equilibrium loading.

CHAIRMAN WALLIS:

DR. SCHROCK: And you have a basis for concluding that that is the worst situation?

MR. PAPPONE: Yes. During the -- the two places that we look at a transition, versus equilibrium core, and during the initial blow down and core flow coast down that would affect the boiling transition time, that is once place that could be affected.

And then the other places during the reflooding. The fuel bundle design is such that it is hydraulically compatible. There isn't much of a difference in one fuel bundle to the next, because they have got to be able to co-exist and intermixed core

So there is very little hydraulic difference between the two, and you put a bundle in that has a lot higher resistance, or otherwise it will be starved and be too limiting locally, where we can't put in a bundle that has got a low resistance that will steal flow from the existing bundles.

So we tend to even things out that way, and then the operating limit CPR will take care of any small differences from one bundle to the next one, and fuel type to the next.

DR. SCHROCK: For your peak clad temperature, your decay power is certainly a consideration, and so the different points in the life of the core and the refueling changes, and all of those considerations, I guess my questions would have been more appropriate a year ago when we were talking about the generic aspect of the thing.

I tried to ask it then, and I didn't get a very satisfactory answer, but my knowledge of it doesn't come really from discussions in these current meetings. It comes from more than 10 year old memory of discussions that we had when that methodology was bring developed.

MR. PAPPONE: Right.

DR. SCHROCK: I really think that you owe an explanation of how these changes in the fuel characteristics impact what you have done to come to the methodology that is employed in applying the ANS standard to get the decay power curves that you are using in these analyses.

And they must be different now than they were when they were developed for the original cores that existed 15 years ago.

MR. PAPPONE: The key assumption for the decay heat is that we are using a nominal -- say mid-cycle exposure, and when we are doing the upper bound calculation, we do have the two sigma uncertainty on there.

DR. SCHROCK: But how do you get to that, that's what I am talking about, and my recollection of it is that you took a lot of different core compositions typical of what would occur in the life of the core, and you calculate the K-power using the ANS standard, and you evaluate the uncertainty using the uncertainty values given there for those conditions that you did a Monte Carlo evaluation.

And it came to some kind of generic curve, which was then applied essentially in all of the many evaluations that you have described here, for example. But it would be a different one now than it was then.

MR. PAPPONE: No, we have not gone back and revisited that Monte Carlo analysis. I am not aware that that Monte Carlo analysis being directly applied in the SAFER world.

DR. SCHROCK: You are not aware of that?

MR. POST: I don't think that ever was directly used in the SAFER world.

MR. HAEGER: You are talking about the AMS standard decay heat curve.

MR. PAPPONE: No, G.E. did an analysis on decay heat sensitivity, where we did go and look through --

DR. SCHROCK: You see, what I understand that I am talking about gets at the difficulty that arises when something has been approved, and the industry can utilize that approval to move ahead and use that methodology and satisfy regulations in that way.

And I accept the fact that that exists, and it is a fact of life, and it is probably necessary. But we are looking at the technical site of the thing here, and we want to understand are the conclusions that are being reached reasonable conclusions.

Now, I find it difficult to come to grips with answering the question when confronted with a situation where many of the details that I think are necessary just don't appear in the discussions.

MR. PAPPONE: We have just recently looked at the decay heat curve that we are using in the SAFER analysis, and come up with a new one for the -- we took a little bit different approach this time. We had been going through and looking at the core average exposure of the fuel types, and the operating cycle link.

And coming up with a bounding decay heat value based on those parameters that would go into this the 79 model. We have been using that in the containment analysis, because that analysis is one where we look at each individual part and make sure that each individual component is conservative.

So out of that family of curves that we have developed for the power uprate containment analyses, gone back and compared that with the decay heat curve that we are using in the SAFER analyses.

And on a nominal basis, considering that we are going from mid-cycle to end-of-cycle exposure, given those differences, the decay heat that we are coming up with now, that bounding envelope, is maybe a half-a-percent higher than what we had in the original SAFER curve.

DR. SIEBER: Could I make an attempt to ask about the Appendix K --

MR. PAPPONE: I haven't even gotten to the Appendix K yet. The other pieces in the SAFER methodology, the licensing basis PCT, is based on an Appendix K PCT calculation, and that includes the 71 decay heat, plus 20 percent.

So we have a large chunk of conservatism that we are introducing in the licensing PCT calculation.

DR. SCHROCK: And that is done at the end for what you have established as the worst situation?

MR. PAPPONE: Right. But what we have done in looking at these containment decay heat curves, and comparing to what we are using today in

SAFER, we are very close. So I hope that answers your question.

DR. SCHROCK: I hear what you are saying, and I am not saying that I don't believe it, but what I am saying is that I haven't seen the backup details that make it totally convincing to me.

DR. SCHROCK: I understand.

DR. SIEBER: Maybe we could back up for a second to the second bullet. When you read that off, you made a statement that I think I misunderstood, which was you chose to use G.E. 14 fuel because it is the hottest fuel?

MR. PAPPONE: Right.

DR. SIEBER: I would think you mean in comparison to 9-by-9 fuel?

MR. PAPPONE: Yes.

DR. SIEBER: I would think that it would be the other way around, because you have more surface with 10-by-10 than you do with 9-by-9.

MR. PAPPONE: If we look at 9-by-9 bundles, or why don't I take the G.E. 9 8-by-8 bundle if it is in there.

DR. SIEBER: Okay.

MR. PAPPONE: We have got the maximum linear heat generation rate that we are allowed is

14.4 kilowatts per foot.

DR. SIEBER: Right.

MR. PAPPONE: But we have only got 62 fuel rods, and they are depending on -- well, we have got 60 fuel rods in there. If we look at the G.E. 14 bundle, its maximum LHGR is 13.4 kilowatts per foot, a kilowatt per foot lower.

But we have gone to 92 fuel rods in there, and so if we look at the power remaining slice, we have got a lot more power.

DR. SIEBER: The density is --

MR. PAPPONE: Right. The total power is higher.

DR. SIEBER: But the PCT should be lower, right?

MR. PAPPONE: Well, the PCT is --

DR. SIEBER: Or what is the point of going to the 10-by-10 fuel?

MR. PAPPONE: It can pack more energy into that bundle.

DR. SIEBER: For a given set?

MR. PAPPONE: For the nuclear site, yes.

DR. SIEBER: For thermal conditions?

MR. PAPPONE: Right. And PCT is primarily driven by the LHGR, but the average planer power is also secondary, but still significant, input.

So, yes, we would expect if we went and looked at an 8-by-8 bundle, and dropped the LHGR, we are going to see a large drop in the PCT, a significant drop. But because we have gone to almost half again as many fuel rods in that plane, the power is up about 12 or 13 percent, 12 or 15 percent higher.

DR. SIEBER: Well, it should be up 17 percent if that is what your core average power increase is. But your surface probably only goes up 10 percent, right?

MR. PAPPONE: When we do the analysis, we put that hot node -- the hot rod and the hot node right on its LHGR limit.

DR. SIEBER: Okay.

MR. PAPPONE: So that doesn't move around. The hot bundle power that we use in the analysis doesn't change. The average bundle power will change with the power uprate.

But when we put that hot node on full power, that is when I am saying the power level is about 12 to 13 percent higher for that node. So we end up with a little higher PCT because of that.

DR. SIEBER: Thank you. That clarifies that for me.

MR. HAEGER: We didn't finish this slide I don't think.

MR. PAPPONE: Okay. So we did all of the analyses for G.E. 14 fuel type, and the full break spectrum, non-recirculation line break, like steam water, and feed water, and single failure evaluation.

And once we establish limiting cases, we went back and evaluated those limiting cases using legacy fuel types, Siemens fuel, and the older G.E. 9 fuel.

And we also did a sensitivity study for the power uprate. We did all of these analyses at power uprate conditions. We went back and analyzed a case of current power condition, where the only changes in the analysis were the reactor operating conditions. So we had a true what is the impact of power analysis on that.

CHAIRMAN WALLIS: Which PCT are you showing us that you did this analysis for different fuels? Which PCT are you actually showing us?

MR. PAPPONE: The PCTs are the G.E. 14 PCTS.

CHAIRMAN WALLIS: And the others are lower?

MR. PAPPONE: Right, except for the upper bound, we had a little larger sensitivity in the upper bound for the Siemens fuel. So the upper bound PCT that we are showing is a little bit higher than the G.E.

It is based on the Siemens 9-by-9 fuel, and that was a little higher than the G.E. 14 fuel. But the other temperatures are the G.E. 14.

DR. SIEBER: Right. Now, let me ask another question. As you march through the next 2 or 3 fuel cycles, you are going to have a mixture of legacy fuel and G.E. 14 fuel, which sort of tells me that when you do your reload safety analysis, unless you do some pretty fancy things in the fuel design space, that you won't achieve the extended power uprate for a couple of cycles. Now, is that true or not true?

MR. FREEMAN: This is John Freeman. I think the question as I understand it was because we don't have a full core G.E. 14, we are not going to be able to achieve --

DR. SIEBER: Yes, and is that true or not.

MR. FREEMAN: No, that is not true. They are essentially operating strategies for the first reload cycle by the enrichment and the guideline choices that will allow us to hit the expected targets.

Now, something that you have to realize is that we are not going to be operating that unit at 2957 right on the money for the whole cycle. We will be just like John mentioned. We will be cycling the reactor power up and down to meet maximum generator output.

So that is all factored into the reload analysis for any particular cycle. But it is done -- obviously the safety analysis is always done at the license conditions, although the energy design will be for what we expect to operate at.

DR. SIEBER: Now, for a two year cycle, and changing the fuel -- the number of fuel rods per assembly, I wold presume that the enrichment has to go up and to control it you have to add more guidelines?

MR. FREEMAN: That's right.

DR. SIEBER: Doesn't that place more pressure on your core shutdown margin?

MR. FREEMAN: The core is designed to meet all of its core shutdown margin criteria.

DR. SIEBER: Well, I understand that, but the pressure -- the more that you go in that direction, the harder it is to guarantee to meet core shutdown requirements; is that true or not true?

MR. FREEMAN: No, actually every core is designed to meet that criteria. So if the design doesn't meet the criteria, it is not used.

DR. SIEBER: Well, yes, I understand that.

MR. FREEMAN: So it is a design process. You either hit the target every time or you don't operate that particular design.

DR. SIEBER: Well, there is trade-offs there.

MR. FREEMAN: Yes.

DR. SIEBER: All of your fuel parameters fit in some kind of a regulatory design box, and somehow or other you have got to get it in there, and the way you do it is to spend money, right?

MR. FREEMAN: That's right. You have to put --

DR. SIEBER: That is usually one of the trade-offs. And I also would imagine that the fuel would be most reactive sometime other than the beginning of life, and obviously not at the end of life; is that true also, because it is a balance between remaining enrichment, versus remaining venerable poisons?

MR. FREEMAN: Where you get into the transient analysis Chapter 15 type world, which is apart from this LOCA stuff, yes, the particular core can be more reactive from a standpoint of a void coefficient, a doppler coefficient, and all of that is taken into account.

DR. SIEBER: So about 30 percent of the cycle lifetime is usually when it is most reactive?

MR. FREEMAN: It depends on the specific design and the goals that are being met for that design, and whether it is a spectral shift core, or whether it is some other goal.

It can change, but it is all within the approved methodology, and the operating limits and to include all of that, as well as the LHGR and upper hydro limits are all protected for any particular design. And that covers the entire exposure for that cycle.

CHAIRMAN WALLIS: I suspect that we are getting behind on time; is that not the case?

MR. FREEMAN: Yes, a little bit.

DR. SIEBER: I should not ask any more questions I guess.

CHAIRMAN WALLIS: Well, if you are getting the right answers --

DR. SIEBER: Well, I understand the answers.

MR. FREEMAN: All right. Let's go on with this slide then. The approach as Dan mentioned calculated full spectrum as required by Appendix K. I would point out that the DBA, which is a break of the recirculation section line, was a limiting case for this analysis.

Of course, small breaks and other selected breaks were evaluated, and per Appendix K, the limiting single failure was determined and it is the diesel generator failure.

And on page 30, I will just go over some of the results that I --

CHAIRMAN WALLIS: I guess I thought when I read the SER that the steam line break brought the drywell air and shell temperatures very close to the limits, and yet you said --

MR. HAEGER: This would not be for the LOCA analysis, but for peak clad temperature.

CHAIRMAN WALLIS: It is peak clad temperature that is the limiting analysis, but for the containment, it may be something else.

MR. HAEGER: That's correct.

CHAIRMAN WALLIS: Now, is this true that this upper bound PCT is exactly 1600 Fahrenheit? There must be some kind of a do-loop in this program.

MR. PAPPONE: Well, no. Well, actually there is a do-loop in the process, and that's where were if we do calculate a value above 1600 degrees, and we run out of fancy tricks to bring it back down to 1600 degrees, we have imposed a map of outer limit on the plant to keep the PCT below 1600 degrees.

In this case the calculated answer came out to be just below the 1600 degrees. What we do when we report these temperatures, we run the calculated number up to the next 10 degrees, because I don't want to say that I calculate that number to four significant factors.

CHAIRMAN WALLIS: Is this what determines the 2957 megawatt thermal?

MR. PAPPONE: No.

CHAIRMAN WALLIS: It's not?

MR. PAPPONE: Even if we had to impose a map of outer limit, and keep the fuel from going up to the 13, there is still margin in the core design world to absorb that without affecting the overall plant power uprate.

CHAIRMAN WALLIS: What is the upper bound PCT with the existing power level?

MR. FREEMAN: The upper bound PCT with the existing power level? I think I have it here.

MR. PAPPONE: Do you mean current licensing basis?

CHAIRMAN WALLIS: Yes, current licensing basis.

MR. FREEMAN: I believe for Quad Cities it is below 1600.

CHAIRMAN WALLIS: Well, it better be, yes, but what is it? It just seems high to me. When we were looking at Duane Arnold, I don't think that we had anything like such a high PCT. Why does it come so high in this case?

MR. PAPPONE: I believe there is a big difference between the Dresden and Quad plants and Duane Arnold. Duane Arnold is a very small vessel, and a very small core, and as a result, when they did the plant design, they used a smaller recirculation pipe.

Their recirculation pipe diameter is a 22 inch pipe, and Dresden and Quad Cities, and the rest of the BWR-3s and 4s, it is 28 inch pipe. So we are looking at for Duane Arnold, their break size is about 60 percent of the Dresden and Quad.

And if we looked at the Appendix K PCTs for the two plants, if we looked at Dresden's and Quad's 60 percent and Duane Arnold's hundred percent break size, they are fairly close.

CHAIRMAN WALLIS: Could you get that number that I was asking about, the current licensing basis upper bound PCT? I think it ought to be on one of your transparencies, but I am not sure it is.

MR. FREEMAN: We will get back to you on that. Okay. I think we are on page 30. What we are looking at here --

DR. SCHROCK: Excuse me, but you mentioned the question of accuracy on the PCT. There is also the question of accuracy on the power level of the plant. When you talk about 1957 or whatever the number is, plus or minus what on that?

MR. PAPPONE: The Appendix K calculations include the 2 percent core power, and also on the linear heat generation rate, peak linear heat generation rate, and that is also factored into the initial CPR that is used in the analysis.

DR. SCHROCK: No, what I am asking is how accurately do you know what the true thermal power is in the plant?

MR. PAPPONE: Well, it is within that two percent and --

MR. HAEGER: That is what 90 percent is for, is the uncertainty.

MR. PAPPONE: Right.

DR. SCHROCK: Well, that is a nominal value that was written into law a long time ago, but that isn't the true uncertainty in what you know to be the case. So what I am asking is what is your known accuracy of thermal power of the plant at any given instance?

DR. SIEBER: It is generally one percent, right? It comes out of a calimetric calculation, which used to be 2 percent, and that's why they put the 2 percent adder on to the core thermal power when it improved their ability to calculate that with improved flow instruments and temperatures.

MR. HAEGER: Right, and in fact many plants of course are taking small uprates because they are demonstrating their uncertainty --

DR. SCHROCK: They have reduced that uncertainty.

MR. HAEGER: Right.

DR. SIEBER: So the increment of margin that is in these calculations fully encloses the uncertainty of the calimetric calculation, at least in my opinion?

MR. HAEGER: Yes.

MR. FREEMAN: Okay. Page 30, these are

the results for the LOCA analysis; a peak clad temperature of 2110 degrees, which is less than the 5046 limit at 2200.

As Dan mentioned before, we talked a lot about the upper bound and I won't go into that anymore. The local oxidation was 6 percent, which is below the 17 percent limits for 5046.

Similarly, the core wide metal-water reaction was .1 percent, and it is well below the one percent limit, and of course the other 5046 criteria are met.

What this analysis showed that was done for the PSAR was that the effect of the power uprate on peak clad temperature was less than 10 degrees, and that is consistent with what GE has seen with other plants.

CHAIRMAN WALLIS: And so going back to my question before then, that means that on the current licensing basis, it is something like 50.90 something?

MR. FREEMAN: The current licensing basis does not have G.E. 14 fuel.

CHAIRMAN WALLIS: Like I was saying the EPU effect on PCT less than 10 degree fahrenheit, that presumably means upper bound PCTs is 1590.

MR. FREEMAN: Well, remember that we

stated earlier that this comparison was done strictly with G.E. 14, and the only change being the power uprate. That was for purposes of determining what the effect on PCT was of the increase in power.

So with the different methods and fuel types that the other plants currently have, that 10 degrees wouldn't apply that difference.

CHAIRMAN WALLIS: So the effect of fuel type is some other number of degrees fahrenheit, which we don't know here?

MR. FREEMAN: That is right.

CHAIRMAN WALLIS: But you are saying it is a small effect, and the message that you are trying to convey would seem to me is that EPU has small effect on PCT, and it may well be that the change in fuel type has a bigger effect than the EPU.

MR. HAEGER: That is precisely right.

MR. FREEMAN: That's right.

CHAIRMAN WALLIS: So we maybe ought to be discussing changes of fuel type, and that is another meeting altogether isn't it?

DR. SIEBER: Yes.

MR. FREEMAN: Yes.

MR. HAEGER: Yes, it is a separate license amendment request that we have before the Commission.

MR. FREEMAN: Okay. Moving on to page 31, I just want to apologize for this first bullet here. It says that the EPU effect on large break LOCA, and in the subbullet, really as you mentioned, sir, it is the G.E. 14 effect on the large break LOCA that motivated us to make a set point change in the swing bus delay timer.

And it really wasn't the power uprate. This was something that came from the use of G.E. 14 fuel, and I think that John mentioned that swing bus set point change already.

Whereas, the really big effect of the power uprate was on the small break LOCA and that was expected because of the higher decay heat values.

To summarize, before power uprate, we could afford to have one ADS value out of service, and we could get adequate depressurization for small breaks with four ADS valves.

However, at extended power uprate conditions, the analysis showed that we needed all five of the five ADS valves to operate in order to keep our upper bound PCTs below the 1600 degrees.

CHAIRMAN WALLIS: Does this only affect the risk?

MR. FREEMAN: I believe the impact upon

the risk will be discussed.

MR. HAEGER: We will be discussing that later.

MR. FREEMAN: Moving on to page 32. In conclusion, the emergency core cooling analysis methodology that is being used is conservative, as well as accepted by NRC.

The licensing basis PCT is a conservative way of calculating the result based on Appendix K models. In conclusion, after meeting all 5046 criteria, the emergency core cooling system performance is acceptable at the power uprate conditions.

And unless there are any other questions, I will introduce Tim Hanley, and he is going to go over the thermal-hydraulic stability.

CHAIRMAN WALLIS: Thank you very much.

MR. FREEMAN: You're welcome.

MR. HANLEY: I am Tim Hanley, and I am a senior reactor operator at the Quad City station. Jason Post of General Electric will be talking about the background methodology and analysis results, and then I will be covering operational aspects and conclusions.

CHAIRMAN WALLIS: I would like to ask

where we are on the presentation, and when I discussed with Exelon earlier, and we thought that we could have a break before the risk evaluation, but I noticed that we don't even seem to be about half-the-way there yet.

MR. HAEGER: What we thought that we would try to do is to get through the slide and all the analysis on that slide that stated the selected analyses.

CHAIRMAN WALLIS: Well, that will get us up to slide 70 something, and we are only to 34 now.

MR. HAEGER: Yes.

CHAIRMAN WALLIS: Can we do that in half-an-hour or 40 minutes, or something? We may have to break before we intended to break.

MR. HAEGER: And we can certainly work around whatever break time you want.

CHAIRMAN WALLIS: We are behind where we thought we would be.

MR. HAEGER: Yes.

MR. HANLEY: With that, I will turn it over to Jason Post of General Electric.

MR. POST: This is Jason Post. Dresden and Quad Cities are still operating with a BWR owners group interim corrective actions in place. They have -- the ICAs provide manual prevention and suppression, and they have been in operation for something over 10 years now with those in place.

They have not yet implemented the stability solution, and the stability solution that they have selected is Option 3, and Option 3 is a robust detect and suppress solution.

It requires some new hardware, the oscillation power range monitor, the OPRM. The OPRM has been installed, but it has not been operational yet, partly as a result of the Part 21 notification that G.E. issued earlier, this summary of the DVOM curve.

It is a robust detection algorithm that looks at LPRM signals, and determines when an oscillation occurs, and if the oscillations go up to a set number of oscillations in a row, called the OPRM count, and the amplitude reaches a certain set point, and that occurs within what is called the trip enabled region, then the OPRM will give an immediate SCRAM.

The next slide shows the ICA power flow map, with the ICA regions on them, and the key thing to note here is that the absolute power and absolute flow on the region boundaries has not changed.

They have been effectively rescaled so that you maintain the same absolute power and absolute flow on those boundaries. And just the way that the ICAs work, ICA in Region 1 is an immediate SCRAM region.

So if they were to get a flow run back into that region, there is an immediate manual SCRAM by the operator based upon simply being in that condition.

It is not -- it doesn't require determining that an isolation has occurred or anything. You get an immediate manual SCRAM. Region 2 is an immediate active region, and so if there is a run back into Region 2, the operator immediately inserts control rods or reduces core -- I'm sorry, increases core flow to exit that region.

Region 3 is called a controlled entry region, and under the Owners Group ICAs, you are allowed to enter that region if you have a stability control. For example, high core boiling boundary, which makes the core more stable.

And actually for Dresden and Quad Cities, they have just assumed or have included Region 3 as part of Region 2. So it makes the immediate exit region include both of those two regions.

CHAIRMAN WALLIS: And where does this Option 3 OPRM -- well, where does that fit in that map in terms of where it would SCRAM the reactor?

MR. HANLEY: That is shown on the next slide.

MR. POST: Let me just say that before we go to the next slide, to remember that the purpose of the ICAs is to prevent a reactor instability, and if one does occur, to have a manual SCRAM.

So it is drawn to be a limiting condition for where you would expect instability to occur.

CHAIRMAN WALLIS: I would expect the limits of his OPRM to be sort of inside the other boundaries.

MR. POST: It actually needs to be larger.

CHAIRMAN WALLIS: Larger?

MR. POST: Yes, it needs to be actually larger, and the reason is that because you want to make sure that it encompasses the area in which an instability could possibly occur.

CHAIRMAN WALLIS: Well, it encompasses it, but where you actually predict that it is likely to SCRAM the reactor is going to be a smaller region than where the operator would do it.

MR. POST: Yes.

CHAIRMAN WALLIS: Otherwise, it would always be done automatically.

MR. POST: That's correct.

CHAIRMAN WALLIS: So the actual -- what you expected to really happen is a fairly small region up in the corner there somewhere?

MR. POST: Yes. If you were to draw a line of constant decay ration, and if you could go to the next slide, please. The line of constant decay ratio would be somewhere in here.

CHAIRMAN WALLIS: It is way up in there. Right. Right.

MR. POST: And so that is the reason that you would expect oscillation would actually occur, and the OPRM and trip enabled region is defined to be well outside that region.

Again, for the trip enabled region, what we do is rescale the region boundary so that the absolute power and flow condition is maintained the same as the pre-uprate condition.

MR. BOEHNERT: When is the Option 3 going to be implemented?

MR. HANLEY: For Quad Cities and Dresden, they will implement that when the Part 21 notification has been resolved. Even plants that have already enabled that have gone back to the ICAs as a backup because it is non-conservative in some points. So as soon as the Part 21 issue is resolved, we will be trip enabling that system.

MR. POST: We are working with the BWR owners group on that, and it will probably be a year from now before it is actually -- the new subpoints are defined and it is ready to go.

Just moving on to the next page then, on the analysis results, we did a demonstration analysis for the demonstration EPU core on the OPRM setpoint simply to demonstrate that that calculation can be performed.

It is a cycle specific calculation and is done for each reload. The three elements of it are the hot bundle oscillation magnitude, and that depends upon the OPRM hardware. It is unaffected by EPU, MELLLA or G.E. 14.

It is strictly related to the LPRM configuration. The second part is the CPR change versus oscillation magnitude, and that is known as the DIVOM curve, and that is currently being revised by the owners group and G.E.

And the third part is the fuel specific CPR performance and limits which are addressed in the cycle-specific analysis. So we use all those elements to calculate what the OPRM set point is that provides safety limit protection for our reactor instability.

CHAIRMAN WALLIS: Well, that doesn't mean anything ot me at all. That is so full of acronyms and --

MR. POST: I'm sorry?

CHAIRMAN WALLIS: It didn't mean anything to me at all.

MR. POST: Well, I'm sorry.

CHAIRMAN WALLIS: I am not sure that you can make it clearer, but --

MR. POST: The OPRM is the oscillation power range monitor, and that is the new piece of hardware that you install specifically for Option 3.

CHAIRMAN WALLIS: Yes, I understand that.

MR. POST: And it has an amplitude sub-point, and so as the oscillation grows, it is a normalized value --

CHAIRMAN WALLIS: So that is on the reactor when the oscillation is big enough, and I understand that.

MR. POST: Yes.

CHAIRMAN WALLIS: But this business about the DIVOM curve.

MR. POST: DIVOM stands for delta CPR over initial CPR, versus oscillation magnitude. Hence the acronym, DIVOM. And that that is, is just how much does CPR change as a function of the fuel type.

What we found for the Part 21 when we did the Part 21 notification is that we had a generic curve, and we found out that we were a little bit overestimated in the generic applicability of that curve, and some specific factors were not fully addressed.

And so that resulted in the Part 21 notification, and we are developing what a new DIVOM curve should be. It is likely to be more plant and cycle specific, and factor in the specific parameters that affect that curve.

CHAIRMAN WALLIS: Well, if you are developing something, what has that got to do with application for a license now?

MR. HAEGER: We should probably go back and put this in perspective. We are going to start up using interim corrective actions, which is what we have been operating on for quite some time. And what we are trying to show in this slide, number 36, is that those interim corrective actions are applicable to the EPU power level.

And so really until this Part 21 issue is resolved, all this discussion about the OPRM system and these DIVOM curves is somewhat moot right now.

CHAIRMAN WALLIS: So does that mean that we have to move on? Now, this is the drunken man's walk; is that what that is?

MR. HANLEY: This is Tim Hanley again from Exelon. I am going to go over some operational considerations in discussing stability. What you see on the screen now is a picture of the power flow curve with the actual data from our last Unit 2 start up.

Two real operational concerns when talking about thermal hydraulic stability is, first, we want to avoid entering the regions of potential instability.

The real concern there is do you have enough room between your cavitation interlock line down here, which is the point at which you can increase your recirculation pump speed, and the bottom of the instability region. It is quite a bit of margin and not difficult to avoid that region during the start-up.

So that is the initial thing that we do, and the other consideration is what do you do if you enter one of the regions of instability, or potential instability inadvertently. The recirculation pump trip is evaporating at a high flow control line at low power.

There is a potential if you are operating at low power, low flow, loss of heat core heating can raise your power levels in those regions. So what do you do if you get there?

Jason mentioned that you have two options; inserting rods or increasing flow. Neither Dresden nor Quad Cities do we have increasing flow as an option. We always insert rods to decrease your flow control line.

So if the operator gets in the instability regions, they will monitor for instabilities, and what they are looking for is about a two times change in the noise level on the nuclear instrumentation -- SRMs, LPRMs, or ATRMs.

CHAIRMAN WALLIS: Well, there is nothing new about extended power about this.

MR. HANLEY: No, the only thing different -- and maybe since we are running behind we ought to keep it at that, but the only thing is that the potential instability region has expanded, because we are going to higher power.

And that area that comes off of the top there that kind of jets out is a new region of instability, and anything above our current 108 percent MELLLA region is new.

But the operator action flow won't change, nor will the OPRM change, when we install that. The region will just be expanded. So in conclusion, really we intend to start up with the ICAs in place that we have been operating under to implement the OPRM, and trip enable that when the Part 21 notification is completely settled and we can do that at the right opportunity.

We have rescaled the instability region, and so we have maintained our absolute levels for when we say we are entering the regions of potential instabilities, and that power uprate doesn't significantly affect how we would handle instabilities and our analysis is acceptable for power uprate with thermal-hydraulic stability. Any questions?

DR. SCHROCK: Maybe it is not important, but there is a curious effect here on this particular curve. It looks like you went up initially, and then you kind of dwelled for a while with rods in and out jingling a little bit. Is that the way they really do it?

MR. HANLEY: What you have got here -- you are talking about the 25 percent power level?

DR. SCHROCK: Forty percent, 40 percent

flow. Well, 30.

MR. HANLEY: And then it is about 25 or 30 percent power. WE do a lot of testing at that point, turbine testing, to verify all the turbine trip SCRAMs are all operational. So we do end up staying at that power level for a while during a start up.

It is also kind of jagged. I did get this, I believe, off of 15 minute increments of data. So that is why it tends to jump around. It is not a smooth curve because I didn't go to minute data.

But there are certain points where we spend more time due to required testing, and that in particular is the turbine testing.

DR. SCHROCK: Well, can the thermal power change by as much as this spread and data point shows without rod movement?

MR. HANLEY: Certainly.

CHAIRMAN WALLIS: And another question becomes how about --

MR. HANLEY: You are looking at flow though, right?

DR. SCHROCK: Well, flow is constant there, that group of points that I am looking at.

MR. HAEGER: I don't know that we can resolve them that clearly. The resolution isn't --

MR. HANLEY: You are looking just at that little glob of points in there?

DR. SCHROCK: Right. Yes. I am curious about why they would stop there, and it looks like there almost was in and out rod jiggling.

MR. HANLEY: What you really see is the -- you are getting -- depending on how long you stay there, you will begin to see some zenon build in, and so you may be pulling some rods. You may be adjusting recircs to compensate for that.

And like I said, during this start up, you may sit there for as much as eight hours doing your testing. So you will in fact be adjusting power at that point.

CHAIRMAN WALLIS: And then there is the jingling around at the hundred percent core flow, and one has to wonder how much jingling around you would do if you got to Point D in your uprate.

MR. HANLEY: Essentially, the way you can operate is that right now we have this band to operate in from our permanent 100 percent power out to the current 108 percent flow control line.

You operate on that line and adjust your recirc flow so that as your Zenon builds in, you will pull up to above the hundred percent flow control line. Zenon builds in your adjust recirc pumps to stay at that same power level.

The operating band we will have is actually between charlie and delta up here. So we will in fact be adjusting recirc flow at the higher power level or doing some power rod moves.

But we do have an operating region that we will be able to operate in so that the operators won't constantly be pulling control rods. They will be able to make slight adjustments in recirc flow and maintain full power.

CHAIRMAN WALLIS: But they still won't go over 2957 megawatts while they are doing that?

MR. HANLEY: No, we won't go over 2957 megawatts, and until we do modifications to the generator, it is unlikely that we will even get there.

We will actually be operating at a lower thermal power level because we will be limited by the capability of the generator.

MR. HAEGER: But I think the point is that you do calimetrics frequently to determine that you are not over the --

MR. HANLEY: Oh, certainly. We have a computer program that warns us if we get within five megawatts thermal of our rated thermal power. So the operators -- it runs on a -- every two minutes. So they will --

CHAIRMAN WALLIS: So it is definitely an upper bound. I mean, it is almost the impression that is being given that with the line through that orange jiggling around that you can jiggle around some set point or something. But actually the 2957, that is an upper bound isn't it?

MR. HANLEY: Well, if you draw crosses, and the top of the crosses are all very much the same place. So the actual data goes --

CHAIRMAN WALLIS: But the top of the crosses would be the 2957 if you ever get there.

MR. HANLEY: The middle of the cross.

MR. HAEGER: The middle of the cross.

CHAIRMAN WALLIS: The middle of the cross?

MR. POST: This is just a plot in XL.

MR. HANLEY: XL uses the point to put a cross at --

CHAIRMAN WALLIS: Okay. So it is not the line that is jiggling around. All right. Okay.

MR. HANLEY: Are there any other questions? With that, I will turn it back over to John Freeman and Jason to discuss ATWS.

MR. FREEMAN: Thanks, Tim. We are going

to talk about anticipated transient without SCRAM, and Jason is going to go over some of the methodology and assumptions.

CHAIRMAN WALLIS: I guess if you are using established methodology and assumptions we can skip to the results.

MR. FREEMAN: Surely.

MR. POST: That would be great. We did have one slide in here on ATWS instability, or actually two slides that I am prepared to cover. As we discussed previously when I was here for Duane Arnold, the two reports were NEDO-32047, which was the instability with no mitigation; and the 32164, had the instability with mitigation.

And our previous argument was that these generic studies were applicable to EPU and MELLLA, and there was some question about that. We since our last meeting, we have done a sensitivity study at a more limiting condition.

It is on a rod line actually above the MELLLA line. It is for an EPU condition, and it is for G.E. 14, and we have finished the no mitigation study, and it showed a less severe fuel response than we showed previously in the topical report with no mitigation.

In other words, it had less susceptibility to the extended dryout. It still could experience the extended dryout, but it took a little bit longer time to get the oscillation that put it into that condition.

So this confirms our expectation that the generic studies are valid for EPU and MELLLA, and confirms our expectation that the mitigation actions will be effective.

MR. FREEMAN: Okay. I would like to skip forward to page 47. These are the results for the five criteria and the limiting event. You can see over here the peak pressure of 1492 was below the acceptance criteria of 1500.

For the peak pool temperature, 201 was below this 202 degrees, which I think Mark may have mentioned was the TORUS attached piping limit that was analyzed for the LOCA.

It turns out -- and you probably remember that 281 was a structural limit for the suppression pool. But these results show that they are quite acceptable.

CHAIRMAN WALLIS: So you are again pushing the limit on pressure and temperature, the 1499 versus the 1500?

MR. FREEMAN: This 1499 is for transition core, and that included -- all these analyses were done with exactly the same inputs, and they have conservatisms built in.

So we would actually expect not to see a pressure like this. That is a conservative number.

CHAIRMAN WALLIS: But in terms of the criteria, you are just meeting the criteria.

MR. FREEMAN: Yes, sir. Of course, with the peak suppression pool temperature, it is very low, and the peak clad temperature is also very low, which has a negligible maximum local oxidation.

So in every case for ATWS, which is a beyond design basis event, this demonstrates that the 50.62 criteria can be met.

CHAIRMAN WALLIS: Doesn't this depend on valves opening and that sort of thing, and numbers of valves?

MR. FREEMAN: Yes.

CHAIRMAN WALLIS: And do you have to have more valves open in this case than before, or is that a different --

DR. SIEBER: It depends on the success criteria.

MR. FREEMAN: The ATWS analysis takes

credit for all the relief and safety valves as is typical for ATWS analysis.

MR. HAEGER: However, in the PRA study, we will be discussing --

CHAIRMAN WALLIS: Yes, you need one more valve to show the open.

MR. HAEGER: That's correct, and we will be talking about that.

MR. FREEMAN: Okay. With that, I would like to introduce Norm Hanley, and he is going to talk about the piping analysis.

CHAIRMAN WALLIS: With the ATWS, there is no requirement about operator reaction time in any of the ATWS regulations? It only appears in the PRA? There is nothing in the --

MR. POST: That's right. There is nothing in the regulation that specifies what the minimum or maximum operator action time is.

MR. N. HANLEY: Good afternoon. I am Norm Hanley, and I am the test manager for the piping evaluations that were performed for the power uprate for Quads and Dresden City.

I am going to present the methodology that was used to do the piping evaluation, and the actual impacts as a result of the EPU, and what the disposition and conclusion, and results of those evaluations that were performed.

The impact of the power uprate would be a change in the operating conditions, flow pressure and temperature in some of the fluid systems. In order to evaluate those systems, we reviewed the plant specific criteria to identify those parameter bases for the existing analysis.

We also as part of that review identified what the original code that was used, the analytical techniques that are used consistent with the license spaces, and also the code allowables.

The one exception to this was that we developed some criteria for the main steam piping consideration for dynamic loads due to a turbine stop valve, and I will address that in my presentation.

The conclusion in the initial review was that the majority of the piping systems were not impacted by the power uprate. The methodology that was employed to evaluate those systems that were impacted was a simple evaluation to identify what we call a change factor.

This looked at those parameters such as, for instance, in temperature, and if the temperature changed or the operating temperature would be higher for a power uprate, we simply looked at that delta change and compared it to the original analysis basis.

And if the comparison was the post-uprate versus pre-uprate was greater than 1.0 the ratio, then we would evaluate it further. Any ratio less than 1.0, the pre-uprate conditions were bounding, and no further analysis was required. For minor changes in the parameter --

CHAIRMAN WALLIS: There didn't go for pressure or anything like that. This didn't go for vessel pressure? This is just piping?

MR. N. HANLEY: This is piping, correct. Now, for minor changes, where the parameter change was between 1.0 and 1.05, again we considered the change acceptable.

And this is based on a conservatism in the original analysis, and some of these conservatisms where the initial inputs were conservative, the combination of loads, and incorporating loads that had been changed for the power uprates for seismic and dead weight, and also due to the inherent analytical techniques where there were gaps between piping and pipe supports were not included.

DR. SIEBER: Could I interpret this to say that if it was less than 5 percent, you didn't bother to find out where the conservatisms were, or whether it was conservative or not? You just said it was okay?

MR. N. HANLEY: Right. And that was based on experience with the piping systems and evaluations that we performed. We have done a number of power uprates where we have used this application.

MR. HAEGER: Realize that we are taking one parameter and if it changed five percent, there are all the other factors in the equation that we are seeing, there is conservatisms in there. So that is the basis of that.

MR. N. HANLEY: I think when I present the systems that were impacted and where we did further evaluations, we will see what -- I think we can support some of that argument there.

Where the change factors were greater than 1.05, we did take the next step, which was to look at that ratio. Let's say, for instance, the ratio is 1.1, and we would take that parameter and scale the existing peak load up, and see if it was within the acceptance criteria of the code allowables.

And gain if it was less than the code allowable acceptance criteria, the analysis was acceptable. Now, for cases where we couldn't do that, we did go back and reevaluate or reanalyze the piping system, and if needed we would do modifications.

The most notable change area was the temperature change due to the TORUS border temperature increase. The increase was approximately about a 20 degree temperature change for the pre-uprate and the post-uprate.

We did have to do reanalysis and modification for this system. However, the modifications were isolated primarily to piping supports, and in existing supports, we didn't have to add new supports.

Those changes resulted in like the replacing of U-bolts, the modification of the base plates, structural members, et cetera. The most noticeable change was that we did have to replace the rigid support with a snubber to reduce the piping loads on the flange connection.

So I think that type of analysis, rigorous analysis that we did there, a significant change resulted in that.

CHAIRMAN WALLIS: Were there any changes that ACRS needs to worry about? I mean, changing bolts and snubbers --

MR. N. HANLEY: These were minor

components to the existing supports, and just to show that their load capacity could be handled. The other significant change that we had was the main steam piping, where we incorporated the dynamic loads due to a turbine stop valve closure event.

The original design for Quads and Dresden is based on static load conditions outside containment, and a dynamic load condition inside containment for a safety relief valve-load. It did not include the turbine stop valve loads.

We evaluated the impact of the uprate on a turbine stop valve closure event, and since we do increase flow approximately 20 percent, we felt that it would be prudent for us to include the impact of that turbine stop valve closure event.

The evaluation identified that there was significant impact on the loading on the piping system outside containment, as well as the piping supports and drywell steel on the inside of the containment. The resulting evaluations required modifications.

CHAIRMAN WALLIS: That's because the closure is rapid; is that it?

MR. N. HANLEY: Yes, you have a very rapid hundred milliseconds or what it is, and so you have a significant on the change. So the approach that we took to the evaluation of that was that we wanted to make sure that for a turbine stop valve closure event itself that we didn't have a defamation of the piping system.

And also we looked at it coupled with a seismic, and we wanted to maintain structural integrity with a seismic event resulting from a turbine stop valve closure.

So the approach that we used was there would be no loss of structural integrity coupled with a seismic event.

DR. SIEBER: Well, you probably had a number of stop valve closure events in the history of these two units.

MR. N. HANLEY: Correct.

DR. SIEBER: Did you get damage?

MR. HAEGER: We have never seen damage.

CHAIRMAN WALLIS: Well, damage in terms of broken snubbers is a pretty minor thing compared with a safety --

MR. D. HANLEY: Right. There was no identified or reported when we did the evaluations. And again the piping system itself is -- that when we evaluated it and used conservative assumptions, then you would see the overload on the existing snubbers and supports.

So the result was that for the piping inside containment, the changes to the existing snubbers, we replaced some with higher capacity. We had to replace some members with higher members.

We also had to evaluate the drywell steel which was supporting -- taking a load from the supports. There we had to stiffen up the connections to take the increased load capacity.

The more significant changes were outside the containment, where the piping as I mentioned earlier was a static load design. We did have to add supports to take the lateral loads.

The main supports were -- well, we put in specially designed clamps with a box frame support at the main steam header to take the load, and we also had some lateral guides through the G-line wall at Dresden.

Quad Cities is similar, and we added some supports on the main steam lines, and these were more towards the main steam isolation valve in the tunnel. Again, we used the specially designed clamps with vertical and horizontal struts.

DR. SIEBER: You would have had to do that whether you were doing an uprate or not, right?

MR. HAEGER: As he said, they were not designed, originally designed for these dynamic loads.

DR. SIEBER: But they should have been, right? I guess in '68, which is the code of record, it was not in the code of record?

MR. HAEGER: That's correct.

CHAIRMAN WALLIS: Okay. Go to your conclusion.

MR. N. HANLEY: Yes. The conclusion is that the piping analysis demonstrated that the piping will meet acceptable requirements based on the -- consistent with the current licensing design basis.

CHAIRMAN WALLIS: But you have made them acceptable.

MR. N. HANLEY: We made them acceptable by doing modifications in the TORUS attached piping area, and also we incorporated the TSV loads, and made those analyses acceptable as well.

So the conclusion is that with the modifications and the reanalysis the piping systems will be adequate for an extended power uprate.

CHAIRMAN WALLIS: I am inclined to think that we should go to this next one, reactor and internals, and perhaps take a break after that.

MR. N. HANLEY: Actually, the next two fit real nicely together, and the second one can be short, but either way.

CHAIRMAN WALLIS: Well, let's see how we do. We are getting pretty close to the time where we are going to need a break. So, let's go ahead with reactor and internals.

MR. N. HANLEY: I would like to introduce Keith Moser now to discuss reactor and internals. Thank you.

MR. MOSER: Hello. My name is Keith Moser, and I am the reactor and internals program manager for Exelon, and I want I want to cover today is the scope and methods that we used to evaluate reactor and internals for power uprate conditions.

And the effect that EPU had on those components, and the modifications that John Nosko talked about earlier. And then finally conclusions.

Before we even started the power uprate project, Exelon and G.E. had developed an asset management strategy that took into account the industry information both from the domestic fleet and G.E.'s worldwide experience, and compared that against what we had done in our inspection program and operating history at Dresden and Quad.

And we came up with susceptibility rankings for each one of our components, and at that point what we did is that we came up with inspection strategies, mitigation strategies, and finally repair strategies if we needed them.

Now, for EPU, we again went component by component and one of the first ones that I wanted to go over was the fluence issue that was just talked about earlier.

Now, back in 1992 -- and, John, if you don't mind holding that up. Back in 1992, we wanted to take advantage of two co-case. The first one was co-case 640, and the next one was co-case 580.

And especially for Quad Cities and Dresden, it lowered our temperature at which we did hydro tests from about the 212 range by 50 degrees to 55 degrees.

And in doing this, we went back and looked at what fluence calculation was done in the past. The fluence calculation of record was for the Southwest Research, and what they had done is that hey had actually taken capsule pools from all four units and the capsule pools ranged after they scaled them up from 3.5 times 10 to the 17th neutrons per centimeter squared, all the way up to 5.1 times 10 to the 17th neutrons per centimeter squared.

In our evaluations, we took the most bounding and said this is where we are going to do our fluence calculations for the 1999 and 2000 PT curves.

What we have come to find out after we have done the neutron transport calculation for power uprate is the following. Yes, we are lower than what was previously put into the PT curves that was done by Southwest Research, but we have an explanation of why.

And I just got that from my expert, Gida Boo, and Sam Ranganath, and Brian Frue, and Betty Bramlin at G.E., and what we think has happened is when they modeled their capsule with their fluence methodology, they had it right up against the reactor wall.

They did not take into account about a little over one inch gap and that difference is where we think a lot of this can be explained. We also understand that the methodology at that point in time didn't require you to model the jet pump in the -- I'm sorry, the fast flux calculation.

Those type of things make it not an apples to apples comparison. Now, there are improvements in the methodology, and we are following the new NRC requirements, but we honestly think it is the spacing that they did not take into account for the capsule itself.

CHAIRMAN WALLIS: Now, tell me more about this. The capsule, it is an experiment? They put something in there?

MR. MOSER: That is a sample capsule that he put right in the belt line region.

CHAIRMAN WALLIS: So it is an experiment. You put something in.

MR. MOSER: It is on a bracket that is held away from the vessel walk and the distance like I was saying is a little bit over an inch. And if you don't model that, even though it is not that far, just the attenuation through that one inch gap, or 1.75 inch gap, is enough to make a significant difference.

MR. HAEGER: Let me make sure that we have the right perspective on this. When we applied for the EPU application, we used the G.E. improved fluence methodology that Keith is describing now. That calculation showed that our fluence is actually lower than what we had projected.

DR. SIEBER: So the bottom line is that you made out, right?

MR. HAEGER: Right, although -- well, let me finish though. At the time that we had our application in, that methodology was being reviewed by the NRC staff and had not yet been accepted.

CHAIRMAN WALLIS: But it has now been accepted?

MR. HAEGER: It has now been accepted, but there are some data that G.E. needs to collect over the next couple of years to do some verifications.

CHAIRMAN WALLIS: So is it true then that the actual fluence has probably gone up, but the calculated fluence has gone down?

MR. HAEGER: That's correct.

MR. MOSER: As you would expect.

MR. HAEGER: That's correct. But to put the final note on this, currently we are only asking the staff to approve our application for one cycle of operation with the current PT curves until this issue is further wrung out.

CHAIRMAN WALLIS: Will there be some future better measurements of fluence that we can rely on, rather than just calculation?

MR. MOSER: Actually, when G.E. did their methodology, they actually had samples from KKM that they had pulled, along with the overall sample program for the industry.

The sample population for BWRs isn't quite as big as it is for a PWR. As we go in time and we have more capsules that are being pulled, additional fluence calculations will be done, and we will make sure that the methodology is correct.

MR. BOEHNERT: Do you have samples at the Dresden and Quad Cities?

MR. MOSER: We have samples at Dresden and Quad Cities, but they are part of the integrated surveillance program that the BWRVIP is in the process of pursuing.

DR. SIEBER: And if you had an extended life license you would not have enough samples to take you to the end, right?

MR. MOSER: Say that again, sir?

DR. SIEBER: If you went for a 60 year license term, you wouldn't have enough samples.

MR. MOSER: Well, as an industry, we will have enough samples, but if we --

DR. SIEBER: You have to use the new dosimetry methods and you will be okay.

MR. MOSER: Yes.

DR. FORD: How much will the flux increase?

MR. MOSER: You know, I had Harmeta look into that for me a whole back, and the nice thing about Dresden and Quad, because they have got such a big vessel -- it is a 251 inch vessel, and my power out of the core is so much lower than a BWR-4 or a BWR-5, and a BWR-6 of the same size.

At this point in life, I am still below 5 times 10 to the 20th neutrons per centimeters squared at the eight-four. Now, we have the shroud repairs already in place, but it is nice when I inspect my vertical welds on the shroud.

DR. FORD: How much will be the flux be?

DR. SIEBER: Seventeen percent.

MR. MOSER: It is about 17 percent, but that is based on actually being somewhat lower than what we had projected with the Southwest Research methodology.

DR. FORD: Is it more than 17 percent because you are flattening the --

MR. MOSER: It will be somewhat less than that.

DR. SIEBER: Well, you don't run it at a hundred percent all the time either.

MR. HAEGER: Well, I guess the point is that we didn't do an apples to apples comparison pre-to-post EPU. We used the new fluence methodology that showed the decrease in the overall fluence, and not having done that apples to apples comparison, I don't think we can tell you.

The point is that it appears to have gone down from our previous count.

CHAIRMAN WALLIS: And what is the core shroud --

MR. MOSER: Actually, we have done Noble Chem, and so that projects the inside and the outside surface, and we have also done the shroud repair tie rods at all four units.

And again that takes care of all of the horizontal welds. So the inspection plan would be the vertical welds, which we are doing on a good basis.

CHAIRMAN WALLIS: I would guess that at the time of license renewal application that all of this is going to be revisited?

MR. MOSER: I am sure it will be.

MR. HAEGER: Yes.

MR. MOSER: You know, going on, the other areas that I wanted to discuss were related to flow induced vibration, and there is two issues; the increase in steam flow, and the increase in the dry flow. If you would switch to the next slide. The Dresden-2 --

DR. FORD: Hold on. How much will the

delta-P increase -- well, the --

MR. MOSER: I just read that, and I don't have that on the tip of my tongue, but we can look that up and give it back to you. It is not a very large increase from what I remember.

DR. FORD: So in the risk assessment, and not the PRA type assessment, but the numerical assessment, was there taken into account any potential cracking of the excess hole covers?

MR. MOSER: You know, for three out of our four units, we have actually replaced the access hoe cover, and so that risk somewhat goes away. And then we with the Noble Chem application, and the hydrogen injection that we are doing, we feel like we have an adequate basis for mitigating the shroud excess hole covers.

And for the one unit that we haven't replaced, we do inspections on a periodic basis per the SIL (phonetic) and the VIP, and while we are down there looking at the shroud support, we also look at the access hole cover. Did that answer your question?

CHAIRMAN WALLIS: Noble Chem is good.

MR. MOSER: Say that again?

CHAIRMAN WALLIS: Noble Chem is good.

MR. MOSER: Yes, I really like that

benefit. Again, for the dry flow, we had the benefit at Dresden of actually being the first BWR-3 plant, and so it was well instrumented across all the reactor or many of the reactor internals component.

And that included the jet pump and the steam separator. When they did the power uprate, they varied the levels of power, and they did single loop and double-loop operations, and then they were able to extrapolate that information as we went to power uprate conditions.

The analytical result of that work was that accept for the eight jet pump sensing lines, I really have no material endurance conditions that I am worried about for the components that I have analyzed.

Now, for the eight jet pump sensing lines, we are slightly increasing our RPM pumps leak speed by about 25 to 27 RPM. And we are so close. One thing that is somewhat unique about Dresden and Quad is we have six vain and pillar rather than a five vain and pillar at Peach Bottom and Limerick.

And when you do that, and just have a slight increase, you have eight jet pump sensing lines that are close to the natural frequency of the vain passing frequency.

We had two options. We could go down

there and do a ring test on these eight welds, or eight jet pump sensing lines. But the time that it took and the benefit of only being able to exclude maybe one or two of these, we decided to preemptively strike and install the clamp on all HF pump sensing lines, and in fact we will be doing that tomorrow at Dresden.

The dryer posed a different problem, and that is a steam flow problem, and just last year at Quad Cities when we were in our fall outage, we found higher than anticipated radiological issues on our secondary side.

And as a result of that, we immediately went into a route cause analysis, and my job was to investigate the dryer and the separators and see if there was enough degradation that would cause that moisture carryover to occur.

We put a camera on every square inch that we could get to with either a robot or a sub, and after we looked at this, we really had no degradation that would explain the moisture carryover.

In fact, they were in fairly pristine condition. So in a sense what happened is that we focused our route cause -- and if you will move on to the next slide, we focused our route cause on the core loading and how we operated the core.

And we found that there is some differentials in pressure as you get hot areas. And the steaming effect -- and this isn't the best picture, but essentially it would overcome the dryer in a certain location, and the dryer, because it didn't have a perforated plate, wasn't able to essentially have the flow dissipate across the dryer bank to make full utilization of the dryer.

So what we did is we used our Moss Landing test data that we had when we were originally designing these dryers, and we used computational fluid dynamics, and came up with a perforated plate, and pulled or looked at each one all the way across this.

And what that does is essentially flattens out the steam flow across the dryer bank and decrease the velocity going through the dryer so that it is able to perform its function.

CHAIRMAN WALLIS: And all of this has already been installed?

MR. MOSER: It is being installed as we speak. In fact, I need to go back and see how the progress is doing.

CHAIRMAN WALLIS: So we don't know yet if it works?

MR. MOSER: We will know in a couple -- about a week or two.

CHAIRMAN WALLIS: Now, we had the Duane Arnold presentation a couple of weeks ago, and they talked about the increase in frequency of loading vibration in the steam dryer, and that being transferred to the brackets on the steam dryer. How are we set for this one?

MR. MOSER: Actually, again, since we are installing the dryer modification, we do stiffen up the whole dryer assembly, but the Dresden and Quad dryers, because they were somewhat smaller and thicker than the models that preceded it, we have a much stiffer unit than say a Peach Bottom unit would be.

Now, we also -- if you will flip to the next slide, we wanted to cover that. You know, based on what we have done with our asset management, we do know that flow induced vibration is a concern.

And even though we modeled everything with a ANSI finite element program, 3-dimensional, and we made sure that both the dryer and the modification were well below their endurance limits, and there were no problems from that aspect, we know that modeling isn't always a perfect science.

And so what we have done is we have gone to the place to say what can we do from an asset management strategy, and what are the safety concerns. Can we address this by just going in and doing an inspection plan.

And one of the things that I want John to hold up -- and this isn't quite a BWR-3 unfortunately, but if you look at this dryer up here, we anticipate that you will get a fairly good sized chunk out of that if it actually cracked off.

And the places for it to go are really down, and so you get on top of the shroud head, and you may get down on the annulus, but it is almost impossible -- well, it is impossible in our estimation to get it into the fuel where you are really going to cause some damage.

The other thing that G.E. did for us is that in the unlikely case that we actually got part of the dryer to go out and get out to an MSIV line, they looked at what the MSIV closure would be, and came to the conclusion that it would not be an issue and that we would be able to close our MSIVs.

DR. FORD: The steam dryer support bracket, have you had experience with those cracking at Dresden or Quad Cities?

MR. MOSER: I have not had any experience with that at Dresden or Quad, but we do understand the Susquehanna event and we do understand that there is an Asian plant that just had an experience with that.

DR. FORD: Because it could potentially crack and you would have he whole dryer assemblies.

MR. MOSER: Well, one of the things that we do is we inspect those are a very periodic basis, and so far we have not had that problem, but we do understand that it is a potential issue, and when we set this, we will make sure that we don't have the rocking concerning that Susquehanna had. Any other questions?

DR. SCHROCK: You mentioned the Moss Landing data. That is an experiment that was done on a partial mock-up?

MR. MOSER: If I remember right, it was a full-scale mockup.

DR. SCHROCK: A full-scale?

MR. MOSER: Yes. This was back in time where Moss Landing --

MR. HAEGER: George is shaking his head no.

DR. SCHROCK: I didn't think it was.

MR. MOSER: Partial? Forgive me, partial.

Any other questions?

MR. HAEGER: Do you want to move on?

CHAIRMAN WALLIS: Well, I guess we should probably take a break. I am just thinking that it would be more reassuring to me if you had some sort of quantitative measure of success here, and you could show that on that scale the present system and the EPU were fitted somewhere so that we knew where we were, in terms of getting to some --

MR. MOSER: On the carry over?

CHAIRMAN WALLIS: Well, you had a discussion here about --

MR. HAEGER: I should point out that each of the reactor internal components was formally evaluated for stresses, and that those were all within acceptance.

CHAIRMAN WALLIS: And again it would be useful if you could show that you have made -- that it appears in the previous case there was criteria for acceptance, and here is the new case, and here is some criteria for acceptance, and see some numbers or matrix of comparisons.

It would be a little bit more reassuring to me than a discursive presentation.

MR. MOSER: Actually, we have a backup

slide. We did testing at the Peerless facility in Dallas to make sure that our perforated plate was going to work, and if you don't mind putting that up.

It is a two-pronged approach. We have to manage the core correctly, and we can't have a very hot spot.

MR. HAEGER: Are you talking about this one, Keith?

MR. MOSER: Yes.

MR. HAEGER: I think he is thinking though about -- you are thinking about the stresses?

CHAIRMAN WALLIS: Yes.

MR. HAEGER: And that is all in the material that we submitted to the NRC. I guess -- I apologize --

CHAIRMAN WALLIS: So we have to ask the staff about how they found this material acceptable, rather than see the material itself?

MR. MOSER: The actual stress loads on the dryer are very, very low from the analytical standpoint. They are well belong 10,000.

CHAIRMAN WALLIS: As long as it doesn't vibrate?

MR. MOSER: Yes, as long as it doesn't vibrate.

MR. HAEGER: And just to summarize what Keith said, we did the finite element modeling on the dryer, and that showed that within limits, and then we are following that up with the inspection program.

CHAIRMAN WALLIS: And you are doing that because the actual prediction of these vibrations is a little bit iffy, and so you have to keep monitoring and inspecting.

MR. MOSER: You know, going back to our asset management strategy, if there is industry experience, we want to keep on top of it, and that is why we have the inspection program.

CHAIRMAN WALLIS: I think this might be a good time to take a break. Can we be back by 3:30? We will take a break until 3:30.

(Whereupon, at 3:19 p.m., the meeting was recessed and resumed at 3:31 p.m.)

CHAIRMAN WALLIS: Back on the record.

MR. CROCKETT: Good afternoon. I am Harold Crockett, and I am the fact program manager with Exelon and Canterra. I would like to talk about our flow accelerated corrosion program this afternoon, and from time to time I will change that name to the acronym FAC.

What have we done to address uprates. I

am going to talk a little bit about susceptibility. It is interesting to note that there are no new systems susceptible to FAC as a result of the uprate.

And I am going to talk about the predictive methodology and the CHECWORKS analysis, and then we will go into the impact in a following slide, and show some of the details of that.

I will discuss our programmatic controls, and how our program works, and how do we do these things. And then I will summarize on a conclusion slide.

It is useful to start with susceptibility. This is a chemical degradation, and fact effects, carbon steel components in a steam cycle, where the temperature exceeds 200 degrees fahrenheit --

DR. KRESS: Do you add oxygen into your system?

MR. CROCKETT: Yes, sir. Dissolved oxygen is typically I think 30 ppb or greater typically. Dresden and Quad Cities use the standardized Exelon programs to predict, detect, and monitor for full accelerated corrosion.

And we use the EPRI guidelines that is really the basis for all domestic power plants, the ANSAC-202L document, and that is really a living document that is revised from time to time, and it has caused us to realize other activities at the plant that tie into our FAC program, notably our performance monitoring leaking valves, and those kinds of things that we turn into our program.

We go in and examine now some of the components, and the feed water heater shells have been a big issue in the past several years. So staying in touch as far as the industry has helped us a lot.

The code that we use for our predictive analysis is the EPRI CHECWORKS code, and that is how we evaluated our changes, and that's how we initially modeled the plant.

And then in the next slide, I will describe the EPU conditions and how they are bounded by the CHECWORKS parameter ranges. This slide addresses the changed input for the analysis.

Obviously, there are other inputs -- the typing diameter, and piping material, and geometry factors, that did not change. But here are some of them that were, and while I was preparing this slide, I called up some of my counterparts at the other utilities just to get a feel for what kind of values they were using in their plants.

Are we are hitting new ranges that we have not previously seen in the industry, and that was kind of my question, and I wanted to find out where they were.

So I am going to talk about four of these values right now; the steam rate, or really for the sake of this discussion the feed rate, and these numbers will vary because obviously you have seen some other charts that may talk about valves wide open, versus hundred percent power, and 115 percent power, and those kinds of issues.

But the numbers will be consistent in our analysis. The CHECWORKS program is really geared up to have a hundred-million pounds per hour, and obviously nobody is at that level.

The pre-uprate, we were at about 9-1/2 million pounds per hour, and we will be going to a little over 11-1/2 million pounds per hour. Now, BWRS, the ones that I talked to were as high at 14 million pounds per hour, and PWRs almost approaching 16 million pounds per hour.

Now, the velocity, obviously since your diameters change throughout the line in going through valves and such, and it is calculated in the program, and feedwater is pretty significant to people obviously.

Our old analysis, I think actually this philosophy was before the feed pumps, where we found 22 feet per second. With the new analysis, and with all the pumps going, we actually -- the highest value that I found was just over 23 feet per second.

And when I was talking to some of the other utilities, the numbers that I got feedback on were 24 feet per second and higher, and after I made up this slide, I talked to one that mentioned 27 feet per second, and these are not uprated conditions.

And so we are still within those values as well. Steam quality. We have talked a little bit about how we are maintaining the dryness of the steam, and the operating temperature, and some slight differences there.

We are going in the final feed water from 340 degrees to 356. Boiling water reactors we have seen 420 degrees, and PWRs, 446 degrees. And actually check codes have been used on fossil plants to slightly higher temperatures.

So the conclusion is that all of our values are really within where the industry is using the predictive analysis.

DR. SIEBER: A quick question on steam quality, do you have a way to measure it in your plant?

MR. HAEGER: Yes, we will do a carry over test with the steam dryers. At Braidwood, for instance, we did it with saviors.

DR. SIEBER: Well, you can't do that with BWR. It gets swamped out.

MR. DIETZ: My name is Jerry Dietz, and I put together the start up tests. We will be measuring the carryover with sodium from the reactor. It is trans-sodium that is naturally occurring, and it will take a sample in the hotwell and in the bottom of the condenser, and we will compare the two, and that ratio will give us the carry over.

DR. SIEBER: Do you do that on a regular basis or just as a part of the start up?

MR. DIETZ: Well, we have been doing it for almost a year now at the plants in regards to our modification, and then we will be doing it as we come up at each pipe toe in the test, verifying that it is correct.

There has been some new industry data, too, that there is some assumed values for carryover and some plants have much lower, and we are also factoring that into our test program.

DR. SIEBER: It seems to me that unless

you measure them on a periodic basis, degradation of the dryer elements would cause additional moisture, which accelerates flow, which accelerates corrosion.

MR. DIETZ: It will change with each set of rod patterns, and configuration of rods, and Tim may be able to tell us more about what Quad does.

MR. HANLEY: Several years ago -- this is Tim Hanley again. Several years ago, we found that we had a carryover issue at Quads City, Unit 1, and to monitor that and address this, we do on a periodic basis take samples in the hotwell and determine our carryover fraction.

I can't say for sure that they do that at Dresden, but I do know that we do that at Quad Cities as part of a routine chemistry sample.

DR. SIEBER: And routine is what, monthly or something like that?

MR. HANLEY: Yes, I believe it is done on a monthly basis.

DR. SIEBER: Thank you.

CHAIRMAN WALLIS: So your concern is corrosion in the steam line; is that what you are worried about?

DR. SIEBER: Yes.

DR. SIEBER: It screws up the carbon, too.

CHAIRMAN WALLIS: Yes, but this is a fact that they are talking about. Does CHECWORKS take account of flow patterns and two-face flow in the steam line?

MR. CROCKETT: In the steam line, the industry has regarded that as being so close to dry that it is essentially non-susceptible, and we do some analysis and testing. But at large the plants consider that to be dry, and not susceptible, the main steam line.

CHAIRMAN WALLIS: When do you worry about what steam for fact?

MR. CROCKETT: We have seen no indications in the industry of wall loss in the main steam lines.

CHAIRMAN WALLIS: So this is a non-issue?

MR. CROCKETT: Yes, that's correct, and as long as the steam does not get any worse, we do not see this as an issue.

MR. HAEGER: I guess the point is that he is asking why the --

CHAIRMAN WALLIS: Well, the 99.8 percent.

MR. HAEGER: I guess it was just to show a representative input to the fact.

CHAIRMAN WALLIS: Maybe we should move on.

MR. HAEGER: Yes, let's go on.

DR. FORD: Could I just check? All you are expecting is a one foot per second increase in the feed water line?

MR. CROCKETT: Well, the earlier higher velocity was before the feed pumps, and now we have three feed pumps going, and this higher velocity downstream of that in the final feed water, and so it is not that 5 or 6 percent throughout. It is just the way that it unfolded in here.

What is the impact on the wear rates, and another thing that I would like to bring up at this time is that we have been fairly proactive in material upgrades, and putting in chrome moly and materials that are not susceptible to flow accelerated corrosion, and that has given us a stronger position at all our plants.

And that is consistent with where the industry is, and we are trying to be proactive so that even the lines that we are doing now and that we are looking at, the scope as time goes on, we continue to reduce susceptible lines.

DR. FORD: So is that first one a chrome moly?

MR. CROCKETT: No, I am not talking about chrome moly in any of this. This is still facts suspectible lines. Once I make it chrome moly, it is not longer susceptible.

In the wear rates, we saw that we had some mild increases and some decreases, and when I first reviewed the data, the uprate data, I wanted to know what systems are doing what.

And so feed water obviously is a significant consequence, and the worst wear rate, or the highest absolute value was this 21 mils per year. There were some lines that had a higher percentage increase. Like the reactor water cleanup was at one mil per year, and that had a 33 percent increase, and so that was 1.3 mils per year.

CHAIRMAN WALLIS: These feed water line wear rates are actually measured as well as calculated?

MR. CROCKETT: Yes, sir. We go out with ultrasonic inspection --

CHAIRMAN WALLIS: When you measurement something like 19 mil per a year on your --

MR. CROCKETT: That is correct. That is correct.

DR. FORD: Now, you predict that it is going to go to 21 mils per year, and so presumably you have got some faith that the CHECWORKS is correct, and presumably in your fact management, you compare --

MR. CROCKETT: We always compare measured wear with predicted wear, and that allows you to refine your predictive analysis.

DR. FORD: And what would you sigma value be on that?

MR. CROCKETT: Well, what the EPRI guidelines are for the predictive analysis is to come up with a line correction factor that ranges from .5 to 2.5, and you get a confidence once your comparison is predictive to measure comes closely together.

If it does not come closely together, then you have to do more work, more inspections essentially.

DR. FORD: Is that a kind of fudge factor?

MR. CROCKETT: Well, it is a continual refinement of comparing it, yes. The line correction factor shows you how close you are.

DR. FORD: What I am trying to get at is that you have only got -- you are only predicting a two mils per year change.

MR. HAEGER: I think the next slide will answer what you are asking.

DR. FORD: I mean, does this mean anything?

MR. CROCKETT: That's why we don't believe it is a significant impact is what you are going to see in the conclusions.

MR. HAEGER: I think the next slide is really what he is talking about.

MR. CROCKETT: Okay. How do we deal with these changes? That's exactly right. On the lines that have increased wear rates, we have brought out next scheduled inspection closer. So if we are looking at R-17 right now, we are at our 17, and the next scheduled inspection was perhaps R-20, and we may have pulled that back to R-19.

MR. HAEGER: Meaning the refueling outage.

MR. CROCKETT: The refueling outage, yes, I'm sorry. And what we have the dash there for, the 1.1 factor of save, we increase our wear rates by 10 percent to account for uncertainties, variations, and to give us a little more conservatism.

And then as I mentioned earlier, we reinspect at least one cycle before we anticipate hitting the minimum wall thickness.

DR. FORD: Are you ever go to advance at a rate -- well, are you ever going to hit the minimum wall thickness?

MR. CROCKETT: Typically, we do not. Our

inspection program has been pretty successful. We don't walk on water. Sometimes things wear slightly faster, and that's why we incorporate the factor of safety.

DR. SIEBER: Well, CHECWORKS is really intended to tell you where to inspect.

MR. CROCKETT: That's correct.

DR. SIEBER: And the official number that you get is the number that comes off of the thickness gauge, the UT thickness gauge.

MR. CROCKETT: That's correct, yes, sir. And I would like to emphasize that in this next bullet that we are going to continue to perform inspections on susceptible lines, and compare them to the predictions, and we are going to continue to upgrade material.

When we see a line that is wearing, we are not going to get their management wear. It is not cost effective to me to keep going out and seeing something that is wearing, and uninsulating scrapple and then UT it.

After we do that several rounds, we are going to upgrade it with fact resistant material. And this was your comment earlier, the last bullet, that whenever appreciable wall loss occurs, we expand the sample, which means that we look upstream and downstream.

And we look in sister trains and that type of thing to make sure that we bounded the conditions of the wear. What we found is that we are bounded by industry experience, as well as our predictive codes.

The predictive analysis has been revised to determine potential impacts, and the inspections for the affected components have been accelerated where it is appropriate. Inspection data is incorporated into the program and it will continue to be incorporated.

In conclusion, the uprated conditions do not significantly affect flow accelerated corrosion at Dresden and Quad Cities.

DR. FORD: I have another question. If you don't have any platinum eroding --

MR. CROCKETT: Platinum in the feed water lines?

DR. FORD: Platinum from Noble Chem.

MR. HAEGER: Can anybody help us with that? Tim, did you hear the question?

MR. T. HANLEY: This is Tim Hanley again. The only part of the feed water lines would be up to the check valve to the vessel, the last check valve that was injected into the reactor water cleanup system. So it would only be that portion up to the last check valve.

MR. CROCKETT: Bill Burchill will be next.

MR. BURCHILL: Good afternoon. My name is Bill Burchill.

CHAIRMAN WALLIS: Welcome, Bill. I have to say that you are twice as old as the last time that I saw you.

MR. BURCHILL: Well, Grant, you have not changed at all. Graham and I did some great things about 25 years ago together, right? Or was it 30. Gosh, it has been a long time.

My name is Bill Burchill, and I am the Director of Risk Management for Exelon, and on my left is Larry Lee from Aaron Engineering. Larry did most of the risk evaluations that we are going to be talking about today. So hopefully he will get a chance to participate here.

On the next slide, I have outlined the topics that we are going to cover. Principally, there are two types of risk evaluations that we did; those that were quantitative, and both of a full quantification of the PRA mode; and also some limited individual special effects quantifications, and then the qualitative evaluations. And we will talk about both of those.

CHAIRMAN WALLIS: ACRS will tell you that there is no such thing as qualitative risk evaluations.

MR. BURCHILL: Yes, I have talked to George about that, and I am fully aware of his position. Thank you though for reminding me. The purpose of this risk evaluation -- and I want to start out by saying that we use generally accepted figures of merit for risk, which is CDF and LERF.

So those were applied and those are the figures of merit that as you know are called out in Regulatory Guide 1.174. We estimated the change in both CDF and in LERF using the full power internal events model, and that was the only model that we actually did a full quantification evaluation.

For other risk sources, external events, and the shut down state, we did qualitative evaluations, although with some numerical evaluation included.

The other important aspect of this was that it helped us to identify parts of the PRA that would be impacted EPU plant changes, and that will guide us then in updates to the PRA that will be used to properly represent the as built as operated plant when EPU conditions are implemented.

A brief outline and the methods. Of course, we had to identify the plant configuration changes that were due to EPU, and most of those had been outlined already today.

We looked at the hardware changes, and the procedure changes, operating condition changes, and set point changes. And in each case, we looked at what those changes would impact within the PRA evaluation models.

We used recently upgraded PRA models for both plants. These are not the models that were used for the IPE studies. They are significantly upgraded models, and both upgrades were completed in 1999.

And in both plants the upgraded PRAs have been reviewed by the BWR owners group certification peer review process. In each case, we identified the elements of the PRA that are affected, and I will go over those in somewhat more detail in the next slide.

The next two bullets will be the foundation for why you will see a number of differences between the numbers that I will show you, and those that you have seen earlier in the afternoon.

PRA by its very nature uses realistic

evaluation techniques. It compares with realistic success criteria, and limits, and therefore some of the numbers that I am going to speak to will be different from ones that you heard earlier, and if you wish, I will go back and explain some of those differences.

When we looked at the impact, we used sensitivity studies, and we did not do a full update of the PRA. We looked at individual parts of the PRA, and we changed those parts as we felt that they were appropriate to represent the impact of the EPU conditions.

And then finally as a benchmark, we compared the results to the guidance for risk significance given in Reg. Guide 1.174. As you know, this is not a risk informed submitted, but we felt that that guidance was a useful comparison for a benchmark.

Now, we reviewed each of the PRA technical elements, and in particular we looked at initiating a bench, and we looked at whether there were any new initiating events, or whether there were any changes to existing initiating events in the PRA.

We looked at success criteria. For example, changes due to EPU and boil down times, and reactor pressure vessel inventory makeup, rates, pool heat load, RPV, over pressure protection and depressurization.

Every one of those as you can readily imagine mechanistically can impact what the success criteria are. So in each case, we did look at that, and either evaluate that it was insignificantly, or if we saw that there was a significant impact, actually put it in the PRA and see what influence it had.

We looked at all of the system changes that were made, both hardware and set point, and we looked for whether or not those system changes produced any new scenarios, and also whether it impacted the failure rates that were assumed within the PRA.

Similarly then we looked at data to see whether or not the increased duty on some of the equipment would impact some of the PRA reliability data.

Probably the biggest area that was identified, and I think you can readily imagine is in the operator response area. There are a large number of operator responses in a PRA. Failures by the operator generally contribute to on the order of 30 to 50 percent of the core damage frequency in a PRA.

So it is a very significant contributor. So we evaluated in each case the most significant operator actions in the PRAs. In both cases, that was on the order of two dozen actions which had a FSAR vastly greater than .005 or a raw greater than one.

Those are the typical values used to determine risk significance, or I'm sorry, a raw greater than two. And we also looked at time critical operator actions.

But we looked at structural responses, which are particularly important of course in containment response. We looked at quantification, and in that regard, you look at whether or not the risk profile changes, which gives you an indication of whether or not there has been anything new introduced.

We looked at individual cut sets, and we also looked at whether or not our truncation was adequate at the uprate conditions. And then the embodiment of all of that shows up in looking at the event tree sequences.

We did do a number of additional thermal hydraulic calculations, many of them with a map code, to evaluate the impact of the changes due to time to boil down, and times to core damage.

The next two slides outline in general the qualitative impact on the PRA, and I will follow that with then an explicit evaluation summary of the quantitative impacts.

I would like to preface this by saying that we didn't find any new accident types, which is of course no real surprise, and we found no significant changes to the existing accident scenarios in the PRA.

We found no changes in system dependencies, and of course that is a very important aspect of plant modeling. And we found no vulnerabilities that were produced by the PRA, or by the EPU rather.

We did find limited logic structure changes relative to operator actions, and then of course changes in the human error probability of some of the actions.

Now, the things that we did find under the operating condition area was the decreased decay heat load reduces times to boil down pool temperature limits and times to core damage itself. This obviously puts more limit on --

CHAIRMAN WALLIS: Hold, please. I am trying to figure out the grammar here. Reduces. I thought that this read that it reduces pool temperature limits and reduces core damage, and reduces qualifying evidently came after.

MR. BURCHILL: It reduces the time to, yes.

CHAIRMAN WALLIS: It doesn't reduce time to pull temperatures limits, or I guess it does.

MR. BURCHILL: Times to is qualifying everything after it, and the impact there is primarily as you can imagine on the operator action times, the response times.

Now, recognizing that, and the fact also is that most of the operator response times of interest are in a fairly long time frame, and so you are talking mostly response times that are greater than 20 or 30 minutes.

So the ultimate quantitative impact is generally fairly small. Increased ATWS power levels and peak pressures; again, more limiting success criteria, and reduced time for operator action.

And then again the increased required number of feedwater and condensate pumps. This has the potential for increasing the turbine trip initiating event frequency, because of the fact that with all of the pumps operating, any individual pump tripping off may have the potential for producing a turbine trip.

CHAIRMAN WALLIS: Increased ATWS power levels and peak pressures; isn't that controlled by valves opening, and it actually increases the peak pressure?

MR. HAEGER: And that is what that second bullet is saying; more limiting success criteria for ATWS, in terms of the number of valves.

CHAIRMAN WALLIS: Pressure controlled by the valves opening?

MR. HAEGER: Yes. And one of the success criteria is how many valves open.

CHAIRMAN WALLIS: I thought the peak pressure stayed the same, but more valves had to open in order to keep it the same. And how you are actually saying the peak pressure itself does go up?

MR. BURCHILL: In a realistic calculation, the peak pressure will go up and you will need more valves to stay below the limit. So both occur.

CHAIRMAN WALLIS: Because of the set points.

MR. BURCHILL: Right. Now, on the last point that I made here, because this is a fairly significant one, this is the only place where we saw a potential increase in an initiating event frequency, the evaluations that were done were done early before a completion of the recirc runback feature that was discussed earlier, and so they do not take any credit for that recirc runback.

We believe that with the recirc runback that there would be no increase in initiating event frequency, except in the case of a recirc runback failure, simply because of the fact that you would not have the single pump tripping leading to a turbine trip.

And in the next slide, we talk about the system effects, and specifically to the point that we were just talking about, an over pressure protection.

We find that an increased number of reactor safety and relief valves is required for over pressure protection. As you know on these plants, there are 13 valves available. The current success criteria is 11 valves to hold the pressure.

And in the case of the EPU, we found that would increase to 12 valves. The increased number of reactor relief valves required for emergency depressurization on any of these plants, there are five valves, and currently only one valve is required for emergency depressurization.

Under the EPU conditions, we judge that

that would go up to two valves. So this modifies the success criteria for transient small and medium LOCAs, and again for ATWS.

And we looked a numerous BOP and set point changes, as well as logic changes, which produced negligible risk, and most all of these changes were described by John Nosko at the beginning of this discussion.

I want to note in particular that the electrical load fast transfer that I think was mentioned earlier, and talked about by Mr. Sieber, that feature, and the addition of the condensate pump trip on LOCA, were both found to have a negligible impact.

Their impact is conceptually on an increased loop frequency, loss of off-site power and initiating event frequency. But when we went through the quantification, we found that in fact the increase was extremely small compared to the existing loop frequency assumed in the model.

DR. SIEBER: I don't know whether you are going to get to this later or not, but in the success criteria for valves and the way you modeled it, it seems that the overriding failure mechanism was common cause?

MR. BURCHILL: True.

DR. SIEBER: And could you explain how you treated common cause failures in your analysis?

MR. BURCHILL: Certainly. You want to go through some of the specifics in each case?

DR. SIEBER: Yes. It doesn't have to be real detailed, but I would like to understand it.

MR. LEE: Okay. This is Larry Lee from Aaron. So initially the success criteria was one of five valves for depressurization. So it would be a common cause of all five valves failing to open.

So now that the success criteria is 2 of 5, you would need common cause failure of any four of the valves. So the common cause failure rate increased by approximately a factor of two from around 1-E minus 4, up to about 2-E minus 4.

DR. SIEBER: And so you came to your detailed analysis using beta factors?

MR. LEE: Yes.

MR. BURCHILL: Okay. The next slide is Slide 77, and if we can have that up. This is the slide that we will probably spend most of our time on, or at least proportionately on slides, and I will even try to time this one.

Mention was made earlier that the Dresden and Quad plants are similar, but not identical. And this of course is true in the PRA representation. Some of the key features, the Dresden plant has an isolation condenser, and it has a dedicated shut down, decayed heat removal system.

In the Quad plant, we have a dedicated high pressure safe shutdown make up pump. We have no isolation condenser. There are a number of differences in the electrical area, and each of those are represented in the PRA, and then lead to a difference being found in the quantitative importance of either those systems or their failure.

We looked at about 15 different model changes that were quantified with the full PRA sensitivity studies, and we looked at a number of other model changes, where we looked specifically, for example, at just the change in the human error probability.

And we found that it was negligible, and then did not include that in the full model quantification. This table then in some detail gives you the most important ones that we found, in terms of carrying through to actually having some significance in the eventual impact on CDF.

And by significance, we looked at anything that was on the order of one percent or more as being significant. And what you will see is that there are three groups.

One is the impact on the turbine trip initiating event frequency, which is on the first line, and as I mentioned that is the only initiating event frequency that we found impacted.

The next five are in the human error or the human operation or action category. And then the last is in the success criteria category, the one that we have already talked about with respect to depressurization.

I will briefly speak to each of these, and if I am going into too much detail, please don't hesitate to stop me. I am sure that everyone would like to get on to something else.

In the turbine trip initiating event frequency, you will see that there is a range represented there for the PRA model change, and the size of that range is not indicative of any significant difference between the plants.

It is indicative of a difference in the modeling technique that was used to derive the numbers. In the Quad Cities case, we used a simplified fault tree of a fairly conservative nature, and that led to the higher number that you see there, the 18 percent change.

I'm sorry, that was the 2-1/2 percent change. In the Dresden case, we looked at actual turbine trip data from a seven year period, and then we made an evaluation of whether each one of those trips would have actually been aggravated by the EPU, or in fact would have occurred under EPU conditions.

And so what that led to was the 18 percent change that you see. In quantitative terms, Quad Cities initiating event frequency changed from 2 to 2.05 per year, and Dresden's changed from 1.14 to 1.35 per year.

Now, those changes, when put into the PRA model, then lead to the CDF contribution increase of the one or less than one to 2-1/2 percent.

Again, I would remind you that if we had accounted for the recirc pump run back feature that that would essentially be zero. It would be negligible.

Each of the five operator actions has to do with times being reduced somewhat for the operator to take action. In most cases, we simply scaled these times relative to heat load because most of them are driven by heat load.

The times that we are talking about in

general are in the 20 to 25 minute range being reduced to on the order of 16 to 20 minutes. So we are talking about relatively long action times. We are talking about more or less a 20 percent decrease in each case.

DR. KRESS: But what is the time on Item 4 on that one?

MR. LEE: Line 4?

DR. KRESS: SPC during ATWS.

MR. LEE: Right. There are two time frames there. There is an early time frame, and I think we talked earlier -- I don't remember if we talked the time frame earlier. On the licensing analysis, it is shorter.

But in the PRA analysis, which is a realistic analysis, the short time to act is 6 minutes. And we looked at the thermal hydraulic basis of that and found that that did not change under EPU conditions. For the longer time to act, that went from 20 down to 16 minutes.

MR. HAEGER: That was line 3, I think, and so --

MR. BURCHILL: He said line 4, but then he said SLCS. So, I think he was talking about SLCS.

DR. KRESS: It was SLCS that I was talking about.

DR. SIEBER: Do you have another one that was down as long as 10 minutes, I guess.

MR. BURCHILL: Yes, it went from 10 to 8-1/2 minutes. I think it had to do with ADS.

DR. SIEBER: ADS during --

MR. BURCHILL: And what happened was that when we evaluated that, that changed and that was well less than one percent impact. That's why you don't see it on this chart.

DR. SIEBER: All right.

MR. BURCHILL: Now, one other thing to point out, that on the second line there is a range of zero to 1.4, and on the fourth through fifth line, it is zero to one. Those zeros are somewhat artificial because of the fact that what we found that the actual HEP that was in the PRA model in each case was a fairly conservative value.

So that conservatism in and of itself masked any impact. However, looking at the other PRA for a very similar plant, we found more realistic values, and we were able to then vary them to give the range of influence that you see there.

On the last line, the one point that I would like to make there, because it is a unique one, is that the inadvertent opening of the relief valve, or a stuck open relief valve sequences, and the increased common cause failure probability that we just talked about, is the only place where we actually found a modified sequence to occur.

If you think about this pre-EPU, we only had one valve required for the depressurization, and therefore if we had that one valve open through an IORV or an SOFV, we would depressurize.

With two valves being required for depressurization, even though you have one valve inadvertently opening or stuck, you still have to depressurize. So there is a new branch that gets added to that event tree to accommodate the fact that the second valve has to be opened.

And Larry has already described the change in common cause. I would also note that you don't see on this chart an impact due to the success criteria change on the overpressurization. That was found to be very small, well less than one percent.

We also looked then at the level two risk. In other words, the containment risk influence. We used a methodology that is described in NEUREG/CR-6595.

This is a fairly conservative methodology, and it has been reviewed and endorsed by NRC for risk-informed submittals. But it does lead to fairly conservative results as we will see in a moment.

There are two groupings of impact that we want to consider here. The first three bullets discuss the disposition of the end states from the level one analysis. And that is actually the methodology that is described in the NEUREG/CR-6595.

It involves a binning technique where a binning of the source terms, or fraction of radionuclide inventory is used. That is unaffected by the EPU. The actual release frequency in each bin is proportional to the level one result.

But the impact of EPU will be specific to each bin, depending upon the distribution. The second three bullets are the risk impact on the containment response itself. So there are in fact been containment responsive ventries that could attach then to the actually end states of each of the level one bins if you will.

There were very minor changes in the Level 2 HEPs, and very minor changes in accident progression timing, and decay heat load, and a negligible change in the timing that we found to containment failure, on the order of several minutes over a several hour period.

So what we found then was that the EPU has a very minor impact on the Level 2 portion of this analysis, but the overall impact on LERF is essentially proportional to or similar to Level 1.

The quantification results then are given in the next slide. The base PRA results are given in the first group there under the first bullet. Again, these plants are similar, but not identical, and for the reasons that I cited before, as well as others, we do not have identical CDF or LERF based values, although I would point out that these are pretty darn close.

CHAIRMAN WALLIS: Why is LERF so close to CDF?

MR. BURCHILL: Because of the conservatism in the 6595. This is about --

CHAIRMAN WALLIS: You might not have the containment.

MR. BURCHILL: You usually expect it to be on the order of 10 to 20 percent. So this is very conservative. To be frank with you, it becomes an economic decision. If we can use it and still meet regulatory requirements, we will.

And at the time that we find that that

won't work, we will go to something more extensive. That will probably be during license renewal. Now, the impact of EPU is quite small on both CDF and LERF, and in fact if you look at the impact on CDF, for both plants, adding up all the little pieces, even though there are somewhat differences in the mix, they both come out to be an impacted 2.4 times 10 to the minus 7 per year, which I think you have seen in the submittals or in the RAI responses.

The difference in percent then is entirely due to difference in base value. It is not a difference in the absolute impact. In the terms of LERF, there is a little bit of a difference. Quad Cities has a face value of 1.3 times 10 to the 7th, and Dresden is 1.4 times 10 to the 7th.

I would note that these results, percentage wise, are very similar to what has been seen in other evaluations for other plants. The last point is that we did compare these results to the guidelines for risk significance in Reg Guide 1.174.

Just to refresh, Reg Guide 1.174 for the magnitude of CDF and LERF for these plants, differentiates between small risk and very small risk at 10 to the minus 6th for CDF changes, and 10 to the minus 7th for LERF changes.

So if you compare what we found on -- well, I think I said that wrong. Yes, 10 to the minus 6 on CDF, and 10 to the minus 7th on LERF. So the change that we found in CDF in both cases is a about a quarter of the way up to the threshold between very small risk and small.

And so we conclude that we are well below any concern here, and that the CDF is well within the very small risk region. Relative to LERF, we are just barely over the line to small risk, and considering the conservatism that we just talked about if we were to do that realistically, it seems pretty obvious that we would be in the very small risk change arena.

An area of considerable concern, and if Dr. Apostolakis were here, we would have some considerable discussion on are the uncertainties. We looked at the uncertainty and the base full power internal events PRAs using standard techniques.

We looked at risk importance measures, and we found that the distribution of them and their general magnitudes were normal. We looked at sensitivity studies and we looked at the pertinence of the various equipment.

We looked at failure rates, and we looked at operator actions using ranges of 5 to 10 times the human error probabilities, and we compared the results to what is reported in NUREG-1150.

But we found no uncertainty sources beyond those that are identified in NUREG-1150, but we did not do an explicit quantitative uncertainty analysis of this EPU risk evaluation.

However, if we were to take the uncertainty range cited by 1150, which it appears we would agree with, the range there is cited to be on the order of 5 to 6 times the calculated point value.

So if we were to apply that to the delta-CDF that we have calculated, we would be just at the borderline or slightly above the range, the threshold between very small and small risk.

And if we were to apply it to the delta-LERF, we would still be within the small risk range, even considering the conservatism. So we think that adequately covers the question of uncertainty.

Now, we looked at four different areas, and qualitatively the present PRA does not explicitly include internal flooding in the quantification.

However, in the IPE studies, we did look at flooding, and it was found to be a very small risk contributor, estimated to be on the order of one percent of the base CDF of the plants.

Therefore, although the dominant full power internal event model changes would apply, because they would be applied to such a small fraction of the CDF, they are essentially negligible.

We found no new initiating events increased during initiating event frequencies, and so the bottom line conclusion is that the internal flood is not impacted by the EPU.

Relative to external events, the IPEEE for both plants concluded that external events other than fire or seismic do not pose any significant risk of severe accidents.

So what we focused on in this study then was the fire and the seismic area. The fire evaluation or both plants used recently revised fire PRAs in the 1999 to 2000 time frame, and we completely redid the fire PRAs for both plants, and resubmitted the associated parts of their IPEEEs.

We did not do a full requantification. Instead, we looked at the dominant scenarios in each of these fire PRAs, and qualitatively evaluated whether or not they would be impacted by EPU conditions.

In both cases, we examined the top 10 scenarios. In Dresden, the dominance scenario is a control room exposure fire, and it contributes about 40 percent of the fire CDF. In Quad Cities, the control room fire is about 10 percent.

Basically, in both cases the control room scenarios were evaluated with a very conservative conditional core damage probability of about .5, and so any impact of EPU would really be subsumed in that, and that is not very satisfying.

So what we did then was that we looked at what were the actual operator actions that that .5 represents, and we said how much time does he have to take those actions.

And then again looking at what would be the actual impact. And, for example, if you take Dresden, and the time to go out and initiate the isolation condenser for a fire scenario, and the dominant fire scenario that we are talking about, is about 35 minutes.

We estimated that would shrink to about 33, and then the time beyond that to restore makeup to the isolation condenser would also change by the type of figure that I mentioned previously, the 20 to 16 minutes.

So again a very small impact. The other major type of scenario is decay heat removal scenario, and the dominant scenario at Quad is a fire in the reactor feed pump area, and that contributes about 25 percent and leads to a loss of decay heat removal.

And that Dresden has about 20 percent of its various scenarios tied up in to decay heat removal sequences. Again, the impact on those sequences through the human error probabilities is very small, because the operator has very long times to respond in each one of these cases, on the order of 30 minutes.

CHAIRMAN WALLIS: Are these fire risks -- the CDF contribution is bigger than the full power CDF that you were talking about?

MR. BURCHILL: Right. It is about an order of magnitude higher mainly driven --

CHAIRMAN WALLIS: So we were worrying about some increases of five percent in something which is considerably smaller than this fire risk?

MR. BURCHILL: Right. The impact of the way that we model fire ignition frequencies, most people who do fire PRAs believes is what drives results of this type. This is not an unusual comparison between fully quantified fire risk and other internal events.

So I think it is fair to say that it is now a significant debate within the PRA community as to how to even compare these two. In most cases, we don't. We simply address them one at a time, because we know that the fire risk evaluation techniques are so conservative.

Other changes in the success criteria -- for example, the number of relief valves, has a negligible impact, and the ATWS related changes that we have talked about would be negligible due to the low probability of a fire induced ATWS.

We didn't find any new fire initiating events or increased fire initiating event frequencies, meaning new fire ignition frequencies. So again we felt that the EPU had a negligible impact on fire risk.

The seismic area was the third area of qualitative evaluation, and we do not have seismic PRAs for either one of these plants. In both cases the IPEEE requirements were satisfied using the EPRI seismic margin analysis method.

So we looked at those seismic margin analyses to determine whether or not there was anything in there that would be significantly impacted by the increase in power.

We found no impact on the seismic qualifications of the structure systems and components, and I think that is no surprise. We did look at the potential impact of increased stored energy on blow down loads, and we found that that was also a very small -- and which as you heard earlier -- the same conclusion as the deterministic analysis of the containment that Mark Kluge described very early in the afternoon.

We also looked at the impact on ultimate heat sink issues, which I think we are going to defer and discuss with you in the open issues area. I will just forecast that the result there was determined to be minor, but we will describe to you under that discussion, which requires really understanding the scenarios.

But we will describe to you how we quantitatively evaluated that using a scenario specific event tree.

CHAIRMAN WALLIS: So you are going to come back to that?

MR. BURCHILL: We are going to come back to that.

CHAIRMAN WALLIS: And the staff has some issues with that.

MR. BURCHILL: Right, the staff has some issues, and we are going to try to address those under our open issues discussion.

DR. SIEBER: I do have one question which you can probably answer in one sentence. I think it is Dresden ultimate heat sink operation. And it talks about using the canal to run through the parking lot there.

MR. BURCHILL: Yes.

DR. SIEBER: And then having time to refill it by pumping into it?

MR. BURCHILL: Yes.

DR. SIEBER: And then the safety evaluation talks about portal pumps. Are those pumps at your site at Dresden, and they can be wheeled out and operated?

MR. KLUGE: This is Mark Kluge. Those pumps are not on-site, but given the large amount of time available to stage those pumps, we have standing contracts with pump vendors, and our belief and our procedural basis is that we can obtain those pumps in ample time to refuel the UHS.

MR. BURCHILL: Not to preempt Mark's later presentation, but we are talking about days.

DR. SIEBER: I'll check that.

MR. BURCHILL: Yes, he will talk about that, but we are talking about days, just so we don't leave that on the table. So our conclusion again is that EPU has a very minor impact on seismic risk, but the particular place where it may have impact is going to be described later.

Lastly, in the qualitative area, we did look at shutdown risk. Again, we do not have shutdown PRAs for these two plants. However, it is easy to recognize that the dominant full power internal events PRA model changes in most cases do not apply, either because the times are different or because the equipment requirements are different.

We did not see any new initiating events or increased initiating event frequencies. It is obvious, of course, that the higher decay heat load will increase boil down times. And then we will have some minor impact on human error probabilities.

Now, recognize that most of the operator actions during a shutdown are of a recovery nature. They are recovering, for example, a lost decay heat removal system, or something of that type. And they mostly occur in the many minutes to hours time frames.

So it is not surprising that there would not be much of an impact. There is one place where there is an impact, and that is that there is a number of backup systems that are available for decay heat removal.

Some of these are low capacity systems, and they are not able to be used until the decay heat load drops sufficiently so that their heat removal capability is sufficient to match decay heat.

And so there is a somewhat shortened time for that to occur, but again we are talking about something out in days, and a shortening of a few days on that. So, a very minor impact there.

And the last thing is that we do manage our risk during shutdown using configuration risk management techniques. We use a commercial tool available that was developed by EPRI called ORAM, and I am sure that you have heard of that.

It is a defense in depth monitor, and there is no impact whatsoever of EPU on the use of that tool, and how it would be applied during an outage. So again we conclude that EPU has a negligible impact on shutdown risks.

So, I will summarize, and I note, Dr. Wallace, that you are getting tired of me saying over and over again negligible, small, minor, but that is what we found.

The risk impact was evaluated using standard PRA methods, and with deference to George, both quantitative and qualitative. The quantified impact was a small percentage of the current plant risk, and it is well within the criteria that the Reg Guide 1.174 specifies for either a very small or small risk impact.

DR. KRESS: Let me ask you a question about that.

MR. BURCHILL: Yes.

DR. KRESS: I seem to recall in Reg Guide 1.174 that they had an absolute limit on LERF of 1 times 10 to the minus 5?

MR. BURCHILL: What you are thinking of is in Reg Guide 1.177. There is an absolute limit of 5 times 10 to the minus 7th on delta risk, which is essentially a CDP, or what is now being called an ICCDP, which is a change in risk, multiplied by the time over which that risk exists. I think that is the only place that there is an absolute.

DR. KRESS: I thought that the 1.174 was divided up into regions.

MR. BURCHILL: Yes, there is.

DR. KRESS: And if you were in a region above --

MR. BURCHILL: Oh, that's true. If your base is too high, you're right.

DR. KRESS: Too high, and that value for -- well --

MR. HAEGER: If I could reply to that.

MR. BURCHILL: Which one are you putting up?

MR. HAEGER: The Quad CDF impact.

MR. BURCHILL: Yes, that's fine. If you want to turn it on.

MR. HAEGER: Do you want to do LERF or CDF?

DR. KRESS: LERF.

MR. HAEGER: You can do it either way.

DR. KRESS: Yes, they are almost the same, but we will do the LERF. Now, the dark region is the region where no changes are allowed.

MR. HAEGER: Unacceptable, right.

DR. KRESS: And on that LERF line that is like something times 10 to the minus 5 --

MR. BURCHILL: Actually, it is about 10 to the minus 4. This is 10 to the minus 5, and this is 10 to the minus 6. And what we found is that we were right about here.

MR. HAEGER: Here is where the box is.

MR. BURCHILL: Yes, where the box is, and we are about here. This is where we are, and the 1.37

times 10 to the minus 7. And at a base of 4 times 10 to the minus 6.

DR. KRESS: And if you were to add in the low power shutdown, and add in the seismic, and add in the fire, would that move you very far in that direction?

MR. BURCHILL: I can give you a judgment on that, because we don't have it quantified, but I would judge that it would be very small movement in this direction.

DR. KRESS: The other question that I have is the LERF value where that line is drawn was derived on the basis of the quantitative prompt fatality health objective.

Now, if you increase the power, it seems to me that that line ought to move back the other direction, because you are increasing the fission product inventory, and if you were to back out the same fraction or release value from the prompt fatality value that you calculate, then the allowable value of that line ought to move back in the other direction by at least -- well, it is not linear because it has to do with a lot of the iodine.

MR. BURCHILL: The way that these explicit boundaries were derived is a mix of philosophy in numerics, but there is a relationship that is known, and that there is about a 3800 megawatt thermal assumption that went into the calculation of trying to relate these figures of merit to the public health figure.

DR. KRESS: They use sort of an average plant.

MR. BURCHILL: But they use a very big plant.

DR. KRESS: And your plant is much smaller than that big one, and so that --

MR. BURCHILL: A 3800 megawatt thermal.

DR. KRESS: So that would move the line in the other direction, and it also uses an average site source. So your site is probably much less populated than the average, considering a large LOCA.

MR. BURCHILL: I know that we are at a lower power level, but I don't know if we are much less populated than what was used there. But I know that in the deliberations that have been going on about revisions to Reg Guide 1.174, that has been on the key points, is whether or not the 3800 that was actually assumed to set these boundaries needs to be looked at, in terms of actually making these lines as you suggest variable.

But if we were to actually take the power level that we are talking about, in theory the line would actually move to the right. I wouldn't subscribe to that by the way. I don't think that is a proper interpretation of how these were done.

DR. KRESS: I was just trying to figure out how close you were actually to that line.

MR. BURCHILL: Well, we know this line should not be moving this direction, and I believe that if we were able to do an explicit calculation of the other risk sources, it obviously wouldn't move very far this way.

And if I were to actually be doing that, I would do an explicit level-2, and this thing would drive down here anyway.

DR. KRESS: Okay.

MR. BURCHILL: That is the real key, because I have got a factor of -- a minimum of two, and probably a 4 or 5 in conservatism in it.

CHAIRMAN WALLIS: Well, your box there is for this FPIE risk evaluation?

MR. BURCHILL: Yes, it is. This is a legend box and I don't know why there is two of them. And then this one is the result.

MR. LEE: That is what we say in region-2 and region-3.

CHAIRMAN WALLIS: You didn't give us numbers for fire related CDF, but the staff has some numbers which seem to be pretty high. I mean, 6 or 7 times 8 to the minus 5.

MR. BURCHILL: Correct.

CHAIRMAN WALLIS: And they are much bigger numbers than any of these.

MR. BURCHILL: Yes, but that is typical.

CHAIRMAN WALLIS: But if we put down the same picture, it would take you over into the greater region.

MR. BURCHILL: If I were to blindly add those numbers, it would do that. But before I would do that, I would go in and I would do a whole lot of work on my fire ignition frequencies, and I would do comp calculations, and --

CHAIRMAN WALLIS: You would bring that down?

MR. BURCHILL: I would certainly be able to bring them down by on the order of --

CHAIRMAN WALLIS: There seems to be a bit of uncertainty about the right number to use for these fire related CDFs then.

MR. BURCHILL: I'm sorry?

CHAIRMAN WALLIS: There seems to be a lot of uncertainty about what to use for these fire related CDFs.

MR. BURCHILL: Well, the fire risk analyses were a part of the IPEEE, which as to identify vulnerabilities. I think there is a lot of question about using them as numerically comparable to internal events.

CHAIRMAN WALLIS: Maybe we will ask the staff what they think about that. Do you know what that hurricane like region is over to the left there on your picture, the dark blob there?

DR. KRESS: That is the crest mark.

MR. HAEGER: That is actually on the screen.

MR. BURCHILL: So our conclusion is that we are well within the acceptable ranges on the 1.174, which we have just looked at in anguishing detail, and that the impact from external events and shutdown is either negligible or minor.

So overall, if we had the last slide up, but it doesn't matter, we believe that the EPU risk impact is acceptable. I would like to make one further comment. I believe that the staff did an extremely thorough evaluation in this case.

And particularly recognizing that this is not, quote, a risk informed submittal, but the fact that we did get asked a large number of questions, and they spent some times with us in July as you have read, I was actually very impressed with their inquiry.

So I just wanted to put that on the record. I know that is something a licensee normally says, but I thought that they did a very good job.

CHAIRMAN WALLIS: They were equally impressed with your answers to their inquiries.

MR. BURCHILL: Well, I am pleased to hear that. Okay. I would now like to introduce Mark Kluge now, who will continue with the discussion of open items.

CHAIRMAN WALLIS: Thank you very much, Bill.

MR. BURCHILL: You're welcome. A pleasure to meet with you again.

MR. KLUGE: This is Mark Kluge, and we are going to cover four of the open items from the staff's safety evaluation. I will be discussing ECCS net positive suction head requirements, and the ultimate heat sink that we touched on just a moment ago.

Then I will bring John Freeman back up to talk about the standby liquid control system, and an issue involved with that. And then finally Tim Hanley will discuss the large transient testing that came up earlier in the presentation.

The pre-EPU basis for both Dresden and Quad Cities was that credit for a containment overpressure is required for adequate ECCS MPSH. Because that is the case, our procedures, our training, are all focused on operator awareness of that need, and the proper actions to maintain MPSH.

The EPU impacts on this condition are that using a limiting analysis with the proper conservative assumptions to minimize containment pressure, we have an overall need to increase the containment over pressure credit for the EPU condition.

Dresden and Quad Cities installed larger suction strainers as to the rest of the BWR fleet, and the staff had some open issues with our methodology in calculating the head loss for those suction strainers.

DR. SIEBER: That was independent of --

MR. KLUGE: That was independent of EPU. However, EPU provided us the opportunity to address those issues.

DR. SIEBER: If that issue is not resolved, I take it that EPU is. What is the caboose behind that train?

MR. HAEGER: Well, we have submitted material to the staff now that we believe resolves that issue.

DR. SIEBER: Well, it takes two to resolve it; you and them.

MR. KLUGE: But we believe that the calculation that we have performed now addresses all of the staff issues with the head loss methodology. It does result in an increase in head loss at a given ECCS flow.

The overall effect from EPU on the Dresden and Quad Cities plants, we have a reduced period of pump cavitation int he short term over the existing analysis. That small period of cavitation has been previously evaluated and shown to be acceptable based on some testing that we did of the ECCS pumps some years ago.

CHAIRMAN WALLIS: Do you actually know the flow characteristics of the pump when it is cavitating?

MR. KLUGE: Well, there are a couple of points to remember here. First of all, the ECCS analysis has to assume a limiting single failure, which means inherently that analysis does not use as much flow as does our limiting MPSH analysis.

Our worse case here is when all of the ECCS pumps are operating, and in fact not only are they all operating, but we assume a loop select failure such that the LPCI pumps are all pumping out the break.

CHAIRMAN WALLIS: But when the pump cavitates, what do you do? Do you put in some reduced pumping capacity as a function of lower suction head or something, or what?

MR. KLUGE: For the assumptions in the ECCS analysis, this cavitation wouldn't occur because of the reduced number of pumps available.

CHAIRMAN WALLIS: I am just saying that there is a period of pump cavitation?

MR. KLUGE: There is a period of pump cavitation if I assume that all the ECCS pumps are operating. That period is limited by operator action at 10 minutes into the event, and you --

CHAIRMAN WALLIS: Well, what is the consequence of having that cavitation? You reduce the flow or what do you do?

DR. SIEBER: You trip a pump.

CHAIRMAN WALLIS: Do you assume that there is no flow or what?

MR. KLUGE: Well, the actual pump operating characteristics would be slightly reduced flow.

CHAIRMAN WALLIS: Slightly reduced flow?

MR. HAEGER: From all ECCS pumps running, and what Mark is trying to say is that the ECCS analysis assumes a single failure, and so the flow rates are much less there.

The cavitation won't get you anywhere near that low of a flow rate. So we are bounded by the ECCS LOCA analysis.

MR. KLUGE: And not to berate the point, but the ECCF analysis also uses lower flows from the available pumps; whereas, we assume full flow capacity to do the MPSH analysis. So there are different inherent assumptions in these two analyses

MR. PAPPONE: This is Dan Pappone. The flow that they are talking about, there will be a degradation in the flow, but that degradation will not go from the actual value down to our analysis value.

The value that we assumed in the analysis was below the grated flow value. So effectively we have accounted for it in the analysis. Another factor is that --

CHAIRMAN WALLIS: Well, maybe I should ask a simpler question. Even if you have this pump cavitation, you are able to calculate that you have enough flow?

MR. PAPPONE: That's right.

CHAIRMAN WALLIS: And this is based on some model or some understanding of effective cavitation on the pump flow characteristic?

MR. PAPPONE: Right.

MR. KLUGE: Another factor is the time when it occurs, and the time when we would expect this cavitation to occur after we have reflooded the vessel and terminated the core heat up.

So that part happens in the first few minutes, and the cavitation is out at -- well, let's say when we get past the reflooding in 3 or 4 minutes, and the cavitation is out in the 5 minute range, the 5 or 6 minute range.

DR. SIEBER: Plus, there is an implicit assumption that there is no vortexing associated with the cavitation; is that correct?

MR. KLUGE: Flow characteristics were based on testing that we did some years ago.

DR. SIEBER: Where you actually induced cavitation?

MR. KLUGE: Where we induced cavitation in an ECCS pump identical to those installed in Dresden and Quad Cities. That cavitation was allowed to continue for a period of an hour, which is far in excess of what we are talking here.

DR. SIEBER: Right.

MR. KLUGE: And when the pumps were inspected, the results of that cavitation were that the pump operability had not been affected.

DR. SIEBER: Well, the vortexing using affects the flow in a major way, and I presume that during the test that you also did flow measurements to see what the degradation was?

MR. KLUGE: That's correct.

DR. SIEBER: And maybe you could tell us the percentage. Was it 90 percent, or 80 percent, or what?

MR. KLUGE: Well, I don't have that information in front of me, but just to echo what Dan said, in every case, even the degraded flow would give us much lower than what was required for the accident analysis.

DR. SIEBER: All right. Okay.

MR. KLUGE: Moving on to the long term reduced pump flow and the long term compared to the previous licensing basis analysis, that is partly a factor of the increase during our head loss, and partly a factor of the increased suppression pool temperatures.

But again all flow requirements, both for core cooling and containment cooling, continue to be met. The next two slides show graphically the available over-pressure above that which is credited in the analysis.

If you compare Dresden and Quad Cities, there are some minor differences due to plant specifics, such as different heat exchanger capacity and piping configuration.

CHAIRMAN WALLIS: Now, what does credited in the analysis mean? Is it what the NRC allows you to us?

MR. HAEGER: Yes.

MR. KLUGE: Yes, what we have requested.

CHAIRMAN WALLIS: Oh, so you have requested something less than what you think is available?

MR. KLUGE: That's correct. And all this information has been submitted to the staff.

CHAIRMAN WALLIS: When you say credited, you mean that is what you need really isn't it?

MR. KLUGE: That is what will appear in

our operating license.

CHAIRMAN WALLIS: That is what you need and so you are claiming you have got more available than what you need?

MR. KLUGE: Yes.

MR. HAEGER: That's correct.

DR. SIEBER: It's always a good idea.

CHAIRMAN WALLIS: And this available is calculated with some sort of conservatism which goes the other way from when you are trying to calculate the loads on the containment when you are conservative in the other direction?

MR. HAEGER: That's correct. There is a number of different assumptions made that limit the containment pressure that is available.

MR. KLUGE: For instance, the containment sprays are assumed to operate since they bring the pressure down. However, the assumed containment heat removal capability is the minimum, which of course drives the suppression cool temperature up.

Moving on to the summary slide, we used acceptable methods to determine the suction strainer head loss and the NPSH requirements. Although we do experience short term pump cavitation, we devaluated that condition and it has no detrimental effect on pump operability or meeting the required flow.

And the long term flow rates are acceptable, and the operators are aware of the need to maintain MPSH per their emergency operating procedures. Therefore, we conclude that the ECCS pump and NPSH remains acceptable under EPU conditions.

CHAIRMAN WALLIS: Does the staff agree with that?

MR. KLUGE: They haven't indicated to the contrary. We do think we have addressed all of the issues with the methodology that we considered.

CHAIRMAN WALLIS: So they have not come back to you and said yea or nay yet?

MR. KLUGE: That's correct.

MR. HAEGER: They have not formally replied to us.

MR. KLUGE: Next, I would like to discuss the Dresden ultimate heat sink and I will ask Larry Lee to come back up here to handle the risk portion.

As was previously mentioned, the Dresden ultimate heat sink consists of the intake and discharge canals to the plant. And there is a picture being put up so we can see what we are talking about.

Dresden 2 and 3 intake valve spans from

this point to this point, and the discharge runs from this point to this point. To give you some idea of the scale from the plant to the south end of the lake is approximately 3 miles.

So we are talking 2,000 foot canals and a total inventory that we are looking at in those canals once we postulate that the river level has dropped to a point, the separation is about 6 million gallons.

The ultimate heat sink inventory is used both as makeup to the isolation condensers to maintain safe shutdown, and for diesel generator cooling water. As indicated before, the canals are then replenished by means of portable pumps to ensure long term safe shutdown, and those actions are all in the current procedures.

CHAIRMAN WALLIS: So whatever it was that caused the dam to fail didn't also inhibit the arrival of portable pumps?

MR. KLUGE: That is the assumption in the current licensing basis.

CHAIRMAN WALLIS: Well, why should that be? I mean, something big enough to fail the dam might --

MR. KLUGE: Well, it certainly could have been a localized effect, such as a river barge, causing enough damage.

CHAIRMAN WALLIS: Or it could be a seismic event or something?

MR. KLUGE: It could be a seismic event.

DR. SIEBER: Well, a lot of plants use fire trucks to do that, and they run around to all the local fire companies and say if we have this problem will you support us.

And I know of a number of plants that have made that arrangement. So it is not impossible to get pumping capacity.

MR. KLUGE: That is correct, and as I indicated previously, we do have standing contracts with pump vendors to ensure their availability.

CHAIRMAN WALLIS: So portable pumps, or something like a fire truck driving up and hitching up as a source of water?

MR. KLUGE: Well, the source of water in this case is the lowered river bed.

DR. SIEBER: Right. Is it about a half-a-mile from the river to the plant?

MR. KLUGE: Yes, but the required distance to pump this water is simply over the contour in the canal that has caused the separation.

MR. T. HANLEY: This is Tim Hanley again.

We actually had our ice melt line fail at Quad Cities, and not this winter, but a winter ago when we had a fire truck actually perform this same type of thing to keep our intake structure from freezing over.

And we had that well within a shift, and then portable irrigation pumps also to back that up. So especially in rural Illinois, there are plenty of irrigation pumps available if you should need that.

MR. KLUGE: And to evaluate the impact of EPU on the ultimate heat sink, we did a bounding analysis, which actually credited the inventory only in the intake canal.

And we determined that the available time for replenishing the canal would decrease from 5-1/2 days to 4 days, which we would still consider an ample time frame to restore make up means from the lowered river bed.

DR. SIEBER: Would you use water from the discharge canal? It seems to me that it was pretty hot, and there is always vapor coming off of there.

MR. KLUGE: The assumption in this particular analysis was not that we use water from the discharge canal. However, that heat would only make a significant difference if we were using the water as a cooling source via heat exchangers. We are just pumping it into the isolation condenser and boiling it off.

DR. SIEBER: Okay.

CHAIRMAN WALLIS: Did you worried about net positive suction heads for the fire truck pumps and pumping hot water?

DR. SIEBER: They are pumping out of the river. So the river probably never gets about 90 degrees.

MR. KLUGE: That's correct. I would like to describe the operational scenario here in a little more detail. The initial makeup to the isolation condenser is from on-site tanks and the capacity in those tanks is considerably beyond what we require in the scenario.

An operator action is required to reflood a bay in the crib house, which due to the lower level has lost suction. And that action is taken by installing stop logs and using permanently installed pumps to reflood the bay.

Then that reflooded bay becomes the suction source to the diesel driven fire pump, which provides long term makeup to the isolation condenser.

I mentioned that the USH also supplies the diesel generator cooling water pumps. Those pumps happen to be at a higher suction level than those that reflood the intake bay.

Therefore, if diesel operation is required, they become limiting as far as the useable inventory in the bay, and they were accounted for in the limiting analysis that I described previously.

The diesel generator water cooling water flow path is from the intake canal, and through heat exchangers, and back to the discharge canal.

The procedures then direct the operator to establish recirculation of that water back to the intake, which maximizes the use of the available water, although again we did not credit the inventory in the discharge canal in the limiting analysis. We do credit the recirculation path.

The lack of a seismically qualified make up path to the isolation condensers was identified during our seismic margins analysis. The original FSAR analysis that was the basis for licensing Dresden relied on non-seismic equipment, but recognized that there was a diversity of make up sources available.

However, as a result of the seismic margins analysis, we identified the need for a modification to provide that seismic makeup path, and that is scheduled to go into the plant in 2003.

The staff requested that we evaluate the risk of operating with the current configuration and in doing that we concluded that EPU had an insignificant impact on the plant risk for the scenario, and Larry will talk about that a little later.

The seismic margin success path must also be able to mitigate a case where a seismically induced equivalent one-inch LOCA comes about. We analyzed the situation, and determined that the isolation condenser and the available ECCS would mitigate the scenario for at least 24 hours.

In order to provide a long term capability, we identified another modification that was necessary, and this would use different portable pumps to make up directly to the containment cooling heat exchangers, and therefore allow us to maintain safe shutdown for a longer time period.

All the necessary actions to accomplish this will be put into the plant procedures, similar to the current required actions. Again, the staff requested that we analyze the risk for the small LOCA scenario, and we concluded again that EPU had a very negligible impact on this risk.

And now Larry will describe those focused risk assessments in some detail.

MR. LEE: Hi. This is Larry Lee. So, consistent with NEUREG or the guidelines provided in NEUREG-CR 2300, we used standard seismic risk techniques to estimate the risk for specific scenarios involving seismic dam failure with failure to the IC makeup path.

And I will speak to a few of the sub-bullets. First of all, the Dresden site-specific seismic hazard curve was used from NEUREG-1488, and the information here is based on the studies performed by Livermore National Labs, and the curves are judged to be conservative.

In terms of the -- we evaluated the entire seismic hazard curve by dividing the curve into discreet .1g intervals so that we could evaluate the frequency and the seismic impact for each of the intervals, and then add the risk for each individual to come up with a total risk for the specific scenarios.

And then the second to the last sub-bullet is talking about we calculated the human error probabilities for the pre-and-the-post EPU associated with the scenarios consistent with how the human error probabilities were calculated, and the base Dresden

PRA model.

And we only credited proceduralized makeup paths. So we didn't credit any non-proceduralized actions associated with any proposed modifications.

In terms of the results, we analyzed two cases. The first one is safe shutdown with the IC for a non-LOCA case, and we found that the delta-CDF associated with EPU was on the order of 1E-minus 8, and for a seismic dam failure with a coincidence small LOCA, the delta-CDF was negligible.

DR. KRESS: Did you do an actual CDF?

MR. LEE: In terms of the actual CDF for the pre-EPU, and for the first bullet, for the safe shutdown with the IC, the CDF was approximately 9.3E-minus 6. So with the delta of 1E-minus 8, the post-EPU CDF was approximately negligible.

CHAIRMAN WALLIS: Within the --

MR. LEE: Yes. For the coincidence small LOCA case, the pre-EPU CDF was approximately 1.9E-minus 6 per year, and the probabilities for a seismic induced small LOCA were based on the Zion analysis from NEUREG-4550.

MR. KLUGE: This is Mark Kluge again. In summary, we have concluded that EPU has minimal impact on the ultimate heat sink capability for Dresden.

We will be completing the required modifications on the previously committed schedule for the seismic margins, IPEEE outlines, and the risk impact and increase in risk is very small for these scenarios.

Therefore, the ultimate heat sink is acceptable for EPU operation. If there are no further questions, I will ask John Freeman to come back up to discuss the standby liquid control system.

CHAIRMAN WALLIS: Thank you.

MR. FREEMAN: This is John Freeman. We are going to be talking from page 101. The issue involved here was the information notice that was sent out a few months ago concerning the standby liquid control relief valve margin response under an ATWS scenario.

Exelon has looked at the standby liquid control system for Dresden Unit 2, and concluded that there would be no interruption of the standby liquid control flow rate delivered to the reactor under the analyzed scenario.

However, Unit 3 of Dresden and Quad Cities 1 and 2 are still being evaluated, and there is a high potential that we are going to need to make modifications to the SLCS relief valves set point in order to ensure that that valve will not lift and that it will get our ATWS rule required flow rate to the reactor.

Therefore, the conclusion is that the standby liquid control is acceptable at EPU conditions for Dresden Unit 2, and it will be acceptable for Unit 3 of Dresden, and Quad Cities 1 and 2, with the completion of the modifications we have planned.

DR. SIEBER: It would seem to me though that whether you add EPU or not, that would still be an issue.

MR. FREEMAN: That is correct.

MR. HAEGER: Yes, this is not specifically an EPU issue. This same phenomenon would occur prior to EPU.

MR. HAEGER: Right.

DR. SIEBER: Okay.

MR. FREEMAN: Okay. If there aren't any other questions, I will introduce Tim Hanley

MR. T. HANLEY: This is Tim Hanley again from Exelon. The topic that I am going to discuss is the large transient tests. As you are all aware, ELTR-1 specifies two large plant transient tests to be conducted.

One is an MSIV closure if the power uprate goes to 110 percent; and the other one is a generator load reject if the power uprate is greater than 115 percent.

Earlier, a question was asked, well, what was the basis, a simple one or two sentence, for not doing these tests. And to begin with, we believe that it is unnecessary to assure the plant's response, and I will go over some of the reasons why we believe that is unnecessary to put the plant through the transient.

In both of these scenarios, both the MSIV closure and the generator load reject, the SCRAM is initiated off an anticipatory signal. In the case of the MSIV closure, when the valves are less than 90 percent full open, the SCRAM signal is initiated inserting the rods, and essentially terminating the power excursion.

And the generator load reject, as the EHC pressure drops and the turbine control valve bodies to a certain point, indicating the fact acting solenoids have actuated that SCRAMs the reactor and terminates the power excursion.

In both tests, feedwater is still available for level control and in the case of the generator load reject, the bypass valves are still available for pressure control.

Most of the major parameters of interest in the input into determining how the plant is going to respond are unchanged for EPU. The SCRAM times are not being changed, and the valve closure times are being changed.

The only thing that has really changed is the peak dome pressure, which is really essential in both of these. The beginning dome pressure is not being changed. The only two parameters that are changing are the reactor power level and the steam line flow.

DR. SIEBER: And the stored energy.

MR. T. HANLEY: Right. You do have additional stored energy. However, that decays very rapidly as soon as the SCRAM goes in. In both cases, you are well within your relief valve capacity are in one case within the bypass valve capacity.

So the real test and the real parameters of concern in these tests is what is your peak pressure that you reach, and what is the peak power that you reach prior to it turning around prior to the SCRAM being effective, and terminating the excursion.

When G.E. originally put these in the ELTR, they had no experience really with uprating plants, and they had no basis for assuming that the

ODYN code that they used to determine the plant response would be effective for uprated conditions.

And since that time, G.E. has concluded that these tests should no longer be required for power uprates at a constant pressure up to a certain level, and I believe it is 120 percent, which we are not exceeding.

CHAIRMAN WALLIS: Where would this large transient test -- you mean that you actually take the system to 115 power?

MR. T. HANLEY: No, no, no. If your power uprate goes to 115 percent of your current power level.

DR. SIEBER: These sub-bullets are misleading.

CHAIRMAN WALLIS: They are misleading, yes.

MR. HAEGER: Yes, that is misleading.

CHAIRMAN WALLIS: Then you have to test the ability of the generator to reject load or something, but you don't -- okay.

MR. PAPPONE: This is Dan Pappone. The tests that we are talking about would be performed at the uprated power level.

MR. CROCKETT: That's correct, but not 115 percent of the uprated power level. If your power uprate exceeds 115 percent of your original license power level, then it calls for that.

MR. FREEMAN: The original intent was to perform those tests at the full uprated power level. The safety analysis that has been done at both Dresden and Quad Cities has been done using the ODYN code. It has been benchmarked against BWR test data, and has incorporated industry experience.

MR. BOEHNERT: What BWR test data?

MR. FREEMAN: Particularly it has been benchmarked at --

MR. HAEGER: It is Peach Bottom, right?

MR. ANDERSEN: This is Jens Andersen. The ODYN code has been benchmarked against full-scale plant testing, particularly the Peach Bottom turbine test.

MR. BOEHNERT: Were those at uprated conditions?

MR. ANDERSEN: No.

MR. BOEHNERT: So what do you have a benchmark at uprated conditions?

MR. ANDERSON: There are start up tests for other plants that have been performed.

MR. T. HANLEY: In fact, we do have a back up of a comparison, I believe, KKM.

MR. HAEGER: Well, what some foreign plants have done is do this testing at higher power levels than Dresden and Quad.

MR. BOEHNERT: At 120 percent? At 115? At 110?

MR. HAEGER: Well, it is the thermal power that they are at, which is higher than Dresden or Quad.

MR. BOEHNERT: So they had a test where they had done it 120 percent of uprated conditions?

MR. HAEGER: I think the one set of data that we have was 110 percent of their original license power. But I guess the point that we are making is that the power levels at Dresden and Quad are at are lower than the power levels of these units.

MR. T. HANLEY: And the beginning dome pressures are lower than the pressures of these other units, and so we are within the bounds of where ODYN has been proven to be effective in determining how the plant's response will be.

We are not extrapolating it out to some place where it hasn't been proven.

MR. BOEHNERT: Do we know how applicable

that plant is to Dresden and Quad Cities?

MR. T. HANLEY: Well, I guess the next bullet on the slide is that ODYN uses plant specific inputs, models of steam lines and geometries of the length.

DR. KRESS: Are the valves the same at these plants, the same kinds of valves that you have to open and close?

MR. T. HANLEY: That I can't say for sure. However, once you isolate the vessel, you essentially have relief valves left as your pressure protection. We do know in fact the opening times of our relief valves, and those are included in there, which would be included at the other plants in their data.

And whether they are exactly the same or not, that is a specific input that is used in the modeling.

DR. KRESS: Oh, that's part of the modeling? That's not in ODYN.

MR. HAEGER: Valve closure times are modeled.

DR. KRESS: Valve closure times are modeled.

MR. HAEGER: Yes.

DR. KRESS: But whether the valves can

actually close during time is another issue.

MR. HAEGER: Yes. We will get to that in the next slide.

DR. KRESS: Okay.

DR. SIEBER: But if you run the test, you are going to get all those relief valves and safety valve actuations at least for relief valves, right?

MR. T. HANLEY: We will get relief valve actuations on the MSIV closure for sure. You should not get any safety valve actuations, but we will get relief valve.

The power uprate, since the ELTRs were initially -- was initially approved, they do have additional operating experience to compare the predicted plant response to actual plant response.

And what it has shown is that the code adequately predicts the way the plants would respond under those real conditions. So of those have been under plant test conditions, and some have been under unplanned transients, where they have gone back and collected the data, and compared them.

And it does show that the code to acceptably predict and also bounding predictions, particularly on peak power and peak pressure. And Dresden and Quad Cities both have adequate collection capability.

And should we have one of these unplanned transients, we would of course go back and verify that the code predictions were as we expected. We have done extensive code analysis and the --

CHAIRMAN WALLIS: You might have an unintentional test anyway.

MR. T. HANLEY: And we have. In fact, at Quad Cities in the last two years, we have had a generator load reject and an MSIV closure at full power.

CHAIRMAN WALLIS: And you have already done the tests?

MR. T. HANLEY: Not at our uprated conditions. Both Exelon and G.E. have analyzed the major components that affect the large transients, and those are MSIVs, steam piping, SCRAM signal, safety release valves, and turbine valves, and the interaction of those.

We have years of operational experience -- unfortunately, some of them awfully recently -- to show that those components do operate as they are designed, and we are well aware of their operational history. And the transient testing does not mean that these components will respond as designed.

MR. HAEGER: Now, that was to your point, Mr. Kress, that to look at each of these components, and really there is nothing in the EPU that would change their response to the timing or whatever the particular feature is.

MR. T. HANLEY: And in each of them we do specific component testing on. We do stroke our relief valves during start up, although some plants have gotten away doing that due to the relief valves leaking.

But in the MSIVs, we do time their closure and set their closure time based on to be within our tech spec limits.

DR. SIEBER: And do issues like Stone and Webster speak to main steam line piping analysis and supports, and those are factors here that may be different than they were at your previous rating?

MR. T. HANLEY: Those could potentially be impacted, because you are interrupting a higher flow.

DR. SIEBER: You have a big hammer, and it breaks snubbers and pull things out of the wall, and all kinds of stuff.

MR. T. HANLEY: The other thing to keep in mind though is that we would be running these tests on the plants at that power level. So whether you do it planned or it happens sometimes unplanned, the results are going to be the same.

So from an operational perspective, why would I induce this transient on the plant unless I had some real concern about the ability of the analysis to accurately predict how the plant would respond.

If I break a snubber under a planned -- we would call it a test, but it is a transient that I am inducing, or if I break a snubber when the turbine trips from full power at some other time, the effects to the operations in the plant are exactly the same.

You still have to deal with a broken snubber, and so that is really kind of my conclusion in all of this, is that we have limited changes to the inputs to the plant because we are doing a power uprated constant steam dome pressure.

Most of the other parameters of interest, with the exception of reactor power and main steam line flow, are remaining the same. So these are in fact -- although they are labeled as tests, they are transients being induced on the plant.

And are challenging the equipment of the plant, and without a compelling reason, it doesn't seem to me operationally to be prudent to go and shut all the MSIVs at full power unless there was some concern that we didn't have high confidence in the modeling.

MR. BOEHNERT: Well, G.E. must have been concerned. I mean, they initially said you should do this testing. What changed their mind?

MR. HAEGER: Well, like I said, they have had experience now with some uprates, and it showed them that everything works out as predicted.

MR. T. HANLEY: Well, I should ask G.E. to respond, but my discussions with them are that in fact they have submitted a constant power uprate submitted to the NRC that would no longer require these tests.

And we can't use that as a basis obviously, because it is not approved, but they have themselves come to that conclusion, and it is based on their experience that their modeling has accurately and adequately predicted the plant's response under uprated conditions.

CHAIRMAN WALLIS: So their argument is that they have already got experience, and there is no extrapolation beyond experience involved.

MR. T. HANLEY: That's correct, and in fact, Quad Cities and Dresden will be at a lower power and lower steam line flow rate than a lot of plants were originally licensed to have.

Van Gulf, which I have some experience with from people that I work with, is over 3,000 megawatts thermal, with a corresponding steam flow rate. So we are within the bounds where this code has been proven to be effective in predicting the plant's response.

CHAIRMAN WALLIS: This is again where some kind of matrix or something would help, and if you could show that here is the experience base, and here is where you are going to be with the uprate, and just as a comparison.

MR. HAEGER: For instance, in the material that we have supplied to the staff, we do show some specific data from KLL, and I have it here. KKL is at 3130 megawatts thermal, and they were -- and that was 113 percent of their original license thermal power.

MR. BOEHNERT: Has the staff accepted your arguments?

MR. HAEGER: That is another open issue.

MR. BOEHNERT: That is an open issue?

MR. T. HANLEY: That's correct.

CHAIRMAN WALLIS: So may be they will provide this matrix, or whatever it is, and that we can actually look at and see the comparison between experience and uprated power in these particular plants, and see if it is covered.

DR. SIEBER: Well, I am not sure that you can leap right away to the fact that everything is okay just by saying that some bigger plant did it before me. I think that it takes more thought than that.

MR. T. HANLEY: But I think that is part of the consideration. I certainly would be more concerned had we been uprating to a new higher power level that no plant had ever been licensed to. So that is one of the considerations to look at.

DR. SIEBER: Well, I think more in terms of power density, and cubic feet of plant per megawatts, and --

MR. HAEGER: Well, once again this power density for our plants is lower than other plants that are licensed currently.

DR. SIEBER: I understand. Okay.

MR. T. HANLEY: So my final conclusion is that we shouldn't intentionally put the plant through what is a significant transient unless there is really a compelling reason, which we haven't found there to be one. Any other questions?

CHAIRMAN WALLIS: And this gets us to the end of your presentation?

MR. T. HANLEY: Yes, it does. It gets me actually to the beginning of my next presentation, which is the implementation, training, and testing.

I am going to go quickly what training we have done for the operators, both classroom and simulator training, and what testing we will be doing during the start up.

When I talk about the testing, it has been completed at Dresden, which is going through their uprate outage right now. With the exception that they are going to have two hours of delta training that they will do just prior to uprate just to get the operators reacquainted with the changes, and what they will be doing differently when they go about their current hundred percent thermal power.

At Quad Cities, we have only begun this, and we will complete all of the training before our February outage on Unit 2, which is our uprate outage.

DR. SIEBER: Will all of the MODS be modeled into your simulator?

MR. T. HANLEY: Yes. In fact, they were modeled in the Dresden simulator prior to their last session of simulator training, which was all focused on EPU, and the same would be true for Quad Cities.

Classroom training covered really everything that we would normally cover going into an outage; any tech specs or other changes; design changes, whether they were for EPU or not.

We are going to or are covering operating procedure revisions that are going in, and mostly those are due to modifications. There are some in general that are just due to EPU.

Some other things that we did is look at the plant limits and operating condition changes, and those things include running all the four condensate pumps, and all three feed pumps, changes in the operation of the pressure control system for the turbine throttle.

The vessel looked at MELLLA, and the new power to flow map, and the differences that you may see during certain transients, such as recirc runback, and recirc pump trip. And we did cover some operating experience from other plants that have done uprates.

Monticello had some feed flow inaccuracies that they had not considered when they did uprates, and Peach Bottom found that they had excessive vibrations and had to put in another coronary EHC system, residence compensator.

And in fact that got factored in as a

modification that we did at Quad Cities and Dresden. Fitzpatrick had excessive vibrations that affected the feedwater heating system, and the air line supplying those control valves. So we went over a number of things that had happened at other plants.

DR. SIEBER: How is that incorporated in these to look for these things?

MR. T. HANLEY: Well, I will go over --

DR. SIEBER: Are do you just depend on the operators?

MR. T. HANLEY: No, this was a heads up to them, but it is incorporated into our start up testing programs. So we will have a controlled look at all of those things as we are going up.

DR. SIEBER: Now, your external nuclear instruments will all be --

MR. T. HANLEY: We don't have ex-core. We have all in-core.

DR. SIEBER: All in-core?

MR. T. HANLEY: That's correct.

DR. SIEBER: Okay. Do they all work?

MR. T. HANLEY: Most of the time. We had some issues with copper migration in some of the SRMs and IRMs in this last refueling outage that we have replaced those that were susceptible. So we have had good response with the nuclear instrumentation.

The simulator training began with a static walk through the similar was set up as full power EPU, and what they should see when they go in to take the unit for the first time, and at its new uprated condition, and just walk around and see where the different parameters are from where they are used to seeing it.

And just basically to get acquainted with the plant as you will be seeing it. And we went through some normal operation scenarios; power changes, inserting rods, and doing some small recirc changes.

And then did some dynamic scenarios that we selected to highlight both the differences that they will see at EPU and the similarities in their response under these conditions.

And we ran through a loss of feed water heating, and feed water controller failure, high recirc controller failure, condensate pump trip. And obviously before a condensate pump trip, the first thing an operator does is verify the standby pump auto starts.

Well, there is no standby pumps, and so now the new action is verify the recirc pumps are running back.

DR. SIEBER: Right.

MR. T. HANLEY: So we ran through a group one isolation and a loss of off-site power with a LOCA, and also a turbine trip without bypass with a ATWS. Really from the operators experience the --

DR. SIEBER: This is a turbine bypass.

MR. T. HANLEY: That's correct. So essentially it is almost the design basis ATWS, because you give no bypass applicability. Really from the operator's feedback, they didn't see a lot of changes in their response to transients or accidents other than those specifically associated with hardware changes, like the condensate pump trip.

And that really is a credit to the generic EPGs now that we work with symptom-based emergency procedures. You are going everything off a parameter.

So you are looking at TORUS temperature, and you are looking at drywell pressure, and you are taking actions at specific levels of those parameters before you reach them. So it doesn't really affect how the operators respond.

DR. SIEBER: Have you had to change your emergency response guidelines for the uprate?

MR. T. HANLEY: Yes, there will be some

minor changes to those.

DR. SIEBER: Like control points, and sub-points, and things like that?

MR. T. HANLEY: Right. We are in fact -- I believe that it is part of this submittal, and it may be a separate one. We are changing our low level SCRAMs at that point from 8 inches to zero inches.

So that obviously is an entry point into the EOP. So that will be a change that goes in. But the overall strategy of the Ops has not changed, and really the operators, their feedback was that they didn't see a significant difference in the way that they attack it as transient.

DR. SIEBER: Has the power uprate created any walk arounds for the operator that otherwise would not exist?

MR. T. HANLEY: We will only be able to tell that for sure once we get to those conditions. As designed, operators are always skeptical, which is good.

But as a design, we should not have controllers left in manual that are supposed to be in automatic. We should not have additional monitoring required once we get through our testing program.

DR. SIEBER: That's right.

MR. T. HANLEY: And those are the things that we are on the lookout for, as designed, and none of those are built into this uprate.

But those will be the things that we will have to look for when we get to the new license power condition to make sure that they are identified, and get put in our program, and get fixed in a timely basis. So we don't intend to incur any operator work arounds to reach our new power, licensed power.

CHAIRMAN WALLIS: Well, then all the modifications will be -- except for records update, will be complete, tested, and --

MR. T. HANLEY: Well, digital feedwater, which is not being installed as part of EPU, but we are taking advantage of that for particular input into the recirc runback, obviously we will be doing start up testing as we start up from that. So there will be testing that goes on with this.

DR. SIEBER: So the run back won't occur until you put that in?

MR. T. HANLEY: No, it will. It will all be in during the outage, but all the testing on that now won't be complete you are at power, and that is the only way to test it.

But our intention is not to have feed

water heat level control valves left in manual, or have the emergency dumps on those bias partially open. So those are the things that the operators are concerned about.

And we have done a lot of analysis, and the increased shell pressure should increase the flow through the same sized valves. So we shouldn't have an issue with the drains on the feedwater heaters.

DR. SIEBER: And you will find that out probably.

MR. T. HANLEY: Probably, and that's -- well, as operations, we are keeping our eyes out for anything that didn't come out the way that we were told it was going to.

That really covers the training portion of it, and so I was going to go on to the testing. The way that we are going to perform our testing is do one power increase a day, and approximately 3 percent, and stop there, and collect all of our data, and compare it to the predicted value acceptance criteria.

And look for anything that would keep us from increasing power the next day, and if we have to make minor system adjustments, and if we have to go back and reevaluate, and if we have to go back and hold power there, that's the point where we will do it.

We will be increasing along a constant flow control line to limit the variables that we are changing at one time. So, really essentially we will be increasing recirc pump speed over the days to increase power.

We are going to start collecting our steady state day at 90 percent of our current licensed thermal power for the systems that we are monitoring for vibration data for the main steam and feed lines.

And we will actually be getting that data at 50 percent of our current license thermal power. But for the systems, we have got good operating history, and we just want to get a base line at 90 percent of our current license power level.

DR. SIEBER: Are you going to do anything special with the turbine since you are getting a new high pressure turbine?

MR. T. HANLEY: And we are changing the diaphragms on the control valves, and what we will be doing is we always monitor turbine vibrations, and we always do --

DR. SIEBER: And that is standard on the start up?

MR. T. HANLEY: Right, and we will be

doing our normal control valve stroking to ensure that the other control valves can compensate adequately for one control valve closing.

But the high pressure turbine itself will have a unique MOD test associated with it, and not related to EPU. In fact, Dresden right now is installing a new high pressure turbine.

And so when they start up, even though they won't be licensed EPU, they will be doing their generic MOD test for that.

DR. SIEBER: Now, you have a boreless spindle?

MR. HAEGER: Boreless rotor?

DR. SIEBER: Yes. Well, a spindle. We always run a line through the bore, and if you don't have a bore, then I am not sure how you align.

MR. HAEGER: The question, George, is if you don't have a bore, how do you do the alignment?

MR. NELSON: This is George Nelson. They are using laser alignment techniques, which are primarily off of the opening of the shaft.

DR. SIEBER: And we shoot through the shaft with a laser.

MR. T. HANLEY: And these tests will be conducted with a dedicated testing team lead by an

SRO. There is one assigned to Quad Cities and one assigned to Dresden. We are also sending our people to Dresden for our start up testing when they begin their power ascension testing.

And then those people from Dresden will becoming to Quad to make sure that we capture any lessons learned about that. We are doing specific signal and system response testing for the two systems, control systems, that are being significantly altered for EPU.

The pressure control system for the main turbine, the control valves will actually control turbine throttle pressure at a lower pressure than it does right now to maintain reactor pressure at a thousand-five, because it is controlling at a new set point, and we will be doing specific pressure incremental changes on it to make sure that it has a stable response.

And that it does not oscillate divergently, and we are also going to do a pressure regulator fail over test to make sure that the back up pressure regulator takes control when it is supposed to, approximately three pounds higher than the normal pressure regulator.

The feed water level control system, we

operate normally in three element control, and so the input is from feedwater and steam flow have been changed.

We are going to do some specific testing of that unrelated to our digital feedwater at Quad Cities and Dresden, which went digital a number of years ago.

And doing incremental level changes and verify the system response as stable. We will put one feed rate valve in manual and make adjustments to it, and verify that the other valve can control adequately.

And then we will do that at varying power levels to ensure that it is stable over the range of normal operation for them. We will be doing specific system equipment performance monitoring.

These are mainly geared towards the balanced plant systems, which are the ones being modified for EU. Each parameter we have gotten from the system engineers are predetermined acceptance criteria.

And the performance parameters, as we go up through our 3 percent increases each day, that is where we will be collecting the data, and comparing that, and seeing if any changes need to be made to the plan, and to the system operation before we continue our increase.

In addition, there are the 10 balance of plant systems that we have selected, and we will also be monitoring the recirc pumps since we will be operating those at a higher RPM than we are currently and also the reactor, and just verifying that we don't see anything odd happening there.

Specifically, we are increasing the flow in the feed water and steam -- main steam line piping, and want to verify that we don't have excessive vibration and it is difficult to try to determine ahead of time where that may occur.

And so we are putting vibration monitoring equipment, both inside and outside containment. We will be getting lower power vibration data, which I talked about earlier, and we are getting about 50 percent power.

And then the acceptance criteria are established from the ASME stress analysis limits on what is acceptable and what is not. And we won't exceed any of those limits.

In conclusion, we have completed at Dresden extensive training, and we will complete at Quad Cities extensive training for the operators, which has used both the design features and are operating and experience from other plants, the testing plans, incremental and comprehensive, and gives us good guidance before we increase power to the next level.

And the project implementation will ensure that EPU is implemented as designed. Do you have any questions? If not, with that, I will turn it over to Jeff Benjamin, Vice President of Licensing and Regulatory Affairs.

MR. BENJAMIN: Since I am on the verge of having to say good evening, I will make my remarks brief. First of all, we are pleased to have the opportunity this afternoon to present our submittal.

As I think we articulated at the beginning of this presentation, our objective at the outset of this project was to increase the power output for the Dresden and Quad Cities stations, while maintaining the appropriate operating margins, and continuing to operate the units safely and reliably.

I think the project team that has worked for the past two years in partnership with our vendors, have met those objectives as we talked about today, and as supported by the bullets up on the slide, I think our package before the Commission for their review and approval also reflects those points.

I want to particularly emphasize what Tim touched on last, and that is that we have had the opportunity to go through three power uprates in our fleet over the past couple of years, and have learned through each one of those the importance of our change management program, including the operator training, testing program, and the monitoring program.

And I am confident that the infusion of those lessons learned, as you just heard Tim articulate a piece of. We will also add confidence that the assumptions that went into the power uprate package will be borne out and tested out appropriately as we bring the unit up on line, and as we test it out at the higher power levels.

So, in summary, we believe that the submittal that we have before the staff demonstrates the acceptability of our proposed power uprate, and that completes our presentation, subject to any questions.

CHAIRMAN WALLIS: Thank you very much. Do we have any questions from the committee or consultant?

Now, you are going to make a presentation to the full committee, and you are going to compress this presentation by a factor of eight or something like that?

MR. HAEGER: Yes, and we would expect some guidance from you on that.

MR. BENJAMIN: I think we would anticipate working with you on the areas of emphasis that you would like to see, and obviously we would compress that material accordingly to facilitate the discussion within your schedule constraints.

CHAIRMAN WALLIS: I think things that you can show in a diagram would be helpful; like with numbers with the containment analysis and the conclusions from the ECCS and so on, and show that you met some criteria specifically.

CHAIRMAN WALLIS: Okay.

MR. BENJAMIN: I also assume that you would look for a condensed version of our risk discussion?

CHAIRMAN WALLIS: I would think we would need that, yes. We need a very brief overview to remind the committee of what is involved with this EPU, in terms of changes in flow rates and so on.

MR. BENJAMIN: We will clearly articulate differences between Dresden and Quad Cities as well in the presentations. So we won't have to go over that again.

DR. SCHROCK: I would think it would save time.

MR. BENJAMIN: I think it will, yes.

DR. KRESS: I think you want to talk about your reasons for doing the transient test, because that will be a question of contention perhaps.

MR. BENJAMIN: Very good.

CHAIRMAN WALLIS: Do we need anything on stability?

MR. BENJAMIN: I had a chance to observe the Duane Arnold presentation, and we may have an opportunity with the full committee to go back over the power to flow chart one more time, and have a chance to articulate exactly how we operate in the higher power regions.

And in a very practical way I think show how we do that, and --

CHAIRMAN WALLIS: This is part of the overview?

MR. BENJAMIN: This would be part of an overview, and I would suggest that Tim could go back through that again with the full committee and do that rather efficiently. And I think that would be worthwhile as well.

DR. FORD: As part of the materials degradation is concerned, I guess one bullet.

MR. BENJAMIN: No problem.

DR. FORD: I don't know if I am allowed to say anything. Am I?

DR. KRESS: Yes, you can say or talk about things like that.

CHAIRMAN WALLIS: Yes, you can.

DR. FORD: Well, I don't see any problems at all with that.

DR. KRESS: Well, it seems like they might want to discuss the FAC, because that is what will come up at the full committee.

DR. FORD: There is a whole range of things, such as the FAC, the flow induced vibration, and potential cracking of the core shroud. It seems to me that all of those issues were in fact being adequately managed. We all recognize that they are being adequately managed.

DR. KRESS: And I think that the committee would probably have a preconceived notion that extended power uprates only affects FAC.

MR. BENJAMIN: So could I suggest that we would have one slide that would cover that topic, and that would have the bounds around how we are managing our materials and draw those conclusions?

DR. FORD: Well, depending on what we hear from the staff, and they don't have any problems with that.

CHAIRMAN WALLIS: And for accuracy, you could have a summary slide for ATWS.

DR. SCHROCK: One thing that never came up in this meeting that I wondered about and that is the statement in the SERs that the task code has not had prior NRC approval, but it is under review.

MR. HAEGER: Dan, can you speak to that?

DR. SCHROCK: That ought to get clarified I would think.

MR. PAPPONE: This is Dan Pappone. The task code has been accepted for transient evaluations, and delta-CPR evaluations, and it is currently under review for the LOCA considerations, where we are using it and taking it one step further.

As far as transients, we are looking at whether or not when or if transition occurs, and in LOCA we are looking at when and where. But that is under review.

DR. SCHROCK: When I look at this table of computer codes used for EPU, for transient analysis, and ATWS, you have a number of codes, and it appears in both places.

MR. PAPPONE: Right.

DR. SCHROCK: It is a little hard to tell -- and also I think it is G.E. terminology. You have SAFER/GESTR, which is a cover name for amalgamations of these various codes; is that right?

MR. PAPPONE: That's right.

DR. SCHROCK: And I may be alone in not understanding how they go together to do what you are doing it with it, but maybe that is something that needs to be clarified.

DR. KRESS: It certainly would be nice to see that database that you referred to on the ODYN code that shows that you are still within the parameters that it has been validated at.

MR. BENJAMIN: Would you like us to submit that prior to the full committee, or would you like us to submit that at the committee?

DR. KRESS: At the full committee would be fine.

MR. BENJAMIN: Okay. That's fine.

CHAIRMAN WALLIS: On the piping and reactor internals, I don't think you need to spend very much time. I think you do have to address the fluence issue, because they expect it to go up and it went down, or it appeared to go down.

DR. FORD: I think that comes under materials degradation.

CHAIRMAN WALLIS: Well, we don't need to go into a lot of the --

MR. BENJAMIN: That would be an approximately one slide treatment as you suggested, yes, and we would pick that up in there.

CHAIRMAN WALLIS: If there is nothing else, we will recess until tomorrow at 8:30 a.m., and we will then hear from the staff.

(Whereupon, the meeting was adjourned at 5:38 p.m, to convene at 8:30 a.m. on Friday, October 26, 2001.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: ACRS Thermal Hydraulic Phenomena Subcommittee

Docket Number: (Not Applicable)

Location: Rockville, Maryland

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Paul Intravia

Paul Intravia
Official Reporter
Neal R. Gross & Co., Inc.