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Okay. I also review the section on leak before break. And the operating conditions under the uprated conditions will not alter the conclusions of the previous leak before break analysis for Waterford 3. It's still valid.

Are there any additional questions?

I'll turn it over to John Tsao.

MR. TSAO: I'm John Tsao from the Materials and Chemical Engineer Branch. I reviewed five sections; coding system, flow accelerated corrosion programs, steam generator tube inspections, steam generator blowdown systems and chemical and volume control systems.

I will be talking about only two systems here; flow accelerated programs and steam generator tube inspections because they are more significant in terms of power uprate.

For the flow accelerated corrosion programs, this morning there was some issue as to how much you increase. I have this backup slide.

The FAC program measure the wear rates in terms of mils per year. And these are the changes that would be due to power uprate conditions.

Also, I want to show you another slide that gives the effectiveness of the FAC program. This

is provided by the licensee. And as licensee said, it is more in the -- they used CHECWORKS. It's a computer program that considers hydrodynamics, heat balance, temperature in particular.

As you can see the predictive method is conservative considered to actual measurement.

DR. FORD: I'm sorry. Could you explain that?

MR. TSAO: Okay.

DR. FORD: It looks as though it's equally scattered around the one to one line. So why are you saying it's conservative?

MR. TSAO: Well, for example, you can see -- let's see.

You can see just for example, this point here the measurement is about 300 mils. The predict value, let's say, from here to here is about 240 mils. So what it says is that the methodology will predict that the tube wall thinner than measured, therefore it also indicated that the licensee may need to do some monitoring or replacement of that pipe.

DR. FORD: But equally there are points on the other side which are not, what you call it --

MR. TSAO: Well, that's true. Yes, that's correct. But as you know this is only a prediction.

Predictions, hopefully -- well, from the data point you can see they are scattered toward the conservative side. And also the FAC program according to EPRI is that it's a process. In other words, the licensees would go out, make an inspection, UT or ultrasonic measurements or the pipe thickness and then they will come back and they input that data into the computer code so that to make sure there is a certain accuracy in their predictions.

Also predict that the -- in the prediction method they include some safety factors.

DR. FORD: It seems to me as though there's a huge amount of scatter around that one-to-one line. And so the question immediately arises as to what is the impact of that in terms of could you get a through wall erosion event taking place when you had predicted it would not have done so?

MR. TSAO: It could.

DR. FORD: Did you go through that sort of "what if" argument? I mean if you look at that data base, you don't really have too much confidence in CHECWORKS.

MR. TSAO: Well, I wouldn't say they would be relying on CHECWORKS per se. The licensees, not only Waterford but other licensees, you know they

include other factors. For example, other industry experience. You know if some plants have some problem with FAC water lines, then they will consider --

DR. FORD: I recognize that.

MR. TSAO: Right.

DR. FORD: But this particular EPU is putting a lot of basis on CHECWORKS to manage this problem. And if this a general observation as to how good CHECWORKS is, my confidence is a little bit shattered.

MR. TSAO: I should point out that Waterford is not unique. I did the review for license renewal, and I also asked questions. And this is type of plot that, you know, other licensee has shown me.

DR. FORD: Yes, I know.

MR. TSAO: In other words, I don't think that licensee is depending solely on what prediction is. They also, you know, include other experiences and inspections. Not only the inspections for the fact, but there are other SME code inspections they have to perform.

DR. FORD: I'll ask again. Did you go through the "what if" scenario?

MR. TSAO: I have Kris Parcziewski from my branch to elaborate on this.

DR. FORD: With that amount of uncertainty in your modeling capability and therefore your management capability, do you not feel uncomfortable?

MR. TSAO: No.

DR. FORD: No?

MR. PARCZIEWSKI: Kris Parcziewski from the Chemical Engineering Branch.

To answer your question, those points are predicted. CHECWORKS predicts but in addition there is a correction factor for each individual line which is here at the top right hand side, line correction factor which indicates that it is corrected for each individual line all the points predicted in the line are corrected by this line correction factor. And the line is defined as a portion of the system which has the same chemistry but not necessarily the same temperature. If I answer your question.

So all those points are already corrected. Ideally, if they were ideal, they would lie in the 45 degree line, the middle line. However, obviously, there is some scatter.

DR. FORD: I understand the physics --

MR. PARCZIEWSKI: Yes.

DR. FORD: -- of the erosion process. It's highly dependent on ph. High dependent on

temperature. Highly dependent on corrosion potential and all of those things are interacting. So that if you're a little bit off on your definition of one of those parameters, then you're going to get a big change. So I can understand why there is a scatter there because you're not able to define your system adequately enough, and therefore that's the physical origin of your LCF. But I still feel uncomfortable about that huge scatter and how you use it in management from their point of view and in terms of regulation from your point of view.

MR. TSAO: Okay. For regulation, basically there's no regulation on FAC program.

DR. FORD: That's what worries me.

MR. TSAO: The FAC program is instituted because of the bulletin. Back in the '80s it was result of Bulletin 87-01 where Surry had a --

DR. FORD: Yes, sure.

MR. TSAO: -- a rupture. And Generic Letter 89-08 that required the licensees to institute some type of program, FAC program. And then the industry, you know, with EPRI guidance come up with this program. And so --

DR. FORD: I understand all that. I'm just looking at what the history has been since then.

And, you know, a few months ago we had fatalities in Japan because of this phenomenon, which was not managed well. And you know if this is supposed to be the state-of-the-art of prediction of management and therefore regulation, I just don't feel comfortable.

MR. TSAO: Okay. Speaking of the Japanese, again from my understanding is that Japanese did not inspect, you know, the last 20, 30 years.

DR. FORD: Correct.

MR. TSAO: Where here under FAC program the licensees will have to inspect at least they say 50 to 100 inspection points for their large bore piping and small bore piping they probably sometime inspect 100 percent. And so there's a constant inspections going on to make sure that the --

DR. FORD: I understand that.

MR. TSAO: Right.

DR. FORD: All I'm pointing out is everyone bows to CHECWORKS and says yes, yes that's the best thing that's around. And I'm just questioning it. Is it adequate?

MR. HOWE: This is Allen Howe.

And I'd just like to add in at this point that we understand the question and we will be happy to get back with you with a response on that.

We're now going to complete the NRR presentation.

MR. KALYANAM: I have one question. Before Rich Lobel goes, we have two experts, one of the FAC CHECWORKS program, the other one on the steam generator tubes. So we had some questions before the break, and I'm sure they'll be able to provide their response to that. Is that okay.

DR. FORD: Well, I've been bagging on the head about this FAC business. I understand it perfectly. The other members might enjoy having a presentation on that.

MR. KALYANAM: Okay. Either way is fine.

CHAIRMAN WALLIS: If it's something we're going to enjoy, I think we should do it.

MR. ROSEN: As many times as possible.

MR. SIEBER: That's one time.

MR. KALYANAM: I have Ken Karwoski from EMCB

MR. KARWOSKI: I guess I understand this morning there were questions from the steam generator two integrity standpoints some questions about whether or not the power uprate, what effect it would have on wear and cracking along the length of the tubes as a result of the increased flow through the steam

generator. And then there may have also been a question about the adequacy of the 75 gallon per day leakage link.

In terms of the effect of the power uprate on the increased flow through the steam generator, there is a potential effect on the amount of wear that can happen at the various support locations, whether it be at the vertical straps, the diagonal bars or at the egg crate supports. There could be an effect on the wear.

In addition, Waterford has exhibited stress corrosion cracking at a number of locations along their steam generator tubes. Both of those mechanisms could be effected by the power uprate. However, the change in the conditions in terms of the flow, the temperatures and the pressures across the steam generator tubes are relatively small and well within the bounds of what exists at other plants. And it's been our experience at the other plants which have uprated power that these small changes have negligible increases in corrosion rates, negligible increases on wear rates. And by "negligible," I mean that it's well managed from one inspection to the next; that when they go in and do an inspection after a power uprate or after an interval, that they still

have tube integrity. That the tubes have adequate regulatory margin --

CHAIRMAN WALLIS: This is where? On the inside of the tubes you're talking about?

MR. KARWOSKI: On the outside.

CHAIRMAN WALLIS: Are the tubes rattling and wearing.

MR. KARWOSKI: Rattling and wearing. And that happens at almost every --

CHAIRMAN WALLIS: These fluid interactions are a little hard to predict, aren't they?

MR. KARWOSKI: Actually, they're quite reliable. I mean there are some instances where some tubes, and this is usually in the life of a steam generator, where some tubes will wear quicker than others because of the placement of the anti-vibration bars or the diagonal straps in the case of Waterford.

So some tubes may wear more than others, but in general these phenomenon are very predictable. Plants leave wear scars in service, and in general they're very predictable. The wear rates tend to be very low and they're left in service for many cycles before they exceed the tech spec.

MR. ROSEN: Do they tend to decrease in rate because they kind of wear off whatever the

contact point and that's it?

MR. KARWOSKI: That has been the experience, and I can't comment on the combustion engineering data, but I know that that's definitely been the experience at Westinghouse design steam generators. But the wear rates decrease with time because of the contact issue point.

MR. ROSEN: Now the question is brought up how about the effect of vibration, vibrational stresses on the kinetics of stress corrosion cracking?

MR. KARWOSKI: Once again, you know, it is possible that that would increase the rate of cracking, may even change the initiation of cracks. But it's been our experience that any change that does occur: (1) It's not readily measurable, and; (2) that it can be managed within the normal frequency of in service inspections. And certainly if there is a change, we will detect that as we review the annual reports that the plant sends in regarding their inspections. And we would expect them to take corrective action, and that would be something we would followed up. But in general we have not observed that. And in the case of Waterford, it's been their practice that when they find a crack, they plug that crack on detection. It's not like some of the

other plants which leave cracks in service and try to manage cracks that --

MR. ROSEN: My questions on those two issues.

MR. SIEBER: The displacements are extremely small and the number of cycles is extremely large. So if there is going to be failure, it would show up fairly early, I would expect.

MR. KARWOSKI: That would be for like the cycle type of fatigue failure.

MR. SIEBER: Right.

MR. KARWOSKI: In this case it's more just the wearing of the tube, which it can be low cycle--

MR. SIEBER: But that's not fatigue failure.

MR. KARWOSKI: No, that is not fatigue. Yes, that's correct.

MR. SIEBER: Right. It's just wearing out.

MR. KARWOSKI: That's just wear.

DR. FORD: Jack, there's a problem discussed earlier on. It's not trangranular fatigue, cracking you see.

MR. SIEBER: Right.

DR. FORD: And therefore it's not covered

by the ASME 3 code or anything like that. Similarly it's just stress code in cracking that's been accelerated.

MR. SIEBER: But wear phenomenon is covered by the ASME code.

DR. FORD: Yes.

MR. KARWOSKI: Through the plugging limits and what not and through the plant technical specifications.

DR. FORD: Right.

CHECWORKS?

MR. KARWOSKI: I think Louise Lund was going to talk about CHECWORKS.

DR. FORD: Maybe if I could just state what my problem was, Louise, and that would make it more efficient for you to answer it.

MS. LUND: Should I introduce myself first for the record?

DR. FORD: Yes.

MS. LUND: I'm Louise Lund. I'm the Section Chief for the Steam Generator and Integrity and Chemical Engineering Section, NRR. And, anyway, I was asked to come over and discuss the FAC program.

DR. FORD: My concern was that the way that they're using CHECWORKS right now, it is

primarily a prioritization tool as to where you're going to look in the carbon steel piping. From the measures that were shown this morning, it's apparent that CHECWORKS is not good on one-to-one correlation. Therefore, it's quite possible that you may use CHECWORKS to say that I should not look at that pipe because of the particular operating conditions of that pipe, but I should look at this pipe. But in fact that pipe there might well be eroding at quite a large rate, but you wouldn't look at it for one, two, three cycles. In that time you could go through wall. So that was essentially my worry that you're using a model which is not precise to make prioritization decisions.

MS. LUND: Right. And I just want to say off the top, you know we have a very active interest in the FAC programs. Specifically we've had generic letters or generic correspondence that has asked industry to put together these type of programs which manage FACs and also have these predictive methodologies. However, it's not a case of just using the predictive methodologies blindly and looking at information on one line or another; there's a number of things that inform the decision as far as what's inspected and how it's inspected. Because it is a

tool, but it's not a blind tool in that particular way. And, in fact, this gentleman I believe is from Waterford and he was mentioning, we had a kind of offline discussion about it and that's why I asked him to come up here and help discuss this, and specifically for Waterford.

I also wanted to say that for these FAC programs, I think that we have an interest in looking at them through power uprate and license renewal in that we ask that the licensee provide information on their most susceptible lines with their measures versus their predicted and whether it gave them information such that they could replace the lines, you know, in a timely manner. Because that's really what we want to know is, is it giving you the information at the time that you need it in order to make the decisions you need to make good decisions about running your plant.

So that's the kind of questions we ask. We do not do a re-review of their CHECWORKS data. We do not take all their raw data and subsequently do an audit of it. Okay. So I just wanted to kind of clarify what it is that we do, you know, in our review process. Usually through a request for additional information we usually will ask them for the most

susceptible lines.

MR. ROSEN: We call that a performance-based regime?

MS. LUND: Right. Right. And when we put out that generic letter where we asked the licensees to put together a FAC program and also have these predictive methodologies, we did inspections of those programs at that time. Okay. In fact, to make sure that these programs were in place and in fact doing what we thought that they were doing. Okay.

Now, I now in license renewal, true license renewal we've been asked to come and give a presentation to the ACRS on FAC and FAC programs. And we've actually been in contact with CHECWORKS user script to ask them to come in and help present this information such that you can look industry-wide at how well these FAC programs are working, specifically with the CHECWORKS program and give you a lot of sense -- instead of looking at just one graph, kind of get a sense for generically how this is working and where it may be challenged in certain ways or another, because they think that they have a very good story to tell.

Now maybe if you could introduce yourself, and then also explain how programmatically it's a much

lighter look at how you choose the lines and -- because there's a surrogate aspect to it where, you know, if you see something you look at other things that are like that. There are a lot of things that go into the program that don't rely on just this measurement.

So, anyway --

MR. ALEKSICK: Good afternoon. My name is Rob Aleksick. I'm with CSI Technologies representing Entergy today.

Real quick about my background. I've had the opportunity to be involved with flow accelerated corrosion since 1989 and in particular have modeled or otherwise addressed approximately 20 EPU efforts in the last two years.

Dr. Ford made a very good point earlier when he said that the graph that we looked at did not display a very good correlation between the measured results and the predicted results out of CHECWORKS. Programmatically -- well, let me back up a second. That is certainly true in the example that we looked at. That is not always the case.

CHECWORKS models are on a per line or per run basis. The run --

CHAIRMAN WALLIS: Could we go back to that

graph that we saw? The graph was a plot of thickness versus predicted thickness.

MR. ALEKSICK: That's correct.

CHAIRMAN WALLIS: Because if you looked at amount removed versus predicted amount removed, it seems to me the comparison will be even worse.

MR. ALEKSICK: That's correct. In fact --

CHAIRMAN WALLIS: That's what you're really trying to predict is how much is removed.

MR. ALEKSICK: Yes, that is true. And my point is that in some subsets of the model, the one that we looked at here which was high pressure extraction steam, the correlation between measured and predicted is not so good. And in some subsets of the model, the correlation is much better.

CHAIRMAN WALLIS: It looks to me that in some cases it's predicting no removal whereas in fact there's a lot of removal. So the error is percentage wise enormous?

MR. ALEKSICK: Yes, exactly. Exactly. Some runs results are imprecise and some more precise. And we look at both accuracy and precision. Programmatically we account for that, that reality, by treating those runs that have what we call well calibrated results, i.e., precise and accurate results

coming out of the model that are substantiated by observations, we treat those piping segments differently programmatically than we do areas where the model is less good. If the model results do not correlate well with reality, different actions are taken primarily increased inspection coverage to increase our level of confidence that those systems can continue to operate safely.

In addition to the CHECWORKS results many other factors are considered to assure that the piping retains its integrity, chief among these are industry experience as exchanged through the EPRI sponsored CHUG group. Plant experience local to Waterford in this case. And the FAC program owner maintains an awareness of the operational status of the plant so that, for example, modifications or operational changes that occur are taken into account in the inspection of the secondary site FAC susceptible piping.

DR. FORD: And my final question on this particular subject was given the uncertainties in the model, changed by this performance based aspect that you just talked about, is there any way that you can come up with a quantification of the risk associated with a failure of a specific pipe?

MR. ALEKSICK: There's currently no accepted methodology to quantify that risk, no. However, it is accounted for primarily on a judgment basis through industry experience and information exchange through the EPRI CHUG group.

DR. FORD: Okay.

MR. MITCHELL: Yes, this is Tim Mitchell.

Just to give you a feel for how we're addressing for this upcoming refueling outage, we have increased our scope for a couple of reasons. One to get additional data and we always do more than just exactly what CHECWORKS supports. So you're always out validating and getting more data to be able to help predict where do you need to be looking. But in addition, we're taking some additional points to make sure we have good baseline data for the next cycle to ensure that those points give us a good indication going forward after the EPU.

The analysis for flow accelerated corrosion shows very minimal changes as a result of power uprate. But we are taking seriously our inspection program and expanding it for this upcoming outage to ensure that we know what's happening not just what we're predicting.

MR. ROSEN: Let me roll that back now,

Tim. Can you tell me like for the last three or four outages have you done some actual replacement of piping based on predictions of FAC from the CHECWORKS code or have you never replaced anything? What are you seeing at Waterford?

MR. MITCHELL: I can give you non-Waterford data better than I can give Waterford to ponder.

MR. CHOWDHURY: My name is Prasanta Chowdhury and I'm working with Entergy design for last 20 years.

I was involved with FAC also for several years in the past.

It's not the CHECWORKS model that determines what replacement is to be done. We base it on actual measurement we take during the refuel outage. So we also project based on actual measurement that what will be our future projected thickness in next refueling outage. So you can survive until next cycle. And then we do some evaluation based on our criteria that makes the stress criteria -- or based on the code requirement. Like make all the equation.

Now code allows to go thinning in local area but the FAC is a local thinning. So we do some local thinning evaluation to make sure that it goes to