UNITED STATES NUCLEAR REGULATORY COMMISSION

+ + + + +

BRIEFING ON MATERIALS DEGRADATION

ISSUES AND FUEL RELIABILITY

+ + + + +

MONDAY

FEBRUARY 6, 2006

+ + + + +

The Commission convened at 9:30 a.m., Nils J. Diaz, Chairman, presiding.

COMMISSIONERS PRESENT:

NILS J. DIAZ, Chairman

EDWARD MCGAFFIGAN JR., Commissioner

JEFFREY S. MERRIFIELD, Commissioner

GREGORY B. JACZKO, Commissioner

PETER B. LYONS, Commissioner

PRESENTERS:

MR. ROBIN L. JONES, EPRI

MR. BRYCE SHRIVER, PRESIDENT, PPL

MR. J. J. SHEPPARD, PRESIDENT & CEO, STPNOC

MR. ALEX MARION, NEI

MR. LUIS REYES, EDO

MR. JACK GROBE, NRR

MR. FRANK AKSTULEWICZ, NRR

DR. CARL PAPERIELLO, DIRECTOR, RES

DR. JENNIFER UHLE, RES

P R O C E E D I N G S

CHAIRMAN DIAZ: Good morning. Thank you for joining us this morning to give us an update on the status of activities to address the very, very important issue of materials degradation and fuel reliability.

Materials degradation, of course, is something the industry and the agency has been familiar with for some time and we take that very, very seriously.

It is not only important for the reliable operation of the plant, on many occasions it becomes an important issue for safety. And, of course, we have a special interest in that.

There are concerns everywhere with the fact that your plants are aging. I think you don't allow them to age, but they do age somewhat and maintaining a balance between how aggressively you keep these components up to date, and preserving the operability and safety of the plant become issues, and I'm sure you are balancing these things.

So we are interested in knowing where the industry is going and what is happening. And I am pleased to see that Robin is here. I have not seen you in some time.

I think you and I were about five years old in that meeting 45 years ago.

COMMISSIONER LYONS: I thought you were 39.

CHAIRMAN DIAZ: Sorry, I made a mistake.

COMMISSIONER MERRIFIEID: Sometimes you lose count.

CHAIRMAN DIAZ: Really, there has been a lot of cooperation between the NRC and the industry in this area and we are encouraged by that cooperation, we'd like to foster and make sure that we keep both the industry informed and the staff informed of the developments that the industry has in this arena.

And with that, I would like to see whether there are any comments?

COMMISSIONER MERRIFIELD: Mr. Chairman, I think this is a meeting we have had over the course of the last few years, I think it has shown the industry does have a degree of focus on some of the issues as does our staff. I am pleased today we are also going to discuss the issue of fuel which is one we have also been looking at to some degree over the last couple of years.

I think there have been some steps forward. Obviously, there are gaps -- no pun intended -- that still need to be addressed, but hopefully the discussion this morning both with the industry and with our staff can help to ease concerns that some may have that we are going in the right direction.

CHAIRMAN DIAZ: Okay, and with that --

MR. SHRIVER: Good morning Mr. Chairman, Commissioners, we are delighted to be here today to talk about the industry initiatives in the area of materials. We understand this is

fundamentally important to the safe operation of our units and recognize our responsibility to ensure that our units are operating safety and we address materials degradation in a very proactive way.

If I could have the second slide please. I'm Bryce Shriver and I am serving as the Chairman of the NEI initiative here, the Materials Executive Oversight Group.

I will be providing an overview of this integrated program that we have to address these materials issues both the ones that exist and the ones that may emerge future.

Robin Jones from EPRI will talk in more detail about the program and the way we are implementing it through a very structured approach to identify the issues and take proactive action to address those.

Joe Sheppard is with me as well from the South Texas Project. He will be discussing fuel reliability issues. Alex Marion is with us here from NEI as well.

So collectively, we will provide a very good overview of the program and the progress we have made over the last year and there has been substantial progress made in this regard.

And, as you said, I think it is a good working relationship between the industry under this program and the NRC staff in ensuring that we are all meeting our obligations for safe and reliable operation of our units.

Third slide. We would like to cover these three objectives

today. One is really summarizing the overall program, to discuss the progress we made over the past year, and the plans we have going forward.

And to very briefly talk about some regulatory implications, for we believe that the structure is in place for the NRC to be able to hold us accountable as we hold our members accountable to achieve these very high level margins of safety.

Next slide. We summarize the purpose of this Materials Initiative, and clearly it's very congruent with what we just talked about, the focus on safe and reliable and efficient operation of the plants, through the management of these materials issues. In other words, we should be ahead of the material degradation and not allow that to affect safety or reliable and efficient operation of our units.

We identified the three major sub objectives under there: to coordinate these programs so we are sure we have a complete and comprehensive and integrated approach, be able to prioritize the key issues, and be sure we are taking aggressive action to resolve those issues based upon their safety significance. And then a new aspect here is really the concept of accountability.

We want to have a very strong structure internally to be sure as we make recommendations that need to be accomplished to assure safe and reliable operations that the utilities are responsive in meeting those obligations. So this is all as a result of, in the past, we recognized as an industry, we did not have an integrated approach.

We had many research programs underway, we had recommendations being made, but they were not integrated, and sometimes they were not timely, and there was not a formal system for accountability.

That is the overall objective of this particular program.

Go to the next slide.

We refer to the document NEI 03-08, which provides the overall structure for this program including policies and objectives. It was endorsed by all the chief nuclear officers back in 2004.

There are a number of unique things in this document as compared to the past.

First of all, we talked about the need to integrate it and having a real strategic plan which I will discuss in a minute.

We talked about a disciplined process for systematically evaluating issues, what their ramifications might be and being sure we are addressing those in accordance with those priorities.

We want to be sure that there will be adequate funding to address these issues, that being one of the limitations in the past. And then, of course, the idea of accountability so that we internally are making sure that we are addressing those issues.

I might just mention funding. Overall, the funding the industry is providing for materials related issues is about $60 million a year.

As a part of this particular process each of the utilities contributed additional funds to address materials issues. That was

about $12 million that we identified just to help focus in on some key areas where we identified gaps as a part of this process and previous funding had not been identified.

So again, there is a strong financial commitment to this as well as programmatic commitment. This slide summarizes the general structure of the program from a programmatic standpoint.

We see at the top is the NEI 03-08 document that provides the policy. Kind of left and diagonally we talk about the strategic plan, the degradation matrix and the issues management table.

Collectively those define and prioritize specific issues. They are the places where we identify materials degradation and the potential impacts of those, and develop the specific plans and issues for dealing with those.

Robin will be discussing those in more detail in the general approach.

In the lower right-hand corner, we talk about the annual work plan, specifically, what are we doing to address these issues. And then, importantly, at the very bottom there, we talk about the implementation guidance.

That's where we identify the mandatory requirements to address these materials issues.

So again, there is a structure of this that collectively provides a high level of detail, a very systematic review to identify and

prioritize issues and then take action to resolve those and to follow up to ensure that they are addressed.

We do have the industry groups, Materials Executive Oversight Group, Materials Technical Advisory Group that provides the oversight for the overall program, and then on the lower right-hand side, the issues groups, such as our owners' groups and the EPRI programs where we get involved in the detailed administration and implementation of those programs. So it has both the details of oversight, from a programmatic standpoint, and the working level.

We look at a few of these documents. In the next slide, we summarize the overall guideline, NEI, 03-08. We talk about the committee structure there because we wanted to be sure that there was a way that we as the industry had our direct involvement in the oversight of that. The executive oversight group again provides a high level of oversight to be sure that we are implementing the program and particularly to identify if there are issues where people are not fully implementing the recommendations, that we will follow up to be sure that the utility understands it and implements those.

The Technical Advisory Group is very involved in the details of the issues and prioritizing them and being sure there is integration among the individual issue groups.

We talked about the policy. Of clearly establishing a policy of being proactive and forward looking in addressing this. To be sure that we have a process for addressing emergent issues and to be

sure that we are properly focused on safety and operational impacts, not economic issues.

So, again, it is a very clear document that's been endorsed by the chief nuclear officers to provide structure to be sure this program will be effective.

COMMISSIONER MERRIFIELD: Clarification. You sort of walked through the feedback mechanism in terms of evaluating the utilities to ensure they are implementing the findings identified.

Who does that?

MR. SHRIVER: There are a number of ways we use that to actually evaluate the effectiveness. The issues group provides an annual self-assessment that is overviewed by the Materials Technical Advisory Group and MEOG. In some areas, we have direct inspections for assessments through INPO and other sources.

COMMISSIONER MERRIFIELD: So INPO is involved?

MR. SHRIVER: Yes, it is. In fact, one of our reports is very detailed in their review over the last year of looking at the BWRVIP VIP program. So we do have involvement independently looking at implementation. And we do have ways of following up on the particular recommendations. In fact, that is an ongoing process, how we are strengthening that process to identify other ways where we can independently verify we are taking the actions.

COMMISSIONER MERRIFIELD: Okay, thank you.

MR. SHRIVER: The next slide. We will talk about the

strategic plan. Again, the purpose there is to provide this integrated review of material issues, to be sure we identify those gaps in particular. And that's been one of the real challenges. And I think the accomplishments of this team, is to be able to look at each of the individual programs in light of the technical issues and identify where there are gaps, things that were not being addressed in the past that need to be addressed to be effective in the future. And then defining the research or implementation that needs to be done to address that.

The next level, the degradation matrix on the next slide. That's where we list the materials within the scope of the project, identify the mechanisms and then, really, make sure that we've got an integrated understanding of what the significance and the risk is associated with each of those. So that's where we really identify the work that needs to be done in moving forward to resolve these longer term issues.

The next slide talks about the issues management tables, which get down to the very detailed levels, which really I think provide kind of our baseline.

This is the collective knowledge we have in the industry and beyond what the key issues are, where we need to be focused to assure that high level of safety. And particularly, Robin Jones will be talking in much more detail about that and how that is working for us to help provide that structure and integration of this overall program.

COMMISSIONER McGAFFIGAN: Could I ask a clarifying

question? The issue management tables, I notice a lot -- some of your stuff is proprietary. Is the issue management table proprietary?

MR. SHRIVER: No.

COMMISSIONER McGAFFIGAN: It's not. Robin.

MR. JONES: Well, right at the moment, it probably is because it has not been reviewed within the industry but we are planning to share it with NRC and in fact, ask you for a review.

COMMISSIONER McGAFFIGAN: At that point, it will be submitted as a public document?

MR. JONES: Yes.

MR. SHRIVER: I think that's an important question because you note from the attachments we have the membership -- in these key committees, we do have vendors involved as well, and we work very hard to be sure we have that open dialogue to really address the issues that are important to the industry, and not let the proprietary type issues dominate.

The next two slides provide examples of some of the deliverables, and those are typically in the form of very detailed guidance, an evaluation of particular issues, and then guidance that needs to be taken to address those issues.

You see, there's just a number of those issued over the last two years that again show the progress we are making of tackling some of these more detailed issues, identifying where the gaps are and making recommendations for addressing those, whether it be through

inspections, analysis, a number of guidance documents there to provide very clear guidance for addressing these issues.

There is a key part of this. The next slide talking about deliverables, we talk about performance metrics.

So we are working to see the effectiveness of this program in reducing the overall impact on our plants. And that is in terms of actual performance of materials related, power D rates or shutdowns, certainly looking for the insights from the Commission inspections, as well, to be sure that we are ahead on these issues and that we are not having a negative impact from a safety reliability standpoint.

The next slide is talking about some of the changes that we anticipate. The key one is that first one, the idea of a more proactive approach. I think in the past, we've been too reactive. We wait until the problem is self-revealing, and then try to take action to resolve it.

Our intent is to get ahead of those so that we do not have issues that affect safe, reliable operation. I think, again, one of the key issues we have is this idea of having mandatory recommendations and having the accountability that we follow up on those as a part of the overall program.

And as another key aspect is the strong communication with you and with your staff to demonstrate that we understand these issues and that we are taking the actions necessary to assure that we

are operating safely.

Next slide: We just summarize a few insights with regulatory process. I think our key thought is that the issues that we identify as a part of this we believe come under your regulatory framework in 10 CFR 50. They are primary system components, they are important to safety.

We believe that you have the right to inspect, certainly in these areas, and that the recommendations that we are making under this program are a part of the methods we use to demonstrate compliance with those regulations.

So we do not feel additional regulatory action is needed to be able to provide that level of accountability to the NRC.

In summary, we have identified a number of the actions we are taking here. Robin and Joe will talk about these in more detail. Their focus is on being more proactive, being accountable ourselves to assuring that the materials issues are identified and addressed, in accordance with their significance, and to provide feedback to ourselves and to you in the progress we are making in those regards. Unless there are comments particularly on this, I will turn it over to Robin to talk in more detail.

CHAIRMAN DIAZ: Thank you Mr. Shriver.

MR. JONES: Good morning. I'm going to talk about the approach that industry is using to identify potential future issues and to identify them proactively, that's to say before they appear widespread

throughout the U.S. nuclear plants.

The approach involves integrated assessments of worldwide plant experience, laboratory test data. And these assessments, the follow-up R&D needs they identify are being conducted within EPRI's nuclear power materials R&D program in cooperation with the NSSS vendors and their owners groups.

Next slide please: There are 7 EPRI R&D programs that are governed by the Materials Initiative.

Joe Sheppard is going to talk about the Fuel Reliability Program in a moment, so I won't talk about it here. But the first three programs cover materials issues in BWRs, that's the BWRVIP, and PWRs, MRP and steam generator program.

The last two are separated mostly for historical reasons and have common advisory structure at this point at the high level.

Those three issue programs get to technical support from the three programs listed at the bottom in the areas of non-destructive examination, water chemistry control of some of the degradation mechanisms and corrosion research to understand the degradation mechanisms of these related to corrosion.

The annual budget is about $50 million for the programs listed here.

The fraction of this total as being spent on proactive R&D has increase from 10% of that total to about 20% since the industry initiative was put in place. So we have had a significant impact in the

last three years.

Next slide please. As already mentioned, the industry approach involves gathering and integrating information from all over the world. EPRI is well positioned to gather such information because, as illustrated here, the licensees are about 75% of the world's nuclear power plants, participate one way or another in the EPRI nuclear program. Materials degradation programs, in fact, are particularly popular with overseas participants because they see it as a way of sharing information and perhaps being ahead of the game since the U.S. has the most mature of all these plants.

Next slide please. For example, this chart list the licensees participating in the BWRVIP and you notice that there are actually more international units than domestic units involved here.

The only noteworthy non-funders in this area are the German BWR licensees with whom we have extensive information exchange agreements. They don't participate directly. There is no funding from them in the BWRVIP Program.

Next slide, please. The integrated strategic plan defines the overall approach to managing materials degradation and involves four main elements: Identification of component level vulnerabilities, assessment of component condition, mitigation of anticipated damage forms, and repair or replacement of damaged components when necessary.

The industry's proactive approach involves the identification and

prioritization of knowledge or capability gaps in these four areas using tools already mentioned, called the issue management table and the materials degradation matrix.

Next chart, please. This is the layout of the management table format just to give you an idea of what the columns are.

The tables themselves are hundreds of pages long so I won't share those with you, because they do go into a component-level assessment.

So the left-hand column, of course, is the component that you are addressing, then about that component, material is defined, what's the material of construction, what are the degradation mechanisms that material is likely to undergo in that particular service environment that it has, what are the consequences of failure if degradation does occur.

Are there mitigation options? Are there repair replacement options? That means things that have already been developed and proved. Is there inspection and evaluation guidance?

Again, is it in the code? Is it somewhere else? What are the gaps that are found in the previous columns, and who has the lead responsibility for actually resolving those gaps?

The information for most of the cells are being gathered and assessed by teams that include staff from utilities, NSSS vendors and EPRI.

One team is working on the IMT for the BWRs. And another one on the table for the PWRs.

To provide the basis for filling out the Degradation Mechanism Column, we undertook an expert elicitation process to create vulnerability tables for major components and sub-systems in the reactor cooling systems of PWRs and BWRs.

Next chart, please. I can probably spend at half an hour on this chart alone, but I won't.

This is the degradation matrix table that the panel created for the PWR pressurizer. The types of materials used in the pressurizer are listed in the row headings, and the potential degradation mechanisms in the column headings. So each cell in the table represents a unique combination of a material type and a degradation mechanism.

The expert panel assessed the cells, one cell at a time, to determine whether the combination of material and degradation mechanism was likely to result in significant degradation under pressurizer service conditions.

Four responses were allowed, ”NA" means not applicable. For example, in this table, the pressurizer components are not subject to any radiation, so radiation-related degradation mechanisms are not applicable.

"N" means degradation is not likely. "Y" means degradation is likely. "Question mark" means that the panel wasn't sure. So the question mark cells represent one kind of knowledge gap.

We don't know about the particular degradation mechanism, whether it applies or not and that is one of the areas that we need to

clarify over the next several years.

Finally, the panel color-coded the state of knowledge for each “Y” cell, each of the ones where degradation was likely; green indicating good knowledge already available. I think there was one green cell in that table.

Yellow is indicating that there was work in progress that would provide good information fairly soon. And orange indicating a knowledge gap not being adequately addressed in current work. Those are somewhat more -- tend to be somewhat more reactive knowledge gaps because if we know really that the degradation is occurring, then we are already dealing with it typically.

So these are sort of a different type of knowledge gap than the blue cells where we just don't know whether degradation applies or not.

In addition to the tables, the MDM also contains linked endnotes for all the “Y” and “question mark” cells that summarize the panel’s comments on these cells. It also includes hyperlinked information papers that summarize the current state of knowledge for materials types and degradation mechanisms.

We used Microsoft Word for this particular table and I would suggest that NRC definitely not do that because there are a number of interesting bugs in the software. However, the next version will probably be WEB enabled which would be better.

Coming back to the IMT, we use the materials degradation matrix

information to fill out the third column, the degradation mechanisms column.

And then I just thought it would be interesting to show you the sort of information that is used in the other columns. And what you see here is a lot of references to things like BWRVIP reports, NUREGs, code sections, et cetera, et cetera.

The current situation is that the BWR IMT is pretty nearly finished. The PWR is taking a little longer but both will be available for review if you are interested, by about mid-year of this year.

Next chart please. For every gap that is identified in any one of the columns in the IMT, there is a one-page description of what the gap is. And I just showed one here to show you the general format. The description defines what the scope of the gap is, what the estimated cost of the work needed to bridge the gap is, who is responsible and the IMT team's estimate of the relative priority on the high, medium, and low kind of scale.

What we are seeing is the highest priority gaps from a proactive viewpoint are somewhat different from those pursued in more reactive issue management programs. And I'll illustrate that in the next chart.

This is a sort of schematic of the stages in the development of intergranular stress corrosion cracking. Typically, research in this area distinguished four separate phases.

The last one is the one that we focus on mostly in reactive programs because at that point, the cracks are large enough to be of

engineering significance and it's necessary therefore to be able to detect them, size them and do an appropriate evaluation of their significance.

However, the stages that are really of greatest interest from the proactive point of view, are the ones that proceed it, stages 1 through 3 where the presence of damage is difficult to detect.

But where if you can make some difference, if you can actually apply some mitigation, you have a very large effect on the useful life of the component and doesn't require very much improvement in many degradation mechanisms to push the engineering significance analysis out beyond the end of plant life.

So there is a fairly clear distinction that Phase 4 is the one that's of great interest in the reactive programs, stages 1 through 3 for the kind of proactive gaps.

Another observation is that many of the proactive gaps require work of a data generation type and therefore are appropriate for cooperation between industry and the NRC's Office of Research.

Next slide, please. We therefore propose that cooperation be pursued and suggest that the first step is to identify opportunities for joint projects based on NRC's review of the industry's issue management tables when they are finished.

Once projects are being identified that we agree are high priority, the needed R&D could be done cooperatively by EPRI in the Office of Research.

The rationale for this approach is shown on the next slide. EPRI's

worldwide role in managing industry-funded R&D on materials degradation has already been mentioned.

In addition, a mechanism already exists for EPRI in the Office of Research to cooperate in R&D programs of mutual interest.

Next slide, please. A MOU was signed back in 1997. I was one of the signatories, in fact, and it has been extended twice because the arrangement defined in 1997 works well for appropriate R&D topics. The industry believes that most of the R&D projects needed to bridge proactive gaps in knowledge are appropriate for joint funding, urges the NRC to seriously consider this approach because we think it will provide leveraging of NRC and industry funds, and will avoid the possibility of us developing completely independent and probably divergent R&D programs.

This completes my remarks. And I would like to introduce, Joe Sheppard of STP Nuclear Operating Company who will cover the fuel reliability area.

CHAIRMAN DIAZ: Thank you, Dr. Jones. Mr. Sheppard.

MR. SHEPPARD: Thank you, Robin. I appreciate the opportunity to be here this morning and to briefly review the industry's perspective on fuel performance. And if we can go to the second slide.

Overall, the number of U.S. plants reporting fuel failures has essentially leveled off with a slightly improving trend.

I think more importantly, there's been no repeat of the large number of corrosion related failures that occurred in the boiling water

reactors in 2003. And we see this as a somewhat encouraging trend.

COMMISSIONER MERRIFIELD: One question about that slide. You've got a chart here with a two-year rolling average for PWRs?

Did you have a similar chart for the BWRs?

MR. SHEPPARD: I do, but I do not show it in here. I'll be glad to show it to you. It is similar except there is a strong blimp up in the 2003 time frame based upon the corrosion failures we saw in River Bend and Brown's Ferry.

COMMISSIONER LYONS: Joe, maybe one other question. The chart, number of failures; is that the plants or pins or rods?

MR. SHEPPARD: Those are rods, okay. Typically, we have about 75 to 80% of the units are operating leak free. So we have about 25% of the units have at least one pin that has a reported leak on it.

If we can go to the third: When we look at the failure mechanisms that we are seeing right now in the pressurized water reactors, the big players are grid-to-rod fretting, debris induced failures and then, PCI which is pellet clad interaction.

In the boilers, debris and pellet clad interaction are the biggest players that we see. Going back to grid-to-rod fretting, grid-to-rod fretting is essentially a design issue.

The vendors involved have all introduced a more robust designs that they feel will resolve this issue. The real problem is that it takes three complete fuel cycles to know whether or not they were right or not. And we have encouraging results to date that they are making significant

progress there.

At my facility, we just did a series of measurements last week on some thrice burned fuel that was of the robust design looking for evidence of grid-to-rod fretting and we found none.

So we have some data points that say that we are making progress there but it will likely take three to five years before we know we have made significant progress with regard to grid-to-rod fretting.

In the area of debris, which is an issue largely in the boiling reactors but is also somewhat of a problem in the pressurized water reactors; there are really two ways to address that.

One is design with debris resistant fuel. And the second is obviously, very, very careful foreign material exclusion management.

All the vendors have improved their design to be more debris resistant and we are working with INPO and others now to make sure that the integrity of the foreign material exclusion programs are improved. And this is not what you would call your classic round of refueling forum to make sure nobody drops a wrench into the pool.

This is more of the very small materials that could be introduced say through maintenance on a feed water heater or things like that we need to be more attentive to.

Finally, pellet clad interaction is a phenomena that is very closely tied to pellet quality. And the quality of fuel pellets, especially the presence of minor surface flaws, is becoming a real key focus area for us in looking at failures and especially failures that have occurred after power

changes.

The picture on the right is one that I have shown to some of you before, that is a cross section of a fuel pin from Lasalle and clearly visible on the right side is where the pin failed and it's right adjacent to where there is a portion of a fuel pellet surface missing.

We have instituted a very strong cooperative effort with the vendors. All the vendors have improved their specification for pellet quality but we are going beyond that. We will have a series of meetings this spring between the industry and vendors where we will share best practices and methods. And vendors much to their credit have agreed to really sort of open up and share their particular experiences and their particular methods with each other, so that collectively, we can improve this overall area.

Finally, an area that we are just starting to look at is a boiling water reactor channel bowing. It's become a new focus area for us because due to some different mechanisms, we are starting to see this as an issue across all vendors and not just in one vendor area.

COMMISSIONER JACZKO: Can you just explain what channel boiling is?

MR. SHEPPARD: In a boiling water reactor, the fuel cells form channels for the control rods to go in and out like this – I'm a pressurized water guy. Due to stresses on the channel, the channel can grow and be warped and therefore, potentially, could restrict the action of the control rod going up and down in the channel.

Does that answer your question, Commissioner?

COMMISSIONER JACZKO: Yes.

MR. SHEPPARD: If we can go to the fourth slide: As both Robin and Bryce have indicated, the Fuel Reliability Program does fall under the Materials Initiative NEI-03-08.

The major areas under the Materials Initiative that the Fuel Reliability Program is focused on is, first, water chemistry impacts on fuel performance, what that integrated interaction is.

Secondly, a very important part is root cause analysis of fuel failures, and somewhat of a reactive piece of this but trying to get ahead of the curve so we can learn those lessons from the failures that have occurred. And finally, an assimilation of operating data and benchmark information so we can share across the industry and across the vendor base what is occurring.

In the area of water chemistry, one of the new areas that we started about a year-and-a-half ago but which is directly funded out of the Materials Initiative money is investigations into boiling water reactor crud and how that affects the fuel performance.

With respect to root causes, we have three hot cell campaigns ongoing right now. We are finishing up a review of the Brown's Ferry fuel that failed back in 2003. And we have just begun investigations into looking at some rods from Braidwood, which had some problems with the once burned fuel on initial startup. And also, some rods from the Hatch Plant, which has some issues during rod exchanges. So those

investigations are ongoing.

With respect to operating experience, we worked closely with INPO to reinvigorate and to repopulate the database called FRED, and we have got largely complete data for the last five years from all the operating plants in the U.S..

This is really starting to, I think, yield important information that we can look at comparisons between performance at different units, different fuel types, different mechanisms, et cetera to help us know where the gaps are that we need to focus on. In all these things, the root cause analysis, the water chemistry, the OE et cetera, all this analysis is fed back across the industry, to the vendors, the utilities, et cetera so they can take corrective actions and preventable actions going forward.

As we go to the last slide, I would like to summarize. Fuel performance continues to not be a safety issue. But the U.S. fuel performance does continue to have adverse effects on potential radiation exposure, on plant generation, and on economic performance. And therefore it is a very important issue to industry.

The goal of the Fuel Reliability Project and the U.S. industry that sponsors it is to operate with zero fuel defects. I think we have to remind ourselves to do the care required when handling irradiated fuel. Research and root cause analysis do take a long time to develop, but we are confident that we are starting to see results from those efforts, and we think that they are going to bearing fruit with improved performance as we go forward.

But we are dedicated in a cooperative effort between the fuel vendors, the utilities, EPRI, the whole industry to improving overall fuel performance, to assuring safety and achieving the industry goal. That completes my presentation.

CHAIRMAN DIAZ: Thank you very much for that presentation.

I believe we have Commissioner Lyons.

COMMISSIONER LYONS: I very much appreciate the discussions this morning.

In preparing for this briefing, my staff took a few minutes to try to explore how long material degradation through corrosion has been studied. And they came up with papers dating all the way back to the 18th century.

CHAIRMAN DIAZ: I wasn't alive, then.

COMMISSIONER LYONS: That was going to be my next question. Certainly, the NRC has been studying it a long time but as the Chairman indicated not going back quite that far.

But clearly, Davis-Besse implications from that have raised our sensitivity, your sensitivity, and increased the importance of this for all of us.

Personally, I'm very pleased to see a strong cooperative program involving industry and the NRC. And I'm very pleased that it's clear that you are viewing this from a proactive point of view.

Perhaps the main question -- I have a few small questions, but perhaps the main question I wanted to ask was to some extent touched

upon in some of the clarifying questions asked by two of my colleagues. But I would like to go into it still a little bit further.

It gets to this question of, Bryce you used the word "mandatory" several times, he word "requirement" shows up a number of times. In the number of view graphs, Robin, you indicated the plan to work toward making the information public. And Alex, you were quoted recently in "Inside NRC" expressing concern that, quote, "Resources might be wasted on detailed risk assessments that the staff is planning since industry is already managing the risk."

I would be interested in comments from any of you about how the NRC should be balancing your point of view of mandatory requirements, with our point of view that requirements probably take on a somewhat different meaning, as well as our concern that we be able to discuss our actions and activities in the public. Robin, you started to address that.

But I would be curious from comments on any of you on that general theme.

MR. SHRIVER: This was said In the opening comment that we want our process to be very open.

So our intent is the results of our studies, the issues matrix and degradation tables will be available for review.

Likewise, as a part of our recommendations, we’re asking for feedback from utilities to confirm that they have implemented each of those mandatory recommendations. In addition, we talk about some of the other methods we're using for assuring that.

I think this ought to be an open part of the inspection process, saying here is a requirement and having the resident inspector or others verify the fact that they are being implemented. That ought to be a very open and transparent process.

MR. MARION: I would just add -- this is Alex Marion -- from the standpoint of risk assessments, my main point was expending the effort to try to determine the probability of degradation in an area where the industry has collectively put in place a number of activities to effectively, manage that degradation.

So you have to make a decision and strike the balance between when do you understand the mechanism sufficiently such that you can effectively manage it, verses trying to quantify further levels of degradation that may not have any real impact in the overall scheme of things.

COMMISSIONER LYONS: But when you talk about mandatory requirements, and I certainly hope you have mechanisms to make sure that all plants do follow your guidance. But you are providing guidance aren't you, or can you actually go further than that?

MR. SHRIVER: It's clear we do not have regulatory authority in the industry part. But again, I think it is a very strong commitment as evidenced by the chief nuclear officers agreeing with this program, the accountability and providing feedback that the recommendations have been implemented and some additional oversight activities we have to verify that.

Again, there's very clearly the NRC regulatory responsibility and

authority that we think is still very active there, and this is a part of that overall basis for assuring that we are meeting --

COMMISSIONER LYONS: I appreciated your comment that INPO is heavily involved in this too. I have certainly been impressed with INPO's work..

CHAIRMAN DIAZ: I'm going to borrow a page from Commissioner's book, for the record and for those that might not be as up to the task as the Commission is, could you explain what is a mandatory program in industry and what is a voluntary program in industry?

MR. SHRIVER: Mandatory versus regulatory program?

CHAIRMAN DIAZ: Right.

MR. SHRIVER: I think from the standpoint of this initiative, there isn't much difference primarily because the initiative focuses on primary system components, and all of those components in one form or another are addressed by NRC's current regulations.

So, if we develop as we have developed mandatory guidance for example, let's take the Westinghouse document on boric acid corrosion control. That document has specific mandatory requirements articulated in it. And the utilities will take that information and change or adjust, modify, if you will, their boric acid corrosion control program. And that program falls within NRC's current regulations right now. There isn't a distinction, per se.

CHAIRMAN DIAZ: But from the industry. when the time the industry actually places a mandatory programs, there is a process that

you take in which -- what is it, two-thirds of the CNOs agree, then that becomes mandatory and then, it is expected, not required, that every power plant would actually follow that. Am I correct on that?

MR. MARION. Well, that vote has already been taken, on NEI-03-08.

CHAIRMAN DIAZ: I'm talking about what's the difference between mandatory and voluntary program from the industry? And the mandatory program has a bigger bite and then, it could be paired or not with a regulatory program. There are mandatory programs in industry that are not regulatory programs.

I just wanted to get that difference in there.

MR. MARION: Let me just speak to Commissioner Lyons' question. Since we started this effort a couple of years ago, this topic has been on the agenda of every meeting of the chief nuclear officers. And we are at the point where we providing status of implementation and accountability. For example, we are articulating what mandatory documents are being developed.

When those documents are finalized, we make it very clear to the chief nuclear officers, this is the expectation of how this will be implemented, here is the schedule. And I would ask Joe and Bryce to chime in on this as well.

We are at the point where they are asking us to update them as to whether or not their organizations and plants are effectively implementing those documents as expected. So we are at that point now

and everyone's interested and we are willing to continue moving it forward in an effective manner as possible.

MR. SHEPPARD: I would just add, as we develop these mandatory requirements, we have had a number of workshops in order to make sure that the implementers within each utility understand what those requirements are, why they need to be done, et cetera. And then, as Bryce indicated, we have, you know, really two or three different levels of accountability.

The Issues Program goes back to each utility and ask as part of their self assessment, whether you you've implemented these requirements or not. We have assessments that are done by the Institute of Nuclear Power Operations. Those are really in two phases. They have a very specific visit that goes and looks at a particular program such as steam generator management program.

They write their findings. And then, when the team comes in for the biennial evaluation, they go back and see what you've have done with those findings of that particular team and if you have not successfully taken care of that, those result in scenarios for improvement, et cetera. And finally, as Alex indicated at the chief nuclear officer level, through the MTAG and the MIOG, there is feedback back to the chief nuclear officers that your organization is cutting the mustard or it's not. And the peer pressure I assure you is very strong if you're not.

COMMISSIONER LYONS: Thanks for those comments and the clarification. I happened to be at the Columbia Generating Station last

week, and there was a little bit of discussion, not much, about WNP-1, which is sitting there off to the side. And it just raised in my mind the general question of where we have facilities like that, which were constructed many, many years ago, in that case, not used or perhaps there are other examples around the industry, I'm just curious, if in your view, we are extracting whatever information we can from those archives if you will, from the standpoint of any of the forms of materials degradation that your groups are working with?

MR. JONES. That is an interesting question. As far as degradation modes that relate to the RCS, which is what the initiative is really about, those do not occur at low temperature.

So the plants that were not completed don't give us very much useful information on those. However, they do give us quite a lot of interesting information with some of the degradation in the low temperature parts of some of the safety systems.

For example, chloride stress corrosion cracking in stainless steels in some of the cooling systems, secondary and tertiary cooling systems.

So we are sort of minding that to some degree. But it isn't any different information than we get out of the operating plants. But in the real safety area, the degradation modes of interest just don't occur.

MR. SHEPPARD: Commissioner, I do believe, and Bryce, you can correct me, we have been able to, as people have replaced like reactor vessel heads, we have been able to go on the old head and take samples,

et cetera to do confirmatory examinations to help us with the degradation matrix and also the IMT.

COMMISSIONER LYONS: I would only encourage that type of work be seriously looked at because it has to be a rich source of additional confirmatory data, and opportunities to ask various NDE or in-service inspections sort of capabilities to make sure that we have the best that we need. Thank you, sir.

CHAIRMAN DIAZ: Just following that buried cables, pipes in concrete, those kinds of little gadgets that are in there, are important.

I already asked my question that I'd written on mandatory requirement thanks to Commissioner Lyons and the other one was accountability and you guys went on for several minutes with accountability.

So I'm going to change the tack. One quick question, technical question: when you showed in the field of slide number 3, Lasalle, and defect on the pellet, I'm curious because obviously, there must have been a surface problem on that pellet, and then, when it was operated, then, that's when actually, the defect actually created stress.

MR. SHEPPARD: Yes sir, that's correct.

What occurs is you don't have good heat transfer at that place because of the gap and that creates a stress, and then, eventually, initiates a crack in the cladding.

CHAIRMAN DIAZ: So actually, it is a buildup of gases in that space plus lack of temperature because you don't have conductivity.

MR. SHEPPARD: That's correct.

CHAIRMAN DIAZ: Now, let me go to something a little more difficult and that might be a real interesting question. As you work in all of this in the materials degradation initiative and being proactive and all of those things that we really like, is part of your group taking a step back and saying how is this useful for new reactors?

Where is this going to inform if there is a new generation of reactors, how are we going to put them in the science stage and as soon as we start using this plan, how are we going to have programs that could serve the potential new reactors better?

Robin, you want to start with that.

MR. JONES: Yes, I will take a stab at that. As you know, several years ago in the ALWR Program, there was a document created called the Utilities Requirements Document which was essentially intended to help the utilities with a common bid spec when they decided to actually build some plants.

And in there, we incorporated the then current state-of-the-art on understanding materials degradation and what to do about it in advance. So it said thou shall now sensitize stainless steels and so on.

What we are doing now, we reached a point, I think, where we need to update that document and update is planed in the next few months.

CHAIRMAN DIAZ: Well, it seems to me like everybody keeps pushing us to get things updated, I think the industry could do a little better

job on that.

MR. SHEPPARD: I would think also, Commissioner, one of the issues we have is the inspectability of welds and that knowledge will pass directly to the construction of new facilities. The use of advanced alloys obviously also will pass directly to the new plants. So those lessons learned are being forwarded as well.

CHAIRMAN DIAZ: If you look at your curve in there, you realize that you put new materials, some of those are going to have problems that you need to know about. So, the issue is, how do you build in the capability to inspect or to determine, or analyze, or predict, project, I can go on and on -- whether their growth is in there and whether it is behaving the way it should be or not?

I can see Robin salivating --

MR. JONES: Well, no. The issue of prediction is a interesting subject because we are nowhere close to being able to predict on a component-by-component basis when damage will become evident.

I doubt personally that we will ever get to that point because the early stages of damage are essentially chaotic processes. It is very much like predicting the weather.

You can certainly determine that there is a likelihood and whether the likelihood is high or low based on the laboratory evidence and some field experience and inspections. But specific predictions are very, very difficult.

CHAIRMAN DIAZ: But that's what makes the capability to inspect

so important.

MR. SHRIVER: Yes. I think there are key things that Robin is certainly eager to talk about more. As you mentioned, part of this project is to understand some of the basic mechanisms as well. So we are going back to some of the fundamentals of stress corrosion, cracking, for example, to better understand that, which should provide a better basis for selecting materials and environments and stress levels that would reduce that in the future.

Plus, another major part we've talked about is the inspection and technology improving our capability, and design that into plants. I think that would be a key part as well. But this program directly supports future plants.

CHAIRMAN DIAZ: Okay. Commissioner McGaffigan?

COMMISSIONER McGAFFIGAN: Thank you, Mr. Chairman.

I want to explore this proprietary information issue just a little bit. You showed us this graph of who's in EPRI – If you are blue, you obviously have complete access to this information. If you are green, what sort of -- you mentioned the Germans were not participating in one BWR issue.

Do they then not get the benefit of whatever comes out of that? So the Germans are in the green, and then the yellows have no access to EPRI data. So proprietary means that Argentina, Eastern Europe, India, Pakistan, Russia, Ukraine, and China basically don't get the benefit of any EPRI research unless they pay for it.

MR. JONES: Yes, and even if they pay for it there are export restrictions for some of those countries that we have to honor. Now, you know, it's not a blanket, okay? Some of the EPRI research is definitely published. And the stuff that's published is available to anybody.

What that the chart really shows is who is actually paying for the programs. The access is more difficult if are you not paying, but some of it, you are going to get anyway.

COMMISSIONER McGAFFIGAN: Do export control restrictions apply to materials research?

MR. JONES: Yes.

COMMISSIONER McGAFFIGAN: Could you give me an example of -- the nuclear suppliers group, I understand, tries to control technology that might be useful from a proliferation perspective, but what sort of things come up that are export controlled? We're about to export maybe to China AP1000's, and they are one of the yellow countries.

MR. JONES: Yes. In fact, we just recently concluded an agreement with Taipei. So China is not completely yellow any more.

But to India and Pakistan, the feedback we get from the lawyers is, don't give them anything that's related to nuclear at all.

COMMISSIONER McGAFFIGAN: The President of the United States has a different view on that, I believe. I think he's working towards an agreement with the Indians that would clearly open things up. And we ourselves have found ways to work on nuclear safety issues with the Indians within the current framework. So I don't know.

One of the things that bothers me -- and I don't want to spend my entire time on this -- is that, if I was looking for countries that needed the help, the yellows would be a pretty good list. And as you guys have come to know, a problem anywhere ends up -- even if it was one of those countries, ends up rebounding back -- becomes your problem.

I know you don't like to do things for free as far as people who, I guess, ride along in the system and don't contribute. But we need to think about that as time goes on and try to find ways to get those folks involved and the information available.

One of the issues in my mind -- you all are saying we don't need additional regulatory programs, but we obviously have in recent years, in the case of boric acid controlled programs, and butt welds, primary stress corrosion cracking, inspections and whatever, we have come up with some additional regulatory requirements.

Are you saying those were over the top, they were not needed, or were those appropriate, in your mind?

MR. MARION: Well, I think, fundamentally, the regulatory requirements that govern boric acid corrosion control have been relatively static over the years. Requirements in general design criteria call for you to maintain the --

COMMISSIONER McGAFFIGAN: I think the inspection requirements are going up, and there is a generic letter to that effect.

MR. MARION: I was going to add that there is a generic letter that was issued that called for utilities to identify their programs, et cetera.

And that's been communicated to the NRC. The fundamental regulatory footprint, if you will, exists.

COMMISSIONER McGAFFIGAN: Are we doing enough inspecting. One of the things that sort of -- as we get older plants, at the same time, there are these ten-year comprehensive inspections –

MR. MARION: In-service inspections.

COMMISSIONER McGAFFIGAN: -- in-service inspections, the ISI inspections, and we oftentimes get people saying, let's postpone it or let's do it less comprehensively, we'll risk inform it. Are we doing enough inspecting, in your mind?

MR. MARION: I think there are certain areas where we have to enhance our inspection activities.

COMMISSIONER McGAFFIGAN: Does that mean you or us; us overseeing you?

MR. MARION: If I may offer a personal opinion, I would prefer the latter. The industry is moving forward with an inspection regime on primary system butt welds. And that regime plays out over the next several years -- increased inspection activities. So what we would encourage the NRC to do is monitor that because you have the right to inspect, but allow utilities to start implementing those inspection requirements.

The challenge becomes one of, where do you strike the balance in terms of confidence in inspection requirements over a period of years such that you can make adjustments to the frequency and content. If you

were finding things, then maybe you ought to increase the frequency and content. But if you're not finding anything over a period of time, maybe you need to sit back and evaluate the extent of inspection activities you have in place.

There has to be a fluid process, again, based upon inspections because you can't answer the fundamental question of whether you can effectively manage a degradation mechanism without having inspection data. It always comes down to that.

MR. SHEPPARD: Commissioner, I would add that while our plant certainly has been on the forefront in some cases of trying to use risk insights to manage the inspection regime, we are increasing the frequency of some inspections even though we might have argued, before we had this particular research, that we might want to increase the frequency.

But we're going back and actually doing it more frequently than we would have previously because of the insights that this industry initiative is providing us.

MR. SHRIVER: I would just like to add one additional comment. I think we are all in agreement that it is the licensees that have the responsibility for ensuring the safe operation of reactors. And that certainly includes the materials degradation type issues.

This program is intended to help us be more proactive in meeting that commitment we have to you and to the public. So certainly there is that need for the independent oversight through the

Commission inspections, and we certainly support that.

But our goal is that we will manage our plants in such a way that you have confidence that our first commitment is to safety of those plants and that this program provides a stronger technical basis for ensuring we're meeting those commitments.

COMMISSIONER MERRIFIELD: So you still didn't get the ringing endorsement for adding more NRC inspections on that one.

COMMISSIONER McGAFFIGAN: I may get it from the second panel.

COMMISSIONER MERRIFIELD: Joe, going to fuel performance, we've had a lot of discussion about this, both privately and publicly. Looking at one of your backup slides for PWR failure mechanisms, there has been -- I think it's notable that there has been a decrease in the issues of manufacturing defects.

It does make me wonder, you know, the major problem for PWR fuel at this point is still the fretting issue. That has been the major problem for PWR fuel dating back 12 years. Why is that? Is it because utilities want to have uniquely designed fuel assemblies?

I don't understand why that is one we haven't gotten our arms around better and why that still presents the biggest problem.

MR. SHEPPARD: I think that, really, the issues are multi-faceted, Commissioner.

First of all, the grid-to-rod fretting is really dependent upon the design of the fuel assembly, the resident time that the fuel

assembly has in the core, and then the flow regime that that assembly is subjected to.

There were some designs ten or so years ago that were introduced that, in my opinion, did not have sufficient empirical data associated with them before they were introduced to determine what their resistance was and how they would respond in the regime they were in.

There were problems at plants like Beaver Valley and some others, where the vibration that the fuel assemblies incurred was really unacceptable. And at other facilities, while not to the same degree as we saw there, they were less onerous. But still, the problem was there and led to grid-to-rod fretting issues.

It has taken a while to perfect the more robust fuel designs to get them into the core and then to be able to see the results. We are now --

COMMISSIONER MERRIFIELD: One of the parts of my question is, is part of that going be helped from a greater degree of standardization of fuel design, or is that not really an issue?

MR. SHEPPARD: Standardization would certainly help some, but each licensee has somewhat unique needs with regard to their fuel and what they need it to be able to do.

A merchant generator may have different needs than a utility that's in a fully-regulated environment, et cetera. So there have been some variances.

I think what the Materials Initiative is doing is making it clear, both to utilities and to the vendors, that we consider lack of progress in this area unacceptable, and pushing us toward the more robust designs that will make this problem go away.

COMMISSIONER MERRIFIELD: I will follow up later on. It just makes me wonder: The more variations you have, the more likely that you can have a problem. And I just wonder whether that is worth some additional focus.

BWR fuel: Significant improvement as it relates to the issue of crud and corrosion. Is that because of a greater ubiquity of fuel cleaning, or is there some other reason for this notable improvement?

MR. SHEPPARD: I don't think the fuel cleaning is necessarily responsible for that. Fuel cleaning has a number of other benefits associated with it.

I think the main thing is a very careful review of water chemistry, more integrated work between the water chemistry research groups and the fuel groups, and being very, very careful with the boiling water reactor chemistry and introductions of new things into the chemistry, as well, and tighter guidelines. We have made the guidelines tighter over the last 12 months or so.

COMMISSIONER MERRIFIELD: One quick last -- this is as much a comment as anything else. Following along on Commissioner McGaffigan's comments relative to the membership, the

EPRI worldwide membership, I guess the heart of the question is, have we really done as much, or have you done as much with those countries which have U.S. like designs or U.S. designs?

One I would point out particularly is South Korea, what happens at those CE System 80+ plants obviously can have a notable benefit to folks at Palo Verde and some of the issues that they're struggling with lately. So I'm wondering, have you done everything you can?

MR. JONES: You sort of guessed that our efforts to include overseas utilities really start with who's got plants like ours, because that's where the information sharing becomes particularly valuable.

The Koreans were an interesting case. They were full members of EPRI Nuclear for a few years. Then they had some economic problems, so they dropped out for a while. They are coming back in to selected programs now. We can't do very much except to go see them regularly and talk to them about what we are working on and why it would be of value to them. But it is still their decision on participation.

I think the case of the Germans is kind of interesting, too, because the reason we have not really pressed for a more active membership is because their designs are quite a lot different, and their materials are different, so their materials issues are different.

So at least from the materials degradation point of view,

there are some things that they have done that we can learn from, but the lessons are more in the research area as opposed to anything practical.

COMMISSIONER MERRIFIELD: Thank you very much.

CHAIRMAN DIAZ: Commissioner Jaczko.

COMMISSIONER JACZKO: I want to ask the question about some of the fuel reliability issues.

One of the issues that I think you talked a little bit about, Mr. Sheppard, was the issue of water chemistry and various activities that are going on with chemistry, water chemistry, and fuel performance.

Is that at all connected to some of the work that's going on with the PWR's in particular for the sumps and some of the things we are looking at there from a chemistry perspective in terms of performance?

I ask that for two reasons. One, if it looks like the way we are going to solve some of the sump chemistry problems is with chemistry changes, are people looking proactively at how some of those chemistry changes may affect fuel performance?

And then, secondly, just the general idea of, if there is a problem with some plating of some of this material on fuel, how is that affecting fuel performance, if that were to happen in accident conditions?

MR. SHEPPARD: Commissioner, we have not actively

taken up a connection between the pressurized water reactor sump performance issue and the fuel. But because of the tight linkage we have now between the water chemistry issue groups and the fuel group, as proposals come up to change the water chemistry guidelines, the fuel programs have to have an active sign-off on those changes. So we will be included. That has not been a focus area as yet.

We are very concerned about what chemical additions in the reactor coolant systems do to the fuel, especially in the boiling water reactors. There's a number of water chemistry regimes that are used to help arrest some of the corrosion mechanisms -- hydrogen chemistry, noble metal addition, et cetera. And that's one of the big focus areas right now is to understand how those additions, which certainly have beneficial aspects to preventing stress corrosion cracking, et cetera -- how do they affect the fuel, and do they con contribute to fuel failures?

Similarly, within the pressurized water reactors, the addition of zinc is an ongoing research area that we have. Zinc certainly helps reduce source terms which is a benefit in terms of overall radiation exposure, et cetera. And there is some preliminary indications that zinc may also help as an inhibitor for primary water stress corrosion cracking in the pressurized water reactors, as well.

But we know that zinc does change the characteristics of the crud, and it has an effect on the plate out of crud on the fuel. And we are looking very, very carefully at that. We have lead plants in

Spain and in the United States that have different duty levels. We are following zinc injection very carefully, doing the fuel inspections after each cycle to determine what those effects are.

COMMISSIONER JACZKO: Did you want to add anything?

MR. JONES: I was just going to add that, increasingly, the development of improved guidelines is aimed at optimization, an optimum chemistry program concerned with all of the components that seed the chemistry.

COMMISSIONER JACZKO: So it's starting to then wrap in some of the sump issues with the actual plating of materials?

MR. JONES: Yes.

COMMISSIONER JACZKO: I wanted to talk a little bit more, perhaps, about some of the things that you mentioned in your discussion. One of the things you talked about is, in the research programs, you had the term in your slides, you said you wanted to avoid the possibility of developing completely independent and possibly divergent R&D programs. Can you explain to me what you meant by that?

MR. JONES: The number of knowledge gaps that we are looking at is enormous. If we don't go through some kind of formal process to rank their significance, and if we don't do that together, there is a very high probability that NRC research will work on this, and we will work on that, because we have different gut level feelings about the

significance.

COMMISSIONER JACZKO: Do you mean that within the same research area, or that there would be different research? Because one could make an argument that if there is a huge knowledge gap, that maybe we are covering more of the map, so to speak, if we are doing divergent work, as opposed to doing the same activities.

MR. JONES: I think, once we agree on what the priorities are, then I would be comfortable with NRC proceeding in some direction. But there is not enough money to address everything. We need to address the high priority things first. That really requires that we look at the issues and decide jointly what are the high priority issues.

MR. SHRIVER: The key point is, we do have a very systematic approach we are using for that. We're aware that the NRC staff is working in similar areas. We think it is important that we get together at some point to review the results and be sure that we collectively understand what the biggest gaps are and are working to address those.

That may very well result in different research by different organizations. But we would certainly like the benefit of NRC's staff insights, and we would like to share the systematic work we have done, as well, to help identify what those priorities are with respect to gaps to make the most efficient use of it.

COMMISSIONER McGAFFIGAN: Could I follow up with this panel still here? The staff has an international expert group, with a report due this summer. You have your process that involved an expert elicitation and ranking. Those expert elicitations depends on the experts, so there could well be differences.

How do you see resolving the differences between whatever comes out in an e-mail, or do you have some insight into the differences between the NRC staff's international experts and your international experts?

Mr. JONES: Well, half of NRC's panel were members of the EPRI panel, as well. So there is a fair degree of commonality in the experts.

I'd say that to the extent that we have actually reviewed the outcome of both efforts against each other, there is pretty good unanimity as far as the reactor coolant system is concerned, which is the only thing the industry panel dealt with.

Actually, that finding is of some importance because the approaches taken were somewhat different. The industry approach, as I've sort of described, was a top-down approach. We got to components through major systems, and just by material evaluation.

The NRC study was a bottom-up in the sense that it started at the component level and grouped components together that we thought would suffer the same degradations.

The fact that those two approaches meet at about the

level that's required for license renewal is kind of reassuring to me.

CHAIRMAN DIAZ: All right. We really want to thank the panel from industry for their perspective. I thought it was a very, very good discussion. I'm sure that you realize that this issue will be revisited over and over again, so look forward to seeing you shortly back around here.

With that, thank you. We will take five minutes and change panels.

CHAIRMAN DIAZ: Since everybody is ready to go, we're just going to go to the staff presentation on their work on materials degradation and their own perspectives. Mr. Reyes?

CHAIRMAN REYES: Good morning, Chairman, Commissioners. The staff is ready to brief the Commission. This is actually an update on what we have been doing since the last time we talked to you on materials degradation issues and fuel reliability. Carl?

MR. PAPERIELLO: Good morning. The staff is here to discuss matters relating to materials degradation management and fuel performance. Both of these issues were respectively discussed at separate Commission meetings in November of 2004 and February of 2005.

The purpose of today's meeting is to update the Commission on these issues. The agency places a high priority in advancing our understanding of fuel performance and materials degradation since fuel cladding and materials comprising the reactor

pressure boundary are the first and second of three barriers that prevent release of radioactivity to the environment.

As a result, the NRC's regulatory program, in part, strives to assure appropriate controls are in place to maintain the integrity of these barriers.

This is achieved through cooperative action by the Office of Nuclear Regulatory Research and Office of Nuclear Reactor Regulation.

The primary role that Research plays is to develop the technical bases to support the resolution of issues associated with fuels and materials degradation.

This information is forwarded to NRR, who incorporates this information into the regulatory framework to assure that the integrity of these barriers is adequately maintained.

We have representatives from both offices here today on our panel to discuss these matters in further detail.

Jennifer Uhle of Research will summarize the staff's continuing development of a proactive materials program to predict and resolve materials degradation before it becomes safety significant.

I point out, the staff is working and has worked to further develop and continue our cooperative research programs with the industry and international organizations.

Jack Grobe of NRR will highlight how these research activities will be incorporated into the regulatory framework.

Frank Akstulewicz of NRR will discuss recent trends in fuel performance. The number of fuel failures continues to be low and, therefore, is not at the present time a significant safety concern.

The staff meets with fuel vendors annually to discuss fuel performance and closely monitors industry effort dedicated to maintaining this level of performance. I would take note of a question from you, Mr. Chairman, on the use in new reactors. A topic not discussed today but still is a degradation mechanism, is pressure thermal shock.

We have worked very hard and done a lot of collaborative and cooperative research to develop the technical bases to revise the rule and make it more realistic. But it has occurred to me, while we were doing all this work and looking at the results, that I would hope, in the design of new reactors, we have learned a lot on how to prevent the problem so it won't grow as fast and how to avoid certain trace elements in metals that made certain steels more sensitive than other steels to pressure thermal shock.

So this is just an example of where I think research contributes to making future reactors safer.

Now I will turn the discussion over to Jennifer Uhle.

MS. UHLE: Good morning. My name is Jennifer Uhle. I'm the Chief of the Materials Engineering Branch in the Office of Research. As Carl has indicated, I'll summarize the NRC research program dedicated to the proactive resolution of materials degradation

issues.

May I have the first slide, please. Thank you.

At this point, I would like to introduce the concept of proactive management of materials degradation. Let me first say that nuclear components have experienced degradation almost since the inception of nuclear power plant operations.

Management of such degradation was incorporated into the original licensing basis of the plants as regulatory requirements included provisions to assure accessibility of components to allow for periodic inspections. So materials degradation concerns are the reason for NRC requirements related to in-service inspection.

In general, the majority of actions taken to date to maintain safety and reliability with respect to materials issues has been largely reactive. That is to say that the degradation was detected and, in response, the NRC and the industry took action to resolve the issues.

Recognizing that materials degradation is a phenomena that will always require NRC attention, we are motivated to take a more proactive approach to materials degradation management. By "proactive," I mean that we will work to predict materials degradation before it occurs. With that, we will hopefully resolve it before it becomes safety significant.

Resolution may be accomplished in two different ways. In the first case, it may be accomplished by preventing the degradation.

Secondly, it could also be accomplished by repairing the degradation. But prediction is the critical aspect of both approaches. The ability to predict degradation will allow to us to better mitigate or even avoid the degradation.

In instances where we cannot avoid the degradation, we can design monitoring and inspection plans that will allow to us to detect the degradation and repair its effects before they become significant.

May I have the next slide, please. Thanks. In April of 2003, following the Davis-Besse incident, the Chairman directed the staff to become more proactive with respect to materials degradation in order to avoid safety significant -- and he used the term "surprises".

So in November 2004, the staff briefed the Commission on its approach to develop a proactive program. In response, the Commission issued a staff requirements memorandum which directed the staff to do four main things.

The first action on the slide there was to continue to do what we were doing, which was developing a proactive program in order to identify and manage future degradation.

The second was to develop integrated research programs that set priorities in a risk-informed manner.

The third was to pursue collaborative research programs with industry and with international organizations.

The fourth was to address how industry's mandatory and

needed implementation categories, which you have heard about this morning, are to be treated in regulatory space.

In my presentation, I will discuss the first three bullets, and in the following presentation, Jack Grobe will discuss the evaluation of the regulatory treatment of the materials issues.

Next slide, please.

NRC's program to protect and resolve materials degradation issues is comprised of four main elements.

The first element is identifying susceptible materials in locations where degradation mechanisms can be reasonably expected to occur in the future. This is the subject of the next slide.

The second element is evaluating whether the degradation can be effectively detached and monitored. We have completed a study on this element, and we will provide NRR a draft report in April 2006.

Third element is determining the safety significance of the component degradation. The initial estimates of the risk importance of component failure is expected to be available by the end of the calendar year.

If necessary, further analysis and research will be conducted to obtain more realistic estimates of the risk importance of component degradation.

And together these first three elements define or help to define what research is necessary and help to prioritize it.

As a regulatory agency, NRC will also perform research to verify the effectiveness of repair and mitigation measures developed by the industry.

So that is our program, the four main elements of our program.

Next slide, please.

To identify the degradation mechanisms likely to occur and to identify the susceptible components, the NRC convened an expert panel of international experts. This eight-member panel was provided some background information to help them, such as the system design and relevant operating experience. There was other information that was provided as well.

The panelists developed a list of PWR and BWR components with susceptibility to degradation, and also provided the basis for the findings. They also evaluated the likelihood of future degradation and our level of knowledge about the mechanism.

We provided a draft report of the PWR components to the Commission in June of last year. Since then, we have completed the BWR component assessment and compiled a draft of the final report. It is currently undergoing peer review at this time.

We have shared our results with NRR throughout the development of the report, and we expect to complete the final report in June of 2006.

Next slide, please. Thanks.

As I alluded to before, being able to predict degradation is the key to being able to resolve issues in a proactive manner. The effort involved in this activity, as Dr. Jones has indicated, is large, and we will only be able to achieve this goal through effective collaboration.

We hope to design a research plan that includes three elements. First is the mechanisms, to identify the potential mechanisms and the susceptible materials.

The second is the effectiveness of mitigation and repair methods. Excuse me. The second is the effectiveness of detection and monitoring techniques, and then the third is the effectiveness of mitigation and repair techniques.

We will strive to minimize any unnecessary duplication of effort so we can complete this work in a more timely manner and as efficiently as possible. So this requires a great deal of collaboration with industry as well as with international partners that we hope to join forces with.

Next slide, please. Thanks.

So with regard to the status of collaborative efforts, consistent with the Commission direction, the staff has taken action to develop a cooperative research program, comprising both international and domestic organizations.

We recently met with industry on January 17th to discuss our respective programs, and we in fact determined that our independent assessment activity generated consistent results. We

also discussed future plans and proposed methods of collaboration that Dr. Jones talked about in the earlier presentation. We are now in the process of planning our next meeting, during which we hope to identify specific areas of collaboration so that we can begin research activities as soon as possible.

Since materials degradation knows no borders, there is also a great deal of interest that has been expressed worldwide. We have already conducted two planning meetings in the U.S. and Japan, which were attended by representatives from countries of North America, Europe, and Asia. Two additional meetings are planned to take place in the U.S. and in Europe.

At this point, all interested parties appear dedicated to ensuring results are shared in a manner that avoids duplication of effort. The staff will continue to work with the Office of International Programs and will request guidance from the Commission with regard to establishing cooperative programs worldwide.

Next slide, please.

So, in summary, the staff is developing a research program to allow us to resolve materials degradation issues in a proactive manner. We are using a risk-informed insight to prioritize this research and are pursuing collaborative efforts with the industry and international organizations to minimize any duplication of effort.

This concludes my remarks, and I would like to turn the presentation over to Jack Grobe from NRR, who will discuss NRR's use

of the Proactive Materials Research Program results and the regulatory treatment of the industry's programs.

MR. GROBE: Thank you, Jennifer. Good morning, Chairman Diaz and Commissioners. As Jennifer indicated, my name is Jack Grobe. I'm the Director of the Division of Component Integrity in the Office of Nuclear Reactor Regulation.

I'm pleased today to describe for you and answer any questions you may have on NRR's plan for using the results of the Office of Research work that Jennifer has just described and to discuss specific examples of regulatory action that we have initiated in response to the proactive identification of materials degradation issues by the industry.

You specifically requested that we address this latter topic in a staff requirements memorandum following our last briefing of you on materials degradation issues in November 2004.

In listening to the industry presentation and the questions that you asked, I have expanded my remarks in several areas to focus on areas of interest to you. The industry and NRC are collaborating on early identification of materials degradation issues, and the NRC is engaging on those issue that represent potential safety concerns.

Slide 9, please.

Following the identification of vessel head degradation at Davis-Besse, NRR staff requested that the Office of Research investigate materials degradation issues.

Jennifer described the Office of Research progress on the three issues that need to be understood to proactively address the regulatory aspects of materials degradation. The proactive materials degradation assessment that Jennifer discussed is the first of three pieces.

The report identifies the degradation mechanisms that may affect various components and our level of knowledge of those degradation mechanisms.

The Office of Research is still finalizing the proactive materials degradation assessment report. However, my staff is reviewing a draft of the report, and we have provided some preliminary feedback.

In general, the assessment appears to be very extensive. Based on our review to date, we have not identified any potential or existing degradation mechanisms that warrant prompt regulatory action.

The second part of the Office of Research effort involves assessing whether existing inspection and monitoring requirements are adequate to detect the degradation mechanisms identified through the proactive materials degradation assessment.

The third part involves assessing the risk associated with the potential failure of components in the event that inspection requirements are not adequate. As Jennifer described, these activities are anticipated to be completed later in 2006.

For those degradation mechanisms where the existing inspection and monitoring requirements are adequate, no regulatory action will be needed. For those degradation mechanisms where the current inspection and monitoring requirements are not adequate or could be enhanced, staff will need to assess any programs that the industry has initiated to address those degradation mechanisms and the risk associated with the failure of the affected components.

Knowledge of the risk associated with the potential degradation of components and the effectiveness of current inspection techniques will permit the staff to prioritize its efforts for engaging the industry and changing the regulatory framework regarding materials degradation.

We will continue to review the results of the Office of Research work as they are provided to ensure that potential safety significant issues are addressed promptly.

Slide 10, please.

The recent industry initiative provides a framework for industry management of all materials issues. This initiative was undertaken by industry to foster a more proactive and integrated approach for managing materials degradation.

The actions taken by industry under this initiative are independent of any regulatory actions that the NRC may take on materials issue.

There have been and will likely continue to be materials

issues that reach a safety threshold where NRC believes regulatory treatment is necessary.

As mentioned previously, the Commission indicated its desire to be briefed on how industry's mandatory and needed action implementation categories are treated by the NRC.

Mandatory expectations in industry documents require independent evaluation from the specific plant if the plant decides not to implement specific aspects of those mandatory expectations. And in needed action expectation, the site organization can make its decision whether or not to implement those specific actions. So that's the differentiation between a mandatory action on the part of the industry and a needed action.

In slides 11 through 14, I will describe three examples of NRC regulatory action resulting from industry's proactive materials degradation program.

COMMISSIONER McGAFFIGAN: Mr. Chairman, could I clarify?

MR. GROBE: Yes.

COMMISSIONER McGAFFIGAN: Even a mandatory action, is that subject to -- a lot of this stuff happens in outages. Is that subject to budgetary, like in postponement of an outage? In Davis-Besse, we saw a lot of stuff postponed in outage. It may be mandatory, but is it postponable? I should have asked the first panel that.

Mr. GROBE: I'll attempt to answer it based on my knowledge. The industry direction for a mandatory action to be accomplished, for instance, the butt weld inspection, has both specific inspection expectations as well as schedules. If it is a mandatory implementation expectation on the part of the industry, for the utility not to accomplish that inspection on that schedule would require somebody outside of their organization to approve the basis for that.

COMMISSIONER MERRIFIELD: Is that evaluated by INPO?

MR. GROBE: I'm not sure.

I'm on slide 11 now.

The industry imitative on management of steam generator tube degradation is known as the Steam Generator Program Guidelines.

These guidelines were first issued in 1997 and were revised in September of 2005. These guidelines were assigned the mandatory implementation category by the industry when they were revised.

The staff has been working closely with the industry for a number of years on revised steam generator inspection programs. The NRC staff concluded that the safety significance of effectively monitoring steam generator tube degradation warranted revision of the NRC regulatory framework.

Recently the staff and industry have agreed on a set of

revised performance-based technical specifications to assure steam generator tube structural integrity.

The essential elements of this industry mandatory guideline will be addressed in the plant technical specifications.

The staff recently issued a generic letter to provide guidance to pressurized water reactor utilities that will facilitate the adoption of these new technical specifications. This was a topic of a recent Commission paper.

The technical specifications for nine operating pressurized water reactors have been revised, and requests from 21 additional units are currently under review.

Slide 12, please.

In April 2004, the Westinghouse Owners Group issued guidance describing key elements of an effective boric acid inspection program for pressurized water reactors. Plant-specific boric acid corrosion control programs and procedures have been in place since at least the time that NRC issued a generic letter on boric acid corrosion control in March 1988.

Westinghouse Owners Group developed this report to improve the effectiveness of these plant programs and to increase consistency across the fleet of pressurized water reactor plants.

Incorporation of these enhanced program elements was categorized by the industry as a mandatory expectation. The issue of boric acid corrosion has received significant attention by industry and

NRC following the Davis-Besse event.

Due to the safety significance of boric acid corrosion in pressurized water reactors, one action that the NRC took following the Davis-Besse event was to revise its inspection procedures used by NRC inspectors to include a requirement to evaluate the implementation of the boric acid corrosion control programs.

In this example, the regulatory framework was adjusted by the addition of boric acid corrosion program evaluation into the NRC inspection program.

Slide 13, please.

The industry's materials reliability program recently issued guidelines on inspection and mitigation of butt welds that are susceptible to primary water stress corrosion cracking. This issue pertains to degradation and has occurred in dissimilar metal butt welds in reactor coolant piping of pressurized water reactors. The industry determined that increased inspection frequency of dissimilar metal butt welds was a mandatory action.

Slide 14, please.

The increase in industry-mandated inspection frequency is beyond that currently required by the ASME code. Based on the potential safety significance of cracking and primary piping, staff recently initiated action to change the NRC requirements to include the increased frequency for butt weld inspections.

The staff issued a letter to the ASME requesting that the

enhanced inspection guidelines be incorporated into the ASME code. Should ASME choose not to update the code, the NRC staff is prepared to proceed with other appropriate regulatory actions to assure implementation of the increased inspection frequency.

Slide 15, please.

As you can see from these examples, the regulatory treatment we use depends upon the issue. Based on the safety significance of the issue, we have imposed, or revised the regulatory framework on some but not all of the industry mandatory initiatives.

To date, we have not taken regulatory action on any industry initiative categorized by the industry as a needed action. We make these decisions on regulatory treatment of industry initiatives based on a case-by-case consideration of the potential safety ramifications.

The actions that we take in response to the industry initiatives meet NRC regulatory goals: first, to maintain safety; secondly, to minimize regulatory burden.

Mr. Shriver, in one of his slides, listed a number of industry initiatives in the materials degradation area. We have taken no regulatory action on mandatory industry activities, for example, on the BWR vessel and internals program, the Alloy 600 Management Plan, or the water chemistry area.

We engage only where it is necessary to maintain safety, and we engage in a clear and predictable way through close

coordination and communication with the industry.

Thirdly, it meets the goal of efficient NRC actions on decisions. For example, there are a number of industry reports that are issued where we do not take regulatory action, but the industry's specific licensees utilize elements of these reports and revisions to their licensing bases.

There are occasions where we issue a safety evaluation on that specific industry report, which provides guidelines to the specific licensees on our expectations with respect to that specific report. It standardizes the types of license amendments we get and improves our efficiency in responding to those.

And, finally, to enhance public confidence. Having a clear, predictable regulatory framework on those issues that affect safety is important.

This completes my presentation. I would now like to introduce Frank Akstulewicz, who will discuss fuel-related materials issues.

MR. AKSTULEWICZ: Thank you, Jack. Good morning. My name is Frank Akstulewicz, and I'm the Chief of the Nuclear Performance and Core Review Branch in NRR.

About a year ago, the staff met with the Commission to discuss fuel performance during power operations and what the industry was doing to manage fuel performance. This morning, I would like to provide just a brief update on fuel performance over the past

year.

Last year, we talked about the integrity of fuel and fuel cladding and how it remains important from a safety perspective because it serves as the first barrier to fission product release.

The staff reviews the performance of fuel under both accident and normal operating conditions before it can be introduced into operator reactors in large quantities. Regulatory requirements, while not specific to fuel failures, are constructed to assure that in the event that any fuel failures occur, exposures to workers and the general public are very small and remain well below regulatory requirements.

We continue to monitor fuel performance in the reactor population to assure that performance issues are identified, that actions are taken by the vendors, and that licensees promptly resolve any performance issues.

The staff maintains knowledge of industry initiatives via periodic meetings with both vendors and licensees. During these meetings, the staff, along with participants, discuss recent fuel performance data and trends, results from pool side and hot cell examinations, industry initiatives to resolve ongoing problems, any new or future design changes, and any submittals that will be coming to the staff for our review.

Next slide, please. Thank you.

In general, there have been only minor changes in fuel failure rates. Since our last meeting, the number of fuel failures in

pressurized water reactors have increased slightly, and the number of fuel failures in boiling water reactors has decreased slightly.

Overall, these changes are not significant, but the staff is continuing to monitor this area to ensure that any changing trends are promptly addressed by the fuel vendors.

Currently, fuel reliability statistics indicate a limited number of fuel rod failures, typically one or two, in less than a quarter of all our operating units. Estimated fuel assembly defect rates in current operating reactors remains low for both PWRs and BWRs.

Next slide, please.

For BWRs, debris fretting and pellet clad interaction continue to be the dominant failure mechanism. As shown, there have been some debris failures reported in 2005.

The introduction of debris filters has reduced the occurrence of debris fretting relative to historical trends. Power maneuvering limits and the introduction of liner cladding has also reduced any pellet cladding interaction related failures.

Next slide, please.

For PWRs, as we heard Mr. Sheppard saying, grid-to-rod fretting continues to be the dominant fuel failure mechanism. It typically occurs at high power and late in assembly life. I'm sorry. It typically occurs at high burn-up, which is late in assembly life. Thirty-one failures were identified in the course of the last year from this particular cause.

The introduction of improved fuel assembly designs will significantly reduce the occurrence of grid-to-rod fretting relative to historical trends once those designs get implemented across the fleet.

As we mentioned at our last meeting, the vendors have continued to introduce improvements in assembly designs to mitigate failure mechanisms. However, it takes several years for these improved designs to be implemented across the industry.

Next slide.

In conclusion, present failure rates for both boiling water reactors and pressurized water reactor fuel, the staff does not believe there is a current safety concern. PWR failure rates have not shown any significant trend over the past few years, while the BWR failure rates have been generally decreasing over the same period of time.

The causes of these failures are generally understood, and the industry nor us have identified any new failure mechanisms at this time.

The industry is continuing to introduce better fuel designs into their operating fleets in an effort to further reduce the potential for any fuel failures. The staff has a sufficient process in place to review and evaluate new fuel designs and fuel failures in order to ensure that exposures to any population would be minimized.

We will continue our program to monitor fuel performance through our periodic meetings with the vendors and the licensees. These meetings have provided the staff with the necessary assurance

that performance issues are being promptly identified and evaluated and that actions are being taken to correct the root causes of fuel failures.

This completes my presentation.

MR. PAPERIELLO: If I could have slide 21. In summary, the NRC will continue to monitor fuels and material degradation issues and take appropriate action And then, as we are in collaboration with the industry, we are enhancing our ability to predict materials degradation. We are also working on a worldwide basis to improve everyone's ability to detect degradation through international collaborative work on NDE.

There is a range of regulatory vehicles used in addressing materials issues. While we're watching it, at the present time the number of fuel failures is not a significant safety concern. Thank you.

MR. REYES: That concludes our prepared remarks, and we are available for questions.

CHAIRMAN DIAZ: Thank you very much. I appreciate it. Commissioner Lyons?

COMMISSIONER LYONS: As I noted with the last set of briefers, and it's certainly true with this set too, I very much appreciate the comprehensive approach to the issue, and I appreciate the fact that the evidence of cooperation between the NRC and industry is very, very evident. The problems are certainly large enough to benefit from all points of view.

Two relatively short questions, I think.

The first would be probably for Jennifer or Carl. I had the occasion and honor to visit the Halden programs this last year, and some of my colleagues are sick of my talking about it.

But I was very impressed with – it's only one data point, it's all I have. But I was impressed with the quality of the work going on at Halden, and it would apply quite directly to some of the corrosion issues that we are talking about here.

I was concerned, coming back from that Halden meeting, whether we had enough representation there -- we, as in NRC -- in order to fully benefit from the information that was being discussed. But again, I have a grand total of one data point.

My question is, in general, do you think the NRC is doing enough to take advantage of international experiences in, in this case, corrosion science, or should we be doing more on the international front? I'll ask more generally at the later briefing this week.

MR. PAPERIELLO: I'm not aware of anything specifically that we ought to do more. When you deal with research, sometimes you have unbounding expectations. I'm generally, yes, satisfied with what we are doing.

In sum, it's going to deal with evolving technology. I have no doubt that as detectors improve, electronics improve, the ability to use computers to interpret data improves, that our overall NDE efforts in time are going to improve.

I know there is an interest overseas, not just in the United States, for presentations on risk-informing the NDE process at the EURO Safe meeting a few months ago. What they identified is that the quality of the initial ten years' inspection was extremely important. It had the biggest payoff of anything that you did in terms of frequency of in-service inspections.

So I think there is value in this, and I don't have any obvious point where I could make a greater investment in international research.

MS. UHLE: Jennifer Uhle. I would just like to add to that, we have already underway a lot of collaborative programs internationally, and you will hear about that shortly in the next Commission meeting.

But, in addition, one thing that the Commission could help us on -- and I think you alluded to that in your question -- was the representation of NRC. I'm assuming you meant of people from NRC at the meetings. That is one area of concern as we are taking Commission direction, to enhance our collaboration efforts.

We are faced with a finite number of international trips. In order to really give and then take back, we do need to have appropriate numbers of foreign trips. If anyone has traveled from the staff, it's a lot different than when you are a Commissioner traveling. It's a lot of work, and it's maybe not quite as enjoyable.

MR. RYES: I think there is unanimous agreement on this

side.

COMMISSIONER MERRIFIELD: Luis, watch out where you are going with that comment.

I will compare my travel schedule with any of the staff.

MS. UHLE: I didn't mean that you don't have a lot of work. I'm just saying that it is in the best interest of the agency to be able to represent -- with the number of technically qualified people, to take the information back that is presented.

COMMISSIONER LYONS: I appreciate your comment. I was personally concerned at Halden in the fuel and materials sessions when I was the only one sitting in there. And I certainly don't quality as a technical expert.

Another question for Frank. You mentioned, or some of your charts mentioned inspection of failed rods. I was just curious, what are the techniques being used for inspection? And then, maybe leading from that, into -- I remember hearing that Argone was closing their fuel cell capability – and I was just wondering if we were coming up with suitable alternatives.

MR. AKSTULEWICZ: In general, there are several types of inspections. The first one and the simplest one is the pool side visuals, where they run a camera up and down the sides of the assemblies to try to identify very quickly any particular failure type, like a debris failure or fretting. Those are easy, generally speaking.

After that, you do get into the hot cell examinations,

where they cut apart the rods and perform metallography and all sorts of other inspections on the contents of the rods themselves, looking for, for example, maybe PCI-type issues, hydrating issues. Things like that. Those are certainly more complicated.

As far as I know, the Argone hot cell question relates to more our research that it does with the abilities of the vendors to do those types of inspections. They use their own facilities, generally speaking, and make arrangements for those inspections by themselves. So there are separate resources.

COMMISSIONER LYONS: So there are enough facilities for the inspections that are needed?

Mr. AKSTULEWICZ: Well, you would have to ask the specific vendors, or the industry themselves. But in general, I have not heard any problems with respect to access to hot cell facilities to do those types of inspections.

COMMISSIONER LYONS: Thank you.

CHAIRMAN DIAZ: Thank you, Commissioner Lyons.

Let me start with -- Gee, I think it was about nine years ago. Commissioner McGAFFIGAN and I were in this room, and we were talking about inspections and things. And I asked the question, do we have a statistical expert that can determine sampling frequencies that are technology specific, and the answer was no, we didn't have anybody that could actually determine what was the sampling frequency for a specific type of test that needed to be conducted, and

the specific types of material, in a manner that was statistically significant.

I was told that that was going to be remedied. I'm sure it has been. But let me bring the issue back again. Obviously, frequency of tests is not the only issue. It is a frequency that is totally dependent on the technology, on the type of application. That becomes extremely important because at times, we get bound by a way of doing things.

I do believe that sampling frequency remains a major issue. I have not seen, of late -- and this just got stimulated today -- that we are really dedicating efforts to come up with almost a performance-based approach to sampling frequencies that allow us to make the determination of what is the adequate frequency for a particular test with a particular technology and how that changed. Any comments?

MS. UHLE: With regard to your specific question about sampling frequency, I don't think we have quite tackled that question to date.

What we have done at this point in time is address the effectiveness of particular NDE techniques. And we have a figure of merit that described as being effective.

The question of, I would say, how much inspection is appropriate is, perhaps, more of an NRR question. But with this particular report that we are providing in April, we have gone to the point of verifying, in particular situations, the effectiveness of the

techniques. And I think that is also a very important question to ask. People are getting dose, and are these techniques effective.

CHAIRMAN DIAZ: I do believe that -- and I think I said this several times -- we are at different stage of knowledge. And it is, I think, time that in every one of these programs, we do integrate not only what we know but what we need to do, and what we need to do in a manner that actually discharges our function.

I think this is an issue that really needs to be looked at because it will impact significantly on the way that we actually perform our work.

Yes, sir?

Mr. PAPERIELLO: MR. Chairman, could I respond, in part, to your question? The presentation that I referenced, I have a copy of the paper, and I can provide it to the Commission, because the presenter of the paper was looking at a European Commission, the European-wide effort, to risk-inform the in-service inspection frequency.

I would say it was somewhat inconclusive. We saw a curve today that showed the growth of stress corrosion cracking, and that enters into it. Can you detect it soon enough to prevent any consequences?

Basically, I would conclude that this is still evolving, but there are people working on it internationally.

Their conclusion was, though, that the quality of the first ten years' inspection was more important than the frequency of further

in-service inspections over the life of the thing.

CHAIRMAN DIAZ: I hear you loud and clear. But that also says it is the quality of the first ten years' inspection was not what it should be, then the second ten-year inspection becomes very, very important, and therefore how that inspection is conducted and the way in which we are going to take those results into account becomes even more important than the first things.

I don't want to monopolize this issue. Do you have some short comment?

MS. UHLE: Yes. Could I introduce Dr. Joe Muscara? He is the senior level scientist in the Office of Research with regard to materials issues, and he was the person behind the NDE effectiveness work, as well as the proactive materials research program. So he is going to add to my comment, in effect, that I was wrong. Your question was answered in that study.

DR. MUSCARA: Let me address it very briefly. In evaluating the effectiveness of the inspection, we considered a number of items. One item was the frequency of the inspection. Another item was the reliability of the inspections, what is the probability of detecting flaws. And the third item was the crack propagation rate.

When one looks at those three items, one can determine the effectiveness of the inspection currently conducted. One of the things we find is that, in some cases, the inspection may not be effective because it is not conducted frequently enough. For example,

it is conducted every ten years. But if the inspection is conducted every five years, then the inspection becomes effective. So frequency, probability of detection, and crack propagation rates were all integrated into this evaluation.

CHAIRMAN DIAZ: Concerning frequency, when I used to be an engineer about ten years ago, it was a critical issue. It has always been a critical issue, and it continues to be a critical issue. So I think it is something that we need to look at. Okay, I think I have exceeded my time.

But since I am still right here, let me just say that if the staff continues to answer questions, if they could go back to that question I asked the industry, are we moving this know-how into the new reactor arena?

Thank you. Commission McGAFFIGAN?

COMMISSIONER McGAFFIGAN: Don't do it on my time.

Carl, you talk about the importance of the first ten-year ISI inspection. And except for Watts Bar, which is probably scheduled this year, the rest of the 103 plants are past that.

It is a good insight, but the Chairman's point that if the first one was not great, the second, third, fourth, and fifth become important.

Are there international differences in the scope of the ten-year ISI inspection, to your knowledge?

MR. PAPERIELLO: I don't know.

MR. REYES: Yes.

COMMISSIONER McGAFFIGAN: A significant difference?

MR. REYES: It depends on the nation. If you go to France, they have a completely different scope because their whole regulatory basis starts with the vessel and works its way out. So it is a completely different concept. So the answer to your question is yes.

COMMISSIONER McGAFFIGAN: So theirs are more extensive in the French case?

MR. REYES: There may be people who disagree with me, but the answer is yes.

CHAIRMAN DIAZ: France, Spain, and Sweden have more extensive ten-year inspections?

COMMISSIONER MERRIFIELD: They put more of their inspection eggs in a ten-year basket. We have a tendency of spreading ours out a bit more evenly.

COMMISSIONER McGAFFIGAN: This gets to an issue that I know is near and dear to the Chairman's heart. But Research put out a report -- and I believe it's out for public comment at the current time -- about seismic issues and determining transition break sizes and whatever, under possible 50.46 change that's out for public comment at the moment.

One senior NRR person said to me, God, if the ISI inspections are that bad that you could have the degradation that would

provoke these seismic events causing pipe breaks, then they need to go fix the ISI Program. This was a senior NRR official.

Do we have a problem? Does the Research report implicate that either there is a problem with the ISI Program or whatever? That we're not going to be able to move on 50.46 changes? What is the implication?

MR. REYES: I have not read the report, so I can't speak to the report. The people who have read it need to answer it.

MR. PAPERIELLO: I'm not sure I have somebody here that can answer that question. I think we will have to get back to the Commission on that.

MS. UHLE: I know about it, but I think it would be more appropriate if we go back and prepare a response to that.

COMMISSIONER McGAFFIGAN: I've brought our progress to a grinding halt here.

I was hoping I was going to get some answers because I will left with two minutes here. I wasn't played out. I thought that one was going to provoke some discussion.

I'll switch to another subject, then, that was my backup.

International collaboration: Do the proprietary issues, if we are going to try to work in a non-duplicative fashion with EPRI, to the extent possible -- do the proprietary issues that EPRI have get in the way of international collaboration with some potential partners?

We have a very extensive program with the Russians.

The Russians can oftentimes do things that we can't, or whatever. And yet, they are an EPRI, whatever the color code was -- yellow country.

How do you see the international collaborative efforts being affected by proprietaries? I know they come up, because Halden is proprietary -- parts of it. So we work those things out. But is it a complication?

MS. UHLE: We talked about that at the January 17th meeting with the industry. At this point in time with regard to the industry, I think they are more interested in developing -- and I'm speaking for them, so they can correct me -- where are they? They are probably making bunny ears behind me or something. They are more interested in having a more formalized agreement under the MOU with EPRI, with the agency.

The reason for that is so that we can define clearly the exact program and deliverables, and be more focused on due dates, and try to facilitate the communication that way more rigorously.

I think there was concern that, in an international program, that there are perhaps more opportunities for gaps to develop in the work that's being done, a question of the technical rigor of the programs and the due dates, if people were going to be specifically adhering to the dates, which is a function of course of funding issues.

So I think that working with EPRI that way, we can define a clear program and make the exchange happen very easily. We have done that already with regard to the North Anna CRDN nozzles and

looking at the Davis-Besse head degradation. That's worked out very well.

We are also very interested in having an international program to look at the proactive work. We already have about eight international programs underway in various areas. What we are trying to do with this program is to develop the more proactive work, which is more looking at things that quite have not happened yet, but will they happen in the future? And we have not had a problem with the proprietary nature of the material.

CHAIRMAN DIAZ: All right. Commissioner Merrifield?

COMMISSIONER MERRIFIELD: Frank, following along on the discussion I had with Joe Sheppard, looking at PWR fuel failure mechanisms: You noted that the defect rates remain low. But obviously, there are still challenges remaining.

I had focused on with them the issue of grid-to-rod fretting and the fact that this is one that has really continued for some period of time.

Would you agree with some of their characterizations of where that is going? What's your sense of it?

MR. AKSTULEWICZ: I agree with the characterization that Mr. Sheppard gave you in terms of the factors that play into grid-to-rod fretting. It is a flow, environment and materials combination question. So any one of those three could change and result in a surprise, if you will, or a degradation progression that you didn't expect.

But as to resolving that issue, I think the industry has a pretty firm understanding, and they have gone to changes in the grid strap design and changes in the pin support structure, and changes in actual -- the materials that are being used. So they provide a more rigid support piece so that you don't get the vibration over time as it relaxes due to the radiation environment. So they're progressing that design as they get new information as to what materials work best in this area.

COMMISSIONER MERRIFIELD: Would increased standardization help out in this particular area?

MR. AKSTULEWICZ: I thought about that when you asked the question. And I can give you a really good example.

Standardization helps. The recent acquisition of CE by Westinghouse is a classic example of how the combination of two designs is working to the benefit of both, where they are taking the best from Westinghouse and the best from the CE and putting them together in their next generation field designs, which are going to be the advance reactor designs, which gets to the Chairman's question. And those designs are currently in Catawba and McGuire, getting real-time service. So they are going to be ready to go when we are ready to license these new reactors. So there are real-time changes at play here.

COMMISSIONER MERRIFIELD: I think I appreciate that.

I think new issues always seem to crop up in this area. I'm reminded last week, we did have some reports about some issues with some Westinghouse fuel annular pellets that had chipped and that causing some issues.

Do you have any recent update on that issue and the staff plans to follow up?

MR. AKSTULEWICZ: Actually, I have a phone call scheduled with Westinghouse at 3:00 this afternoon to hear the results of their final assessments. But this morning, I spoke with some representatives from Westinghouse and they pretty much have reached the conclusion that the fuel is going to be fine as it is and they are going to make recommendations to put whatever fuel has been manufactured into their respective plants.

Other than that, I can't give you any more details at the moment.

COMMISSIONER MERRIFIELD: Well, certainly, you all can follow-up with me as you get more findings. I was going to ask some questions but I think Commissioner McGaffigan covered it fairly well about the need for collaboration with EPRI and international. So I won't plow that territory again. I agree with the overall approach that we need to make sure we are all working to a greater degree of harmony so as not to needlessly overlap or duplicate our work.

On slide 21, Carl, you outlined the major issues that we've been grappling with. Obviously, these have a great degree of

complexity. Both the staff and industry are working hard to understand these issues and address them before they become safety significant.

But I guess the question I would have, given their complexity, but given their importance to what we do day-to-day in our work, what kind of strategy are you all using in communicating our efforts in this area of the general public in order to hopefully enhance the confidence this public has that we are in fact focusing on the right issues and we got the right resources directed their way?

MR. PAPERIELLO: You know, most of the research we do and most of the things we develop are all in the public domain. We put out NUREGs. They are all on the web. And so most of what we do is we make all this information publicly available.

It's on our website or it's in ADAMS. Even some of the lower level documents that we do, all our research reports are public documents unless they contain proprietary information. Obviously proprietary information is fenced off.

COMMISSIONER MERRIFIELD: I appreciate that. To a certain extent, though, that is somewhat a data dump. We publish everything -- it's all there. But one of the questions I think a lot of folks in public say to themselves, is gee, you may proceed me with all this research results but it is of such a highly technical nature, how do I really understand you are accomplishing anything?

And so how do we -- what kind of strategies are we using to put that or at least, a summary perhaps, of some of the results in a

way that is meaningful to someone who doesn't have a high level technical expertise?

MR. PAPERIELLO: We have put in and I started an initiative to put plain English forward on all of our NUREG documents. You know, we don't really have a effort or budgeted effort underway to -- shall we say, present the information to a non-professional or non-technical public other than what is in the plan English Foreword. That's why we put out the plain English Foreword.

We are a support office, we support NRR for NMSS for the Commission and NSIR with technical information.

But we generally don't make a major effort to turn around and take all this highly technical material and reduce it. Now, we have some web pages that kind of describe our program. But it would be a major effort to do that. It could be done but we just don't have it budgeted at this point.

COMMISSIONER MERRIFIELD: It may well be that some portion of the work is complete. In fact, you are doing forewords that are written in a way that is more understandable. And perhaps, whether it is through Public Affairs or some of the communication folks we have, maybe there's some ideas we can put out there to capture some of that work already done in a way that may enhance the understanding of what's being accomplished.

CHAIRMAN DIAZ: I think it is a very fair question for major items like materials degradation and others. So we will take a

look at it.

Okay, thank you Commissioner Merrifield.

COMMISSIONER JACZKO: Quick question. First of all, back on the fuel failure issue, Frank, I think you made the comment that we kind of have a good understanding of most of the issues or the failure mechanisms. But looking at the chart and for each of the last 3 years, certainly there is a large number of things in the inspected and unknown, almost to some extent a third. Granted, we are dealing with very low numbers here, so whether that is a significant sample or not is I think certainly a question. But are those items that will eventually be moved into one category or another or are those simply things that we don't really understand?

MR. AKSTULEWICZ: That particular category, one of two things happens. Sometimes there are third burn discharge assemblies and there is really no attempt to identify what the cause of the failure was. And so, in those cases, there won't be.

Others are removed from the actual assembly, transported and done further examination. And then, they are moved when specific failure mechanism is identified from the inspection process. So those numbers do change year to year as those inspections are completed.

COMMISSIONER JACZKO: Okay. So they are not showing an indication of the things that we don't know put but things that we have yet to figure out.

One of the things that we heard in the first panel, back to the issue of materials degradation. One of the things I heard from the first panel, was this idea that industry took a look coming from the top down at areas where we are likely to have degradation, and kind of got down do a certain level. The NRC staff took an approach from the bottom up and you kind of came together in the middle.

I'm wondering if you can perhaps talk a little bit more about the process. I think we started out with about 2200 components, and got down to about 200. If you can describe how that -- what kind of criteria we are using and how that decision was made to get those 200?

MS. UHLE: This is Jennifer Uhle. Actually, the way the process worked is we started on a component level and Joe Muscara help me if I miss some points here. And there was about 4,000 components across BWRs and PWRs. And the work that was done was we gave them a lot -- excuse me, the staff provided a lot of information to the panel with regard to the actual details of the systems because these people didn't necessarily have systems knowledge. They had more materials specific. And we identified in each different system, all the different components that were there and provided information on the operating conditions, provided some information on the NDE work that gets done as far as in-service inspections and provided some operating experience as well.

And these people stepped back and brainstorming came

up with what they thought to be the failure mechanisms that are known as well as that are likely to occur.

So there were about 15 or so of the failure mechanisms, and then they cross-correlated the components to those failure mechanisms and said, okay, yes, that's possible to happen here because of the material, because of the operating conditions. And I think that Robin Jones gave an example of in the case of the pressurizer, they did not consider a irradiated assisted stress corrosion cracking because there was no neutron fluence to worry about.

So they went through and ranked the component and whether or not the degradation mechanism was susceptible. And also from their understanding of the physics involved, determined the susceptibility of the components. Some components were more susceptible than others for a variety of reasons and then also indicated how much knowledge we have on the component in its susceptibility to this particular mechanism.

And we also had a list of what their -- I would say uncertainty level was.

So if the answer came back that, I'm really uncertain, I don't know and we don't have a lot of knowledge, and we think that perhaps there is some likelihood here, then, of course, that was a red component to us. That meant that we need to look at doing some work here to understand this more.

COMMISSIONER JACZKO: So was there kind of a clear

demarcation between these 200 that we wound up with –

MS. UHLE: Yes, they came up with that as well as looking at -- Joe can provide it but exactly, there was a clear demarcation that those were the ones that we didn't know a lot about and that they were highly susceptible. And we also from a proactive standpoint identified components that we knew a lot about but we didn't have an effective mechanism.

COMMISSIONER JACZKO: Actually, Mr. Chairman, if I could go because I want to ask one other quick question unless there was anything.

MR. MUSCARA: Just to clarify very briefly how we came down to 200. We, in fact, did a somewhat quantitative evaluation of the potential for degradation. One of the items we evaluated was the level of susceptibility.

So in the BWR example that you mentioned, we had 4,000 components or so that we evaluated. Every one of those components was susceptible to some degradation mechanism to some degree. The way we got down to 200 is for those components where the susceptibility level was very high, so there were 200 components approximately that have very high susceptibility to materials degradation mechanism, the others were susceptible, but not as susceptible. So this helped the 200.

COMMISSIONER JACZKO: Thank you. Just a very quick question for Jack. One of the things this Boric Acid Corrosion Control

Program, one of the things you said that's happened in terms of NRC regulatory changes is that we have now included inspections of these programs in our inspection activity.

What are the results that are coming back from that right now? Are we seeing that these boric acid control programs are doing what we think they should be doing? Or is there some areas of weakness for those, or do you not have information yet?

MR. GROBE: I don't have information prepared on that topic. I think it would be best to answer that specifically, collect information and answer it specifically. Just to be clear, there wasn't really any regulatory changes. The provisions of 10 CFR 50 Appendix B, criterion 5 in the Technical Specifications are adequate regulations to ensure implementation of an effective boric acid management program. It was an additional focus on inspection to make sure that those programs were being properly implemented.

COMMISSIONER JACZKO: If you could just provide some more detail on it.

MR. GROBE: Sure.

NRC STAFF MEMBER: There was a Davis-Besse lessons learned task force recommendation action item -- sorry for the long handle -- to evaluate the effectiveness of those programs and my understanding is that there were no surprises, that the programs were inspected and shown to be performing effectively three.

In terms of -- I think you asked your question in terms of

areas for further expiration or weaknesses or whatever, and I think that I would like to point out that those programs are not really designed to detect leakage as a result of primary water stress corrosion cracking.

Those programs are basically not designed to remove insulation from the various dozens and dozens of components that have dissimilar metal welds that are susceptible to primary water stress corrosion cracking and that has to be covered by other programs. Some of them -- most of them have been addressed by a variety of bulletins that we put out since 2000

Even the MRP effort that has to do with butt wells that was talked about previously by some of the other presentations includes components of their inspection program that would identify weaknesses or degradation due to primary water stress corrosion cracking and there are some other components that are addressed by a code case that the ASME developed and that is also the subject of another MRP program that we understand is going to come to completion this year.

So there are various other programs in place to address that one particular area that the boric acid programs were never really designed to cover.

COMMISSIONER JACZKO: And Jack, if there is anything else, you can just do that in writing, that would be fine.

MR. GROBE: Okay

CHAIRMAN DIAZ: Thank you Commissioner JACZKO.

And I want to thank the staff for preparing and doing all the right things and hopefully, keep doing the right things.

Sampling frequency, is there, and I don't know if my fellow Commissioners --

COMMISSIONER MERRIFIELD: Mr. Chairman, I would make two comments just following along on some comments made by Commissioner Lyons. The first one relates to Halden.

I had a chance go there a while back as you well know, and I would certainly support efforts that would make sure that we getting a return on investment there and if that requires sending some more staff abroad, so be it.

The other thing that was mentioned today was the issue of Argone and the lab -- our use of the lab up there.

Again, that's one that I'm familiar with, have been to see, and I think is a real asset to some of the work we do and certainly would be supportive of taking a look at that as it relates to the agency's need, if we need to.

All right, thank you Mr. Chairman.

CHAIRMAN DIAZ: Thank you so very much. With that, we are adjourned.