Official Transcript of Proceedings ACRST-3172

NUCLEAR REGULATORY COMMISSION

ORIGINAL

Title: Advisory Committee on Reactor Safeguards
486th Meeting

PROCESS USING ADAMS
TEMPLATE: ACRS/ACNW-005

Docket Number: (not applicable)

Location: Rockville, Maryland

Date: Thursday, October 4, 2001

Work Order No.: NRC-039

Pages 1-265

TR04

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

OCTOBER 4, 2001

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

486TH ACRS MEETING

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THURSDAY

OCTOBER 4, 2001

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ROCKVILLE, MARYLAND

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The Advisory Meeting met at the Nuclear Regulatory Commission, Two White Flint North, Room 2B3, 11545 Rockville Pike, at 8:30 a.m., Dr. George E. Apostolakis, Chairman, presiding.

PRESENT:

DR. GEORGE E. APOSTOLAKIS, Chairman
DR. MARIO V. BONACA, Vice Chairman
DR. DANA A. POWERS, Member
DR. WILLIAM J. SHACK, Member
DR. THOMAS S. KRESS, Member at Large
DR. JOHN D. SIEBER, Member
DR. F. PETER FORD, Member
DR. GRAHAM B. WALLIS, Member

ACRS STAFF:

DR. JOHN T. LARKINS, Executive Director

DR. PAUL A. BOEHNERT, Executive Secretary

MEDHAT EL-ZEFTAWY, ACRS Staff

DR. ROBERT ELLIOT, ACRS Staff

CAROL A. HARRIS, ACRS/ACNW

DR. JAMES E. LYONS, ADTS

SAM DURAISWAMY, ACRS

DR. SHER BAHADUR, ACRS

PRASAD KADAMBI

I-N-D-E-X

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

(8:30 a.m.)

CHAIRMAN APOSTOLAKIS: The meeting will now come to order. This is the first day of the 486th meeting of the Advisory Committee on Reactor Safeguards.

During today's meeting the Committee will consider the following:

The Duane Arnold Core power Uprate; and the Readiness Assessment for Future Plant Designs and the Staff Proposal Regarding Exelon's Regulatory Licensing Approach for the Pebble Beach Bed Modular Reactor.

The Action Plan to address ACRS Comments and Recommendations Associated with the Differing Professional Opinion on Steam Generator Tube Integrity.

And the Proposed Resolution of Generic Safety Issue 173A, the Spent Fuel Storage Pool for the Operating Facilities; and the Proposed ACRS Reports.

A portion of this meeting may be closed to discuss General Electric Nuclear Energy proprietary information applicable to the Duane Arnold core power uprate.

This meeting is being conducted in

accordance with the provisions of the Federal Advisory Committee Act. Dr. John T. Larkins is the designated Federal official for the initial portion of the meeting.

We have received no written comments or requests for time to make oral statements from members of the public regarding today's sessions. A transcript of portions of the meeting is being kept, and it is requested that the speakers use one of the microphones, and identify themselves, and speak with sufficient clarity and volume so that they can be readily heard.

We will begin with some items of current interest. You all have this document with items of interest, and it contains a speech by Chairman Reserve on the growing area of radiation protection of patients. He gave his speech at the IAEA general conference of senior regulators.

And also there are some safety significant findings that would be of interest to us when we discuss the reactor oversight process. There was a yellow finding at the plant and six white findings. I found them very interesting to read for later this afternoon.

The NRC is putting together the 2002

regulatory information conference, and requesting suggestions for agenda items. If you have any, you have by October 5th to send them to the staff.

And Dr. Larkins has a short announcement to make. John.

DR. LARKINS: Yes. Good morning. Members of the public and all non-NRC employees attending this meeting to be escorted when leaving this floor. It would be appreciated if people would leave at the end of the session, such that an ACRS office individual can escort you to the first floor.

An escort will be available at the end of the session, or each session, to take individuals down to the first floor on the elevator. Obviously, this does not preclude individuals from using the facilities, the restroom facilities and others on this floor, as a guard will be stationed outside of the meeting room.

We appreciate your cooperation in what we hope will be a temporary situation. Secondly, I would note for ACRS members and staff, that the Deputy Executive Director for Management, Ms. Pat Nouri, will give a presentation at one o'clock today in this conference room on security issues at I and II White Flint Complex, and other matters.

You are invited to either have your lunch before or during this discussion, and she will answer questions related to matters surrounding the operation of the two buildings. Thank you.

CHAIRMAN APOSTOLAKIS: Two more items. By a voice vote on September 26th, the Senate confirmed former Commissioner Diaz to serve a second term as an NRC Commissioner, through June 30th, 2006. Dr. Diaz will be sworn in today for his second term.

And the last item is that because of illness, our member, Graham Leitch, will not be attending this meeting. He is at home recuperating, and of course we all wish him a speedy recovery.

Now, back to the agenda. The first item is the Duane Arnold Core Power Uprate. Dr. Powers is the Cognizant Member. Dana.

DR. BONACA: I would like to make a statement. I have a conflict of interest.

CHAIRMAN APOSTOLAKIS: So you will keep quiet for a change?

DR. BONACA: I will try to keep quiet.

DR. FORD: On the Duane Arnold issue, I have a conflict of interest being a former GE employee.

CHAIRMAN APOSTOLAKIS: It is going to be

a quiet meeting. Dr. Powers.

DR. POWERS: Gee, I don't have any conflict of interest. Sorry. Well, we are going to discuss the application for a power uprate from Duane Arnold. It has significance for us, and it is the first that we have heard of many that we expect to come in the future.

Many, if not all, of the BWRs, were designed for much higher powers than they have been operating for the last several years. They were kept at a somewhat lower powers because of concern over the ATWS and the reactor stability issue back a long time ago, and part of that concern came from the ACRS itself.

So it is somehow fitting that we should hear about the relief from that concern, which has come about in a generic way from General Electric. When we go into this power uprate, you are going to see that the applicant and the staff have addressed a host of issues, quite a lengthy list of issues that had to be addressed in looking at these power rates.

But in truth, they are relatively few that are of particular concern. Those tend to be the ATWS, the operator response times, material degradation, and some infrequencies in the containment response capabilities, and I think that is where the committee should be focusing its attentions.

The application that is being made here is not a risk informed application. This is a classic deterministic application. But I think you are going to find that risk is a language that has crept into the classic deterministic analyses, and has played a role.

And in some cases I might say the applicant has done some very imaginative and creative things in the use of risk, even though he has a deterministic application here.

And I think it would be great fun to have them back and go through in some detail the risk portions of what they have done with their plant, because I think we would find it interesting on what they have been able to do, and what they have been able to learn from risk.

But that is not our focus here. The order of presentations today is going to begin with a presentation by the applicant himself. We have given him a very easy chore. We have only asked him to compress 4-1/2 hours of a very detailed presentation into 26 minutes or so.

And in looking at his view graphs, he has done a manful job of doing this, but do recognize that he is giving a synoptic account of all that they have done; and that will be followed by the staff, who are equally time constrained for their -- what amounted to a little over 4 hours of presentation on their part before the subcommittee.

So with that, I am going to introduce Ron McGee to begin the presentations, and Ron, you will introduce Tony and other people as they present.

MR. MCGEE: That's correct. Thank you, Dr. Powers. Good morning. As he stated, my name is Ron McGee, of the Nuclear Management Company at the Duane Arnold Energy Center.

We have been asked to provide an overview of the material that we presented to the subcommittee, the Thermal Hydraulic Subcommittee, and as a subcommittee members kind of test, we provided a large amount of information.

And hopefully we can address any of your questions. As you can see from the introductory slide, our original rated thermal power was 1593 megawatts thermal, and we uprated the plant in the early 1980s, and are currently licensed for operation at 1658 megawatt thermal.

The application that we have before the

staff at this time is for operation at 1912 megawatts thermal. We prepared a deterministic application in accordance with the previously approved General Electric topical reports.

Although the application was not a risk-informed submittal, we have performed an impact review utilizing our PRA, and I will point out how that information was utilized in some of our upcoming slides.

Concerning the modifications for power uprate, we installed all of the necessary safety related hardware changes during the 2001 spring refueling outage. For the balance of the plant, we have decided to implement the power uprate in two phases.

They are the modifications in Phase I for operation up to 1790 megawatt thermal, which were also accomplished during our spring refueling outage. The remaining modifications will be installed during a future refueling outage.

Operator training. Once the engineering evaluations were completed and the modifications were designed, we began training the operators on the impacts of power uprate.

In the classroom, we emphasized the design basis changes, and explained the plant equipment modifications. In the simulator, we showed them static and dynamic examples of the most significant changes, and then put the crews through routine simulator accident and transient scenarios.

The PRA analysis and the engineering evaluations each pointed out the importance of the ATWS event as we mentioned earlier. Specifically, the operators' ability to correctly inject standby liquid in a timely fashion is critical to mitigate this event.

So we emphasize this point in the classroom, as well as in the simulator training sessions. The revised PRA assumes a 20 percent failure rate for injecting standby liquid.

In reviewing past performance records, we found 58 evaluated ATWS, with a 100 percent success rate for the operating crews completing this task for injecting standby liquid.

DR. POWERS: This is a striking thing. I mean, you go through the human reliability analysis, and you come up with .1 and .2, and some sort of failure rate. You get a hundred percent success rate in your training exercises.

And I looked at some of the studies that have been done in the past, and while I find for in NUREG CR 3737 that they went through an analyses, and they came to the conclusion that there was no relationship between scores during training exercises, and air rates by plants. Do you have any thoughts on that?

MR. MCGEE: We merely used the information provided to us by the training session as a benchmark so that we were certain in our minds at least that the failure rate that we had chosen was at least conservative.

So utilizing the industry acknowledged standard for error rates for operators, we were confident that we were bounded by that particular document.

CHAIRMAN APOSTOLAKIS: Where did that 20 percent come from?

MR. MCGEE: Brad, could you address that, please, the 20 percent that we assumed in the PRA analysis for the operator failure rate for injecting standby liquid.

MR. HOPKINS: This is Brad Hopkins from the NMC. The error rates that we used come from a variety of industry standard methods for determining human error probabilities. So we have a formula that considers the complexity of the actions, and how time they have to achieve the actions.

DR. POWERS: Can you give us an idea of how the time changed, and from your originally licensed power to the higher level, or the intermediate to the higher, whichever one is easiest for you to do.

Well, for the key operator action, or for the ATWS event, is the time available for injecting standby liquid control, and there we have values for early injection, and one for late injection.

For early injection, the time decreased from six minutes to about four minutes; and for late injection, I believe from 15 minutes down to about 12 minutes.

CHAIRMAN APOSTOLAKIS: So what was the failure rate when the time was 6 minutes?

MR. HOPKINS: You will have to excuse me. I have a slide with that number on it. Just a minute.

CHAIRMAN APOSTOLAKIS: So are you planning to talk about these things later?

MR. HOPKINS: Yes.

MR. MCGEE: We do have a slide presentation on PRAs.

CHAIRMAN APOSTOLAKIS: So you know then

what question I am going to ask.

MR. HOPKINS: Yes. Here is the answer. From .11 to .18.

CHAIRMAN APOSTOLAKIS: And we will have some questions on that later.

MR. HOPKINS: Okay. Very good.

DR. POWERS: In my thinking on this subject is the human reliability analysis has done its job here, and that you record a relatively high potential for failure in this operation, and consequently you train on that.

And we can't just help feel that training must help in keeping that number lower than perhaps we calculated here. We may not know exactly what it is, but at least we are providing experience and training with this kind of an event.

MR. HOPKINS: That's correct.

DR. POWERS: That is my interpretation of what has happened here.

MR. MCGEE: Unless there are other questions at this point, I would like to turn the presentation over to Tony Browning.

MR. BROWNING: Good morning. Once again, my name is Tony Browning, and I am with the NMC at the Duane Arnold Plant. I have the privilege this morning to present to the ACRS the results of our thermal hydraulic evaluations for EPU, our reviews of plant materials in the EPU environment, and finally our investigation into risk insights from EPU operation, using our probablistic risk assessment methodologies.

Today I will briefly summarize our evaluation in these key thermal hydraulic analysis areas. For the ATWS EPU evaluations, we analyzed the four bounding events identified by the generic studies in the ELTRs:

The main steam isolation valve closure transient, and the pressure regular failure open transient, and the loss of off-site power transient, and the inadvertently opened relief valve transient.

These evaluations were performed using NRC accepted methods and assumptions. This is a deterministic evaluation, with conservative assumptions and acceptance criteria; as opposed to our more realistic or best estimate evaluations performed with our PRA models, which I will discuss later in a presentation.

The purpose of this evaluation is to demonstrate compliance with prescriptive hardware requirements of the ATLS rule, 10 CFR 50.62, by showing conformance to the underlying analysis basis for BWRs as documented in the GE topical report NEDE-24222.

As we can see the results were all within their respective acceptance criteria, with margin. Thus, the DAEC will continue to comply with the ATWS without changes to the existing plant hardware.

Next I would like to discuss our evaluation of thermal hydraulics stability. First, I would like to start off with some background information. The DAEC has implemented the stability solution called Option 1-D.

The key point of the Option 1-D solution is that it has been demonstrated that these plants, through their inherent design characteristics, are only susceptible to core wide or fundamental mode oscillations, and not the regional or higher harmonic oscillations.

This greatly simplifies the solution approach. This solution utilizes a combination of prevention with detection and suppression measures to conform to general design criteria 12.

DR. POWERS: What this means is that you are getting parallel channel flow problems?

MR. BROWNING: No. That's the regional mode, where you have one side of the core oscillating out of phase with the other side. Our plant is not susceptible to that mode of oscillation.

It is only the fundamental mode where the code is oscillating in unison.

DR. POWERS: It is sometimes called the direct loop oscillation?

MR. BROWNING: Correct.

DR. POWERS: And it is an NED24222 that I will find the mathematics on this?

MR. BROWNING: No, the General Electric topical report that I referenced earlier was for the ATWS evaluation. I'm sorry, but off the top of my head, I don't remember the topic number for that solution.

DR. POWERS: I have looked, and I cannot find the underlying analyses that support your contention.

MR. BROWNING: It is in one of the early topicals, but I don't know it off the top of my head.

DR. POWERS: If you happen to find that after we are done here, I would sure appreciate looking at it.

MR. BROWNING: Very good.

DR. POWERS: I am willing to believe right now, but --

MR. BROWNING: Yes. Prevention is accomplished by establishing this exclusion zone right here, this red line, on the power to flow map. Operation is restricted in this region inside of here.

Thus, we prevent the oscillations by affording the area of operation most susceptible to instability, and we introduce a 20 percent margin by using a conservative criteria of 0.8 for the calculated K-ratio used to establish this boundary.

We introduce additional margin by establishing this buffer zone, represented by the orange line, by adding another 0.05 to K-ratio margin to the exclusion zone, where operation is allowed only when the SOLOMON software is available on the plant's core monitoring computer.

The SOLOMON software is the same model as ODSY, the frequency domain code used to calculate the decay ratios used to establish the exclusion zone and buffer zone boundaries.

So we are only allowed to operate in this region between the two lines when SOLOMON is available to provide the operators a prediction of their margin to an unstable condition.

Otherwise, operation is prohibited in the boundary zone region as well.

DR. KRESS: This is a picture of how you start up and shut down?

MR. BROWNING: Correct.

DR. KRESS: Are there accident conditions that will force you into that zone?

MR. BROWNING: Yes, there are. Any number of transients, either single or dual pump --

DR. KRESS: Will take you down the mellow line.

MR. BROWNING: -- will put us down into this region, right. And the operators are instructed any time they enter the exclusion zone to take prescriptive measures to leave that zone immediately.

And if they notice any instability condition on their in-core monitoring, they are to SCRAM the plant immediately. Detection and suppression comes from the flow bias neutron flex reactor trip signal.

We validate this capability by demonstrating analytically that any oscillation will be suppressed by this flow bias SCRAM prior to the fuel experiencing a transient that would exceed the safety limit minimum critical power ratio.

While the major impact of extended power uprate on thermal hydraulic stability is through the introduction of MELLLA, which is raising the rated load line from the black line to the blue line, which expands the size of the exclusion and boundary zone regions on the power to flow map, the operational impact is acceptable as seen by this actual plant start-up trace.

As we see, it is possible to maneuver the plant around these zones, and thereby introducing more margin in the stability.

DR. POWERS: When you plot power versus flow, if I were to look at power versus time, would I see a continuous curve here, or would I see a lot of steps and overshoot and undershoots of that curve?

MR. BROWNING: I will let Steve answer that, our plant operator.

MR. KOTTENSTETTE: I am Steve Kottenstette, and I am an operations shift manager at the plant. Normally over time, you will see us come up in power and stabilize to do some annual requested testing, and then go up.

We don't have overshoots or anything. We just pretty much gradually go on up in power.

DR. POWERS: So where you come up and enter your buffers or touch your buffer zone margin at about 25 million pounds per hour, I would not see you jumping in and out of that buffer zone?

MR. KOTTENSTETTE: No, you wouldn't. Remember that the start up here is to our current 1658, and the power flow map that you have there is actually what we will have.

DR. POWERS: I understand that. I am just asking generically what the curve is. It seems to me that the curve could have been drawn with a much wider pencil if there was a lot of overshooting and undershooting, and things like that. You are really telling me that I am really looking at the outer bounds on it?

MR. KOTTENSTETTE: Right.

MR. BROWNING: Thus, by establishing conservative boundaries for the exclusion and boundary zones and demonstrating the detect and suppress capability of the flow by flux SCRAM to ensure that safety margins are maintained under extended power uprate operation.

And as seen from our start up example, adequate operating margins exist under extended power uprate as well. Now I would like to move on and discuss the impact of a potential --

DR. WALLIS: While you have got this figure up there, you are a hundred percent power, and you are asking for 1912 megawatts, and it looks like if it is a very small region of flow rate that you can be in to be at the hundred percent power.

MR. BROWNING: Right.

DR. WALLIS: And you are right in the corner of that graph, and the question is whether you can really keep it as close as that without stepping over some boundary. There is very little room for error up in that corner.

MR. BROWNING: A very astute observation, Dr. Wallis. Our reactor engineering crew is going to be challenged to find drive patterns that will allow maneuvering in here. Most likely what will happen is that we will have to be very slow and deliberate in this region to ensure that we don't encroach on the boundaries.

And so again you are very astute. It is going to be somewhat of a challenge to operate up in this very tight corner of the power plant.

DR. WALLIS: And as your fuel burns up, you will have different work patterns and so on in order to maneuver in there.

MR. BROWNING: Correct.

DR. WALLIS: So you might well find yourselves operating at 95 percent power for quite a while until you learn how to get up there.

MR. BROWNING: Yes. We will need to have some operating experience in this region in order to better refine our capability there.

MR. MCGEE: And also -- this is Ron McGee -- during our interim plant, or during our phase one session, we expect to accumulate quite a bit of operating experience because we will have a larger flow window. We will be operating between our current and the expected maximum allowable.

MR. BROWNING: Right.

DR. WALLIS: And if you look at what you do now, that wanders around in an almost erratic way as you search for broad patterns near the top in the present plant.

MR. BROWNING: Yes, and also compensating for Zenon as things build in. Now I would like to move on and discuss the impact of a potential ATWS instability during DPU operation.

As part of the closure of thermal hydraulic stability issues, generic studies were performed to determine whether the combination of a core wide instability event with failure to suppress the oscillations by a plant SCRAM because of an ATWS event would lead to significant fuel failure.

And if so, to determine mitigating strategies that would minimize these impacts, because the first study did confirm that such an event, assuming no mitigation at all, would lead to unacceptable fuel cladding failure.

And a second study was conducted to find mitigating strategies. The conclusion of the second study confirmed that existing ATWS strategies implemented by the BWR owners group emergency procedure guidelines were effective in precluding these fuel cladding failures.

And these being lowering the water levels below the feed water sparger, which reduces the core inlets subcooling, and which lowers the magnitude of the power spikes during the oscillations.

And, second, and in the lower term, injection of boron through the standby liquid control system to completely dampen the oscillations.

DR. POWERS: When these studies were done did they consider the power profiles similar to the type that you will have once you start operating at the higher power?

MR. BROWNING: Yes, and that is a good seagueway. The generic studies were found to be bounding upon Duane Arnold because they had previously considered operation in the MELLLA region.

And they were also looking at peak bundle powers significantly higher than what Duane Arnold will be operating after an extended power uprate. So it is the peak bundle power that drives the response, and that was bounding upon us.

DR. POWERS: I guess what I am questioning is whether the peak bundle power is really what is limiting here, or does it make a difference how that power varies along the length of the core?

And the reason for asking the question is that it is fairly simple. You lower the water levels so that the collapsed level is below the top of the core. So you are relying on a certain amount of steam cooling for the upper region of the rods.

Now, your upper regions of the rods have a higher decay power than they would if you had a classic cone type of power distribution. You have a little different one now.

And so what I am asking you is does that make any difference in this recovery process or is it being looked at?

MR. BROWNING: Unfortunately, I am not the person to ask that. We don't have our General Electric experts with us today.

DR. POWERS: Gee, with all the conflicts of interest at the table, maybe they could answer.

MR. BROWNING: One of the things that is important in the extended power uprate for Duane Arnold is that we are going to the GE14 fuel design, which has partial length fuel rods.

So that tailors the power shape in the upper region to keep it from being overly top-peaked. So by that combination, I think if we did do the investigation we would find that that would be the factor that would keep us bounded by the study. And you have stolen most of my thunder of this presentation.

DR. POWERS: Keep covering your thunder. Don't stop.

MR. BROWNING: And one of the important points of this is what we have touched on; is that the peak bundle power under extended power uprate is not increasing from where it is today.

What we are doing is flattening the radio profile and raising the average core power so that the peak bundle response is not changing from where we are today.

DR. POWERS: I have to admit that when you first came into this application for a power uprates, and you find that nothing seems to change, you are wondering if it is done with smoking mirrors here.

MR. BROWNING: That is a astute observation, because you find through this exercise the parameters that do drive the response, and it turns out in many cases that just basic power level is not one of them.

But this is an area of containment where we will see it. We will see it. So, for the DAEC extended power uprate, we reanalyzed the containment response using previously approved NRC calculational models and assumptions for the FSAR events.

To illustrate the impact of EPU, let's look at both the short term and long term cases for the design basis loss of coolant accident. First, for the short term response, the increased subcooling due to EPU increases the blow down flow rate, which directly drives the dry wall pressure response.

As we see here the dry wall pressure increases slightly due to EPU, but we are not increasing the reactor pressure, and the impact of EPU is not dramatic in the short term. So, we have learned it is the reactor pressure that drives this response, and not the sub-cooling.

However, because the decay heat power

increases proportional to the increase in core thermal power, the long term impact is a bit more noticeable as you see here.

DR. WALLIS: But that temperature depends upon the temperature that it starts out at doesn't it?

MR. BROWNING: That is correct.

DR. WALLIS: So how close is the initial temperature controlled?

MR. BROWNING: That is controlled by technical specifications in our license. We are not allowed in steady state operations to go above 95 degrees unless --

DR. WALLIS: So this is calculated assuming you are at 95 when you start?

MR. BROWNING: That is correct. That is a conservative input measure.

DR. ROSEN: At the time that you reach the 215.3 degrees in the suppression pool what is the pressure in the containment?

MR. BROWNING: At the corresponding time?

DR. ROSEN: Yes.

MR. BROWNING: Do you have that number, Al?

MR. RODERICK: Not off the top of my head, no.

MR. BROWNING: Do we have one of our back up slides?

(Brief Pause.)

MR. BROWNING: We are looking it up for you. We will move on then. This impact is also true in the calculation of net positive suction head in the emergency core cooling system, plus taking suction from the suppression pool.

The hotter pool, due to increased decay heat from EPU, leads to an increase in the amount of over pressure required to ensure adequate MPSH. It should be noted that Duane Arnold has always been licensed to allow over pressure for meeting adequate MPSH.

As we see here the DAEC's dependence is not in the short term, but only in the long term. We also see that we have adequate margin between the 5.3 psi that is required, and the 13.3 over pressure that is available during the peak suppression pool temperature for MPSH.

DR. POWERS: I think that gives us the pressure doesn't it?

MR. BROWNING: It is similar, but this is a slightly different analysis, with slightly different assumptions. So it is not quite the answer you were looking for.

DR. KRESS: Usually in the long term the pressure corresponds to the saturation pressure from the temperature in the pool. That is probably pretty close.

MR. BROWNING: It is very close.

DR. POWERS: It seems to me that if I was going to have to have over pressure giving me enough net positive section head, I would want it in the short term and not want it in the long term. And it seems exactly the opposite here.

And things are going to degrade and I am going to lose pressure and it is in the longer term and not in the short term.

DR. KRESS: Well, I don't know when they call to require that section head. It is probably needed in both short term and long term.

DR. ROSEN: I think what they are saying, Tom, is that it is not needed in the first 10 minutes. It is beyond 10 minutes where it is needed.

DR. WALLIS: But the two are interrelated. I mean, the amount of containment pressure and the amount of MPSH you need is sort of interrelated, because the temperatures are interrelated anyway.

MR. BROWNING: A lot of it has to do with the density of the water in the pool, and so that is what happens, and that is what you see in the longer term.

It takes a while for the pool ot heat up, and then at that point with the new strainer designs that we have, and the assumption of the debris loading, it is not until much later when we get into a position where we require the over pressure in order to meet MPSH.

All right. This is the time response in hours for the event, and as we see here, the red line is the required MPSH for the core spray pump, which is bounded over the RHR pump, and we can see here the time frame in which we need the over pressure as we cross over atmospheric. So it is after about the first hour into the event, and lasts until about 23 hours.

DR. WALLIS: That's what I mean about the temperatures being interrelated. These curves all have the same shape, and if you are going to change one by something, then probably the others will change as well. If you have some sort of containment, then they will all change.

MR. BROWNING: Right, and you can see here that this is the actual response, and it is significantly more throughout the duration.

DR. POWERS: So we have about a one day window in which we need over pressure.

MR. BROWNING: Correct.

DR. POWERS: And so we can't have any degradation of the drywall pressure boundary during this period, right?

MR. BROWNING: That is correct. One of the assumptions that goes into this calculation -- and Mr. Roderick can correct me if I am speaking out of turn here, that one of the assumptions for this analysis is we assume twice the tech spec allowable leakage rate for the containment to do these calculations. So it is a conservative calculation.

DR. POWERS: Well, why did you pick twice? Why not 10 times?

MR. RODERICK: This is Al Roderick with Duane Arnold. The assumption of a 5 percent leakage, which is a little over twice the tech spec limit, is consistent with the way that the containment analysis was done when we established over pressure for the original license. And that assumption was used at the original plant licensing.

DR. POWERS: Well, you didn't really tell me what the underlying scheme is.

DR. WALLIS: It is really a factor of two because this is thermal hydraulics. If it were a PRA, you would use a factor of 10.

DR. POWERS: I understand. And if it were metallurgy, we would use a factor of a hundred, right?

DR. BONACA: I have a question. Did you have to make any changes to your EPGs?

MR. BROWNING: As a result of?

DR. BONACA: As a result of -- well, these issues, but also power uprate in general.

MR. BROWNING: No, we did not. There is subtle changes in some of the parameter graphs that are driven by the decay heat levels, but the actual flow charts with the operator actions and precautions were not changed as a result of the EPGs.

DR. BONACA: When you went through a total review of the EPGs?

MR. BROWNING: That is correct.

DR. POWERS: This requirement for over pressure for net positive section head, however, is not qualitatively different than what was required in your original license, and there is simply a quantitative difference?

MR. BROWNING: That is correct. The shape of this curve is fundamentally the same as it was in the original license.

DR. POWERS: Was the period of time that you needed for the net positive section head, has that changed?

MR. BROWNING: I can't answer that today, Dr. Powers. We would have to go back and look, unless Al has information on that. Were you able to do some background there?

MR. RODERICK: This is Al Roderick. Just from the standpoint of the increase in the power level, the decay heat is going to be running you out further.

So given that the pool temperature really drives when you need the over pressure, I would say the time from the time that the overpressure is needed at 1593, compared to 1912, yes, we are going to need a longer period of time.

DR. POWERS: The curves are all the same shape. It is adding one thing. It is not like we have a very long tail here.

MR. RODERICK: While I am up here, the answer -- you asked what the containment pressure was when we are at the peak pool temperature of 215.3 for this event, in looking at the graphical results, we are about at 20 psig for containment pressure at that point in time.

MR. BROWNING: If there are no more questions, I would like to move on, and we would like to talk about ECCS analysis that was performed. The DAEC has utilized the SAFER/GESTR methodology for ECCS analysis prior to EPU and this is an entire change for us.

Under the SAFER/GESTR LOCA methodology approved under the provisions of SECY 83-472, for the use of nominal or more realistic models, dual acceptance criteria, are applied.

First, the licensing basis peak cladding temperature is calculated using the required Appendix K inputs to demonstrate conformance to the 50-46 acceptance criteria of 2200 degrees fahrenheit.

The second acceptance criteria is on the so-called upper bound PCT, which is calculated from the nominal inputs statistically adjusted for the uncertainties in the models due to both generic and plant specific inputs.

The resulting upper bound PCT is first compared to the licensing basis PCT to demonstrate that the licensing basis calculation is higher, and does a bounding result.

And then we ensure that the upper bound

PCT remains within the 1600 degree fahrenheit limit placed on the methodology, which ensures that the results stay within the bounds of the test data on which it is based.

DR. POWERS: Let me make this very clear. Is there two different analyses, with different sets of assumptions, going into them?

MR. BROWNING: Correct. And it is graphically depicted here. This figure is a bit busy, but it succinctly presents a number of key points about the analysis.

First, we see that for small and large breaks, they were analyzed to confirm that the large break, or the dba case here, remains limiting under extended power uprate conditions.

Next we see that the upper bound PCT is indeed less than the licensing basis PCT, and below its 1600 degree limit. In addition, we see that the licensing basis PCT has significant margin to its 2200 degree limit.

Now, comparing the current and EPU results, we notice that here in the small break LOCA, we see a slight difference. But as we move up at the licensing basis calculation, the EPU does not have as big an impact on the licensing basis PCT.

And this is because the peak bundle power is not changing from the pre-EPU conditions, which is what drives the PCT calculation. Thus, we conclude that under EPU, we have both substantial safety margins as required by the regulation, as well as a significant operating margin here. This concludes my presentation. If there are no further questions in this area --

DR. ROSEN: I do have a question. I would like to come back to the question and answer we had a moment ago about the peak pressure, and if you would go back to your slide nine.

(Brief Pause.)

DR. ROSEN: And when we talked about the suppression pool temperature in the long term, and the EPU conditions of 13.3 degrees, it was offered from the floor that that pressure is 23 psig in the containment at that time.

But if you go to the next chart in the long term, what we see there is that the pressure is 13.2 psig over pressure at the peak at the suppression pool temperature.

And I don't understand the distinction between those two numbers, and perhaps you could clear that up.

MR. BROWNING: The 13.2 psig is the over pressure required, and the absolute power is 28 pounds at that point.

DR. ROSEN: But I am comparing the 20 psig that was offered from the floor at that similar condition, and there was a statement made that they are not exactly comparable.

Hence, the difference between 13.3 and 20, but I don't understand the reasons why they are not exactly comparable. I don't expect those numbers to be the same.

MR. RODERICK: This is Al Roderick. Those are two separate analyses that use different assumptions. The DBA LOCA is using assumptions that will maximize pool temperature, and takes no credit for heat syncs, et cetera.

When we do a containment analysis looking at over-pressure, the assumptions that we make in that model, while we have to balance the needs, we are doing two things.

One, we are trying to maximize pool temperature, and at the same time we are trying to minimize containment pressure. So it is its own containment analysis. So that is why you see a lower pressure in the over-pressure for MPSH at 13.3 at its peak temperature, versus the 20 pounds in the DBA LOCA.

DR. ROSEN: It's a question of doing the conservatisms differently because of the two different acts or two different conditions. In one case, you are trying to show conservatively that you have enough MPSH, and hence you could up with a lower number.

MR. RODERICK: Correct.

DR. ROSEN: And in the other case, you are doing the DBA calculations to look at the containment response, and the margin to containment design conditions.

MR. RODERICK: That's correct.

DR. ROSEN: So I understand now. So what it is then is both of those analyses, if done conservatively, so that you have an appropriate margin of conservatism for the parameter of interest for that analysis.

MR. RODERICK: That's correct.

DR. ROSEN: Thank you.

MR. BROWNING: Let's now move on to a discussion on BPO and pictorial materials. Before I begin with my formal presentation, we would like to take this opportunity to address the subcommittee's open item from last week's meeting.

For the record, we have included in the handout package a copy of the written response that explains in the increase in stress on the main reactor flange from the increase in temperature due to EPU.

And I would be happy to address any questions that the Committee might have on this particular issue at the end of our prepared presentation.

With that, I would like to begin our discussion on the impact of EPU on materials, and specifically our programs for addressing flow assisted corrosion, otherwise known as erosion/corrosion and in-service inspection of the reactor vessel internal and associated piping systems.

DAEC has modeled its carbon steel piping systems, which are susceptible to flow assisted corrosion, using the EPRI CHEKWORKS package. The changes in flow and temperature profiles due to EPU have been modeled in CHEKWORKS and its resulting predictions for wear are being incorporated into the second and most important part of this program, which is the actual inspection of piping for wall thinning.

These CHEKWORKS predictions tell us to expect a slight increase in wear after EPU, on the order of a half, to one-and-a-half mils per year. But based on our base line from previous inspections, this increase in wear should not cause a wall thinning problem over the remaining life of the plant.

It seems that we have been blessed with fat pipes, with wall thicknesses on the high side, with the specified manufacturing tolerances. So we have installed margin in this area.

DR. ROSEN: What are the most sensitive components to flow assisted corrosion?

MR. BROWNING: It is generally the chemistry and the temperature.

DR. ROSEN: No, but what components do you find the biggest changes as a result of EPU?

MR. BROWNING: The feed water piping. We have a table for that. This is the results on the representative feed water piping that shows the increases. So from this we could see where the changes occurred in the parameters.

DR. POWERS: I think you will probably have to translate for the committee what DLA-02-E14 is. The Committee reads these things very thoroughly, but they probably just have a hard time recalling those particular sections.

MR. BROWNING: These are particular sections in feed water piping, and this is how we designate them in our plant drawings so that we know what we are talking about.

And this is an elbow, and as you can see, it is in elbows that you would expect to see most of the wear.

DR. ROSEN: This is main feed water piping at the elbows, and --

MR. BROWNING: Correct. You can see the current wear ways to predictions, and you can see the predictions, and then from there you can see how many bills of margin we have to the acceptance criteria. So, they say we are blessed with fat pipe.

DR. WALLIS: How do you measure a minimum thickness? You measure thickness at various places, but to get a minimum, you have to measure everybody?

MR. MCGEE: They have several spots when they pick a section of pipe, and they have a grid work that they work out for the entire pipe basically for --

DR. WALLIS: So it covers many, many, many measurements?

MR. MCGEE: Yes, hundreds of measurements in a small area.

DR. ROSEN: Now, you have a column called, "Current Predicted Wear Rate." And looking at the 10 inch elbow, it is 5.9 mils per year. Is that at the EPU, or is that prior to EPU?

MR. BROWNING: Correct. Here is the EPU wear rate, a 120 percent prediction. So you can see like we said about 1-1/2 mils in some of the larger areas as being --

DR. WALLIS: What was the actual wear rate from the measured values?

MR. BROWNING: This is the last --

DR. WALLIS: Yes, but what was the wear rate actually? Was it much less than predicted?

MR. BROWNING: Yes, it should be significantly less, and not having a prior inspection before the current one, we don't have that data available unfortunately.

MR. MCGEE: But the predictions versus the actuals, they do compare those, and they found a very good predictability of the wear rate. So it is very close to the actuals that they find in the model.

DR. ROSEN: If you would look with me at the 16 inch elbow, what you see is that there are lots of margin as you point out, but that the rate for wear for the EPU has gone up substantially from 3.6 to 4.9 mils per year, and that is about a 30 percent increase in the wear rate.

MR. BROWNING: Correct.

DR. ROSEN: So it is having a rather substantial effect on the feed water piping at these locations.

MR. MCGEE: And not necessarily from the flow. The temperature effect as we have discussed previously at the thermal-hydraulics subcommittee, depending on where in the pipe the temperature that you get the best or the highest wear rate at, the temperature may have moved up in the pipe or occurred earlier in the pipe now.

So this particular pipe might have seen a cooler temperature previously, but now because of a power uprate and the feed water heating effect that you get an increase in the temperature, and thus an escalated wear rate associated with that temperature.

DR. WALLIS: Maybe I could point out to my colleagues that the NRC is using a proprietary description of this, and that does give the predicted, versus the observed, in the corrections, et cetera.

So many of these questions are addressed here, and I don't think it is going to be talked about, but it is in this document.

DR. SHACK: Of course, they mis-labeled the figures, whether it is an over prediction or under prediction. But we can figure that out. Now, how long is the period between inspections?

MR. MCGEE: Refueling outages

MR. BROWNING: As we try to stretch them from an 18 to a 24 month cycle, and we are going to be transitioning to 24 month cycles.

DR. SHACK: So you use up about 10 percent of your expected margins or something like that?

MR. BROWNING: Yes. And we will now move on. For the reactor vessel internals, and other stainless steel components, those inspection programs conform to the recommendations that a boiling water reactor vessel internals project or VIP program.

So this program directs the scope and frequency of the inspections to be performed each refuel outage, and DAEC is a leader in the industry in implementing the recommended inspection program. DAEC is also a leader in the industry reactor water chemistry, and being the lead plant for both hydrogen water chemistry with crack or erosion/corrosion verification, as well as the application of Noble metals.

DAEC has performed two successful applications of Noble metals to date. Because of our good inspection results in the past, and by maintaining our excellent water chemistry program as we move into EP operation, and while we do not expect to see any impact on IGSCC susceptible components due to the uprate.

And while the core power is increasing substantially, the increase in fluence on key components, susceptible embrittlement or irradiation as to stress, corrosion, or cracking, such as the vessel walls, core shroud, or top guide, is not increasing as dramatically.

This again is the influence of the partial length full rods in the GE14 design. And with less fission taking place in the upper port of the core, where the fluence spectrum is hardest, we minimize the impact of the increase in core average power and flux profiles on that area of the vessel, and internals most susceptible to radiation damage.

Thus, we believe that with our aggressive monitoring programs for both fact and stress corrosion cracking, we will ensure adequate safety and operational margins are maintained as we implement the uprate.

DR. FORD: My original questions at the subcommittee meeting on this particular item really related to the fact that the VIP inspection schedules and deposition curves for degradation, those latter were based on data produced with very low flow rates in the laboratory.

And so the question really was how would you expect those degradation kinetics to increase or decrease with flow rate?

Now, those are not taken into account in the VIP documents, and flow rate is a critical change when you go to a power uprate in some components. So, that was the question. How would the risk increase because of specifically flow rate increases?

MR. BROWNING: In most cases -- for example, in the core region, the flow rate is not going to change at all.

DR. FORD: Correct.

MR. BROWNING: And so in those areas there is no change at all. In the down come region, we are getting a slight increase in the drive flow by about .3 percent to overcome the delta-P as a result of the increase in the power in the core.

So we are seeing a slight increase there, but that has the most impact on the jet pump assemblies, and not so much on the areas that we are concerned about for cracking.

Now, those are just long term wear issues and vibration issues which we did investigate and didn't see any susceptibility there. And then the third area of the vessel of course is in the upper region, where the increase in the steam flow rate is going up somewhat proportional to the increase in the power level, an approximate 16 percent increase in the steam flow rate.

So we do see an impact in the upper regions, but we have investigated those as well for the concern of the flow induced vibration issues, and also the actual operating experience of those components to the chemistry changes that they are in so that you don't get quite the same protection from the hydrogen water chemistry in that region as you do in the lower part of the vessel.

So we have seen industry experience with IGSCC on those components, and our inspection program has factored that in from the GE seal and from the VIP recommendations to inspect those components carefully for those issues.

So that is the way that we have tried to address it on our end, is through the inspection side of the world to look more carefully, and be more cognizant as we move up in the higher flow regimes.

DR. SHACK: And the VIP report on hydrogen water chemistry does address flow effects. Now, you may not agree with all of what they say, but they have addressed the issue.

DR. FORD: I was being a devil's advocate to a certain extent, because many of these aspects of flow rate are well known in the technical community. In fact, generally they decrease the cracking susceptibilities.

And I just want to make sure that it goes out in the public domain that these things have been talked about in this committee.

DR. POWERS: I am going to move this along now.

MR. BROWNING: We are ready to move into the risk perspective.

DR. POWERS: That would be great.

MR. BROWNING: Very good. I would like to now move into the insights that we have learned from using our risk assessment tools. And as we said earlier, although our application was not risk informed in accordance with Reg. Guide 1.174., we did apply our probablistic risk assessment tools to gain valuable insights into the possible effects of this extended power uprate on the operation of the Duane Arnold Energy Center.

Although the results of both the Level 1 analysis of core damage frequency, and the Level 2 analysis of large early release frequency due to the uprate, were not significant as defined by the EPRI guidelines for evaluating plant changes. We did gain valuable insights from this exercise.

DR. POWERS: Did you calculations include that extended period of time on any effect that might have the -- well, the extended period of time that you need the net pressure suction head margin?

MR. BROWNING: I would turn to Brad, our PRA expert.

MR. HOPKINS: This is Brad Hopkins from NMC. We do factor in net positive suction head into the PRA.

DR. POWERS: In the interest of time that you need that, that enters into the --

MR. HOPKINS: In the Level 2, yes, we are looking at a 24 hour period after the start of the event. So, yes, we do factor in the likelihood of pump failure due to inadequate net positive suction head.

CHAIRMAN APOSTOLAKIS: What kinds of uncertainties do you have there? I mean, you say 1.55 and 10 to the minus 5.

DR. POWERS: That is very accurate, George. That is precise.

CHAIRMAN APOSTOLAKIS: This is 10 to the minus 5.

MR. HOPKINS: This is Brad Hopkins again. We have not performed a detailed uncertainty analysis for the PRA. We addressed uncertainty in our initial IPE submittal, with a sensitivity analysis, and for the present power uprate study, we started the study by selecting sensitive parameters, and sensitive operator actions, and sensitive components.

CHAIRMAN APOSTOLAKIS: Well, Regulatory Guide 11.74 requires the use of mean values. And you don't know that these are mean values do you?

MR. BROWNING: Right. But as we said, what we are looking for is insights. We are not looking for a specific precise calculation of what the actual core damage frequency is. We are just looking for changes and what drives those changes to look for the insights.

CHAIRMAN APOSTOLAKIS: And what are you going to do with the insights?

MR. BROWNING: Well, first, and most importantly, no new risk vulnerabilities were identified in initiating event frequencies, component reliability, or key success criteria. This is because sufficient plant operating margins will be maintained during the implementation of the uprate either through inherent design margin, or modification to equipment, such that the plant's overall reliability will be the same as before.

The one area where we did see an impact to the uprate was in the event timing, and in particular where operator actions are important to success, almost all of the change in core damage frequency and large early release frequency is due to changes in human error probability.

And especially in those events where there is heavy reliance on operator actions, such as ATWS. As you heard earlier in Ron's presentation, we use this insight to tailor our operator training in both the classroom and dynamic simulator scenarios to ensure that the operators would continue to respond successfully in these events after the uprate --

CHAIRMAN APOSTOLAKIS: I am just curious. Suppose that PRA never had been abandoned, and you were following the strict traditional deterministic licensing approach, would this issue of operator actions come up here?

Is there a part there that says to

calculate the time for operator action?

MR. BROWNING: It may not have been so much driven by time, but I think as we would have gone through the exercise of looking at the deterministic evaluations, we would have also in parallel been looking at the impacts in the emergency procedures that the operators have to follow.

And from that side of the world, we would have driven probably the similar conclusion that there are certain key actions in the emergency procedures that are important for the operators to take in a timely manner in order to be successful.

So I think we probably would have come to a very similar conclusion in this case, because ATWS drives both of those, and what we are seeing here is a corroboration of that knowledge.

DR. POWERS: I think it is a most obvious conclusion when you say Dana Powers is going up, and you say, well, since the plant is kind of fixed, operator response time is going to be shorter just because of higher power.

MR. BROWNING: Especially by those things that are driven by decay heat.

CHAIRMAN APOSTOLAKIS: Okay.

DR. POWERS: And I will just interject

here. George, you didn't get to attend the subcommittee meeting, but you might want to look at some of the notes on that, because one of the things that they did was use the PRA to look at all of their operator actions and get a raw on them on risk achievement work.

And then that gave them a prioritization to go through and look at them, and I thought it was a fun thing to look at.

MR. BROWNING: Right. And back to what Brad was talking about with respect to sensitivity cases as well. We also went back and looked at those operator actions that were below the raw value of 1.06, and did some sensitivity cases there as well to make sure that we weren't missing anything by setting a screening criteria in appropriate levels.

So we look at all actions underneath that screening criteria, and made some adjustments there in sensitivity.

CHAIRMAN APOSTOLAKIS: Do we have these slides?

MR. MCGEE: I can get you a copy, George.

DR. KRESS: In the subcommittee, we asked what delta-CDF meant and the raw value corresponding to it, and at one time I believe it was 1 times 10 to the minus 6.

MR. BROWNING: Right.

DR. KRESS: I thought I remembered that.

DR. ROSEN: Here you have only discussed a couple of the operator actions that were actually examined and reported to the subcommittee. I think there were a half-a-dozen key operator actions that were examined.

Some of them, you know, have fairly longer times available than the particular one that we focused on here, which was the initiation of standby liquid control within ATWs, which goes from 6 to 4 minutes.

But there are others described there, took, George, that are not -- well, that one is the most severe and the largest change.

MR. BROWNING: There were four key actions that really came to the top of the list, and three of them were driven by ATWS; and then the last one was transients where the reactor stays at high pressure, and the need for the operator to respond to pressurize the vessel in a timely manner to get low pressure ejection on it. And those were the key operator actions that we learned from the PRA.

DR. POWERS: I am going to move you along on this. We can talk PRA for a long time.

MR. BROWNING: And that is pretty much the conclusion that we came to, and the insights that we gained from the PRAs, and with that, that concludes my portion of the presentation, and I am going to turn it back over to Ron now.

CHAIRMAN APOSTOLAKIS: I am very curious about how you quantified this thing. You have a number of the available time that goes down from 6 minutes to 4 minutes, and the failure probability increased from .11 to .18.

Now given the state of the art in these things, this is really noise.

DR. POWERS: Well, I think that the issue is bigger than that, George. I don't think that the change from .1 to .18 is what is striking. What is really striking is that we have a relatively high probability of human error here, but we have a database on simulator training where their rate after 50 or 58 tries, I believe, is zero.

CHAIRMAN APOSTOLAKIS: Yes, and that's why I am curious.

DR. POWERS: And that is what is striking.

CHAIRMAN APOSTOLAKIS: And how old is the methodology, and how all that stuff comes together.

It must be somebody's judgment at the end.

MR. BROWNING: I think that is a great deal of it, and it comes down to expert panel type judgments, where you have a number of people sitting down and looking at video type of operator performance, and doing the calculations, and factoring all those pieces together to arrive at a conclusion.

I don't think it is strictly driven solely by any one aspect. You are trying to model something that is very complicated, and so you are trying to use as much input as you can from diverse sources and opinions.

CHAIRMAN APOSTOLAKIS: So if you were to draw on uncertainty as an analysis to this, the .11 could be as high as .6?

DR. WALLIS: No, no, no, George. It is a change, George, that they are talking about.

CHAIRMAN APOSTOLAKIS: No, it's not. They are talking about increased from .2.

DR. WALLIS: Yes, but it is only influenced by one small thing, and the change --

CHAIRMAN APOSTOLAKIS: It was .11.

DR. WALLIS: The change is what they are talking about. The change is much more precise than the uncertainties, and these absolute values.

CHAIRMAN APOSTOLAKIS: The change is more precise?

DR. WALLIS: Yes.

DR. POWERS: I think it is one of the esoterics of human error reliability that will arise in our November meeting. I need to move us along here.

DR. WALLIS: Could you bring up your number seven very quickly for one minute, the number seven slide. There is something different about your slide and mine, and I just think for the record that the arrow in my slide points to the blue line, and whatever is going to go into the record should be the right slide, which may be a copy of this one. Thank you.

MR. MCGEE: Unless there are any other questions, and I heard no open items for us, then in conclusion the DAEC believes that our submittal has shown that EPU will result in only a minimal increase in risk, and that a substantial margin of safety will be preserved.

The conclusion was confirmed by the NRC staff's confirmatory analysis, and a review of calculational results, on-site audits of design record files, and our responses to many requests for additional information.

As reflected in the draft SER, after scrutinizing our limited deviations from previously approved methodology and in general, a healthy questioning attitude during its review of our submittal, the NRC has confirmed our view that the proposed power uprate complies with NRC regulations.

And that there is reasonable assurance that public health and safety will be protected. We believe the rigor with which we prepared our submittal and the thorough NRC staff review have demonstrated that operation at the uprated power level is acceptable. We thank you for your time and attention today.

DR. POWERS: Are there any other questions for the applicant? If not, Ron, I thank you for your presentation, and I will call on John Zwolinski to begin the staff presentation.

MR. ZWOLINSKI: Dr. Powers, thank you for recognizing me and our staff is prepared to go forward. Good morning to all of the members. For the record, my name is John Zwolinski, and I am the Director of the Division of Licensing Project Management in the Office of Nuclear Reactor Regulation.

During last week's ACRS Thermal-Hydraulic Subcommittee meeting, we made a presentation on our review of the Duane Arnold extended power uprate.

I am here for two reasons. One is to represent senior management and the support of our staff, and secondly, to emphasize that the staff has conducted a thorough review in all areas potentially affected by this power uprate submittal.

The staff conducted its review consistent with existing practices, including the lessons learned from Maine Yankee. If you recall when I briefed the subcommittee a few months ago, I went into great detail on lessons learned from Maine Yankee.

I did not intend to repeat those. I did want to take just a couple of minutes to reflect on the process. I also reflect that Dr. Powers did allude to the staff diving deeply into certain review areas, and highlighted a couple of those that we intend to speak to specifically today.

Those are ATWS, fatigue containment, and things of that nature, but as a general reminder our staff did undertake this activity using template reviews. We relied on our standard review plan. There was an extensive effort that our staff undertook to ensure that we crossed all the T's and dotted all the i's.

We got into the field as you have heard with General Electric and with the licensee. Our senior staff and management team that is here today have been deeply involved with this activity.

We have relied heavily on GE topical reports that have been reviewed and approved, and presented to this committee in days go by. And management and the Division of Engineering, through Jack Throwsnider in the Division of Systems Safety, and through Gary Hallahan, as well as in projects myself, have all been deeply involved to ensure that this project moves on smartly.

DR. WALLIS: This SRP is not specifically for uprates is it?

MR. ZWOLINSKI: That's correct. It is for individual sections or topics within various chapters of the standard review plan. Although we reviewed the information in many areas and on a licensing basis of the Duane Arnold plant and beyond by use of risk information, we will focus our presentation today on the areas that we believe to be the most interesting to the power uprate.

And we will also address the areas that the ACRS expressed interest in. I would like to now turn to our project manager, Brenda Mozafari. We are essentially prepared to give about five minutes of presentation each, and we will try to move quickly, but obviously we want to take questions as appropriate.

MS. MOZAFARI: Good morning. My name is Brenda Mozafari. I am the project manager assigned to the Duane Arnold at NRR, and I am going to tell you briefly what our agenda is.

We have received the open remarks from John Zwolinski, and I am going to provide an overview of how the staff proceeded in their reviews.

The NRC staff evaluation is going to be presented in large part by Ralph Caruso, who is going to address the reactor fuel performance and in GE audits that were performed to assist in the review.

Kamal Mandly is going to present some information on the cumulative usage factors, and we are going to have Rich Lobel present an evaluation or the staff's evaluation of the containment response evaluation by the licensee, and then John Zwolinski will give some concluding remarks.

Okay. I think it is important to note that the staff started out with a submittal by the licensee that was provided to us within the guidelines of ELTR-1 and ELTR-2 as the framework for the review.

The Monticello -- we previously approved the Monticello safety evaluation as more or less a template to kind of guide where the emphasis would be put in the reviews and the depth of the reviews, and plant specific design differences were addressed within our draft of safety evaluation which you have received.

Several additional submittals of information were provided following teleconferences to support NRC staff reviews. Now, in this I would like to speak a little to this streamlined RAI process that encouraged questions by our staff.

Although we have many additional submittals of information along the way that we felt were necessary to put on the docket, there were a lot of telephone calls where we got clarifications to make sure that we truly understood how the licensee remained within the bounds of the generic topicals and the analyses, and to make sure that we understood the manner in which they performed calculations.

We were building our lessons learned from previous uprates, and the licensee did make a submittal that was informed by previous RAIs that have been done on Monticello and Hatch,a nd tried to address those up front, and provided us with detailed lists of methodologies.

DR. WALLIS: I guess the streamline process also allowed enough time to analyze the answers to the questions, as well as allowing you to pose questions?

MS. MOZAFARI: Right. And it allowed us to have a good interchange of information to make sure that there was true understanding. Statistically, we ended up with a 120 page application that the licensee submitted, which resulted in about 3,000 -- it will be in excess of 3,000 staff review hours.

And we incorporated the staff review hours and the inputs into approximately a hundred page draft safety evaluation, which we did provide you.

And it is a work still in progress and we recognize that it had a few quirks, but the outcomes or the conclusions would not change.

CHAIRMAN APOSTOLAKIS: I was not present at the subcommittee meeting, but I am trying very hard to understand what these statistics are telling me. More than 3,000 review hours. Okay. So what? I mean, what does this prove?

MS. MOZAFARI: The staff will go into that. What I am trying to say is that it wasn't a cursory review, where we just looked briefly at the submittal and said, oh, they need the generic guidance.

We did go into -- and I will outline what was done to substantiate what the licensee provided. The review questions came from eight different branches within the NRC, and there were 26 written responses, and we had three general meetings with the entire review staff.

I would like to show you just briefly the scope of the review. We did review -- and you can read them -- in all these areas involving these different branches, and from those branches, we gleaned the fact that we had three characteristic types of ways that we would evaluate things.

Site audits were performed by the reactor systems group, and we reviewed specific calculations. For example, electrical and stress calculations, and Kamal Mandly is going to demonstrate the kind of stress calculations we have looked at, and we did confirmatory analyses, particularly in the containment systems area.

And with that, I will turn it over to Ralph Caruso, who is a section chief on the BWR systems and nuclear performance section to present the field specific issues.

MR. CARUSO: Good morning. This is an introductory, and this is who I am. I don't have a lot of slides this morning, and I am going to be doing mostly talking from this one particular slide.

The staff review of the power uprate for Duane Arnold was quite involved. This was a significant review because the power level increase that was requested was above any power level increase that had been granted before.

Before we started the review, we had lots of meetings with the Duane Arnold people, and I believe they even came in and talked to the ACRS before the application.

And one consistent question that came up during this time is how can you do this. How can you raise the power level in this reactor by 20 percent and not change the pressure. Aren't all sorts of things going to change, and how do you do this.

There was just a lot of incredulity expressed by a lot of knowledgeable engineers about how you could do this. Well, we talked to GE about this, and it turns out that the way they actually did it when it comes down to looking at the course is pretty simple.

They flattened the flux shape in the core. They got the peak bundle constant and they raised the average bundle power, and that is a pretty simple thing to do.

I mean, it requires some sophisticated engineering by GE to do core design, but when you look at it, fundamentally it is pretty simple, and they were able to accomplish this within the existing analysis methods that have been used over the years to evaluate the performance of BWRs.

Now, that is what I am talking about when I say in this first bullet that approved methodologies were used for the safety analyses. BWRs are nice machines. I wasn't originally trained on them, but I have grown to appreciate them over the years.

They are basically channel reactors, and they scale very well, and the analysis methods are pretty simple because they just boil water. They don't have these strange steam generators and funny loops and stuff.

So if you can figure out a way to define the flux shape and stay within the limits for the individual channels, you can raise the power levels with a reasonable amount of effort, and the staff review of this reactor looked at these methodologies to make sure that they were being done in accordance with those methodologies.

DR. KRESS: And you get an increased steam flow.

MR. CARUSO: That's correct.

DR. KRESS: And how do you maintain your pressure constant with that?

MR. CARUSO: How do you maintain --

DR. KRESS: The head pressure being constant.

MR. CARUSO: Well, the reactor pressure remains the same. The pressure in the reactor vessel remains the same, and you open the valve at the other end a little bit more, and you redesign that valve, and you redesign the turbine so that you can get more steam flow.

DR. KRESS: So you redesign the turbine and the control valves?

MR. CARUSO: Yes, but you maintain the steam pressure in the reactor constant, and that makes a lot of other things a lot simpler.

DR. KRESS: So it is not just simply a flux flattening.

MR. CARUSO: I understand that, but I think -- I started this because that was one of the big questions that came up in the beginning was how can you do this. People were just incredulous that you could do this. And I have got to give GE credit for this. They were very clever.

DR. WALLIS: So how do you know the flux is flat when you are doing all this rod stuff and the operation. Do they measure the flux profile in some way?

MR. CARUSO: There are surveillance requirements for operators to periodically measure flux distributions, and to ensure that the reactor is operating within the analyzed limits. Those are important not just for safety purposes, but for economic purposes.

DR. WALLIS: So they actually measure the flux distribution?

MR. CARUSO: Yes.

DR. WALLIS: Thank you.

DR. KRESS: You would have a real problem getting another 20 percent increase. You have already flattened the flux about as much as you can do it.

MR. CARUSO: I don't know. I don't want to speculate on that. I mean, I don't want to foreclose the skills of GE's engineers.

DR. POWERS: Well, I don't think we should take the view as this being a very simple change because of some generic feature of the BWR. The fact of the matter is that actually the boiling water reactor is fairly complicated.

MR. CARUSO: I would not disagree with you.

DR. POWERS: You have the void and reactivity are coupled, and in a fashion that inherently makes this system non-linear. So stability, which we can analyze in a linear fashion, becomes complicated when you are working with a non-linear system.

MR. CARUSO: I understand that, Dr. Powers, and I think I will be addressing some of this in my fourth bullet.

DR. POWERS: Will you be able to tell me where I can go to look and see if in fact 1-D is applicable?

MR. CARUSO: Right here. And I have got someone on the staff here.

DR. POWERS: So I will be able to look at differential equations and see IKON values?

MR. CARUSO: I am not so sure about that, but maybe I can point you in a direction.

DR. POWERS: Somebody I would hope would

point me, because I would really like to see the differential equation analysis with this core, with a flat and flexible --

CHAIRMAN APOSTOLAKIS: The stability analysis --

MR. CARUSO: Well, let me think about that.

DR. POWERS: Quite frankly, the stability analysis has been done with enormously complicated equations and are actually fairly simple equations.

MR. CARUSO: So I am starting out with the point that the licensee used approved methodologies; the SAFER/GESTR methodology for LOCA analyses, and TRAC-G for stability, and ODYN I guess is one of the codes.

There are a number of methodologies that are used for various different Chapter 15 analyses. This brings me to my second point, which is the licensing limits for these analyses were retained.

The 2200 limit that is in the regulation for LOCAs is still there, and the license showed you that they continue to meet the 2200 limit. They continue to meet the 1600 limit, the additional 1600 limit that is in the SAFER/GESTR methodology.

They continue to meet the 99.9 percent of all rods do not undergo boiling transition, which is the standard for AOOs. They continue to meet the ATWS SLC injection requirements that are in the regulation.

They continue to meet the subsidiary requirements int he ATWS analyses that they don't exceed the 2200 degrees and the field geometry limit, and the containment pressure limits. All of those limits are retained.

DR. WALLIS: And these are all based on calculations done by the licensee?

MR. CARUSO: Yes, or its contractor, General Electric. And given the increase in power, and the amount of the increase in power, the staff decided that as part of its review to go out and actually do an audit of these calculations.

We sent a team of four or five people to GE-Wilmington for a week, and they went through the detailed design calculations for this plant for a number of these transients and accidents in order to satisfy themselves that the methodologies were being appropriately applied, and that the results were acceptable.

During the course of that review, that audit, we found a few problems with some different aspects of the GE methodology that we described and discussed with the subcommittee, and I think that we discussed several months ago.

And that was useful. We found that useful, and GE has resolved those issues, and we don't think they stand in the way of this power uprate.

So based on the fact that they are using the approved methodologies, and that they meet the licensing limits, and which hasn't changed -- and I brought that point up because there were some concerns that we might have changed something like the fuel burn up limit.

There is no change to the fuel burn up limit. There were concerns that because it was a power uprate that the fuel would be burned to a higher level, and therefore, it would be in some sort of a weakened state.

And the answer is, no, it's not. The fuel is being burned within the limits of the methodology. So those concerns turned out to be not well-founded, and based on the use of these methodologies, and the audits that we did, and the reviews that we did in-house, we believe that this is a fully-justified power uprate.

Now, the last bullet concerns ATWS issues. There were several ATWS issues that came up during the subcommittee meeting. One concerned -- I thought it was Dr. Powers's radio peaking factor, and whether the flattening of the flux shape resulted in a core that was different than what was actually analyzed as part of the ATWS stability bounding calculations.

And in talking to GE, we discovered that indeed it is bounded by the analyses that were done back then, and that flattening the flux shape does not invalidate those analyses. I think today that you had a question about an axial power shape.

DR. POWERS: Axial power shape comes up in the ATWS recovery.

MR. CARUSO: Okay.

DR. POWERS: The first one that you are raising I guess -- well, that was one of the questions.

MR. CARUSO: Well, I can show you a power -- well, I don't want to get too complex, but there is a concern about operating at the MELLLA point, and comparing the new operation at this MELLLA point here to the original license value, and whether the core state would be somehow different, and therefore whether the bounding analyses didn't apply.

And GE talked about this at the subcommittee meeting; that in any case, if you have an

ATWS and you don't do any mitigation, in both cases the reactor ends up at the same stay point, which is inside the instability region.

So the initial conditions are essentially the same for instability. And therefore this operation at this higher value is bounded by the original bounding analysis.

And in actual point of fact, when you look at ATWS and you look at the mitigation that occurs, the plants don't go to that particular state point, they actually drop down further on a natural circulation line.

So we would expect that they would not end up inside that instability region. The analyses aren't --

DR. WALLIS: There is extra steam in the lower level that reduces the power.

MR. CARUSO: That's correct. That's correct. When you reduce the water level, you will be reducing the reactor power. Now, you had a concern this morning --

DR. WALLIS: That is below the stability line?

MR. CARUSO: I don't show the stability region here, but just looking at it and eyeballing it, I believe it is below the instability region. Now, you had a concern this morning about I believe decay heat in the upper part of the bundle if you had started with a core that had a top skewed power shape.

DR. POWERS: The question really is does the -- well, when we looked at the ATWS recovery, part of that involves bringing the water level so that the collapsed level is below the top of the fuel.

MR. CARUSO: Right.

DR. POWERS: The staff resisted that substantially when we discussed the recovery sequence, or when it was first being considered. We have actually agreed to that because there was adequate steam cooling of the top of the core.

That was with an unflattened power profile in the core. The question is that now that we have flattened it, we have raised the amount of heat that is available in that upper part of the core.

The staff is still comfortable with dropping the collapsed water level below the top of the core, and why?

MR. CARUSO: Okay. I have one of my staff members here, Tony Ulyses or one of my former staff members. He now works for the Office of Research here, and he can talk about this a little bit.

MR. ULYSES: Yes, my name is Tony Ulyses, and essentially, Dr. Powers, the question boils down to the fact that when the water level was originally developed -- and again this is referred to as the minimum steam cooling reactor water level.

It was derived with the assumption of a top feed axial power distribution, which at the time was obviously not realistic, but it was done in order to bound any future operations.

And that power distribution will continue to bound the current operational strategies that are being used right now and at the power uprate conditions.

DR. POWERS: And where do I find in the safety examination that the staff has done the discussion that the staff looked at the flattened power flow profile, and found that indeed it was bounded by the original analyses and that the ATWS recovery sequence was still applicable?

MR. ULYSES: In the SER that you are looking at right now, the draft SER?

DR. POWERS: Yes.

MR. ULYSES: I would say probably nowhere, having not actually written it myself.

MR. CARUSO: Off the top of my head, I

don't know that we explicitly addressed that particular issue.

MS. ABDULLAHI: If I may interject. I actually did the review for --

MR. CARUSO: Introduce yourself.

MS. ABDULLAHI: I am Zena Abdullahi, Reactor Systems Branch. Dr. Powers, the submittal itself did not actually consider or address instability, because instability is considered by the industry at large as a closed issue.

However, due to the concerns of the ACRS, I did go through and looked at these topical reports, and see if it is bounded. And I think that Mr. Caruso has sections of it in which it talks about the power shape in the topical reports itself.

What the draft SER basically says is that we have not received any analysis, for specific analyses, for instability, for ATWS instability, for Duane Arnold. That's number one.

And, number two, we expect as an Option 1-D plan if in fact you have the transients that create the potential for instability, and that they would end up being or have the potential for core-wide instability.

Having core-wide instability, they would take the mitigating factor, the mitigating steps, for SLC introducing water level, and the analysis that was done, could it be bounded for Duane Arnold. And operators would also get -- in other cases, the alarms would let the operators know that they are experiencing -- the plant is experiencing instability.

DR. POWERS: I bet you when they go into instability that there is a whole lot of information going to the operators telling them that things are not quite right. The question is whether the recovery process still going to work.

MS. ABDULLAHI: There are a couple of things that I could point out basically from the top of my head right now without getting to you with the details.

DR. POWERS: Well, what was in the part of the examination.

MR. CARUSO: I am looking at the draft SER here on page 60, and it is the section that talks about aspects of ATWS instability and the EPU reports. It talks about operator actions to mitigate ATWS instability.

And the staff made a conclusion that the mitigating actions that the plant will take with regard to ATWS instability are exceptional. We make that statement there. Is it your concern that we did not specifically say --

DR. POWERS: Well, when I read statements like that, I am not sure what you did. So, I am just asking. It just seems to me that when somebody comes into me and says I am going to do something to a BWR, almost the first question that comes to mind is ATWS, and the second question is ATWS recovery.

It seems like maybe it peculiar to me, but those are the things that I promptly think about, and I am asking what was done with the recovery sequence. I think the previous speaker said that she looked at it, and that is just is not something to worry about, and I am willing to accept that.

MR. ZWOLINSKI: And it would strike me, Dr. Powers, that would be the type of issue that we would consider as follow to put in the final safety evaluation.

DR. POWERS: There has got to be something more than we looked at it and everything is okay.

MR. ZWOLINSKI: I understand your point.

DR. SHACK: There is another peculiar sentence in the SER on page 61 that says that the staff realizes that the EPU safety analysis did not include a review of the applicability of the generic instability analysis specified in EPU operation involving a high density core MELLLA and GE14 fuel design.

And my question is why didn't you? I would have thought that was the number one item to be addressed.

MR. ULYSES: Actually, Ralph, I can probably answer that question. Essentially, if you look at the instability mitigation strategies which have been approved, they are intended to be reactor design specific, and at the time of the submittal we didn't have the actual specific reactor design to go to the EPU conditions.

But that will be dealt with during the reload calculational phase. What we did do was we looked and we considered the applicability of Option 1-D, and we actually looked at the calculations which were done by GE on our staff audit, and which was done on what they called a representative core.

In other words, it is not the actual reactor that they are going to be running, but it was a representative core to demonstrate that they will continue to be able to use Option 1-D.

Essentially, they show that there is a -- that the core-wide instability mode will continue to dominate. And all these calculations for reactor instability based on the GE methods are done with frequency domain methods.

In other words, they are calculating basically to K-ratios. So they are not looking at these instabilities in a time delay domain. They are not using the TRAC code, for example, and those are not being used in this case.

And those calculations were examined and they were looked at, and there was a finding basically that, yes, that basically from what we see right now, we can conclude that they will continue to be able to use Option 1-D.

However, it will have to be confirmed on a cycle-specific basis, and that is the methodology which is approved now, and that is the methodology which will continue to be used in the future.

DR. WALLIS: I have a question, and maybe it is for management. When we read these SERs, we read the issues and then we reach the bottom line, which as the staff stated is that this was acceptable or something like that.

And then we hear in these presentations that actually there is a technical basis for this. Isn't there a paper trail somewhere where the staff actually records the technical basis for accepting these particular calculations by a licensee, whatever the issue is?

MR. CARUSO: It depends on the issue. I mean, the staff reviews -- well, we accept things based on doing our calculations, which leaves a paper trail, and by looking at the actual calculations that the licensee does step-by-step.

DR. WALLIS: Well, if we are curious can we find that paper trail? Can we follow it?

MR. CARUSO: Sometimes, but realize that a lot of the time that staff decisions are judgment calls.

DR. WALLIS: Well, that is what bothers me. I mean, where is the part that was reassuring when there was a technical analysis before.

MR. CARUSO: But in the end what it absolutely comes down to is I have knowledgeable engineers on my staff, and I count on them to have good judgment. That is what it comes down to.

We don't have black and white criteria for a lot of these things, because they are judgment. I mean, I sit here and I listen to all 12 of you, and you don't have black and white criteria. And you disagree very frequently about what those criteria should be. The staff is in the same position.

MR. ULYSES: Let me jump in here and say that one thing that we can do when the staff reviews, Dr. Wallis, is that we can look at the application of an approved methodology, and when we do the review, we confirm that the methodology will remain applicable.

But that is something that we can do that is black and white, and that is one thing that is done, and that is something that was done in this case as well.

MR. CARUSO: Okay. One last item that you have on that was concern of the operator response times, and Dick Eckenrode from the staff is able to address that.

MR. ECKENRODE: First of all, are there still concerns about operator response time?

DR. POWERS: You betcha.

MR. ECKENRODE: I am Richard Eckenrode from the operator licensing and human performance staff. As part of the human performance review, we examined all of the risk important operator actions identified by Duane Arnold as being affected by the power uprate.

There were five actions which in time

available the operator complete the action was reduced. Initiation of standby liquid control in the ATWS events is the most limiting time dependent action.

The time available to avoid emergency depressurization will be reduced from 6 to 4 minutes. The staff requested Duane Arnold to prove or provide evidence that the operators could perform this action successfully.

This is a critical task in the operator requalification training and testing program. An examination of the last four years of regular test results showed that the ATWS scenario was exercised 58 times, with 100 percent success.

Since the ATWS EOP says to initiate SLC based on suppression pool temperature approaching the boron initiation temperature, it is not based on time.

CHAIRMAN APOSTOLAKIS: Well, let me understand this. It was exercised 58 times you said?

MR. ECKENRODE: Yes, over the last four years.

CHAIRMAN APOSTOLAKIS: And when you say successfully, you mean it was completed within how much time?

MR. ECKENRODE: That task -- that was what

I was just about to say now. The task was not timed. The reason it was not was because the EOP indicates that you want to do it before the suppression pool temperature approaches the byte temperature. And so it is not a timed item. You are watching the suppression pool temperature increase.

CHAIRMAN APOSTOLAKIS: But that must have something to do with the 6 and 4 minutes?

MR. ECKENRODE: Correct.

CHAIRMAN APOSTOLAKIS: So is it correct to assume that it was done successfully within 6 minutes roughly?

MR. ECKENRODE: Obviously, yes.

CHAIRMAN APOSTOLAKIS: And what does that tell us about our ability to do it within 4 minutes?

MR. ECKENRODE: I have that, too, and am coming to it. In fact, that is the next statement really, is that it was estimated in those runs that the action takes about 10 to 15 seconds.

DR. BONACA: It is not the action itself it seems to me. It is deciding to do it.

MR. ECKENRODE: It is the decision, right; the decision to do it, yes.

DR. BONACA: It took 10 seconds?

MR. ECKENRODE: No, the action takes 10 to

15 seconds. The decision is simply as the two temperatures approach each other. Again, it is not a timed decision.

DR. BONACA: So what you are saying is that they really don't look at their watch.

MR. ECKENRODE: That's correct.

DR. BONACA: It's just that this temperature is approaching, and then we trust that as this temperature approaches this particular limit, even within a minute, they will react appropriately?

MR. ECKENRODE: Correct. Correct.

DR. BONACA: Which is a significant assumption here is it not?

MR. ECKENRODE: Yes.

DR. BONACA: I mean, you are saying that this is really the driver. They see the temperature going up, and whether it goes up in 10 seconds or 3 hours, they are going to do the right thing. And that is exaggerating a little bit, but not much.

MR. ECKENRODE: At the high power levels, in which most of these were run, the time that you are talking about here is what is the 4 minutes.

CHAIRMAN APOSTOLAKIS: But the four minutes is from the initiation of the ATWS event, and not from the moment in which the temperature reaches the point?

MR. ECKENRODE: That's correct.

DR. BONACA: And the question I have is how long does it take from the beginning of the ATWS event to the point where the temperature reaches that point, and the operator takes the action?

MR. ECKENRODE: At the high power level, it used to be six minutes.

CHAIRMAN APOSTOLAKIS: So, six minutes, and now it is four.

DR. BONACA: Okay. I understand now. All right.

CHAIRMAN APOSTOLAKIS: So they have to decide to do it, and then do it within that period of time.

DR. BONACA: And then do it within 15 seconds.

DR. ROSEN: They have four minutes to do it, but once they have decided the question of actually initiating it, that takes 10 seconds.

DR. POWERS: And as was said that is hardly the issue. Let me ask you another question. The licensee came in with their analyses and found five critical operator actions. When you looked at it independently did you confirm that there were just five to look at, that merited being looked at?

MR. ECKENRODE: No, I did not do that. The risk people did that, I believe.

MR. HARRISON: This is Donnie Harrison, and I am in the PRA branch. What we did was after the licensee submitted their information, they identified five operator actions that had a raw value above 1.06, which as we talked about before was equivalent to a CDF impact if you assume that operator action failure is 10 to the minus 6 core damage frequency increase.

What we did was that we went back to the licensee and asked them if there were operator actions that were below that criteria that may if you were to look at combinations become more important, and the licensee came back and identified one additional operator action that was a little bit below the criteria.

And its impact was identified that if you assumed it failed as an impact on core damage frequency of 5 times 2 to the minus 7, they also then went back into all of their operator actions that were screened out, and they doubled their operator action failure rates.

DR. POWERS: What I am asking really is you found their case so persuasive that you felt there was no need to independently look at those?

MR. HARRISON: What I would say is that first of all the PRA part of this is confirmatory to gain insights. It is not the basis for the decision making process. That first. Secondly --

DR. POWERS: Well, operator actions is very much a part of this.

MR. HARRISON: Right, and the values that they provided of a 20 percent chance of failure the staff felt was a conservatively high number, especially given the antidotal events from the training simulators that they meet their criteria every time they have done it in the last four years.

DR. POWERS: But from your own reports there is no correlation between scores on training exercises and operator errors.

MR. HARRISON: Right, and we are not basing our answer on that. We are just saying that is just information.

CHAIRMAN APOSTOLAKIS: Now, it would help me to understand the situation here to know what is the error forcing context in the initiation standby liquid control?

MR. HARRISON: I'm sorry, but I didn't catch the first part of your question.

CHAIRMAN APOSTOLAKIS: What is the error forcing context? Have you heard those words before?

MR. HARRISON: I am not a human factors person, but there is performance shaping factors and on this one there is --

CHAIRMAN APOSTOLAKIS: So you are using what, the level of stresses that are going out?

MR. HARRISON: This is not my analysis, and I would actually turn to Brad Hopkins from the licensee to address actually how they modeled that. Again, I believe he referred to these as a group of different human action models to come up with their probabilities.

CHAIRMAN APOSTOLAKIS: But you approved them?

DR. POWERS: Mr. Chairman, I am doing grievous damage to your schedule.

CHAIRMAN APOSTOLAKIS: Yes, you are.

DR. POWERS: And I know that your generous nature doesn't extend to me in that direction. I think I am going to have to move this along here, and I will turn to the speakers and ask if you can help me any, because he gets violent with me.

MR. CARUSO: The next speaker is going to be Kamal Manoly from the civil engineering and mechanics section of the Division of Engineering.

DR. POWERS: I am I am the one that was particularly interested in communicative usage factors, and could I say that I think that this is not an essential thing for the committee, and we can move on.

CHAIRMAN APOSTOLAKIS: And that is no reflection of you, Mr. Manoly.

MR. MANOLY: Thank you.

MR. LOBEL: My name is Richard Lobel, and I am a reviewer in the plant systems branch in NRR. And I have been asked to address the audit calculation we did to look at the GE calculations for the Duane Arnold Power Uprate.

We decided to do the audit for four reasons. First, there was a large increase in power, and we wanted to be sure that we understood the behavior with that increase in power.

Second, there was a lack of a staff review on one of the codes that is used by the licensee, and we wanted to gain some confidence in the GE code.

There was also a desire to better understand the input assumptions that are used by the licensee; and finally there was the issue of the credit that was taken for the containment accident pressure, and doing MPSH calculations.

Four cases were considered by the licensee, and we audited -- that is, we did our own calculations for two of those cases as indicated by the little hand-pointers.

The name of the GE code I put in parentheses. The peak pressure calculation is a short term calculation that is done with the M3CPT code, and the peak wet well water temperature calculation was done with a SHEX code.

And that is a long term calculation, and the difference between short term and long terms is in the type of assumptions that are used, and the way that the two are modeled.

Another calculation that is done with SHEX is the containment conditions for the MPSH pressure, the MPSH margin calculations; and finally there is a peak dry well temperature calculation that is done for EQ purposes, and that is done with SHEX and a spread sheet.

Okay. The calculations were performed for the NRC staff by Information Systems Laboratories, Incorporated, ISL. They did a very good job. ISL used the NRC contained two code at our request.

ISL was also requested to use some

guidance that was developed by our Office of Research for the use of contained 2.0 for design basis accident calculations.

Contained 2.0 is a best estimate code, and this guidance document was some work that was done for research at our request to ask what assumptions should be made to do a conservative calculation.

The guidance is similar to the licensee's assumptions in many ways. Finally, and this is important, we used the licensee's mass and energy as an input. Mass and energy is important, and this is where the effect of the uprate shows itself in the containment calculations.

But we were interested in assessing the containment codes, and in this case we weren't looking at the behavior of the reactor and the blow down of the reactor.

So we used the licensee's input for the mass and energy.

DR. WALLIS: How many nodes are there in this model for the containment?

MR. LOBEL: I believe -- Ben, do you want to answer that?

MR. GITNICK: My name is Ben Gitnick, and I work for Information Systems Laboratories, and I was the engineer who performed the audit calculation for the plant systems branch.

The audit calculation model as developed by CND in this guidance that Rich just mentioned has a four-node --

DR. WALLIS: Four nodes?

MR. GITNICK: Four nodes, and the reactor program system is one node, and the dry well is one node, and the suppression pool is another. In this case though it would not really make much difference because we are not looking -- and particularly in the long term, we are looking more at the mass and energy, and not so much --

DR. WALLIS: So it is a very simple calculation, and probably a simple problem.

MR. GITNICK: Well, there is some great complex mechanics going on in vent clearing, and I was going to say the fourth node is the vent, and it has a special model, which is sort of a response to the vent clearing.

Containment, of course, is very flexible, and you can set up as many nodes as you like, but we are not looking at issues of stratification or mixing as much as vent clearing and energy deposition in the suppression pool.

DR. WALLIS: And another question is what is the basis for the bottom line?

MR. LOBEL: I was told that you were all given a copy of the contractor's report, and --

DR. WALLIS: You are not going to show us the curves?

MR. LOBEL: I can show you the curves if you want to see the curves.

DR. WALLIS: Well, they seem to know what the basis for a good agreement is.

MR. LOBEL: This is a curve of the long term pressure, and I have another one of the long term --

DR. WALLIS: So is there some criterion for how close they have to be?

MR. LOBEL: No, this gets back to what Ralph Caruso was talking about. There is no criteria for how close they have to be. Really what we were looking for was that the curves basically would have the same trend, and be fairly close int he absolute values.

DR. WALLIS: And not step outside some regulatory limit?

MR. LOBEL: Right.

DR. WALLIS: Well, that would be good to

show some limit. A limit is a criterion. A regulatory limit is presumably a criterion.

MR. LOBEL: Well, the limit in this case -- and I don't have the conversion off the top of my head, but it would be 281 degrees fahrenheit.

DR. WALLIS: Which isn't shown here. Are there some other kinds of units for temperature here?

MR. LOBEL: Right.

DR. POWERS: I have to say that this report that you provided on this was very helpful to understand the conclusions that you reached, and it was the kind of thing that we were looking for in some of the other areas.

MR. LOBEL: Thank you. I guess I am done. I was going to say a few more things, but it isn't necessary. Are there any other questions?

(No audible response.)

MS. MOZAFARI: I would just like to have a few concluding remarks by John Zwolinski on behalf of the NRR staff.

MR. ZWOLINSKI: I would like to thank the committee for the opportunity to present our review of a first of a kind extended power uprate to you.

The staff has considered this a first of a kind application because of the magnitude of the uprate. It is the first application to take a plant to 20 percent over its original rated thermal power.

I would like to again emphasize that the NRR staff has taken an extensive review of the Duane Arnold Power Uprate request. All areas affected by the power uprate have been reviewed and evaluated.

The staff has critically examined the methodologies and their application for this power uprate request. The staff has concluded that all analytical codes and methodologies used for licensing analysis are acceptable for this application.

The results of the deterministic analyses have demonstrated the proposed increase in power level at Duane Arnold is acceptable, and meet regulatory requirements.

Based on the review the staff has concluded that the proposed power uprate can be approved at this time, and Dr. Wallis, your comments are ringing in my ears, as well as the Committee's, and Dr. Power's.

I can assure the Committee that the safety evaluation will contain the appropriate technical basis to support each section and thus the approval of the power uprate. And with that, this concludes our presentation. I would be happy to take any additional questions.

DR. POWERS: Are there any other questions posed to the staff in this area? Seeing none, I will thank you, Mr. Zwolinski and Ms. Mozafari, and your speakers.

And I will thank Mr. McGee and his team for their presentation to the staff, and presentation of materials to the Committee, and I will turn the session back to the Chairman.

CHAIRMAN APOSTOLAKIS: Thank you very much, Dr. Powers. We will recess until 10:55.

(Whereupon, the meeting was recessed at 10:35 a.m., and resumed at 10:55 a.m.)

CHAIRMAN APOSTOLAKIS: We are ready to go back into session. The next item is the Readiness Assessment for Future Plant Designs and the Staff Proposal Regarding Exelon's Regulatory Licensing Approach for the Pebble Bed Modular Reactor. And Dr. Kress.

DR. KRESS: Thank you, Dr. Apostolakis. I think the committee will find this session to be quite interesting. We ought to view it as a sort of an early interaction on this issue and something more like a briefing more than anything else.

I don't think we will be charged with a

letter, but if we have any preliminary responses to what we hear, then we can make some oral statements, or we could write a letter if the Committee thought it was necessary at this time.

But I think it is a little preliminary to do that. We are going to hear two things. From the staff, we are going to hear how ready they are to attack the licensing or certification of these events plans, and the plans for getting ready.

And from Exelon and also the staff, we are going to hear about how to -- well, a possible proposed approach for certification of the Pebble Bed Modular Reactor itself.

And since most of our regulations are highly biased by LWRs, the question is how do you wedge a pebble bed modular reactor into that structure. So I think that will be a very interesting subject matter and very enlightening.

So with that, I guess I will turn it over to whoever this guy is. Who are you and why are you qualified?

MR. LYONS: In case you forget, my name is Jim Lyons, and I would like to thank you for the opportunity to come talk to you this morning.

DR. KRESS: Before we go any further, I

would like to note for the committee that one item on our handout, Item F, is still very preliminary, and is for internal committee use only in our handouts. So treat it in that fashion, please.

MR. LYONS: I would like to talk just a little bit about -- and I am going to try and go through this quickly -- our readiness assessment that we have done to assess the staff's readiness to license and inspect the new reactor.

And what this paper is trying to do, and it is up and getting ready to go to the Commission, and it will probably go to the Commission next week, and then it will be made public in a week or two after that, after they have had a chance to look at it.

But back in -- and I will go to my next slide, but back in February the Commission asked us to assess the technical licensing and inspection capabilities that the staff has to perform these new reactor licensing.

And we were supposed to identify any enhancements for reviewing or inspecting early site permits, licensing applications, and the construction of new plants.

They also asked us to assess 10 CFR Part 50 and 52, both of them, the regulatory infrastructure, and whether that was sufficient for us to move forward with these new plants.

As part of that we considered the certified designs that are already in the rules, and the certified designs that may come in in the future, and the pebble bit modular reactor, which we are going to talk more abut today. And other generation 3 plus and 4 light water reactors.

We also were asked to provide schedules and resource estimates to perform these reviews. I am not going to get into those too much today. Those will be in the report.

I guess I would like to say at this point that some of those estimates are pretty high. They are really based on the information that we had at the time.

We are starting to get more information, but as we get more information, we are going to be updating those resource estimates and we are proposing to the Commission that we come back to them like on a 6 month interval to let them know that as business decisions are made, and plans are firmed up, what really we are going to be working on, and what we are not going to be working on.

To perform these assessment, we formed an inner office working group with members from the NRR, Research, NMSS, and the Office of General Counsel, to look at these things.

And the group has had several licensing scenarios for future applications based on the information that we had gotten. We worked to estimate the duration of the reviews and the resources that would be necessary.

They used the results of critical skills and resource survey that we presented to the staff. We also had the benefit of industry plans and proposed schedules that we heard in presentations or they sent to us.

We looked at what it took to do previous licensing and pre-application reviews, and previous design certifications. We tried to factor in the effect of complex technical issues or policy issues that will be coming up.

And we also looked at previous resource and schedule evaluations that had been done in the late '80s and early '90s when we were in the midst of doing the design certifications before. We had tried to do some projections, and so that kind of made the basis for where we were.

One of the things that we wanted to do was identify the capabilities of the staff to perform these reviews, and we identified skill gaps, or what we are calling skill gaps, and what we are calling skill gaps are areas where individuals with the expertise we needed are either limited in number, working on some other important issue that the agency has in-house, or maybe not even in the office where the gap exists.

We did not do a whole lot of looking across offices. We did look at these mostly within the offices that -- well, each office looked individually.

We tried to identify people that were at or near retirement and that we might expect to see leave the agency within the next 6 to 12 months. And that expertise that just doesn't exist in the staff at all.

There were still gaps that we identified, and kind of a big picture or manner identified on this next slide. We see gaps in nearly all areas of the site environmental reviews, and that is something --

DR. KRESS: A lot of those in the past have been done by subcontractors.

MR. LYONS: Right.

DR. KRESS: And can you still call upon

those people?

MR. LYONS: We still can, and in fact we have these gaps within the offices if you would, and within NRR, but in the license renewal arena, we have been doing environment reviews.

We have contracts set up, and I think we have somewhere on the order of 140 contractors that we have identified that could help us in this area. So we think in the short term that some of these gaps could be handled by contracting out to the National Labs or other suppliers of environmental reviewers.

Let me go through some of the other things. Historic and archeological resources that are part of this site environmental review, and that is something that we don't have here.

Financial analysts, and especially in the anti-trust area. We have financial analysts that are looking at license transfers, and we have some strong people there, and we are starting to look at anti-trust reviews, and that would be another area that would be hard.

CHAIRMAN APOSTOLAKIS: Did the agency ever have experts on the historical and archeological resources?

MR. LYONS: I think they actually had

people that did those reviews back in the '70s, and when we were doing that. We had people that would go and look at historical records and look at archeological records, and we had those people in-house.

Obviously, we have not had the need for that, and in some of the cases -- and the reasons that we don't have these people available anymore is because there really wasn't any work for them. So they left and took on other jobs, and we never replaced them.

And there are some fairly senior people around that have been involved in some of these areas that can help us, but they are not at the reviewer level that we are going to need to do some of these reviews.

And in environmental reviews, a lot of the environmental reviewers and sitemologists, and geologists, hydrologists, that were in NRR have now shifted over to NMSS, and are working on Yucca Mountain and that type of work. So there might be some people to draw on.

DR. KRESS: I guess the natural question is given that you have identified these areas where there are gaps in skills, you are going to make plans on how you are going to deal with those gaps?

MR. LYONS: That is one of the things that we are working with the Office of Human Resources on, on how we are going to bring people in, and what areas should we be targeting to bring new people in.

And then again like I said, in the short term, we can fill some of these gaps with contractor resources. Obviously, that group is mostly for the early site permits, which we would expect to be the first areas that we would see.

DR. ROSEN: Jim, one of the critical areas on the pebble bed will be fuel performance, and I expected to see that as a gap here.

MR. LYONS: I think that is really the next bullet, which is high temperature gas reactor and graphite technology that the fuel aspects are going to be very key to this. And in fact how you spend your time looking at the various aspects of the plant.

DR. ROSEN: But my point is that there is no bullet on the slide that --

DR. KRESS: Fuel performance.

MR. LYONS: Well, that's really what I meant by the high temperature gas reactor and the graphite technology. We also need help in metallurgy and chemical engineering, and high temperature gas reactor accident analysis.

And then when you look at inspections, construction inspectors, and all the people that are doing the construction inspections have now moved on to doing other types of inspections.

We are especially light in the geotechnical areas, and the same with the environmental reviews. Also, as part of our discussions with the regions, you might have some fairly senior people that had construction inspection experience, but now are in the region or somewhere else, and it may be a little bit difficult to get people to go to a site to start doing these construction inspections.

The other thing that we identified was that with construction that there may be large portions of a plant that are built away from the site.

So having a strong site presence, you will need that in some instances, but you also will need to be sending inspectors to the fabrication facilities to do some of the inspections there.

DR. KRESS: That is something that you haven't done much of have you?

MR. LYONS: Yes, which we have not done much of in the past, and we did have an inspection program that did look at that, but again that has kind of gone by the wayside. So that is an area that we are looking at.

Moving on, the overall conclusions of the report, and I will run through those, is that first of all the licensing processes that are in 10 CFR Part 52, are ready to be used. That doesn't mean that they couldn't be better, but right now we can license a pebble bed modular reactor, and we can license any other combined license that comes in.

We can use the procedures and the processes that we have now, and I guess that is our first point that I want to make. And with resources that we have got lined up, we can see that we can complete the current new reactor license activities, which include the AP1000 pre-application review, which I know that the Committee is seeing some work on.

And the PBMR pre-application review that we are working on, and the rule makings that were going on in 10 CFR Parts 51 and 52.

DR. WALLIS: You said that 10 CFR 52 is ready to be used. What does that say about something like containment for PBMR?

MR. LYONS: Well, right now there are in the regulations and the general design criteria, and they have criteria for containment. And as part of this licensing approach, the discussion that we will have next, we will talk about how Exelon is going to take the group regulations that are in Part 50, and how they are going to identify which of those regulations they will meet, and which ones they will meet in-part, and which ones are not applicable.

And that's really the whole crux of the next presentation. So let me defer that to that. The other thing on this Part 52 rule making that we have ongoing right now -- in fact, we just put up on our website last week draft rule making language to get some early interaction with stakeholders.

We are working on preparing a proposed rule making by the end of March of next year, and those changes are really meant to address lessons learned if you would from the design certifications that we have done previously to clarify the regulations and to make them easier to use.

And we have also had some initial discussions with the industry on how we are going to implement the early site permit, and the combined license reviews.

So they are more trying to make the rule a little more efficient and easier to use. So that is what we are working on there. We also identified research and additional infrastructure changes that will make the reviews for early site permits, and license applications, more effective and efficient, and to in the long run maybe reduce some unnecessary regulatory burden in that area.

For one thing, we were looking at is there a another way or another regulatory framework that we could have put in place that would be more risk informed, and that would be technology neutral if you will.

So those are all things that we are looking at in the long term to try and do. We also need to reactivate our construction inspection program, especially the 2511, and I don't want to get into a bunch of numbers.

But the 2511 portion of the construction inspection program is the pre-construction inspections. So those would be the ones that are actually applicable to an early site permit review, and the inspections that we would have to do there.

That manual chapter is no longer active because we weren't using it. So we have to look at how we are going to do the construction inspection program to verify the inspections test analysis, and acceptance criteria, the ITAAC that are put in place as part of the combined license.

So there is a lot of work there just to kind of construction inspection program back up to use. As you know, and as you may know, I guess, the House and the Senate have appropriated $10 million to the NRC for next year or I guess for this year. It is this year now.

And that is to work for future licensing, but those bills have not gone to conference, and they have not come out, and so we really don't know whether we are going to get all $10 million of that, or we will get any of it, or more, or what.

But right now it looks like they are in pretty much agreement that we would get $10 million. Certainly the events of September 11 may affect that.

So all the work that we have done on this readiness assessment was really pre-September 11th, and so we don't really -- other than to recognize that it may change, you know, it is really not factored into our readiness assessment.

But even if we get the full $10 million, there is more work identified than there would be resources to do. So obviously we would have to prioritize what we are going to do and which activities need to be worked on.

A lot of that has to do with how the industry falls out in making business decisions that are supposed to be made in the next 3 to 6 months. So we will start to see really what applications we are going to get, and what applications we are not.

So that is why we are saying that our priorities are still evolving, and so we have kind of given a first cut at this, and the report looks on a project basis.

It gives resource estimates and duration estimates on a project basis, and it doesn't break it down on a year by year basis, because again we are not sure exactly when a lot of these things are going to start.

DR. KRESS: Would that $10 million, assuming that you get it, go mostly to acquiring new staff?

MR. LYONS: That would be another thing. Some of it would be to bring in new staff, but I would say that it is about -- I would say about a fourth of that money would be bringing in new staff and about three-fourths would be using contractors assistance for the first year.

The budget looks as it goes out that the

Commission is looking at more money in the out years and we are trying to prioritize that work, too. Just to kind of give you -- this is something that is in the report, but to kind of wrap this thing up, is that future Commission correspondence, and the Commission papers that we are working on, we are working on two that are in due in November, legal and financial issues that are based on a series of white papers that Exelon has provided us.

We don't plan on coming to the Committee with that paper. It gets into things like anti-trust reviews, and the number of licenses, and what should the annual fees be, and I don't think that you all are really that interested in that.

You might be interested in seeing the paper, and reading it, but I don't think we need to give a presentation on that.

DR. KRESS: I think we would be very interested in the second one though.

MR. LYONS: In the second one though, Exelon's licensing approach, which is what we are really talking about today, that paper will give you an idea of where Exelon is coming, and where we are coming from, for that paper.

DR. KRESS: Will we have that one on our

November agenda?

MR. LYONS: I think so.

MR. ZEFTAWY: We can have it for the November agenda, provided that we can get it in a couple of weeks before the November meetings.

MR. LYONS: I think we will need to work with you on the timing of when we will have that paper.

CHAIRMAN APOSTOLAKIS: Yes, we need it two weeks before the meeting.

MR. LYONS: Yes, I understand that. I remember.

CHAIRMAN APOSTOLAKIS: But now you are on the other side.

MR. LYONS: We will give it to you the day of the meeting. No, I understand. The other things that we are working on now is AP1000, Phase 2 review, which I think is already on the schedule.

And the proposed revision to Part 52 is now looking for late March or early April; and we have some work on alternative regulatory frameworks that NEI is talking about presenting a paper.

Again, resources may cause us to not get too far into that, and that may or may not happen in June. But definitely I think the last two would be ones that we would definitely come to you when we start talking about technical issues and policy issues for PBMR.

So we will get into things like containment and some of the other technical issues on how the fuels will be verified and fabricated, and that sort of thing.

So those are other things that will be coming to you. But that is mainly all I wanted to talk to you about. I would like to turn it back over to Exelon.

DR. ROSEN: Not so fast.

MR. LYONS: Okay. Sure.

DR. ROSEN: Could you go back to the first slide. I think I have a simple slide or a simple answer. What do you think the step requirements memo is talking about in the very last bullet on that slide?

And did your remarks cover that? Is that the AP1000 that you are talking about there on that slide?

MR. LYONS: To consider the certified designs and other generation --

DR. ROSEN: The last bullet there, that says other generation --

MR. LYONS: Yes.

DR. ROSEN: Do you see anything else coming down the pike in the near term other than PBMR?

MR. LYONS: Yes. We are already in discussions with Genotomics on the GTMHR, the gas turbine modular -- well, I am trying to learn these as they changed their name. Actually, it is from the MHGTR that they had before.

So, the GTMHR, and they are looking at coming in, and also Westinghouse is looking to come in with the IRRAS plant. So that might be another one, and there may be other vendors out there that would seek for us to review --

DR. ROSEN: Well, do you want to reconsider any of your questions about capability? Imagine if you got all of that.

MR. LYONS: Well, that is one of the other messages that I am trying to get, is if industry -- if all the industry proposals, and plans come to fruition, we are going to be very tight on resources.

And we are going to as an agency are going to have to work with industry to try and prioritize which reviews will go forward and which won't.

And obviously the first priority would always go to someone who came in with a combined license application, because that pushes you forward to actually license a plant.

I think early site permits would also be high on our list to review, but that is one of the things that we are really looking at, is that it is going to be tough if everybody comes in.

That is one of the messages that we were trying to send to the Commission. Any other questions? I will turn it over to Kevin Borton and Exelon.

MR. MUNTZ: Good morning. I would to thank the ACRS for this opportunity to discuss our proposed licensing approach for the PBMR in the United States. I would like to introduce our team. I am Jim Muntz, vice present for Exelon for PBMR North America Activities.

And next to me is Rod Krich, who is our vice president for PBMR licensing; and then Mr. Kevin Borton, who is our manager of licensing for PBMR. We have Mr. Greg Krueger, from Exelon, who is our PRA expert.

And Mr. Fred Silady from Technology Insights, a consultant to Exelon. And Mr. Steve Frantz, a consultant to Exelon from MLB. At this point, I would like to turn it over to Kevin to start through the presentation.

MR. BORTON: Good morning. As Jim said, I am Kevin Borton, and I am the licensing manager and in today's presentation we would like to present to you the proposed methods and processes that we presented to the staff that we feel could use to assess the PBMR design in order to obtain an NRC license.

We will also demonstrate these methods with some examples from an earlier advanced gas coolant reactor. We will describe our process which we will use to judge the applicability of the current regulations, and we will compare the approach with some current regulatory practices.

Just an outline of this morning's presentation. We will give you a brief summary of our licensing strategy and what built up to our strategy.

We will go into some detail about the elements of our licensing approach, and we will do a high level summary of some NRC policies and practices that we would like to compare this to.

Also, we will talk about some outcomes or desires that we have for the pre-application activities with the NRC, and with this last bullet in mind, you just heard that the staff has identified some technical issues that they would like to resolve with us during pre-application space.

Our intention is to work with the staff during pre-application to bring some of these technical issues to resolution. However, what we are presenting this morning does form the basis on which we could work with the staff to resolve those technical issues.

CHAIRMAN APOSTOLAKIS: You will come back to the Regulatory Guide 1.174??

MR. BORTON: Yes.

CHAIRMAN APOSTOLAKIS: Okay.

MR. BORTON: This is just the outline of what we have for today. Now, briefly our strategy has been to work within the Part 52 process in order to obtain a combined license.

We are building upon a design and review of a South African demonstration plant. We are not looking or seeking for any new rule making. We are going to use the existing regulations.

Part of our strategy was to ensure that there is a definable and stable licensing approach, and this is the basis of today's presentation. Part of the strategy was to develop a licensing basis acceptance criteria, and will be building upon the

MHTGR work done in the 1980s by the DOE and reviewed by the NRC.

Now, it will take a little time here, but this is the basis or the biggest part of our presentation today, is the elements of our licensing approach.

The first element is the top level regulatory criteria, and that establishes what must be achieved in order to conclude that the public is adequately protected.

Equally important is the licensing basis event, which define the situations when the top level regulatory criteria must be met. We will establish some design specific regulatory design criteria, and safety related equipment classification, which will establish how it will be assured that the top level regulatory criteria are met.

And then we will identify the conditions for and special treatment of the equipment to assure us how well the top level criteria are satisfied. Now, if you take a look at the first four elements, that could define the licensing basis.

However, in addition to that, we are going to use those first four elements to determine the applicable regulatory requirements which will establish the scope of our application.

DR. ROSEN: I am going to have to interrupt and ask a question about the fourth point. When you talk about special treatment requirements and defining how well they need to be applied, it seems to me that is a little bit of a conflict with the prior slide, where you talked about use of current regulations.

Will you be seeking exemption from the special treatment requirements in Part 50 as part of this?

MR. BORTON: We are going to be addressing the special treatment in there with our analysis and I think when we walk through those steps later on that you will see specifically how we are going to do that.

DR. ROSEN: Are you going to use 50.12 to try to get an exemption, as has been done in light water reactors recently?

MR. KRICH: In those cases where we need to get an exemption from an existing rule, yes, we would use 50.12.

DR. ROSEN: And that's what I thought you could do, and I am not characterizing that is a good idea or a bad idea, but I am just saying that it doesn't seem consistent, unless you would say that using 50.12 is using the current regulations.

MR. KRICH: Using 50.12 is using the current regulation.

DR. ROSEN: Fine.

CHAIRMAN APOSTOLAKIS: On Item 2, I don't understand the word when; define when the TLRC must be met. Are there other situations when they are not met? The word when throws me off.

MR. BORTON: We are going to be looking at different frequency of events and categorizing those frequencies, and then how we compare those different regions against the top level regulatory criteria. So we are looking at a number of criterion.

MR. KRICH: I think as we go through it we --

CHAIRMAN APOSTOLAKIS: Will it be replacing the current design basis events?

MR. KRICH: The licensing basis events incorporates all the events that covers the anticipated operational occurrences.

CHAIRMAN APOSTOLAKIS: I guess the word when is not clear to me.

MR. BORTON: This next slide depicts the overall approach in a model. As you can see on the right side, there is a green area, and that is our elements 2 through 4, our top level regulatory criteria, aligned with the NRC mission and safety goals.

Again, those elements were the licensing basis events, and development of regulatory design criteria, safety related equipment selection, and special treatment.

As you can see the block towards the center in the compare, we break these down into a functional level, and the resulting criteria then could be used to compare it against the current regulations on the blue side there, also at their functional level or underlying purpose, which goes back to the question of 50.12.

DR. KRESS: This approach, which I would call a risk informed approach, is going to rely heavily on having a good PRA.

MR. BORTON: That's correct. And we are going to talk about some of the attributes of the PRA.

DR. KRESS: Talk about the attributes of that, and then how it is going to be reviewed and qualified as a good PRA.

MR. BORTON: We will get through the steps on those.

DR. ROSEN: Well, it will be more than

just the PRA, because this is a risk informed approach and not a risk basis approach.

MR. BORTON: It's both.

DR. ROSEN: So it is going to require the same kind of expert panel structure and protocols that have been developed to make applications work on the light water side as well, I think. Is that your view of it, Greg?

MR. KRUEGER: Yes.

CHAIRMAN APOSTOLAKIS: Another thing. It says licensing approach, NRC mission and safety goals. As far as I know the safety goals are not the regulation --

DR. KRESS: They kind of show up in regulations here and there, and like the regulatory analysis. They show up in 1.174.

CHAIRMAN APOSTOLAKIS: But the Commission never said that if you meet the goals that you are okay.

DR. KRESS: No, but this is a different date and time, and a different reactor, and you have to start somewhere.

CHAIRMAN APOSTOLAKIS: So it is the blue boxes then --

DR. KRESS: Yes.

CHAIRMAN APOSTOLAKIS: And right now that is what it is, right?

MR. BORTON: That's correct. Just the lower part of that model shows that we will be going through and looking for the regulations that are applicable, and partially applicable, and not applicable, or identify areas where this design requires attention to that.

We will also be in a better position to address any policy issues, and being armed with this information, and being able to put together the scope of our application.

DR. ROSEN: Does the PBMR specific block imply that there may be some new requirements that are not in Part 50 now?

MR. BORTON: Yes, that's correct, design requirements.

DR. KRESS: Does this have to do with the graphite, for example?

MR. BORTON: Yes. The first element is the top level regulatory criterion, and this fits into the establishment of a reference value to make sure that there is adequate protection afforded by the design.

We will look at the criteria coming from the current regulations and guidance based on these specific principles. We want to ensure that there are direct statements of acceptable health.

In other words, ensure that the criteria is fundamental to protection. We will look at it and make sure that it is quantifiable, and measured or calculated, and ensure that we can make an indisputable conclusion or come up with unambiguous conclusions.

And finally that it is an independent reactor type site, and generic in terms, and to ensure that is purely top level.

DR. KRESS: In terms of this independent site, it sounds like a touch assignment to me. That means that you are going to have to bound any potential sites that you have because these attributes, these top level criteria, are dependent on population, and meteorology, and that sort of thing.

So in order to make them what you have to meet in, say, certification, and site independent, you will have to have sort of a bounding site or a bounding meteorology, or something of that nature?

MR. SILADY: My name is Fred Silady. We are looking at their current regulations and screening them on these three criteria. When it comes to the assessment, yes, at a particular site, and then there are various approaches on whether to do it individually or bound.

DR. KRESS: I see.

DR. BONACA: If you are working at developing these criteria that you would propose to the NRC, I guess since it is going to be an independent reactor type, are you working with other designers? Are there some industry standard committees being formed to look at those issues?

MR. BORTON: No, what we are doing is we are trying to look at establishing those top level criteria, and I think the next slide gets a little bit more into details of why we selected what we selected.

And again it is used as a reference value to judge -- not to measure, but to judge the acceptability.

CHAIRMAN APOSTOLAKIS: I see. All right.

MR. BORTON: So looking at those principles, we did select these limiting top level regulatory criteria for the PBMR. The first is 10 CFR 50, Appendix I, which is the annualized off-site dose guidelines.

And 10 CFR 50.34, which are the design basis accident off-site doses; EPA-400, which are the protective action guideline doses; and the NRC safety goal for individual prompt fatality risk.

So again these are the direct measures, quantitative, independent limiting criteria used to assess the design against. The second element is to define what are the licensing basis events. So it is when these top level criteria must be met.

So we will look at off-normal and accident events for the PBMR, and Exelon will develop the licensing basis events through our PRA, in which they are collectively analyzed for demonstrating conformance with the safety goals.

Now, thinking back, we have a top level regulatory criterion, and in order to assess these events in relation to those criteria, frequency regions are necessary to frame the criteria in the context of risk, and this is the three regions that we alluded to before which have been identified.

The first region is the anticipated operational occurrences region. This is where events are expected once or more in a lifetime of the plant.

A plant is defined as having up to 10 reactors. The plant lifetime is assumed to be 40 years, and therefore a lower frequency of 0.025 times 10 to the minus 2 was selected.