One of the bills in the House, Heather Wilson has a provision that would require us to do something we would have done anyways which is, provided we have adequate funds, and even if we don't we'll reprogram some, to do some vulnerability assessments using the National Laboratories. Sandia, Los Alomos and Livermore, are probably the three labs we'll primarily use for those analyses. They have done work in the past for us, but they have also work for other sectors.

Sandia did some interesting work for the Gore Commission with regard to transportation, looking at the transportation system as a whole and how security could be -- airline transportation system, and how security could be enhanced.

So we are -- I think that is an area where -- I'm sure I'm not telling you anything, but that takes up most days. We get about ye-thick set of documents to read, some of which are classified, some of which aren't, all of which are sensitive. We plow through that. The Chairman is in charge if it's fast moving, but if it's slow moving, the Commission as a whole deals with the issue. As I say, we are looking at everything. Everything is on the table.

Although I do want to say, and I'll say

publicly, I mean I have had debates with Paul Levanthal sort of privately. I believe that I am proud of the security system that we had in place on September 11th. I think it provides the highest standard of security of any private sector enterprise in America and appropriately so because there are significant risks. There is no chemical regulatory commission that looks at the petrochemical plants and has requirements for security that are inspected by chemical regulatory agency staff, and there are no on-force exercises, and none of the apparatus that we have in place is in place for much of the rest of the infrastructure. It is quite clear that you can get catastrophic consequences in industries other than the nuclear industry.

That said, that we had a very, very high level of security on September 11th, and we have maintained it and obviously enhanced it, we are going to have to take into account the events of September 11th and looking at security in the future.

One thing that we have stressed since September 11th is that we have to think in terms of what's appropriate for private security forces to do, and what is appropriate for the Federal Government to do. If it makes sense to defend against air threats, diving commercial airliners, and I'll get back to that, then that clearly is not something that we are going to ask licensees to do.

I do think we have to worry about commercial airliners, but I think given that we have been attacked by four of them, but the way to handle that is with enhanced security on the airplanes themselves, the cockpit door reinforcement that has been talked about, enhanced security at the airports to prevent people getting materials onto the planes that could be used to attack the pilots and take over the plane, additional air marshalls, all of those sorts of security.

The notion of having -- I mean Paul Levanthal for a month, until I talked to him on October 18th, has been calling for the deployment of surface -- not surface-to-air missiles, of guns, of anti-aircraft guns. I informed him on October 18th at our public meeting that the U.S. military doesn't have guns. I mean the last guns I was aware of was in 42 dusters that were in the New Mexico National Guard while I was working for Senator Bingaman. Div-ad was cancelled. In 1985, I was working for Bingaman then too. It would have been a hell of a gun. But all of our air defense forces are designed for the clash of tank armies on the battlefield in Germany as the Russians try to pile through the Folda Gap and we try to stop them. They were not designed for defending the sort of 63 nuclear power sites.

So he has now amended it. He has figured out that we only have surface-to-air missiles, so he is now correctly saying that he wants -- really correctly in the sense of what's available in the American inventory. He wants surface-to-air missiles at the 63 sites.

I try to explain to Paul the command and control issues involved in having 63 surface-to-air missiles. I also try to explain to Paul the mal-deployment of scarce defense resources that would be involved in trying to have -- having 63, you know, taking essentially all the Hawks and Patriots we've got and sticking them around a bunch of nuclear power plants that aren't particularly vulnerable.

Now you get into this issue of -- you know, we have not except at Seabrook we looked at FP-111 going into Seabrook because at Pease Air Force base nearby there were large numbers of FP-111s stationed until they were taken out of the inventory. We looked at Harrisburg, at TMI we looked at 707s. So we have not done an analysis. We are clearly working on it, an analysis of what happens when a large commercial aircraft crashes into a containment dome or elsewhere in a nuclear power plant.

But you know, there's at least a pretty decent chance as I agree with Intergy, I think was in today's New York Times, is a pretty decent chance that these plants would survive famously. Number one, it would take a hell of a pilot to hit some of these plants. They are not the World Trade Center. Number two, the main thing, the Germans and the Swiss do have regulations. They looked at things like FB-111s. What was it, the old, I think it was F-104s. Yes, the F-104s Starfighters just routinely dropped out of the sky all through the 1970s. People decided they better look at what happens when Starfighters hit them at high speed. They look at speeds like 700-odd kilometers an hour. It's the engine, whether it's a jumbo jet or it's a fighter plane that's the key thing that might penetrate.

Even if it penetrates containment, it isn't clear that you have an accident yet that you can't recover from. So what has happened, thanks to Paul Levanthal and others, is this notion that if you hit anywhere, you have certainly got a catastrophe. You know, they don't take into account the defense and depth of the plants. You know, we can't rule out, just we can not provide perfect assurance, perfect safety to the American public. But we have provided a very high level of safety. We will continue to provide a very high level of safety. A lot of the issues that some of these members of the public are trying to trot out are in my mind the sort of worst national security analysis one could possibly come up with. You know, they are suddenly becoming national security experts. If you follow their prescription, you will do a disservice to American defense, in my view.

But that is just a passing comment. I do not really expect you guys to comment on that. I just had to get, in case there's somebody from the press here, I get it out and let them report it if they want.

What else? Risk informed regulation, one of you guys' favorite topics. We are making slow progress, in all honesty. I don't think any of us have dusted off the 50-46 paper we have in front of us. I keep promising I am going to vote on the 50-44 paper because it's relatively straight-forward, but I am under no pressure to do so because just about no one else has. We are diverted at the moment.

So I think the staff continues to make progress. The staff that's involved in the security issues isn't the same staff that works generally on risk informed regulation. The staff has made good progress, as I understand it, at least they have a couple options out there with regard to how the option two would work, and I think are having this month discussions with the public about these various options for how they would deal with the special treatment requirements at the nuclear power plants on a generic basis.

The Commission has encouraged the staff, as you know, to put drafts out even before they come to us in order to expedite these rulemakings. We will continue to do that. I think that is one of the big changes that has occurred in recent years. We learned from some of our rulemakings, the Part 70 rulemaking on the materials side, that sort of going closed for long periods of time and saying everything is pre-decisional and doesn't really help the process. When the information finally comes out, you tend to have a big controversy.

So we are hoping -- we learned through the 50-59 revision process was very open and transparent. The maintenance rule revision, the A4 revision, as we called it, was open and transparent. Now we are going to try to do that with these new risk informed rules.

But anything that requires a Commission decision in the near term, we are a fairly diverted and distracted Commission at the moment. So things may get coagulated a little bit.

With that, and having taken about 15 of the 60 minutes, why don't I open myself up to your questions and see what you want to ask me about.

MEMBER POWERS: Can we come back to the security issue? I think one of the areas that the Committee could probably contribute on. I don't think we can contribute to some of your more policy things, but I think one of the areas that the Committee probably could contribute in is looking at what the staff is doing and the depth to what it's doing then, especially if we had a better understanding of the kind of information that you would like to have on the threat posed by terrorists to the nuclear power plants.

MR. MCGAFFIGAN: I don't want to get -- I think you'd need to talk -- I mean I almost would volunteer except I'll be in a briefing about other things at 3:00, whenever you are going to get briefed by the staff. But I could stick around some day in a closed session with you and go through some of the things that are in our minds as to where we might have to adjust our security posture.

One thing I will say to you in open session. The spent fuel pool study last year, you know, the possibility that cannot be eliminated that however infinitesimal it may be, that years after the spent fuel is put in an ISFSI or left in the spent fuel pool, I guess you were talking about a spent fuel pool here, years after the stuff has been put in there, there is still an infinitesimal chance -- I'm using my words, not the study's -- that you possibly would get a zircoloy fire is now of course being used to say that there's a real vulnerability in spent fuel pools.

You know, as you know, Commissioner Diaz and I and others at the time had problems with that because the assumptions where the staff went from there being a zero probability of an accident to there being some infinitesimal probability that therefore we had to relook the exemptions we already have. You all said that wasn't a -- I think they said that that wasn't something that desperately needed to be done quickly. We still haven't had any relook information from the staff about the exemptions previously granted. But it's sort of -- I wish we could have brought that study further along to the point where we really had some sense as to whether there's a vulnerability there that really needs to be addressed.

My understanding was with the proper earthquake and the proper misalignment of the fuel and assuming that heat somehow doesn't get out, you could somehow get a zircoloy fire, but it was even if the stuff has been cooled for five years, I think it's related to the point I made earlier. This sort of search for perfect security and perfect safety, you know. Is the remote, remote, remote possibility of something, with significant consequences if you believe it, something that we should expend in this case regulatory resources on to try to prevent? I don't know.

MEMBER KRESS: I think you have the right take on that. I think when we relook at it, we might ought to relook at it from the standpoint of how quickly can we get that stuff out. Because it would be much -- you would be a better risk status if you could get the stuff out and put it in the dry cask because I think they are much less vulnerable to a sabotage event.

MEMBER ROSEN: Better yet, put it in the

mountain.

MEMBER KRESS: Dry cask first.

MR. MCGAFFIGAN: But you can't possibly put anything in the mountain because moving any spent fuel from here to anywhere is a mobile Chernobyl. Right?

I am not going to get into putting it in the mountain. Clearly, you would be better off -- I think our view historically has been the spent fuel pools and the ISFSIs are protected of public health and safety. I don't know how -- one of the things we will have to look at is the vulnerability of spent fuel pools to various sabotage and whether -- there's an additional argument now compared to before September 11th to get things into ISFSIs.

But the pools themselves are pretty darn safe. A plane diving into one, it strikes me, you know, you have got a lot of time to add water if the worst thing happens. I just don't -- you know, I don't -- compared to what one could do at various very soft targets around this country that aren't regulated by us, I am not sure that it is something that we are going to have to expend a lot of extra resources trying to regulate. The Nevadans actually have tried to use the September 11th event to say see, you can't possibly move this stuff. It has to stay where it is. I think your comment is closer to the truth, that we clearly never envisioned having spent fuel in large quantities forever at the sites. We would have been better off moving it off some time ago. Not to reprocess, because processing is not economic at this time. It may not be economic for a long time, given the price of uranium.

But the ideal world, we would have moved this material off of these sites as quickly as it had adequately cooled to make the transportation and the casks easy to carry out, the campaign easy to carry out. But I don't know.

MEMBER KRESS: I really like your view on this issue that the best thing you can do is control the initiating event frequency, but not dealing with the security of the airplanes.

I wonder what your view might be on, as part of that, having a no-fly zone over all the plants?

MR. MCGAFFIGAN: I am skeptical about no-fly zones, to be honest with you. A plane traveling 400 miles an hour travels six-and-two-thirds miles in a minute.

MEMBER KRESS: That's not much warning

time.

MR. MCGAFFIGAN: At 12 miles, you have less than two minutes warning time. You obviously aren't going to recognize it instantaneously either, so there's a delay time in the recognition.

We only in certain places have combat air patrol aircraft. They will not be there forever. Obviously they are there at the current time over the east coast and other places, and we have Strip Alert aircraft, but the Strip Alert aircraft aren't going to get there in 30 seconds or a minute, whatever time.

MEMBER KRESS: I was thinking about warning time to the reactor operators so they might be able to do something to shut down the reactor scrams.

MR. MCGAFFIGAN: To scram the plant, right. Well, that requires again, a tremendous degree of capability that we some day could have there, but I don't think we have today. In some places in the east coast, you are well inside FAA radar areas. If somebody dips inside the zone, a controller would recognize it. But you are talking about sort of real time communication from that controller to the reactor. We don't have that capability today.

We have the event on October 17th at Three Mile Island. We did shut -- the FAA did shut

Harrisburg Airport. This turned out to be a non-credible threat the next morning, but one we had to treat as credible that evening on the advice of the intelligence community. But the airport was shut down. That was announced actually, as I understand it, at O'Hare Airport, you know, Harrisburg has been shut down due to threat to Three Mile Island.

The combat air patrol aircraft were in the vicinity. We had a specific time. Once it expired, the airport reopened and the combat air patrol aircraft went away.

MEMBER POWERS: Does the reactor being operated or shutting down if it's hit by an aircraft make any difference? I think it makes no difference at all.

MEMBER KRESS: I don't think it would either.

MEMBER POWERS: They certainly would shut down by itself. They shut down by themselves pretty easily.

MEMBER KRESS: It's assuming the control rods can go in.

MEMBER POWERS: Even if the control rods don't go in, it will shut itself down.

MR. MCGAFFIGAN: The other problems with

no-fly zones, as I say, it isn't clear -- you get some seconds of warning time, which it isn't clear we could utilize today. Some day we might be able to utilize. But around many of the sites there are airports not far away, you know, where people like to fly their --

MEMBER KRESS: You'll have to shut those down.

MR. MCGAFFIGAN: Well, you tell the airline owners and pilots association you would like to shut down all the airports that are within X miles of nuclear power plants. We were getting a lot of calls, and the FAA was getting far more last week, from Congressmen whose constituents were grounded. They honestly don't feel that they are much of a threat. These little pilots, you know, Lynchburg Airport down near the Cat1 Fuel facility in the western part of Virginia in the Shenandoah Valley. That airport was shut down the week that FAA had the controls in effect.

That's another piece of analysis we are going to have to do. I suspect it's going to be a straight-forward analysis, but people have suggested publicly that we need to look at small aircraft diving into the plant with explosives on board, sort of the air truck bomb. If the analysis previously done about the engine being the most important part of the ability to penetrate containment, these plants aren't going to be moving that fast. They don't have very massive engines. The additional explosive may not make much difference on the outside of the containment. Most of the explosive force is going to go out.

MEMBER POWERS: That's not where you want to hit the plant.

MR. MCGAFFIGAN: You can think of better targets, and that is what Paul Levanthal has been saying publicly. He can think of better targets, and I guess we all can.

No-fly zones just are something that it's sort of an example -- it's like the surface-to-air missiles. You know, it's an example of an easy solution that people gravitate to. In this case, the analogy early on was the first week we were protecting football stadiums during football games, you know, to the extent that no-fly zones protect them. So if it's good enough for Oklahoma versus Nebraska, why isn't it good enough for the nuclear sites was the basic question being asked by the public.

The same sort of thing happened with the Coast Guard coming around some of the plants. The

Coast Guard, just as it's on high alert and wanted to know where the nuclear plants were, they put assets around several of the -- or at least they were patrolling near several of the sites. As one of the staff -- one of the staff aphorisms around here is that no good deed goes unpunished. When they actually wanted to take those assets out because they figured out that maybe they would be better utilized somewhere else in some of these busy ports where you have these large liquified natural gas tankers wandering through and whatever, there was uproar and human cry as to how dare you pull these Coast Guard assets from the nuclear sites.

A lot of the security people, and I'm glad Governor Hodges visited Catawba yesterday or the day before. He came out of the plant very impressed with the security. He visited with his director of state security.

Most of the people who go to our plants, you know, and see the capability that we have at the plants, especially in the state they are in at the moment, come away saying this is not the highest and best place to assign my marginal resources or that they are not particularly needy of National Guard assets compared to other places in that state. That we have a very mixed bag.

I saw in today's press clips that the Governor of Illinois felt peer pressured into putting the National Guard at his sites. I don't know whether he shut it down today or not. Texas took their National Guard out of Comanche Peak, feeling that the capability was adequate. I believe that's probably going to happen at Palaverde in Arizona. Governor Hull had put National Guard assets in there, and I think is probably going to pull them out. But these are decisions governors have to make, given the information that they have.

There are times when augmenting with National Guard, clearly augmenting -- we have encouraged since September 11th that there be these protocols in effect between the licensees and state and local. They are sort of there always. We have encouraged dialogue with the governors. Some of our licensees have asked for National Guard augmentation. That is fine.

But in many cases, Governors have gone in with their security folks and said, gosh. I don't think it's needed. I've got some state police there. That is enough. I don't need to put the National Guard in.

In Florida, we had two different utilities making two different choices. Florida Power at Crystal River decided they didn't need the National Guard help. Florida Power and Light accepted it at St. Lucy and Turkey Point.

We probably at some point need to, you know, as a Nation, think these things through. They are clearly not decisions just for the NRC. We are not the deployers of national security assets of the country. But there is a real concern that we have that by focusing too much on the nuclear facilities, you are going to actually hurt overall security by raising vulnerabilities at these software chemical, petrochemical, et cetera, sites that would offer very attractive targets.

MEMBER SIEBER: I was wondering, you spoke earlier about doing vulnerability studies. It would be my impression that to really do good ones to try to redefine the design basis threat, it might take a year or two to do that.

MR. MCGAFFIGAN: Well see, the vulnerability studies, I'm not sure will inform the design-basis threat. If I am postulating that I personally do not think that we are going to add ever air strikes to the design-basis threat. By definition, the design-basis threat is the threat against which licensees should have high assurance of being able to defeat. Licensees have assets that are constrained by law as to what they can have. I don't think even Charleton Heston, who we'll have to pry that gun out of his cold dead hands, wants surface-to-air missiles in licensee hands at these sites. It wouldn't be Patriots, it would be Stingers.

You solve one problem that we may solve by other means and we create another. Proliferation of Stingers around the country at a variety of sites, and god help us if somebody gets their hand on a Stinger. That's the real way to bring down a commercial airliner.

So some of these vulnerability analyses are going to be more of interest to the Pentagon and the Office of Homeland Security in terms of trying to decide how important it is that they assign assets that are under their control to the defense of these plants. Vulnerability analyses, the sort of analyses that we're going to have to -- the design-basis threat, we are going to have to decide about the numbers of attackers, and we are going to have to decide about the weaponry that the attackers are going to be hypothesized to have available to them.

We are going to have to decide how large the truck bomb. We have a certain sized truck bomb in our design-basis threat at the moment. We'll have to, as Mr. Levanthal requests, and I think we would do it in any case, look at whether a larger truck bomb will need to be protected against.

We will need to look at -- I mean there's legislation that you all should look at pending. It is attached to the Price Anderson Act, reauthorization in the House, that would require the President to do a study in which he would parse. It is the so-called Tauzin, Dingle, Markey amendment, in which he would parse threats into two bins, the design-basis threat bin and the enemy of the state bin. Then the provision would require us to do regulations within a certain time period, I believe 275 days after receiving the President's report, to adjust our design-basis threat. Then presumably the enemy of the state threat, that information would be used by the Pentagon and Office of Homeland Security and others to decide what they were going to do.

It also mandates that we will have essentially an OSRE type program, but an expanded OSRE type program, in that it defines sensitive nuclear facilities for which an OSRE will be required to include reactors, category 1 fuel facilities, the gaseous diffusion plants, spent fuel pools, decommissioned reactors, et cetera. So you would have -- we have done OSREs in the past at the 63 or 64 sites, depending how you count them, that we have, reactor sites.

We have not done OSREs -- we have force-on-force exercises at the 2 Cat 1 fuel facilities as well. We have not done them at decommissioned reactors or spent fuel pool facilities that are independent of reactors. So it envisions an expansion of the OSRE program, and in a sense, the design-basis threat analysis that they want us to do I think given the definition of sensitive facility, would also require that the Presidential study look at binning design basis threat and enemy of the state threats for this larger category of facilities.

MEMBER POWERS: What was their force-on-force exercises? The problem you always have with large-scale tests, you get to do one.

MR. MCGAFFIGAN: We got to do four. Each OSRE has four drills that are gone through.

MEMBER POWERS: That's right. It gives you a very limited view of what your actual defensive capabilities are, and does not allow much in -- if you find deficiencies in those defensive capabilities, your choice is to amend them, and then to go retest. You don't have the facility for looking at lots of different options.

That is a problem that the Air Force encountered in defending lots of its bases. There has been a fairly well developed technology of developing computerized scenarios, where you calibrate against a test for the facility and what not, and then you use these computerized capabilities to evaluate options and designs and what not, and make your testing along some sort of a progression where you improve actually.

MR. MCGAFFIGAN: Right.

MEMBER POWERS: I wondered if we shouldn't be thinking about bringing those technologies to bear here, rather than just going out and running lots of OSREs at every facility around the country at God knows what cost.

MR. MCGAFFIGAN: I think we understand some of the limitations of force-on-force testing. I would welcome any thoughts as to how to bring that technology. Unfortunately, the dynamic that has been set up is, you know, the factoid out there is that 47 percent of the time licensees over the last X number of years, ten years or so, have failed OSREs.

MEMBER POWERS: I'd like Dick's response on that one too.

MR. MCGAFFIGAN: I'm not sure what his response his. The actual number is more like, you know, in terms of the four drills per site, licensees have actually succeeded 85 or 90 percent of the time in these drills. When they have had problems, we fix them, like you say.

Does that mean that the whole strategy has been fixed? It isn't clear. It means that that one hole in the strategy that was tested that day in one of four tests has been fixed. I don't know whether that -- I think we're better off having done OSREs than the chemical industry that doesn't have anything like this capability. I think we do give hard tests.

These tests that the staff uses in an OSRE, they do a bunch of tabletops. Then they detect what they think is a vulnerability. Then they test against that vulnerability. So these are fairly smart -- the four drills that are carried out, they can't all test the same vulnerability, but if they see a vulnerability in the tabletops in the licensee's defense posture, we go try to probe that vulnerability in the OSRE. As I say, if we find it, as we did at Vermont Yankee or other places, we get it fixed promptly with compensatory actions.

But I think trying to find a way -- you know, I have come at OSREs a little bit from at Fort Irwin in the desert in California, we do force-on-force exercises at very large units. The red team is pretty damn good, and they win. It is better for our other units to learn in the desert in California than to learn in the battlefield in Iran or Iraq. So there is a value to force-on-force because you are getting to make mistakes that don't matter, so that when it does matter, you are better able.

MEMBER POWERS: I think when you get to do repetitive tests that that's true. I think you are running into the problem of diminishing returns because in many respects you are playing got-you with the licensee here, because they don't happen that often at each one of them. I think there is room for bringing an improved technology into this.

MR. MCGAFFIGAN: Well, I would love to hear about it.

CHAIRMAN APOSTOLAKIS: Can we move onto other subjects?

MR. MCGAFFIGAN: Sure. You guys are falling into the September 11th trap that we all are in.

CHAIRMAN APOSTOLAKIS: Let me come back to something you mentioned in passing earlier and others also mentioned it in the public forum. Risk informing the regulations is proceeding at a very slow pace or slower pace than anticipated.

I guess I am a little puzzled by that. Can you elaborate? I mean what should we have done by now to be able to say we are on schedule?

MR. MCGAFFIGAN: I don't know. In 50/46, there's some fairly complex issues, that paper for us. You guys have it. I forget if you sent us a letter on that paper, I forget whether you have. You probably have. It shows you how much I've read.

The problem is others are suggesting from the industry that the strategy in the 50/46 paper is not aggressive enough, and that we would do better to carve out a few things and to get some early success. I have not -- you could use the next few minutes if you want to educate me as to why I should go back to my office and just check yes next to the approved column and move that paper along.

I thought that probably given all the letters that we have gotten from members of the public, mostly from industry to be honest with you, that it was worth my looking at them, thinking about them, and seeing whether the industry folks were right that there's some parts of this -- they also are disappointed, is my recollection, that we are not willing to -- they have been arguing, as I understand it, for an amendment to 50/46 that essentially would say you can change the large break loca. We will entertain changes to the current double guillotine break large break loca design-basis accident. You know, they fully expect that any change would have to be done with NRC approval.

They would like to get that regulation moving so that there's a regulation in place whereby owners groups could submit arguments for another design-basis accident, and we all could grapple with it. As they see the staff proposal, it is going to be many years before they can even have the argument with us. I don't know what the right answer is there. So I am trying to figure out what the right strategy is on the 50/46, the various 50/46 options that are before us.

CHAIRMAN APOSTOLAKIS: So it seems then that --

MR. MCGAFFIGAN: On 50/44 it is going to be straight-forward. When we all get around to voting on it, we are going to basically, I think, endorse what the staff, the revised approach the staff is taking. I think that one will go reasonably rapidly. 50/69, or whatever the option two stuff, I think depends how these meetings go and whether the staff itself can come to consensus. But if you, the staff, and the public were all to come to consensus that this is the right 50/69 option, that could go fairly quickly. It's the 50/46 is the place where I see a problem.

CHAIRMAN APOSTOLAKIS: So as long as the first 50/46, not the overall.

MR. MCGAFFIGAN: Not the whole thing. As I say, I think a lot of people are working, the people who do risk-informed regulation on a day-to-day basis are out there trying to figure out how to do it. They are having their meetings. But I think it is the option three stuff that I see as going a little slower.

MEMBER POWERS: I think we have run into some technical challenges on 50/46 that made consideration of going for some of the gimmes in 50/46 attractive. I mean things like, for heaven sakes, why can't we update the decay heat curve. That is kind of a gimmee.

MR. MCGAFFIGAN: Well, see what Oshuk

tells me in my office is well, not so fast, Commissioner, because that is clearly an area of over conservatism, but there may be a few places in 50/46 where we're not being overly conservative. By giving up the over-conservative here, are we somehow upsetting something. So my understanding is, and the 50/46 paper I think reflects this, that everything is connected to everything else. So therefore, you can't do the gimmees because everything is connected.

I am skeptical about that, to be honest with you. If you all were to come in and say take the gimmees, I think it would have a strong effect on how the Commission would think about this stuff if there was a consensus in this group.

But the staff's approach is that everything is connected and everything will only come together when everything comes together. That could be some significant period of time.

MEMBER ROSEN: That sounds to me like a prescription for not doing anything for a very long time.

MR. MCGAFFIGAN: I worry about that, yes.

MEMBER POWERS: I think there was merit to what the staff's approach was when it looked like you could move forward. They have run into a real technical barrier in one aspect of it. I think you need to rethink your strategy here and look for the gimmees in this thing.

Before, you know, they are right. There are tentacles from 50/46 that go out and touch lots of places, but now that you have run in and found a hard spot, it is going to take some substantial work. Why can't we go back and look for the ones where the tentacles are few in number and limited in extent.

MEMBER ROSEN: The decay heat curve that you mentioned is one of those places. It is merely being used as a -- we need to trade off something with it. I don't think that's the right kind of thought process.

MR. MCGAFFIGAN: I tend to agree with you. You know, the staff is in this sort of let's make a deal mode. I'll give you that if you will give me this. I am not sure that that's -- there is clearly an awful lot of conservatism in 50/46. There may be a place or two where there isn't, but there's an awful lot of conservatism in it. It drives a lot of stuff. It may not be the best place to expend resources. So we need to think about it.

As I say, there is an opportunity for you there. I will tell you, the number of commissioners who have voted on the 50/46 paper is a null set. So you would be still timely if you have any additional thoughts you want to make on the 50/46 paper. You have heard some of the comments, I suspect, from NEI and others in your deliberations in recent months. If you have now come to the conclusion that we should think about gimmees, I think it could have an effect.

CHAIRMAN APOSTOLAKIS: The difficulty you just raised I think is an important difficulty. In the old traditional way of doing business, we put conservatisms in various places. You should get them as a package as a whole. You can't really start removing here without thinking about what happens somewhere else.

But the concern now, and I understand how that evolved because risk-informed regulations came a few decades after the original system was put in place. What I am concerned about is that we are about to create a situation that will be very similar to this for the future reactors. Again, there are good reasons for that, but maybe we should try to be a little more vigilant to avoid it.

The reason why people want to use as much of the existing system as they can, like Exelon, for example, is that of course it is much faster. I mean if you use something that is already in the books and you modify it a little bit to accommodate your new design, then you have a hope that sometime you will see your license.

MR. MCGAFFIGAN: Within a glacial time period.

CHAIRMAN APOSTOLAKIS: Well, on the other hand, you are creating again a situation where we're perpetuating philosophies and approaches to regulation of the past. Then we're going to say again, 10 years, 15 years from now, my goodness now how do we remove burden, how do we -- I mean we are stuck again with safety-related and non-safety related components. What do we do about it? The year will be 2020.

So I don't know what to do about it, frankly, because I appreciate the difficulty or the concerns that the applicants have. You know, we can't wait until you guys come up with a new system. Right? But it's really something I think that should be of concern to everyone.

MR. MCGAFFIGAN: Isn't NEI talking about giving us a new part 50 for --

CHAIRMAN APOSTOLAKIS: We have not seen it yet.

MR. MCGAFFIGAN: Part 53, whatever they

call it, for new reactors?

CHAIRMAN APOSTOLAKIS: The last time the representative was here, he didn't present anything.

MR. MCGAFFIGAN: This is a new. I mean it doesn't exist, but I thought they wanted to come up with some sort of risk-informed operating regime for --

VICE CHAIRMAN BONACA: We have heard the rumors.

MR. MCGAFFIGAN: I haven't seen -- I've seen it in Inside NRC or Nuclear Next Week, reliable publications. I assume they have sent it to somebody in public.

I understand what you are saying, George. I don't know that -- there is at least, my understanding is that they are going to take an extra year to make their pebble bed decision or at least nine months. So there is some extra time for us to try to put different regimes in place. But there isn't a lot of -- that probably isn't the focus to be either Exelon's or the staff's work at the current time.

I see Graham Wallis. I should mention I do like the work that you guys have been doing with regard to reviewing some of the staff's work on approving codes and whatever. I see some of these hard-hitting letters. I commend you for those letters. I think somebody has to keep the system honest. You guys are clearly doing that, so at least as one commissioner, I appreciate that.

MEMBER FORD: Can I ask you a question? Going on from the risk-informed aspect. Come back to the very first topic, CRDM housing. Specifically, what do you want our advice on?

MR. MCGAFFIGAN: Should we issue an order shutting down Davis-Besse 100 days earlier than their normal outage because there is the risk of allowing them to operate that extra 100 days does not provide reasonable assurance of public health and safety. Or should we not issue an order and allow the 100 days to run and let them shut down at the normal time and do the inspections at their normal outage date. That is the issue before us. It is before the staff.

As I say, the staff is -- Davis-Besse is talking to you. Davis-Besse is talking to the staff. Davis-Besse is trying to argue -- I mean the undertow of what you guys were watching this morning was this dance between the staff and Davis-Besse.

If the staff isn't satisfied that they believe there is reasonable assurance of public health and safety during this 100 day period, they will sometime in December come to us with an order. They won't come to us. They will send us -- Ken Rogers is in the audience. They will send us an email to one of our staff saying we would like to issue -- not hearing from the Commission otherwise, we will issue five days hence, an order to Davis-Besse and perhaps to this other facility telling them to shut down on December 31st and get their inspection done.

I am capable of a lot of stuff, but I am not an expert in this. So this is exactly where this group of people could tell us is the staff on the right track or should we give Davis-Besse the extra 100 days. You don't see a lack of reasonable assurance during that period.

If you were to send us that letter or just even threaten to send us that letter, the staff --

CHAIRMAN APOSTOLAKIS: Actually, there may be some procedural problem here.

MEMBER FORD: We really haven't had enough data. I don't think we have really heard, we haven't heard formally from the staff on their position on this. We have had in fact remarkably little information. We have heard a lot of plans of what's going to happen. So any advice we give you would be very, very --

MEMBER ROSEN: I would offer one perspective, which is that when you're talking about 100 days in the timeframe of this whole thing and saying it somehow goes against our analysis, it ascribes through our analysis a degree of precision that I'm not sure is really there.

MEMBER POWERS: That's right.

MR. MCGAFFIGAN: As I say, I'm open to whatever you guys want to advise. But the issue comes down to how conservative do we want to be and when do we lose reasonable assurance.

If one of these circumferential cracks grew and the whole thing was severed, is that an accident that we would want somebody to have to endure and recover from? My understanding is that that accident is well within the design-basis of these plants, and they should easily be able to handle it if it occurred.

MEMBER POWERS: Provided it's just one.

MR. MCGAFFIGAN: Provided it's just one, right.

MEMBER ROSEN: And the consequence of the accident, it's a medium loca, are within the containment. So the public's health and safety is not at issue.

MR. MCGAFFIGAN: Right.

MEMBER POWERS: It's a medium loca with a failure to scram is what it is.

MR. MCGAFFIGAN: That is the issue that is going to be before us. There is a procedural problem in probably the Commission as a whole. This one commissioner hasn't asked you guys your opinion. But if you would want to be asked, I could work on getting you asked.

(Laughter.)

CHAIRMAN APOSTOLAKIS: Soft vote.

MR. MCGAFFIGAN: But that is an issue that of all the issues that are currently sort of kicking around that is so up your guy's ally and so not up my ally, that I would ask for any help I could get on it.

MEMBER LEITCH: We haven't really had a chance to talk about this yet, but after hearing the Davis-Besse presentation this morning, this cracking phenomena, and I haven't bounced this off my metallurgical counterparts here, but the cracking phenomena is extremely proportional to temperature. A relatively small reduction in temperature gives considerable relief from this phenomena.

I was just wondering -- chance to ask the

Davis-Besse people this morning, but I don't know. It seems to me that plant may be able to be operated --

VICE CHAIRMAN BONACA: At lower power.

MEMBER LEITCH: At lower temperatures, at lower power levels. So perhaps --

VICE CHAIRMAN BONACA: There's a compromise there.

MEMBER LEITCH: A compromise position might be a -- I don't know what the temperature of a say, an 80 percent power might cause a reduction of seven degrees or something like that. I mean I don't -- it might be of that order.

MR. MCGAFFIGAN: And I don't know what the TMI data. You know, the TMI data where they did not see circumferential cracks when they inspected. We had the Oconee data. These are all, what, BNW plants. So we know we have the TMI data. Does that mean that we should have more assurance now that we have the TMI data and there weren't circumferential cracks? I don't know how you handle all that.

But as I say, it is clearly an issue that you are more capable than I of thinking it through, although I am willing to hear from anyone on the subject.

Other questions? I have almost used up my hour.

MEMBER ROSEN: Well, I was interested in your take on the whole question of advanced reactors and licensing of them. Where do you think where the Commission is headed on it?

MR. MCGAFFIGAN: I don't know. We clearly are putting resources into it Congress has been happy to give us. We did get 10 million dollars extra in our budget to help us deal with advanced reactor issues this coming year. What's most important to the industry as a whole is what we need to work on, the early site permits.

My understanding, Intergy now has just as Exelon has lined up with the pebble bed, Intergy has lined up with the modular high temperature gas reactor General Atomics. Others are still looking at the Westinghouse AP1000.

We just need to put adequate resources into doing the things we need to do. We need to look at the PAR52 rulemaking, to update it on certain things that I think would expedite the process if it starts. We're all a little skeptical, to be honest with you.

I mean a year ago when the price was up here, and it was easy to see these plants being quite economical. We're about to go through a winter where the price of gas is going to be a lot lower, and I don't know what to predict for the long-term price of natural gas, which is one of the key things that utility executives look at when they try to make a decision to invest in a nuclear power plant.

So we're trying to put adequate resources into it. If we get early site permits, we will try to run that process expeditiously as we have done the license renewal process.

I think the September 11th events -- we have 2 206 petitions before us. We have various folks who are going to be trying to raise for anybody who does come in for an early site permit, some of these security issues.

Mr. Waxman -- there is a provision in the House version that was adopted unanimously by the House Energy and Commerce Committee that would require us to consult with the Office of Homeland Security before providing any Price Anderson indemnification to any new applicant.

That will require, if it becomes law, require us to put in place some procedures that we don't have today to get -- I'm sure our licensee will want to get that check off from the Office of Homeland

Security very early in the process. They are not going to want to build the plant and say, okay, give us our Price Anderson indemnity, and we say sorry, Homeland Security vetos your plant.

So it's an extra little bit of uncertainty. I think it's handleable. But if that becomes law, and as I say it was adopted by voice vote in the committee, and I don't believe the Administration is objecting to that provision in the statement of administration policy in the House bill, we will just have to build that into our process in a way that isn't there at the moment.

So I think if that is the only thing that results from September 11th, that isn't much of a burden and we'll handle it. But I can't fully predict what's in the minds of utility executives at the current time in light of the price of gas going down and the climate being complicated by the security events, and the undue focus on vulnerability of nuclear assets.

General Atomics, and I'm not sure it's good for the industry as a whole, you know, General Atomics and Exelon have helpfully said that they could bury their plants.

CHAIRMAN APOSTOLAKIS: And still produce

power.

MR. MCGAFFIGAN: And still produce power, right. They can make these almost impossible targets if indeed we have to worry about it. If they want to bury their plants, great. I am not sure that as a regulator I am going to require them to bury their plants in order to take on diving commercial airliners.

Is that enough of an answer?

CHAIRMAN APOSTOLAKIS: Any other questions for the Commissioner?

MR. MCGAFFIGAN: Okay. Well, thank you very much.

CHAIRMAN APOSTOLAKIS: Thank you for coming down here.

We'll take a five minute break.

(Whereupon, from 3:00 p.m. until 3:15 p.m., the proceedings went off the record.)

CHAIRMAN APOSTOLAKIS: Okay. We are back in session. We have an ad hoc presentation by the staff on the issue of power uprate.

MR. BAILEY: Yes. This is Stewart Bailey. I am the Project Manager for Quad Cities. We are here to try to answer some of the Committee's questions related to how Exelon is achieving the power uprate out of their BWR course. So with that, I'll turn it over to Tony Ulses.

CHAIRMAN APOSTOLAKIS: What's the name again?

MR. ULSES: Tony Ulses. How to do a power uprate in ten words or less.

CHAIRMAN APOSTOLAKIS: Good.

MR. ULSES: What I would like to start off with is -- well actually I'd like to not put that on right now, Stu.

I was kind of reviewing this material that you all got yesterday from GE. I kind of see where the confusion is coming from here. I would like to make a brief comment on it, and then try and avoid getting into it because I don't really understand all the details of how the information was generated. I understand I will probably have limited success at that, but that is kind of where I would like to go.

Essentially what you are seeing here when you compare this information from cycle 17 to cycle 18, what really is causing the confusion is that they are introducing a new type of fuel into cycle 18. In other words, they are going from a nine-by-nine fuel in cycle 17 to a ten-by-ten fuel in cycle 18.

MEMBER SIEBER: Partially.

MR. ULSES: Right, partially. That is going to be the new batch that they are inserting, is going to be ten-by-ten. That fuel in fact can run at higher total bundle powers than the nine-by-nine fuel. That is how you can increase the average and not cause the peak average to go down because you are in fact increasing the peak maximum of bundle power, but you are not increasing the peak rod power, kilowatts per foot. Because basically you have more rods to work with, you can make more power. That is basically what they are doing.

Also, another feature of the ten-by-ten assembly is that they have additional margin to minimum critical power ratio, which allows them to get this additional power out of the assembly due to changes in the assembly design, mainly in the spacers and the optimization of their axial location.

That is all I really wanted to say on that, unless there are any questions.

MEMBER WALLIS: Well, ten times ten is 100 and nine times nine is 81. The difference is something like 19 percent or something, which is what they are asking for almost.

MR. ULSES: Well, I think that might just be a coincidence.

MEMBER SIEBER: It's the surface that counts there. The surface doesn't go up by 20 percent.

MEMBER WALLIS: I think they said this morning that the fuel is also more enriched.

MR. ULSES: Yes. They are running at a higher enrichment because they want to get more energy into the core.

MEMBER WALLIS: And they play more tricks with Gadolinium. They also put in pressure fuel more often. So the more fuel, the more --

MEMBER SIEBER: More assemblies, yes.

MR. ULSES: Let me jump into the presentation here. I have this stuff on the slides. Let me go ahead and change this around, Stu.

All right. How to do a power uprate. So essentially they have to do three things. They have to get more fissile content into the core. They want to burn more U-235. So they load more bundles. Also, in this case the bundles happen to have a higher bundle average enrichment, although I don't know that that's necessarily generally true. That means they withdraw more as well because they have a fixed number of locations.

MEMBER WALLIS: The total level stays the same, but in each load they exchange more.

MR. ULSES: Exactly. They have a fixed number of locations. Essentially they extract more and they add more fresh, which gives them a higher fissile content and they can burn it.

Now with this new fuel, they have to keep it within limits obviously. So what they do is they use more changes in the Gadolinia loading, both axially and radially, and they also do a lot of radial enrichment and axial enrichment changes in the fuel as well. These modern beauty bar fuel assemblies are extremely complicated.

MEMBER KRESS: Tell me what the different Gadolinium loading means. You add less of it in?

MR. ULSES: Well, what it means is that within one bundle you could see different locations that actually have different Gladolinia concentrations radially and axially in order to shape the power. Then within each type of bundle that they insert at the beginning of core, you could actually see actual different total Gladolinia loading as well.

MEMBER KRESS: It might put more in the central channels and less in the --

MR. ULSES: No. What they are doing is putting in what they need where in order to maintain the power distribution. You know, the concepts of doing like an outer middle, inner ring loading, that is not done any more.

CHAIRMAN APOSTOLAKIS: But by fuel rod, fuel rod by fuel rod.

MR. ULSES: Exactly.

MEMBER KRESS: Pellet by pellet almost.

MR. ULSES: Sure. Right. Well that's actually the truth, pellet by pellet. You are going to see radial and axial enrichment changes, and also Gladolinia loading changes. They also will increase the total load of gad in order to keep the reactivity down as they burn the core, because obviously they are going out to longer burnouts. Well they are going out to higher -- the batch average burnouts are not increasing the fuel burnup over the limits. I mean let me just get that out there.

MR. BAILEY: Higher reactivity.

MR. ULSES: And essentially they have been doing this for about 10, 15 years roughly. It actually started with their later eight-by-eight products. It is in the nine-by-nine products, and it's in the ten-by-ten products that are out there right now. This is also not just done by GE, it's done by all BWR fuel vendors to a certain extent.

Now for EPU, which is basically the power uprates that get up in the 15 to 20 percent range, they are going to have to go to these newer fuel designs because they have to get more maximum bundle power. You just simply can't get it out of the nine-by-nine assembly because mainly limits on the critical power ratio. In other words, they are going to go into dry out in these assemblies if they run them up in power.

MEMBER KRESS: Where do they get this extra space? Do they actually cut down on the spacing of the fuel?

MR. ULSES: What they do is they make the pin smaller.

MEMBER KRESS: That's what I meant.

MR. ULSES: Right. They are actually physically smaller themselves. Then they will increase the enrichment, they will offset any changes in the actual physical geometry of the assembly. That allows them to run these bundles out to higher burnups.

Now like I said before, they are going to have to get more CPR performance out of these bundles or they won't be able to increase the maximum power, but that has been achieved over the years by changes in spacer design and by the physical changes of the geometry themselves. But the key point here is that it is confirmed with prototypical tests. They actually design a prototypical bundle with electrically heated rods. They put it into their atlas test facility, and they do CPR testing in order to confirm the continued applicability of the correlation they use to predict critical power. That is done for each fuel type that they manufacture.

Essentially just the last bullet there is just kind of the point that they made incremental design changes over the years, but if you look at the modern fuel, basically what they have done is they have grabbed everything that they have learned, and they have put it all into one place, which is really what is allowing them to get this extra power out of these assemblies and maintain the actual local limits on the assembly, which is how they are really licensed.

MEMBER WALLIS: It's obviously a very complicated fuel management program.

MR. ULSES: Extremely complicated.

MEMBER WALLIS: If you look at these, you find 1.39 is beside .99, and then there's another 1.15. There's no pattern at all that makes any sense.

MR. ULSES: It is extremely complicated, which is why if you look at the way they do the actual reactor design these days, they are going to take the core and they are going to do detailed calculations of the reactor as it burns out on its lifetime because they need to ensure that they are going to maintain thermal limits.

Actually, I have got a lot of --

MEMBER WALLIS: The flux may not flatten. The flux flattening is probably a red herring.

MR. ULSES: But that is more consequence of what they are doing. They are going to load more reactor fuel at the beginning of the life, and the flux has to flatten simply because they are loading more fuel and it's going to take up more locations, and the flux is going to have to flatten. So I would say it's more of a consequence than a means to an end, myself.

That is even more true when you are talking about inserting new types of fuel which can run at higher maximum bundle power.

MEMBER WALLIS: Also the axial distribution varies tremendously from beginning to end.

MR. ULSES: What I was going to say is

that I have a lot of -- actually, I have a lot of background information up here which is actually GE proprietary. I would obviously rather not get into it here, but if anyone wants to look at it, I can stay by after we're done here and I could show it to any of the members who would be interested in seeing information about the design.

MEMBER ROSEN: The ACRS handles a lot of GE proprietary information during the reviews. It was an innocent that was asked to try to follow just a little deeper in the proposal which said something like we're going to flatten the profile and that's how we are going to get a lot more power out of it.

So I asked for the profile. Let me see a core map. Let me see a beginning a live core map. Let me see an end-to-live core map, the pre-EPU and post-EPU so I can get a sense of just taking it another level down so we understand. That may have turned out to be the wrong question.

What I would like to know is, because I think we need to go another level beyond oh, we're just going to flatten the power. That is all that was really said about how we're going to get all this power in this stack of documents this high. I would like to go another level down below that, get a little more sense of sensible information. I don't know the right question. What is the right question?

MR. ULSES: The right question to ask is will they maintain the bundles within their rating, within the thermal limits.

MEMBER ROSEN: What are those? Show me what your projections are and all that.

MR. ULSES: If we look at how we license BWR fuel, it is very dependent on the local parameters because of the fuel channels. The reactor fuel itself doesn't really care what's around it because of the channel. All it cares about is what it sees at the inlet and the outlet.

So it is very local. It is very specific on the assembly. That is one of the reasons why they are able to do this, because they are able to using basically the tool of the Gladolinia, if you will, in this case it uses the tool, that they able to shape the power in the assembly such that they can keep the peaking within the assembly down as they burn the fuel. They can stay within the applicable limits.

Let me go and jump to my next slide here, which is how we license fuel. But as for your question about what you need to ask --

MEMBER ROSEN: I am going to ask a

question on the next EPU that comes through, and I understand there is going to be a lot of them.

MR. ULSES: There will be.

MEMBER ROSEN: I don't know exactly what the question is but I will certainly want to zero in on this. I would ask the staff to help me with that.

MR. ULSES: Well I would say without thinking about it a great deal, the question that I would ask is, just like I said, I mean essentially are you maintaining the bundles within the design limits. That information ought to be able to be provided to the Committee. Essentially those limits are you have to maintain the LHGR limits. You have to maintain the MCPR limits, and you have to maintain the maximum average planar linear generation rate.

What is in parenthesis here is what those limits are trying to protect. Essentially you don't want to melt fuel. You want to maintain good heat transfer, and you want to meet the 10 CFR 50:46 exception criteria, which is what you have the maximum average planar linear generation rate for. That is going to be set by your loca analysis.

MEMBER WALLIS: Average planar is local?

MR. ULSES: It's an average planar, right. That's the mapple hover.

CHAIRMAN APOSTOLAKIS: Just one comment I have is that I think at least I was mislead in the statement of flatten out the power distribution. You are assuming that that meant that the peaking factors go down. That is not the case. You are pushing it up. Let me finish.

You are pushing it up axially at the top and bottom because the same strategy is being used by the PWR vendors.

MR. ULSES: But actually the axial power profiles, but those have been used for many years. That is not atypical. That is in use right now.

Essentially what they are doing is they run the core early in cycle with a highly bottom peaked power distribution. That allows them to spectral shift the reactor. Then they start moving it up at the top because they want to burn the fuel out evenly. In other words, they want to use all the uranium that's in the core.

If they went back to like what they used to do was like a hailing concept, but that is not used any more because it does not allow them to burn out all the fuel. Essentially the utilities are spending money on enrichment that they are not using.

So what they do now is they go to these --

is that they go to these management strategies that allow them to move the axial power distribution around a great deal during the cycle. That is how every reactor that I am aware of currently operates right now.

MEMBER WALLIS: What's LHGR? Like the number here, .77. What's that? I am looking at these printouts we got, to relate them to your criteria. It says LHGR .77. That's not a temperature?

MR. ULSES: What we need to do is look at the thing at the section called the thermal limits summary. You look at maximum kilowatts per foot, which is for the one I'm looking at, is 10.14. Another one is --

MEMBER WALLIS: I think that's the second one on the list.

MR. ULSES: It's actually the second to last.

MEMBER WALLIS: What's rapid LHGR?

MR. ULSES: I actually don't know. That's a value that they probably use --

MEMBER WALLIS: Same symbols as you have up there.

MR. ULSES: Well, what they call a maximum kilowatts per foot is what I am referring to here as

LHGR. Other than the limits of what they are going to use is what are more than likely going to be used by the operator in the control room. They try to come up with parameters in the control room that are really easy to understand. They try to ratio the parameters.

MEMBER WALLIS: This is less than 13 or something like that?

MR. ULSES: The values vary from field type to field type, but that is a pretty good average number.

MEMBER WALLIS: Where do I find MCPR?

MR. ULSES: That is --

MEMBER WALLIS: That's the 1.79.

MR. ULSES: The one you are looking at, 1.79. Yes, that's going to be limited in the technical specifications. The value is on average typically I want to say 1.09, 1.1.

Ed, is that about right? In this particular case, yes.

MEMBER WALLIS: Then the other one, MCPR, is --

MR. ULSES: The next one is the mapple hugger.

MEMBER WALLIS: That must be the APLHGR, .77.

MR. ULSES: No. That is actually going to be the one that is above the actual thermal limit summary which is on the order of 9.14 in this case, and on the other ones --

MEMBER WALLIS: Somewhere else?

MR. ULSES: Yes. You have to go right up above the section that says thermal limits summary, to something called maximum APLHGR.

MEMBER WALLIS: It says 9.11?

MR. ULSES: Right. In this case it's 9.14. I'm not exactly sure what those units are. I assume they are probably kilowatts per foot. That would make sense.

MEMBER WALLIS: So what you guys do is you assure yourselves that all these numbers that are going to be varying throughout the cycle and with different fuel loads and all kinds of strategies, never go over some regulatory level?

MR. ULSES: Exactly. Those are specified in the fuel type and bundle-specific basis. They are monitored continuously throughout the cycle. The reactors, they are actually running online monitoring which actually runs a three-dimensional solution of the reactor all the time, comparing it to the in core instrumentation. They are using that to ensure that they are meeting all applicable thermal limits on the fuel.

MEMBER ROSEN: Maybe you could help me with the second question. The first question is are you maintaining LHGR for fuel temp and for loca and MCPR below the limits? The answer they give me is yes.

MR. ULSES: Yes. That is the answer they have given us. We have confirmed that through our audits.

MEMBER ROSEN: My next question is what should my next question be? Show me, right?

MR. ULSES: That would be my next question. Show me.

MEMBER ROSEN: What do I ask for? What should they provide that shows me that they are doing that?

MR. ULSES: They can give you a map, I suspect, just like you got with the normalized power distribution which has the kilowatts per foot on it for a bundle. But the maximum value per pin in a bundle. That would be useful information.

You can get the information about the minimum critical power ratio that's in the reactor. You can also get the mapple hugger limits.

However, most PWRs are not going to be limited by mapple hugger. They are typically limited by MCPR values simply because they have so much ECCS injection. Normally loca is not a limiting factor for PWRs.

But those would be the questions that I would ask if I wanted to convince myself, and those are the questions that we do ask when we want to convince ourselves that the power uprates are not going to exceed any applicable licensing limits on the fuel. That information ought to be readily available to the Committee.

MEMBER SIEBER: Actually, the way all this is licensed is a little bit misleading. When you go for a change in license for a power uprate, you are basically using a demonstration bounding core to show that you can actually manipulate the fuel in order to get the power output. Each time you refuel the reactor though there is a design process that goes on that specifies how each fuel assembly will be built, how it is to be oriented in the core, and where it is supposed to go, plus where all the other ones are supposed to go because you've shuffled them around.

Each time they do that, they send in an RSE, a reload safety evaluation, the licensee does, that says I have followed all the procedures that the staff approves and I have done all these calculations and this is a good core. It's a 10-page document, which is what they get. So the process is approved by the staff, and then each reload is approved by saying I followed the process.

MR. ULSES: Right.

MEMBER SIEBER: So that is the kind of paper flow.

MR. ULSES: That is for a plant that's at a given power level and they are just reloading it.

MEMBER SIEBER: Well, what will happen here too.

MR. ULSES: Sure.

MEMBER SIEBER: How they have licensed a plant to go to a higher power and they have changed their machinery around to achieve that, that the next reload that goes in is going to have an RSE that's going to be reviewed by the staff using the same old process as General Electric always used or Westinghouse or Siemens or whomever. That is the process. There is no change to the process and there's no change to the analysis that they will do. They will use the same tools.

MR. ULSES: The reason why they don't do

an actual calculation on what they expect the real power uprated reactor to be is that when we're in the review process, they are not going to know what target they are shooting at because they don't know exactly where the actual real core will be at the end of a cycle.

So they try and do a generic analysis to give us an understanding of what it is going to look like, but then you are certainly right, that they will use the standard reload process. We will get what actually nowadays is called a core operating limits report, but it's the same thing. It basically describes the fuel that's in the reactor, the method used, and a summary of a few key results which are the thermal limits.

MEMBER SIEBER: Then during core operation, you take flux maps or in core instrument readings to determine how well core is reproducing what the calculation showed in advance of refueling the core?

MR. ULSES: Right. Exactly. Nowadays that is done online continuously.

MEMBER SIEBER: So you get a map out of the computer that looks like the map they gave us, which is an analytical map as opposed to a flux map.

MEMBER WALLIS: Do we have enough to go on those in Committee?

MEMBER SIEBER: The change I would suggest is the same one I said yesterday. All they have to do is change one word.

MEMBER WALLIS: I have concluded that this power uprate is achieved by having a new fuel.

MR. ULSES: That's true.

MEMBER WALLIS: Ten-by-ten instead of nine-by-nine.

MR. ULSES: That's correct.

MEMBER WALLIS: And by using new fuel management techniques.

MR. ULSES: That's correct.

MEMBER WALLIS: Which are so complicated in detail that there's no way that this Committee should try to explain them in a letter.

MR. ULSES: I definitely wouldn't try to explain them in a letter myself. It is an extremely complex process that has evolved over several years.

CHAIRMAN APOSTOLAKIS: Have we achieved what the purpose of this meeting was?

We certainly appreciate your coming down.

MR. ULSES: No problem.

CHAIRMAN APOSTOLAKIS: On such a short

notice.

MR. ULSES: I hope that we have straightened this out. Information on the first slide is basically a summary of what they are doing to achieve these power uprates. You can have this information if anyone is interested.

CHAIRMAN APOSTOLAKIS: Thank you very much. You answered a lot of good questions.

Why don't we recess for 15 minutes. Then we'll come back and do planning and procedures.

(Whereupon, at 3:36 p.m. the proceedings went off the record.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: ACRS 487TH MEETING

Docket Number: (NOT APPLICABLE)

Location: ROCKVILLE, MARYLAND

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Pippa Antonio

Pippa Antonio
Official Reporter
Neal R. Gross & Co., Inc.

Licensing Approach for the Pebble Bed Modular Reactor

Staff Presentation to ACRS
November 9, 2001

Eric J. Benner, NRR, 301-415-1171
N. Prasad Kadambi, RES, 301-415-5896

Outline

Presentation Based on Staff Assessment to be Contained in Commission Paper

- Staff's Considerations
  - Licensing of Fort St. Vrain
  - Pre-Application Review of MHTGR
  - NRC Strategic Plan
- Exelon Proposal Summary
- Preliminary Staff Assesement
- Potential Policy Issues

Staff Considerations/Activities

Licensing of Fort St. Vrain

- AEC review focused on how the design met the intent of proposed GDC
- 1972 safety evaluation report reached conclusion that intent of GDC was met and that sufficient barriers and defense-in-depth were provided

Staff Considerations/Activities (cont)

Pre-Application Review of MHTGR

- NRC review focused on conformance with:
  - Advanced reactor policy statement
  - NRC regulations, regulatory guides, and standard review plan
- Staff assessment (NUREG-1338 in 1989 and 1995) identified issues to the Commission, applicant, and public

Staff Considerations/Activities (cont)

Strategic Plan's Performance Goal: Maintain Safety

- Staff's approach is to use:
  - Advanced Reactor Policy Statement as the basis for requiring (as a minimum) that PBMR provide at least same degree of protection as current LWRs
  - Expectation to realize enhanced safety margins
  - Applicable current regulations
  - PBMR-specific requirements (license conditions)
  - Defense-in-depth principles

Staff Considerations/Activities (contd)

Strategic Plan Performance Goal: Maintain Safety

- Staff must develop defensible basis to make adequate protection finding
- Subsequently apply performance monitoring program
- Defense-in-Depth considerations from White Paper on Risk-Informed, Performance-based Regulation
- Defense-in-Depth considerations from Risk-Informing Part 50 Option 3

Staff Considerations/Activities (cont)

Strategic Plan: Increase Public Confidence

- Staff aproach is to:
  - Apply Commission Advanced Reactor Policy Statement to provide stakeholders with timely and independent assessment
  - Provide opportunities for public comment and discussion
  - Adhere to Commission guidance on public confidence building initiatives

Staff Considerations/Activities (cont)

Strategic Plan Performance Goal: Increase Efficiency, Effectiveness, and Realism

- Integrated Risk-Informed, Performance-Based decision-making:
  - From Regulatory Guide 1.174
  - From White Paper on Risk-Informed, Performance-Based Regulation
  - From Option 3 Framework

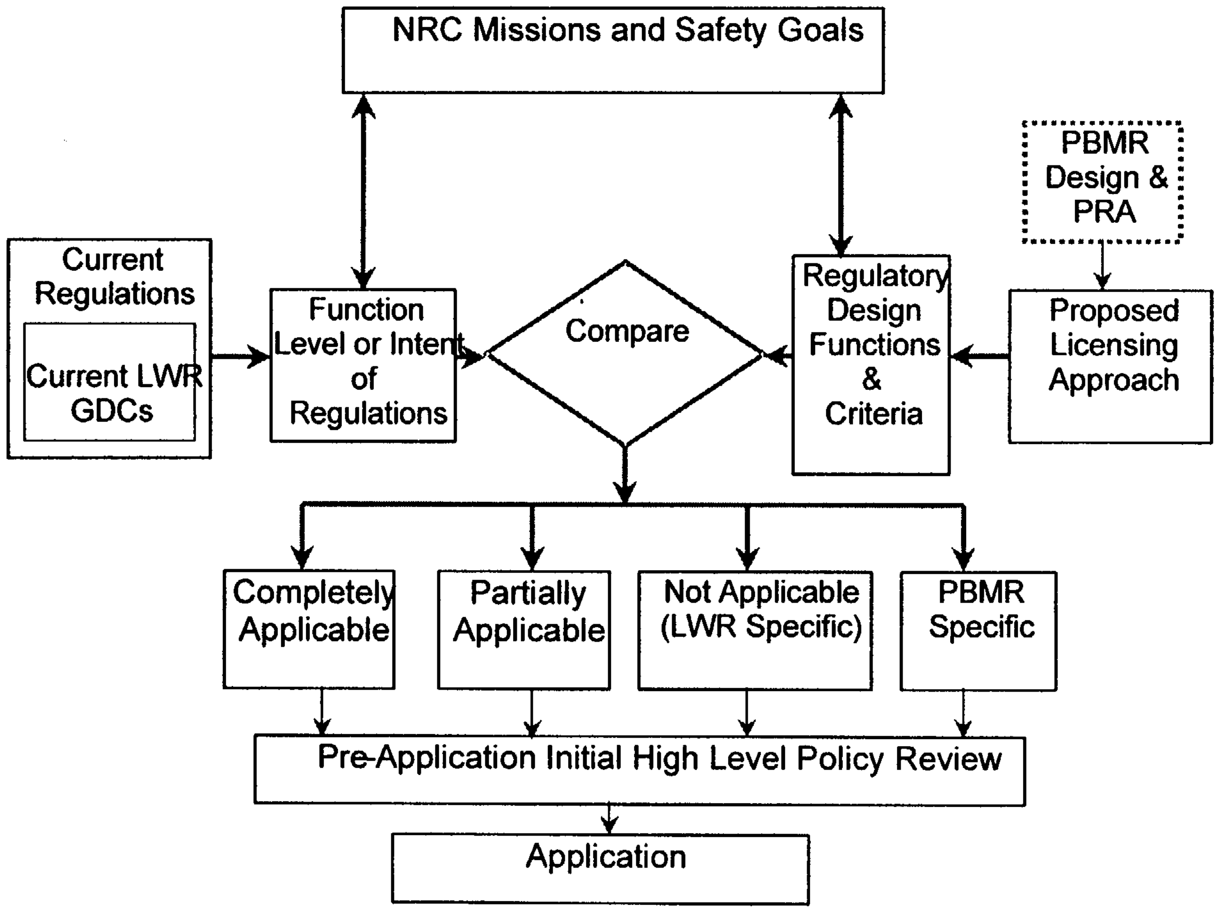
Staff Considerations/Activities (cont)

Strategic Plan: Reduce Unnecessary Burden

- Staff approach is to use the Safety Goal Policy Statement which provides guidance on when regulatory burden can be considered unnecessary
- Licensee flexibility when performance-based approach is appropriate.

Staff Perspectives

Exelon's Graphical Depiction of Screening of Regulations



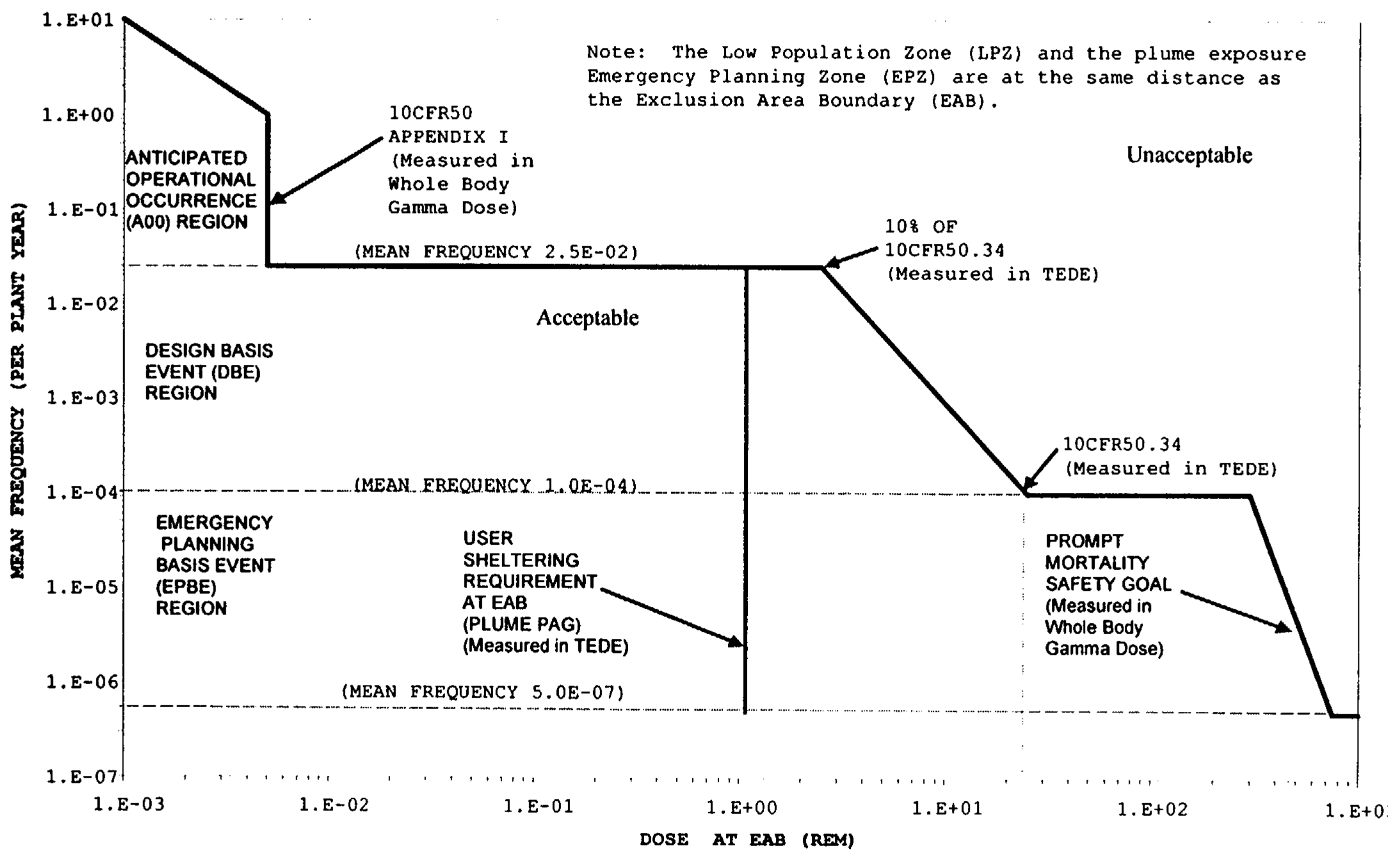
Staff Perspectives

Screening of Regulations

- Similar to MHTGR Pre-application draft Safety Evaluation and Ft. Saint Vrain Licensing
- Preliminary screening of regulations not assessed in detail because of need for design and design-analysis information to make a meaningful assessment
- Final decisions on applicability of regulations made by the regulator

Staff's Perspectives

Exelon's Proposed Plot of Top-Level Regulatory Criteria



Staff Perspectives

Top-Level Regulatory Criteria

- Plotting of TLRC is useful to illustrate bounding criteria
- Early fatality safety goal stated to be be most limiting; latent fatality safety goal also needs to be addressed
- Staff assessing lower cutoff for DBE region for conformance to Option 3 of Risk-Informing 10 CFR Part 50

Staff Perspectives

Licensing Basis Events

- Assurance needed that set of LBEs is reasonably complete, including bounding events
- Process for selection of LBEs: necessity for appropriate combination of deterministic and risk information
- Development of "source term" is necessary for assessing LBEs
- Validation of process requires design and design analysis information not currently available.

Staff Perspectives

Determination of Safety-Related Structures, Systems, and Components

- Licensing basis consists of set of requirements applied to safety-related SSCs.
- "Inherently reliable" components may need appropriate requirements because of uncertainties.
- Defense-in-depth also provided by non-safety-related SSCs
- From STP experience, component-level special treatment may not be feasible

Potential Policy Issues

- The use of probabilistic criteria to select events
- The use of probabilistic criteria to make design decisions, specifically regarding the role of a containment in the design and emergency preparedness.

OVERVIEW OF BULLETIN 2001-01:

"CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL HEAD PENETRATION NOZZLES"

Allen Hiser

Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Division of Engineering

Briefing for Advisory Committee on Reactor Safeguards

November 9, 2001

OVERVIEW OF BULLETIN 2001-01

Bulletin was issued on August 3, 2001

Bulletin requested information on:

- All plants:
  - Plant-specific susceptibility ranking
  - VHP nozzles (number, type, ID and OD, materials of construction)
  - RPV head insulation type and configuration
  - Recent VHP nozzle and RPV head inspections
  - Above the head structures, missile shield, cabling, etc.

- Plants that have found cracking or leakage:
  - Extent of cracking and leakage
  - Inspections, repairs and other corrective actions
  - Plans and schedule for future inspections
  - How plans will meet regulatory requirements

- Other plants:
  - Plans and schedule for future inspections
  - How plans will meet regulatory requirements

QUALIFICATION OF EXAMINATION METHODS

- Verify compliance with regulatory requirements through QUALIFIED examinations
  - Graded approach depending on PWSCC likelihood
  - Examinations of 100% of all VHP nozzles
    - Based on statistics and no identified preferential cracking tendencies
    - All VHPs - similar materials, etc., only failure consequences vary

- Effective Visual Examination
  - Capable of detecting small amounts of boric acid deposits and discriminating deposits from VHP nozzle and other sources

- Plant-Specific Visual Examination Qualification
  - Plant-specific demonstration that VHP nozzle cracks will lead to deposits on the RPV head (interference fit measurements, etc.)
  - Must be capable of reliable detection and source identification of leakage (insulation, pre-existing deposits, other impediments)

- Volumetric Examination Qualification
  - Demonstrated capability to reliably detect cracking on the OD of VHP nozzles
  - Appropriate if Visual Examination cannot be Qualified

REVIEW OF BULLETIN 2001-01 RESPONSES

Bulletin places PWR plants into 4 groups based on relative susceptibility ranking:

- Plants that have found Cracking or Leakage - 5 plants
  - Suggests qualified volumetric examination by end of 2001
  - Staff accepted qualified visual examination at last outage
- Plants with High Susceptibility (within 5 EFPY of Oconee 3) - 7 plants
  - Suggests qualified visual examination by end of 2001
  - Staff accepted qualified visual examination at last outage
- Plants with Moderate Susceptibility (between 5 and 30 EFPY of Oconee 3) - 32 plants
  - Suggests effective visual examination at next RFO
  - Staff accepted effective visual examination at next RFO
- Plants with Low Susceptibility (more than 30 EFPY of Oconee 3) - 25 plants
  - Suggests no additional actions required
  - No requirement to provide plans or schedule

Staff has addressed clarifications to Bulletin responses, and numerous licensees have provided revised or supplemented Bulletin responses

PLANTS THAT HAVE PERFORMED "BARE METAL" VISUAL INSPECTIONS

Plants	Most Recent Inspection				
	Date	Method & Scope	Summary of Cracked or Leaking CRDM Nozzles		
			Total Number	Circumferential Nozzle Cracks	Number Repaired
Oconee 1	11/2000	Qualified Visual - 100%	1★	0	1
Oconee 3	02/2001	Qualified Visual - 100%	9	3★★	3
ANO-1	03/2001	Qualified Visual - 100%	1	0	1
Oconee 2	04/2001	Qualified Visual - 100%	5	1	5
Robinson	04/2001	Qualified Visual - 100%★★★	0	0	0
North Anna 1	09/2001	Qualified Visual - 100%★★★	8	0	0
Crystal River 3	10/2001	Effective Visual - 100%★★★★	1	1	1
TMI-1	10/2001	Qualified Visual - 100%	8★	0	6
Surry 1 (in progress)	10/2001	Qualified Visual - 100%★★★	10	TBD	5
North Anna 2 (in progress)	10/2001	Qualified Visual - 100%★★★	(3)	TBD	TBD

★ Thermocouple nozzles also cracked/leaking: Oconee 1 (5 out of 8), TMI 1 (8 out of 8)

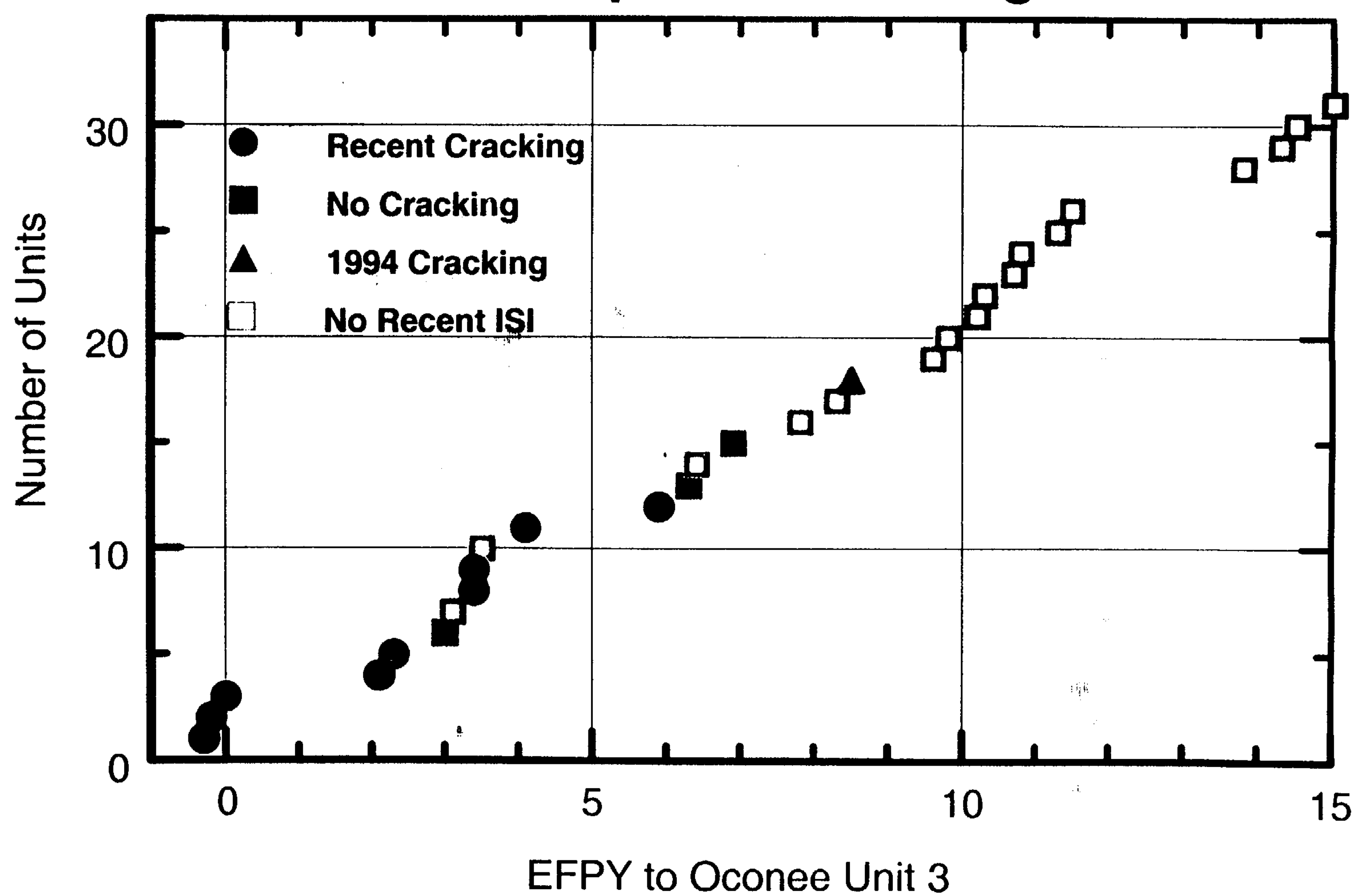
★★ The size of 2 out of 3 circumferential flaws were identified from destructive examination.

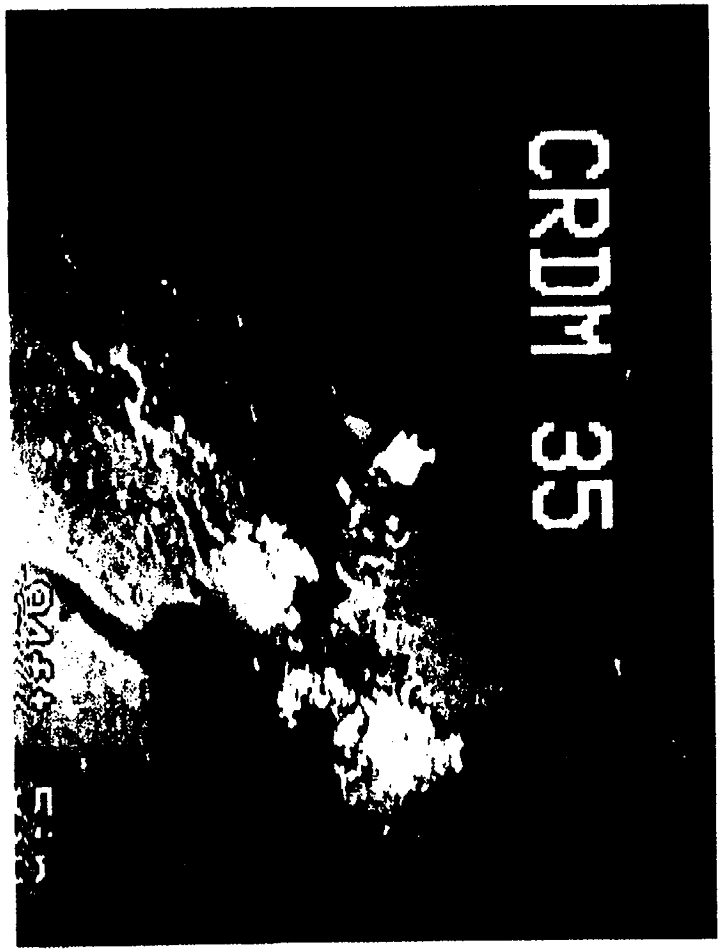
★★★ Pending acceptability of licensee's supplemental response

★★★★ The highest ranked MODERATE susceptibility plant.

Moderate susceptibility plants that have completed effective visual examinations in Fall 2001 with no evidence of boric acid deposits: Beaver Valley 1, Farley 1, Kewaunee, and Turkey Point 3

Time-Temperature Histogram

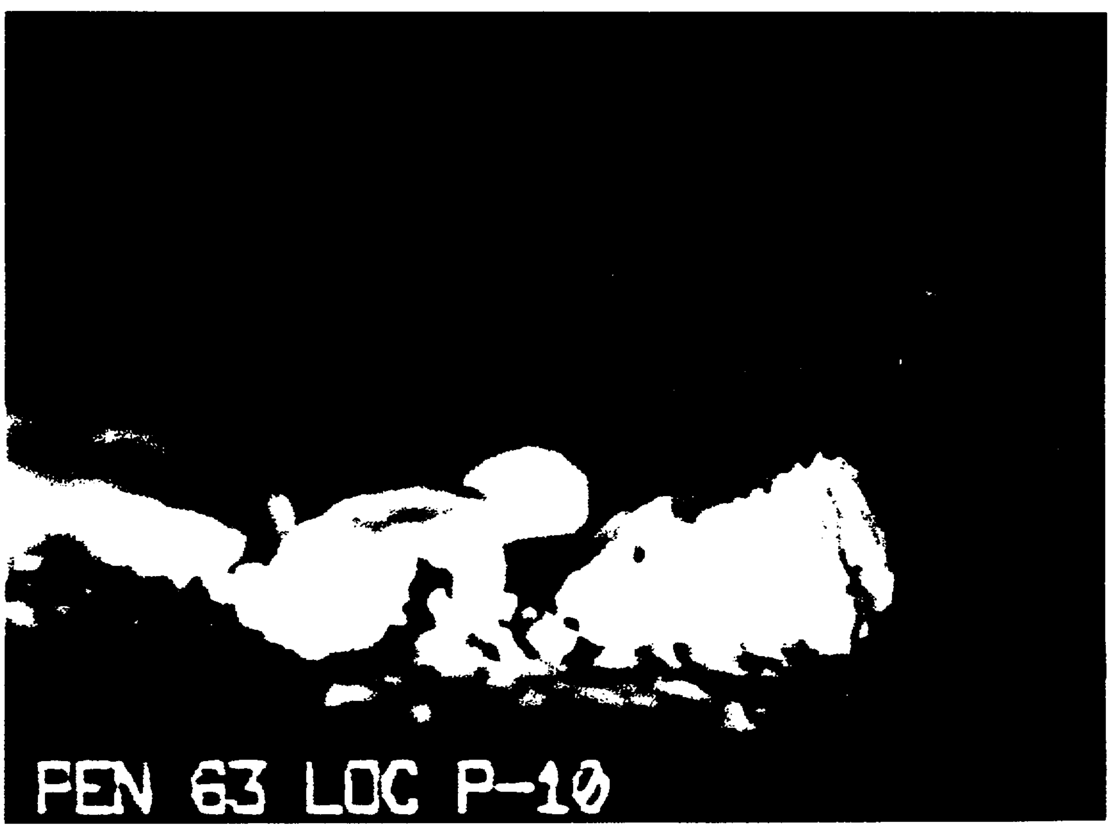


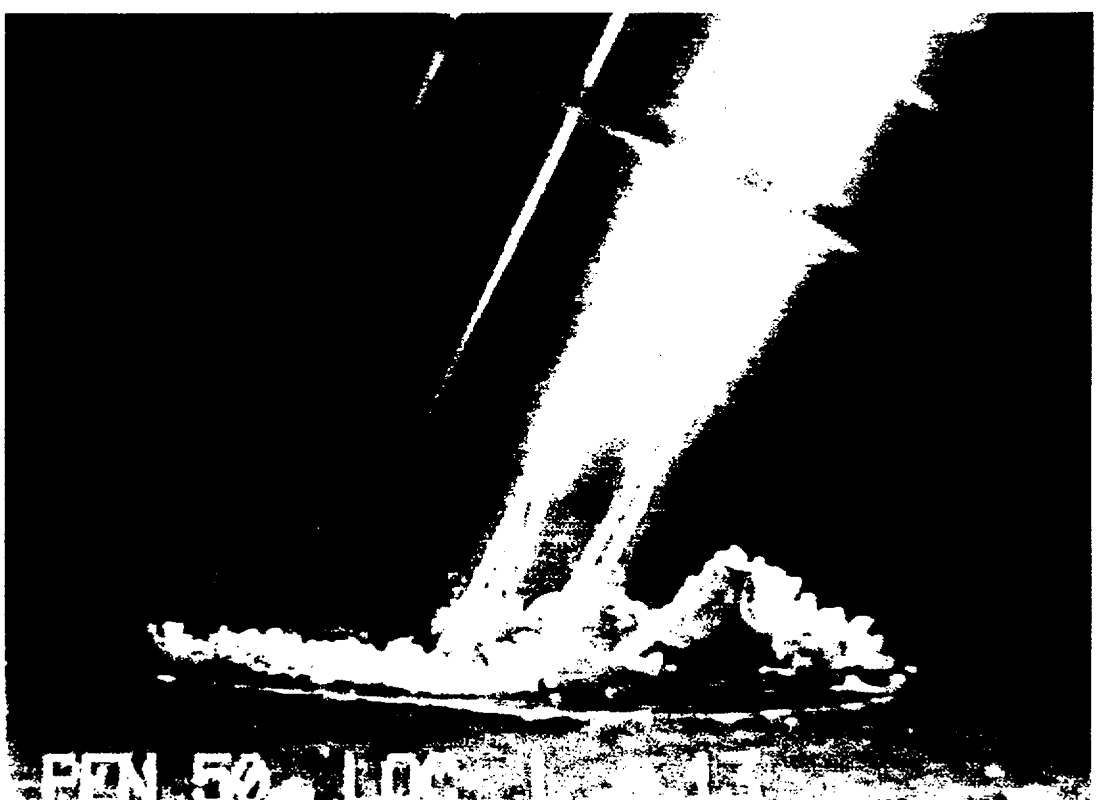

CRDM 35


CRDM


RDM 37


FEN 62 LOC K-14 QUAD C-B


FEN 63 LOC P-10


PEN 5Ø

OVERVIEW OF STAFF PRELIMINARY TECHNICAL ASSESSMENT

Summarizes available data and evaluations related to:

- Environment in CRDM annulus region
- Crack initiation
- Crack growth rate
- Stress analyses and crack-driving force
- Critical crack size

Deterministic assessment

Probabilistic assessment

Inspection timing

STAFF CONCLUSIONS

Annulus Environment

- Not expected to be highly aggressive - normal PWR reactor coolant
- Annulus deposits from leaking nozzles should be obtained and analyzed by industry to provide confirmation of the assumed annulus environment

Crack Initiation

- The operating experience of leaking nozzles appears to be well modeled by the Weibull analysis with b = 1.5
- New findings data will continue to be assessed

Crack Growth Rate

- Crack growth rate data for PWSCC is a reasonable approximation for OD VHP nozzle cracking
- Analysis of data provided in Table 3 is appropriate for use at 325°C (617°F)
- The Arrhenius relation can be used for crack growth at other temperatures

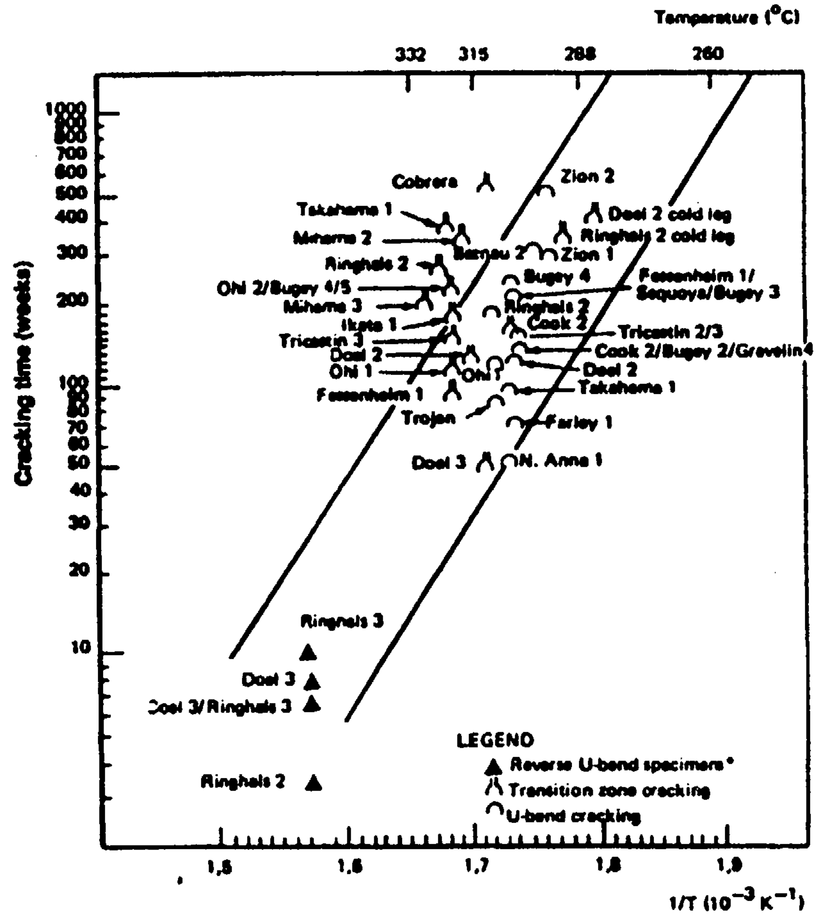


Figure 3 Dependence of initiation time on inverse temperature for field cracking.

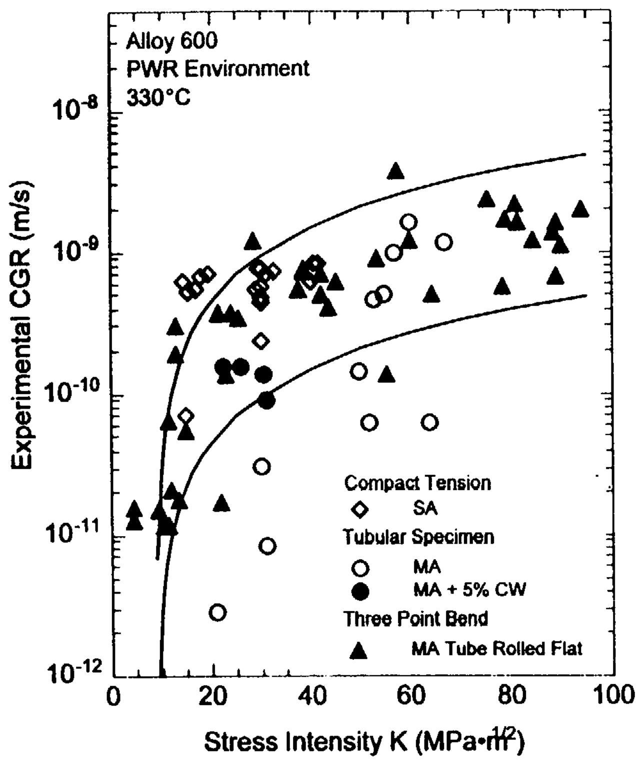


Figure 6 Crack growth rates in PWR environments for a variety of product forms. The curves correspond to a correlation based on the work of Scott (Ref. 17).

STAFF CONCLUSIONS (cont.)

<u>Stress Analysis and Crack-Driving Force</u>

- A single estimate for K as a function of circumferential crack length was provided (with a value of 66 MPa$\sqrt{m}$ (60 ksi$\sqrt{in.}$) due to residual stresses for a crack angle of 90°)

<u>Critical Crack Size</u>

- A safety margin of three on pressure -- 270°
- Nozzle failure and possible ejection - 324°

DETERMINISTIC ASSESSMENT

<u>Base Case - Assumptions</u>

- Critical Flaw Size
  - 270° with a safety margin of three on pressure
  - 324° for nozzle failure and possible ejection
- Crack Growth Rate
  - 95/50 statistical bound
  - 318°C (605°F)
  - A for Scott model is 1.303×10^{-11}
- Initial Flaw Size
  - Unknown - basis for issuance of the Bulletin
  - Used as a parameter

<u>Uncertainties and Sensitivity Studies</u>

- Different statistical bounds to crack growth rate
- Effects of temperature on crack growth rate
- Initial flaw size as a parameter

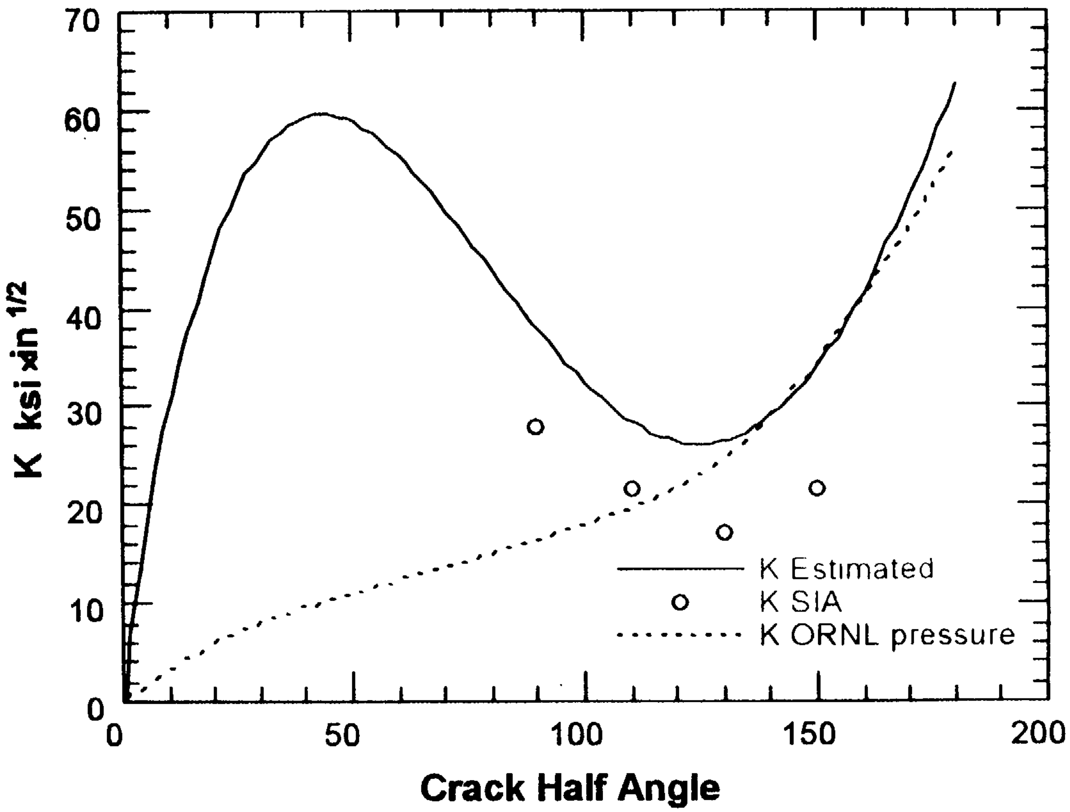


Figure 15 Estimated stress intensity factor K for a CRDM nozzle based on SIA and ORNL results.

Table 4 Summary of OD Circumferential Flaws Identified in Spring and Fall 2001 Outages

Plant	Nozzle ID	Circumferential Crack Length	Through-Wall Extent
Oconee Unit 3	50	165°	100%
Oconee Unit 3	56	165°	100%
Oconee Unit 3	23	66° *	35% *
Oconee Unit 2	18	45° *	10% *
Crystal River Unit 3	32	90° *	50% *

* Crack dimensions estimated from UT data.

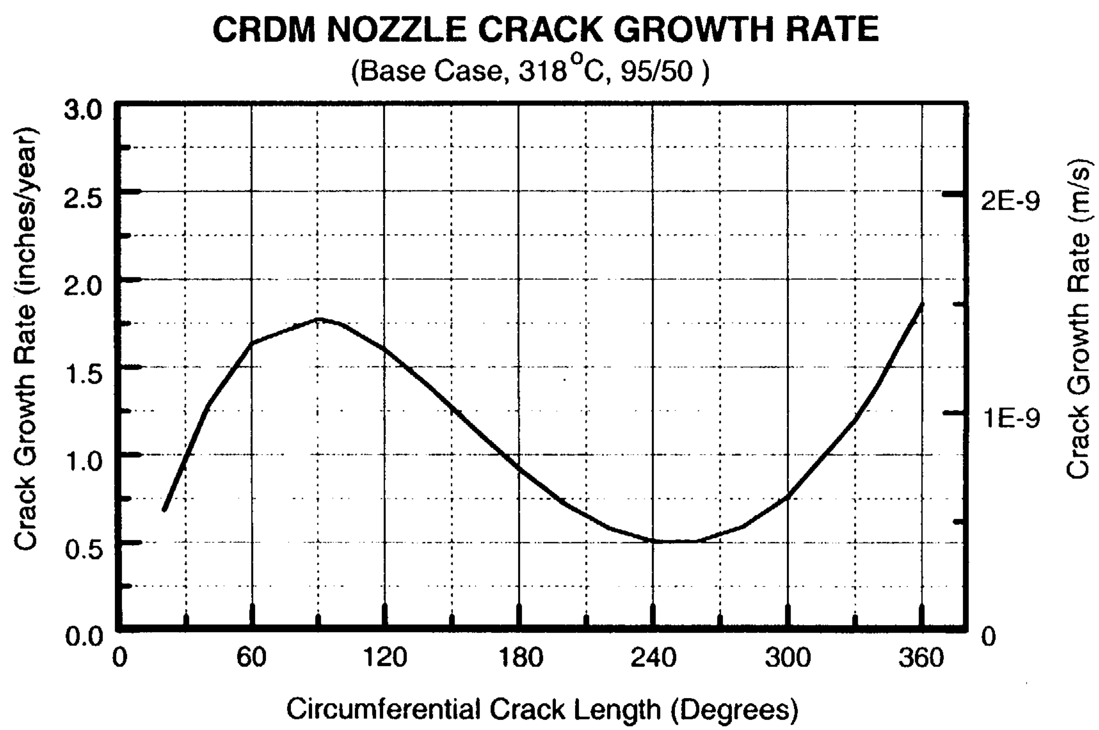


Figure 18 Variation of crack growth rate with circumferential crack length for the base case of 318°C (605°F) 95/50 curve.

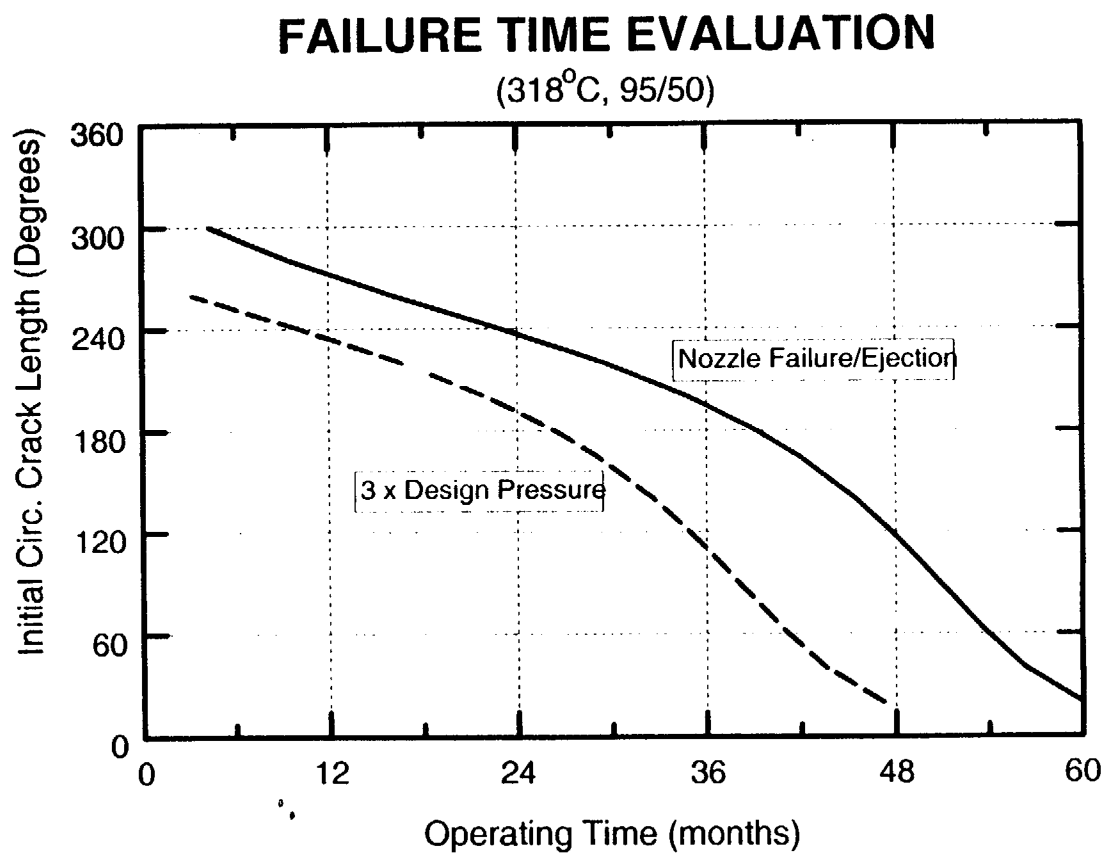


Figure 19 Variation of time to failure as a function of initial crack length, for the base case of 318°C (605°F), 95/50, crack growth rate.

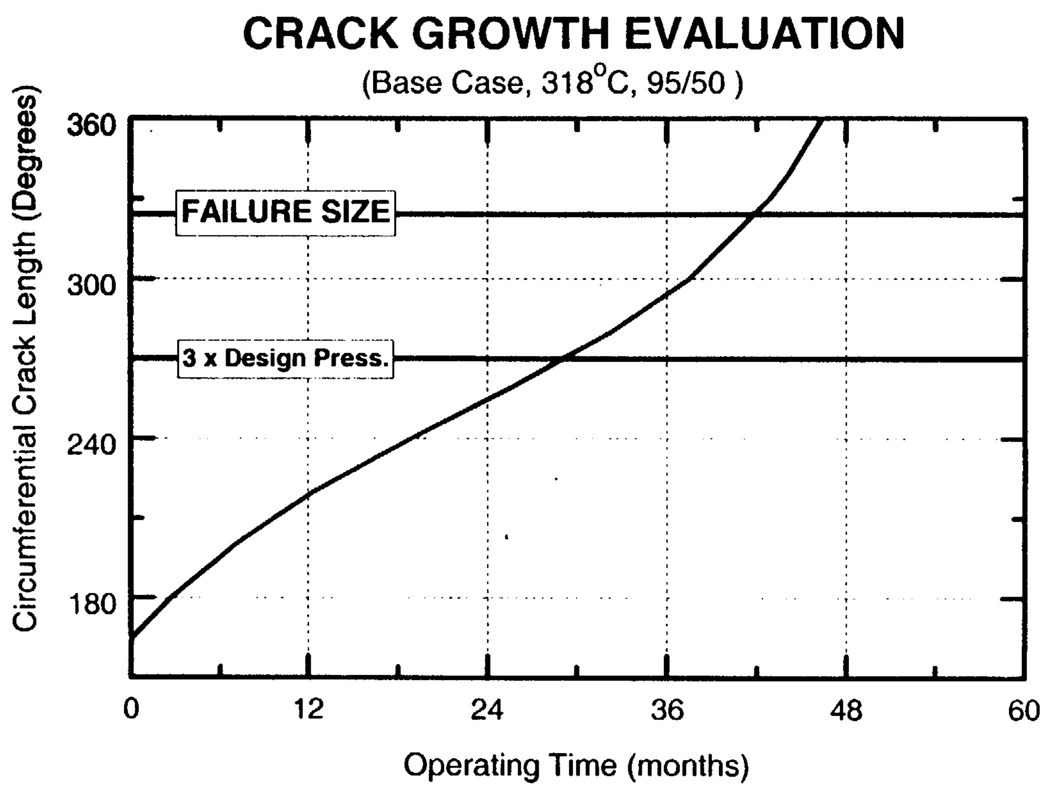


Figure 20 Evaluation of operating time to reach critical flaw sizes at three times design pressure and at nozzle failure/ejection after development of a 165° long circumferential through-wall flaw.

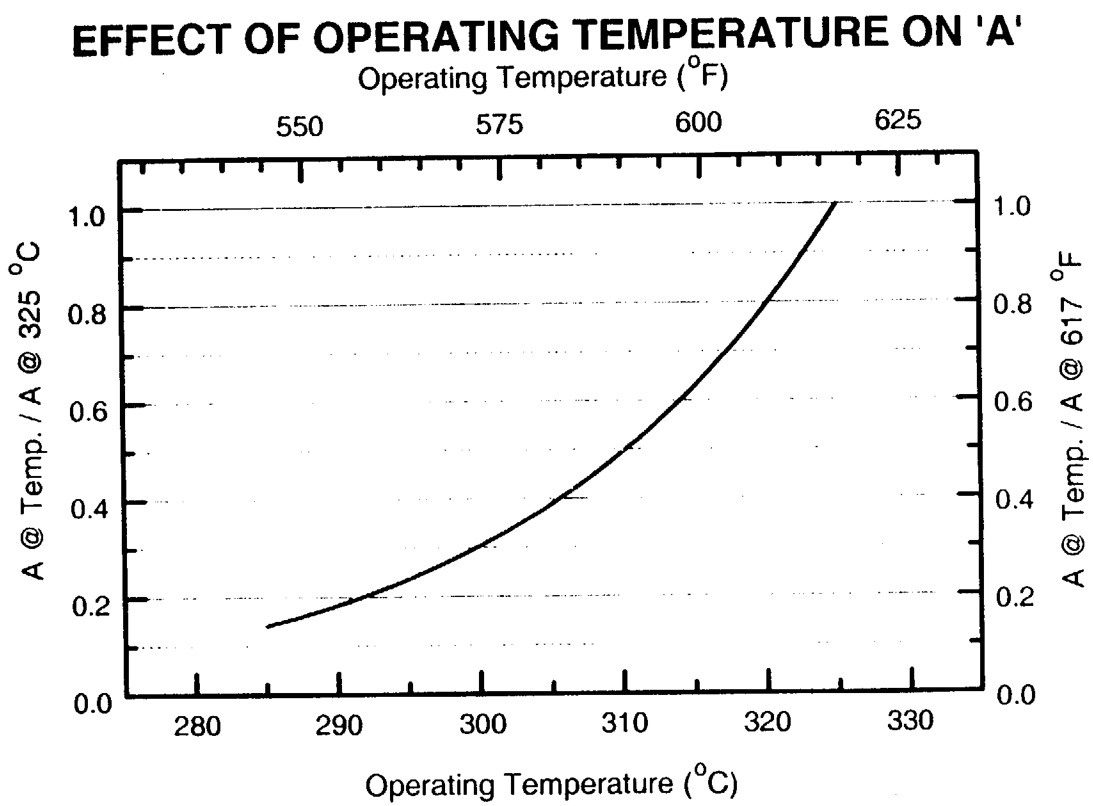


Figure 21 Lower operating temperature results in lower crack growth rates for VHP nozzle materials, within the operating temperature range of the nozzles.

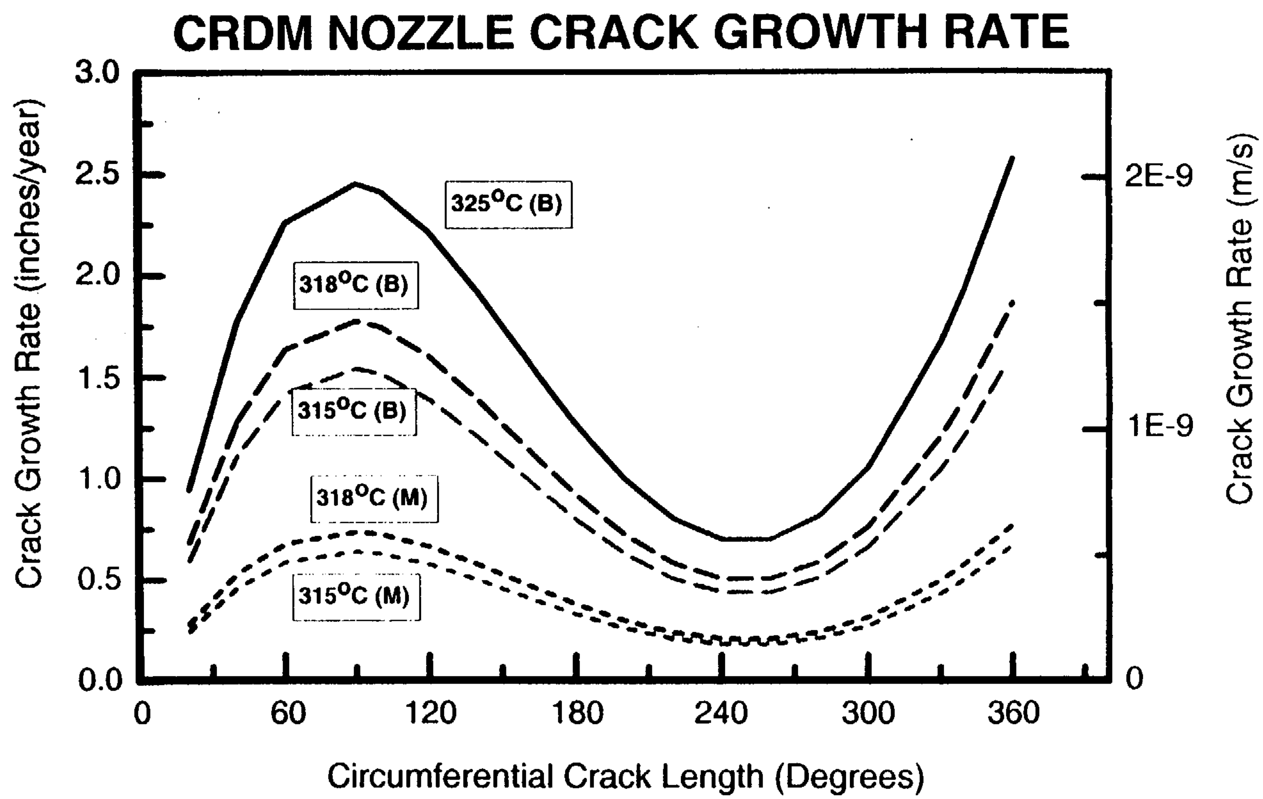


Figure 22 Variation of crack growth rates at several pertinent temperatures and using 95/50 ('B' on the curves) and mean values ('M' on the curves).

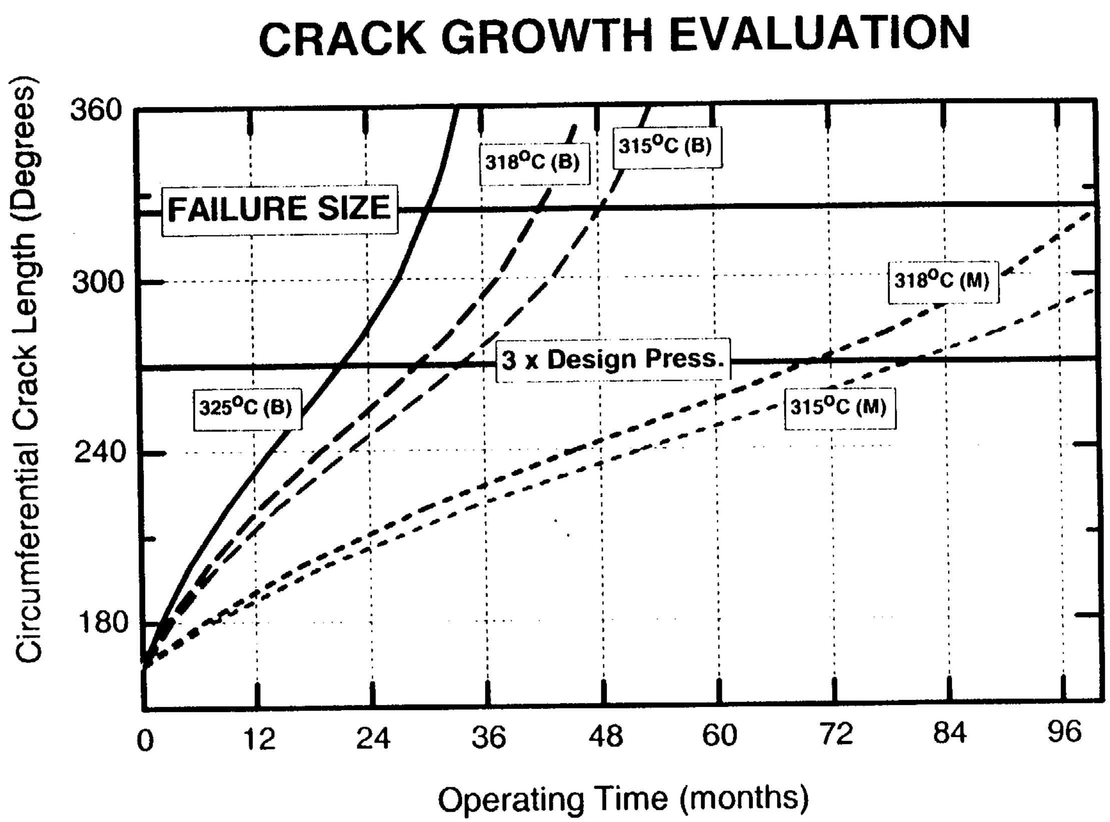


Figure 23 Crack growth analysis using various crack growth rate assumptions, from an initial flaw size of 165°. Although decreasing the temperature has some effect, the most dramatic increases in failure times occur with the mean crack growth curve instead of the 95/50 curve.

TIME TO 3 X DESIGN PRESSURE

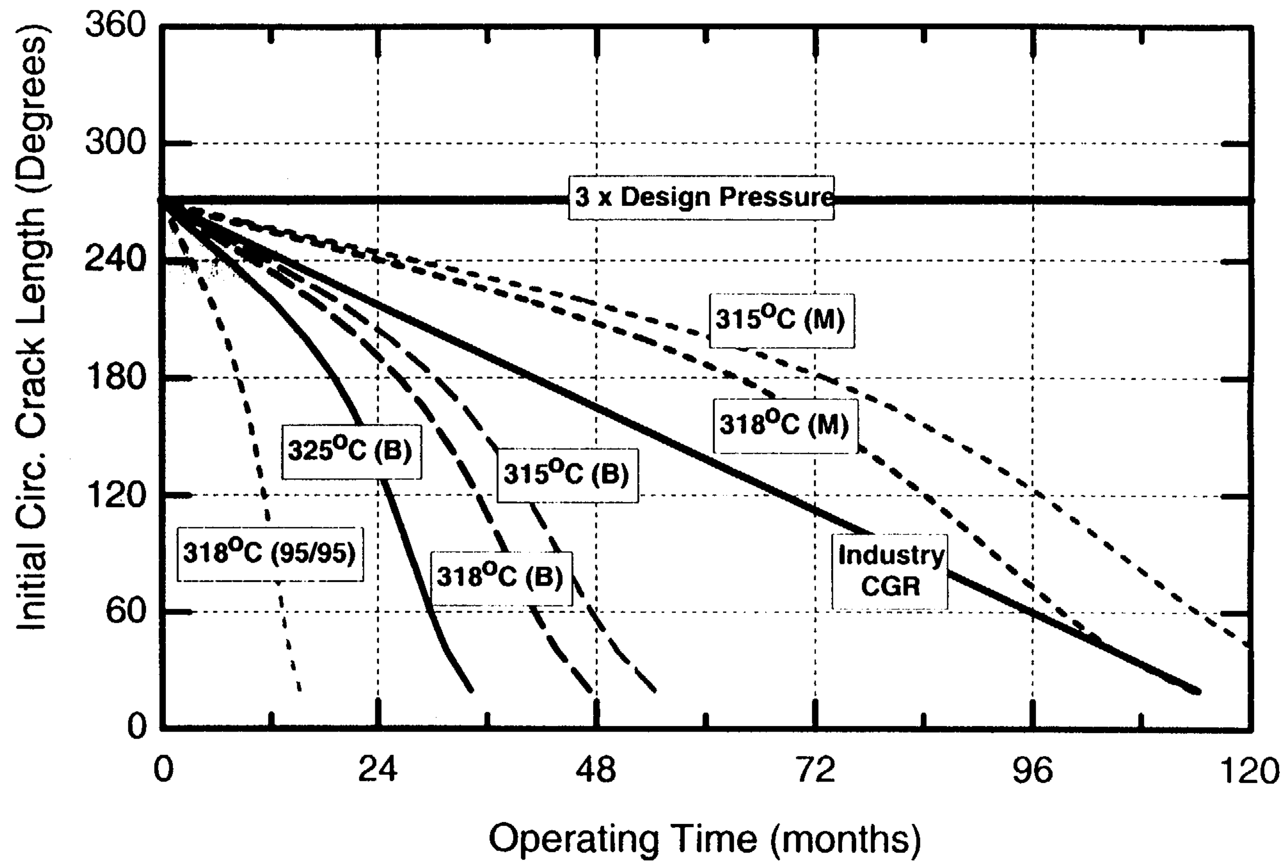


Figure 24 Comparison of time to reach the flaw size representing three times the design pressure, for a variety of crack growth rates and as a function of initial flaw size.

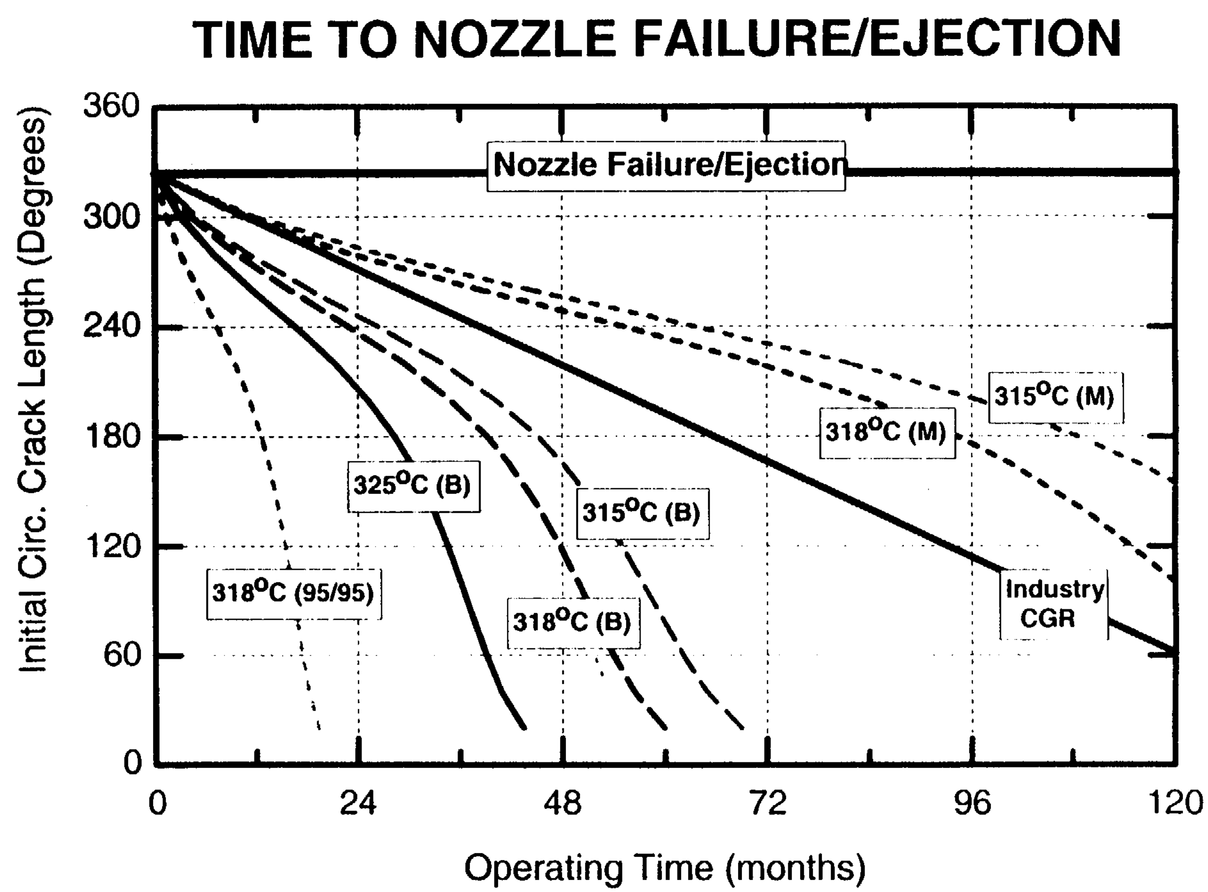


Figure 25 Comparison of time to reach the flaw size representing three times the design pressure, for a variety of crack growth rates and as a function of initial flaw size.

CONCLUSIONS FROM DETERMINISTIC CALCULATIONS

Results are very sensitive to:

- Initial flaw size
- Statistical bound on crack growth rate
- Temperature

Traditional safety margins may not be sufficient to account for large variability in crack growth rates for Alloy 600 in PWSCC conditions

PROBABILISTIC ASSESSMENT

- A Complete Phenomenological Model
  - Requires a better understanding of the complete cracking process
  - Requires data to characterize critical parameters (means & bounds)

- Empirical Model
  - Based on reliable data on number and size of cracks found in service
  - Qualification of NDE sizing an issue
  - Cost of destructive confirmation large

- Need to determine Frequency of Failure to estimate Core Damage Frequency

INSPECTION TIMING

Based on Likelihood of Circumferential Cracking

- High susceptibility plants - 8 out of 9 have identified axial or circ. cracking
- Moderate susceptibility - effective visual examinations will provide additional data

High Susceptibility Plants That Have Performed Effective Inspections

- Can use Figures 24 to 25
- New circumferential cracking can initiate

High Susceptibility Plants That Have NOT Performed Effective Inspections

- Need baseline inspection to provide basis for evaluation

Inspection Method

- Qualified visual examination is appropriate
- Surface or volumetric examinations

Inspection Scope

- 100 percent of nozzles
- Entire surface or metal volume of interest
- "Wetted surface" - J-groove weld, nozzle OD (below the weld), and nozzle ID to a location above the weld
- Volumetric - OD of nozzle above the J-groove weld
- Visual qualification analysis can occur ex-post facto after the inspection

FUTURE STAFF PLANS

- Continue development of probabilistic modeling
- Complete review of Bulletin supplemental responses
- Assemble findings from inservice inspections
- Issue NUREG report
- Long-term inspection plans
  - ASME Code revisions
  - Rulemaking
  - Other regulatory actions (Generic Letter, etc.)

INDUSTRY INTERACTIONS

- Interactions on deterministic and probabilistic analyses

- Inspection methods and findings

- Destructive confirmations
  - Flaw sizes
  - Annular conditions

Materials Reliability Program Update on Reactor Head Penetration Activities

Larry Mathews
Chairman, Alloy 600 ITG

ACRS Meeting

11/9/01

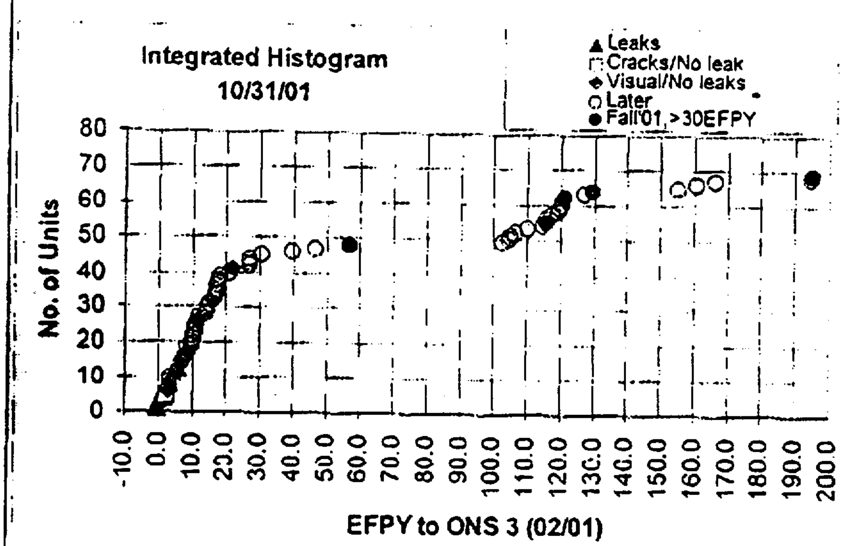
Agenda

- Crack Growth Rate
  - Annulus Environment
- Risk Assessment
- Inspection Impacts on Susceptibility
- Recommendations for Spring
- ASME Code Activity

Risk Assessment

- Preliminary Work Performed for Various Plant Types
- Meeting 11/6/01 to Finalize Approach
  - Industry Statistics for Probability of Thru-Wall Flaw vs. Time
  - PFM for Probability of Crack Propagation vs. Time, from Leak to thru wall or rupture
  - CCDP for Resultant LOCA/Ejection, including Assessment of Collateral Damage
  - CDF vs. Time for Each Unit

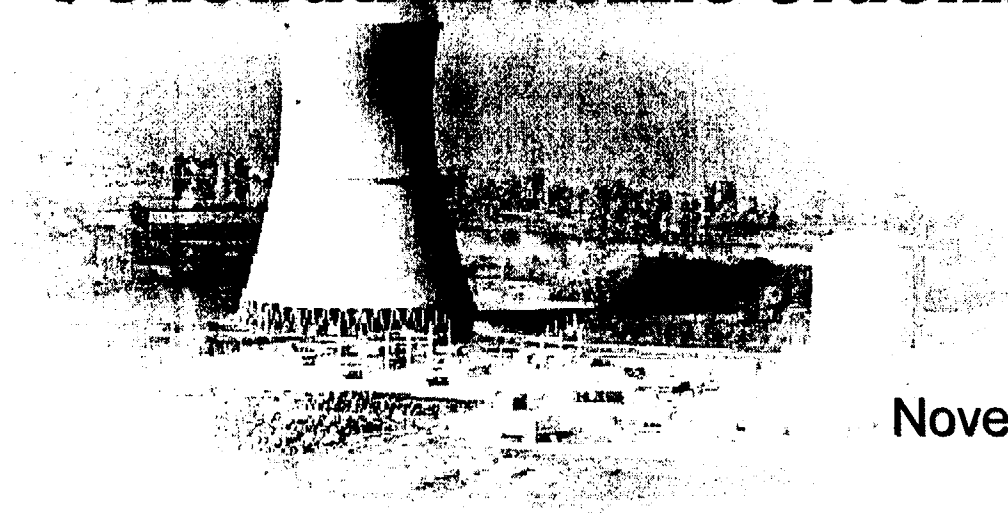
Ranking with Inspection Results



Long Range

- ASME Section XI
  - Established Working Group to Look at Alloy 600 Inspection Requirements
  - Met at Last Sec. XI Meeting
  - Will Meet Again at December Meeting

Davis-Besse Nuclear Power Station Briefing Regarding Reactor Pressure Vessel Head Penetration Nozzle Cracking



November 9, 2001

FENOC
FirstEnergy Nuclear Operating Company

OPERATIONAL EXCELLENCE
Beaver Valley · Davis-Besse · Perry · FENOC

Objective:

☆ Have ACRS consider additional industry information as it deliberates on the Control Rod Drive Nozzle cracking issue

☆ Include this additional information in formal correspondence to the Commission.

Reason for Request:

- Davis-Besse is considered a high-susceptibility plant as discussed in Bulletin 2001-01
- Davis-Besse is the only high-susceptibility plant that will not perform a visual inspection by December 31, 2001.
- Impact of continued safe operation of the plant until March 2002 refueling outage is negligible.

OPERATIONAL EXCELLENCE

FENOC

Plant-Specific Deterministic Aspects:

- ☆ Qualified visual inspection performed in 1996, additional inspections in 1998 & 2000
- ☆ Finite element analysis show that 65 of 69 nozzles will allow leakage
- ☆ Larger allowable flaw size
- ☆ Conservative initial flaw size
- ☆ Over 3 adjusted effective full-power years less operation than Oconee Unit 3

Plant-Specific Risk Evaluation Results:

- ☆ CDF - Davis-Besse plant specific risk assessment conservatively estimates incremental core damage frequency as 6.7 E-6, which is categorized as "small" per RG 1.174.
- ☆ LERF - The plant specific risk assessment conservatively estimates incremental large early release frequency as 1.0 E-8, which is categorized as "very small" per RG 1.174.
- ☆ Public Health Risk - The plant specific risk assessment estimates person-Rem per year to be 6.5 E-1 which is negligible.

Bounding or Conservative Inputs:

- ☆ Nozzle Leak Frequency
- ☆ Probability of OD Crack Initiation
- ☆ Time to OD Crack Initiation
- ☆ Initial Flaw Distribution
- ☆ Crack Growth Model Stresses
- ☆ Failure Definition
- ☆ Leakage Detection
- ☆ Probability of Core Damage

OPERATIONAL EXCELLENCE

FENOC

Consideration of Sensitivities:

- ☆ Visual Inspection Reliability
- ☆ Initial Crack Size
- ☆ Temperature
- ☆ Crack Growth Rate Coefficient

OPERATIONAL EXCELLENCE

FENOC

Summary:

Based on deterministic and probabilistic assessments independent of the NRC's preliminary staff assessment, there is reasonable assurance that Davis-Besse is safe to operate until the next refueling outage (March 2002).

OPERATIONAL EXCELLENCE

FENOC

OFFICE OF RESEARCH INITIATIVES ON REACTOR VESSEL HEAD PENETRATION CRACKING

Briefing for
Advisory Committee on Reactor Safeguards

Ed Hackett
Assistant Chief, Materials Engineering Branch
Office of Nuclear Regulatory Research

November 9, 2001

Office of Research Initiatives on Reactor Vessel Head Penetrations (VHPs)

- At the request of NRR (June 2001), RES formed an independent group of experts to review technical aspects of the recent VHP cracking occurrences at Oconee and ANO. The expert group assessment was completed and documented in an inter-office memo on September 7, 2001.

- RES staff and contractors have continued to provide support to NRR in development of the technical assessment of the VHP cracking through on-going programs:
  - Environmentally Assisted Cracking
  - Non-destructive Evaluation
  - Structural Integrity/Fracture Mechanics
  - Probabilistic Risk Assessment
  - Thermal Hydraulics

- RES has provided support to NRR for VHP inspections at plant sites.

- RES staff and contractors are developing a probabilistic fracture mechanics (PFM) assessment of the VHP cracking and have interacted with the industry in this regard
  - Conference call (9/27/01)
  - Public meeting (11/8/01)

RES Initiatives on
Reactor Vessel Head Penetrations

Key Considerations in PFM Analysis

- Crack Initiation
- Crack Growth Rates
- Analysis of Stress State
- Maintenance of Structural Margins
- Inspection Methods and Timing

<u>RES Initiatives on</u>
<u>Reactor Vessel Head Penetrations</u>

Key Considerations in PFM Analysis
Crack Initiation

- Location/Process
  - Axial crack initiates in the J-groove weld interface / progresses above the weld/ through-wall penetration causes leakage to the annulus /stress state causes "turning" to circumferential crack following the weld
  - Axial crack in VHP or J-groove weld progresses through-wall / through-wall penetration causes leakage to the annulus / multiple circumferential cracks initiate on the OD following the weld profile
  - Consideration of time to initiation from inspection data

- Annulus Environment
  - potential site for concentration of aggressive chemical species
  - concentrated primary water if boiling occurs at exit of crack
  - normal primary water when boiling occurs well above the J-weld
  - unlikely to be oxygenated
  - analyze deposits to confirm environment

RES Initiatives on Reactor Vessel Head Penetrations

Key Considerations in PFM Analysis
Crack Growth

- Data for the environment of interest do not exist
- Significant variability in alloy 600 PWSCC data
- Appropriate to consider variability on a heat basis
- Complicated due to consideration of multiple initiation sites
- Crack growth rates in excess of 1 inch/year are possible

RES Initiatives on Reactor Vessel Head Penetrations

Key Considerations in PFM Analysis
Analysis of Stress State

- Stresses due to primary pressure and crack face pressure

- Residual stresses
  - welding
  - fabrication processes & sequences, installation procedures
  - modeling details
  - influence of VHP through-wall strength gradients

- Differential expansion stresses at the root of the J-groove weld

- Potential for contribution from cyclic thermal stresses

RES Initiatives on
Reactor Vessel Head Penetrations

Key Considerations in PFM Analysis
Maintenance of Structural Margins

- Intent would be to perform PFM analysis on a "best estimate" basis for all input variables

- Assessment of uncertainties in previous elements indicates the need for application of margins

- Where to apply margins and appropriate magnitude(s)?

RES Initiatives on Reactor Vessel Head Penetrations

Key Considerations in PFM Analysis
Inspection Methods and Timing

- Certain inspection methods have been "qualified" for determination of leakage and for VHP ID cracking
  - External Visual of RPV head for evidence of leakage
  - Eddy Current examinations for axial ID cracking on VHPs

- Other Inspection methods remain to be qualified for the OD circumferential cracking "process"
  - surface and volumetric exams for the J-groove weld
  - volumetric exams for the VHPs

- Determination for appropriate inspection intervals from PFM analysis will also depend on reliability and effectiveness of inspection methods

RES Initiatives on Reactor Vessel Head Penetrations

Summary

- RES and NRR are developing an integrated technical perspective on VHP cracking using deterministic and probabilistic (PFM) methods

- Development thus far indicates that key inputs are lacking appropriate data and/or are highly uncertain

- At the current state of development, these uncertainties limit the ability of a PFM assessment alone to provide an accurate evaluation of structural integrity and guidance on appropriate inspection intervals

- Continued efforts in this area should result in reductions in uncertainties in key input variables

ITEMS OF INTEREST

487th ACRS MEETING

NOVEMBER 8 - 10, 2001

engineers & scientists. Give one copy to John Larkins. Return originals to me.
Thanks
Sher
10/23

UNITED STATES NUCLEAR REGULATORY COMMISSION

ENHANCING THE NRC'S CAPACITY TO MEET NEW REGULATORY CHALLENGES

Richard A. Meserve, Chairman
U.S. Nuclear Regulatory Commission

Nuclear Safety Research Conference
Washington, DC
October 22, 2001

ITEMS OF INTEREST
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
487^{h} MEETING
NOVEMBER 8-10, 2001

Page

COMMISSIONERS' SPEECHES

MISCELLANEOUS

Introduction

Good morning. I am pleased to be able to address you today.

Although this is the 29th year that the NRC has held a conference on reactor safety research, I want to take special note of the change in the name of this conference. When I spoke at this meeting last year, I had no idea that I was addressing the final "Water Reactor Safety Information Meeting." Those of you who attended that meeting may recall that it was devoted in large part to a retrospective on the WASH-1400 report, which may, in hindsight, have been the perfect way to bring the era of the water reactor safety meeting to a close. I now have the pleasure of addressing the first "Nuclear Safety Research Conference."

The new name reflects the reality that the research carried out by the NRC, our contractors, our international partners, and the industry now extends beyond water-cooled reactors. The new name reflects an effort by the NRC to reach out to the broader nuclear community to explore new concepts and approaches in reactor design, fuels and materials, waste disposition, and related topics – in addition to addressing issues associated with the current generation of water-cooled reactors.

Nuclear Security

I would like to take a few minutes at the outset to reflect upon the events of September 11, and the impacts that those events have had on the NRC. Tomorrow marks six weeks since the United States was viciously attacked by terrorists. Although nuclear facilities were not targets, these brutal actions have brought home, in no uncertain terms, the potential threat that we face. When I say "we," I do not mean only the United States, but rather all those in the nuclear community, both in this country and internationally.

Let me say just a few words about the NRC response to the terrorist events. Shortly after the second attack on the World Trade Center, we fully staffed our Emergency Operations Center at headquarters and the counterpart offices in the Regions and put our major licensees on the highest level of alert -- a status we have maintained since September 11. We have no specific or general credible threat directed at an NRC licensee at his time, but the general threat environment is obviously very high. As a result, we have issued a variety of different threat advisories to our licensees, as well as guidance as to actions that our licensees should undertake to enhance security. We have engaged with the FAA, resulting in the issuance of a notice to airmen to avoid flyovers of nuclear power plants. We have also interacted with the military to assure that there is full awareness of the nature, and limits, of licensee capability to respond to attacks. We are working with the FBI and others in a variety of ways to assist in investigations and to assure the NRC's actions are coordinated with other agencies. And the NRC has communicated with the Governors of 40 states so as to assure that state assets -- state police or National Guard -- are available as needed.

The September 11th events have served as a wake-up call throughout the Government about the need to focus greater attention on the terrorist threat. With the full support of the Commission, I have directed the Executive Director for Operations to commence a top-to-bottom review of the NRC's safeguards and security system. This will encompass not only regulatory requirements, but also communications, the security of NRC facilities, and coordination with other agencies. Many of the important issues -- including in particular the definition of the boundary between those responsibilities that must be assumed by the private sector and those that must be undertaken by Government -- will require a broader societal discussion. These will not be issues of the NRC and its licensees to resolve alone.

I recognize as well that the effort does not stop at our borders. We must also depend on our friends and partners internationally to provide information on potential threats and to help find methods to deal with them. We must remember that a serious event or accident at a nuclear plant or facility anywhere in the world affects us all, and we must redouble our efforts bilaterally, multilaterally, and through organizations such as the IAEA and the NEA, to ensure the safety of nuclear facilities everywhere. I am hopeful that, with a dedicated focus by all, we can limit the threat that terrorism presents.

Let me now turn to the main topic of my speech -- enhancing the NRC's capacity to meet regulatory challenges.

NRC's Regulatory Challenges

Last year at this event I discussed the efforts of our Office of Nuclear Regulatory Research in the context of ongoing agency programs, especially those related to the economic deregulation of electricity. I focused on license renewal, power uprates, and the transition to a risk-informed approach to regulation. I then discussed anticipatory programs to prepare the NRC for new challenges, including innovative designs for new nuclear power plants.

In many respects, the situation today mirrors that which existed last year. I am pleased to say, however, that we are moving forward in meeting the technical and regulatory challenges. Our license renewal program is proceeding aggressively: three applications have been granted; seven plants, totaling 14 units, currently are under active review; and almost half the plants in the U.S. have indicated that they intend to pursue renewal. In fact, we expect that almost all of the plants in the U.S. will ultimately apply to have their licenses renewed.

We also expect to receive a large number of applications for power uprates of 10 percent or more, as licensees seek to maximize the economic contribution of their nuclear plants, while maintaining adequate margins to plant safety limits. Our responsibility, of course, is to ensure that such margins are maintained in order to protect public health and safety. New instrumentation and more realistic analytical techniques provide the means to justify power uprates without a compromise of safety margins.

We continue to make progress in risk-informing our regulations, although this has proven to be a slow and sometimes challenging process. And with regard to future reactors, we are proceeding with the "pre-application" reviews of new reactor designs, such as the AP1000 and the pebble-bed modular gas-cooled reactor, in anticipation of formal applications for design certification or a combined construction permit and operating license at some point in the future.

In these and many other areas, our research activities have made and continue to make significant contributions by providing the technical bases that comprise the foundation for our regulatory activities. The NRC's ability to continue over time to make such progress depends, however, on a fundamental underpinning -- what I shall call the "research infrastructure." There are three different components to this infrastructure -- technical personnel, experimental facilities, and analytical tools. Each of these components helps to provide the technical foundation for regulation. All are important because significant degradation of any of the components can seriously undermine that foundation. It is the maintenance of this infrastructure that is the focus of my remarks this morning.

Personnel and Technical Skills

Since becoming Chairman of the NRC, almost two years ago, I have come to regard the NRC staff as one of the most technically competent and highly skilled groups in the Federal government. Nonetheless, I must also acknowledge that the NRC is facing a potentially serious situation with respect to maintaining technical capabilities in the next few years. We have many times more people over the age of 60 than under the age of 30, and a significant fraction of the most experienced staff members are currently eligible to retire. Unless we can bring skilled new people on board and somehow transmit the accumulated knowledge of the veteran staffers to them, a great deal of the NRC's corporate memory may simply walk out the door. This problem of an aging workforce is not limited to the NRC; in fact, it extends across the nuclear industry, including utilities, vendors, and national laboratories.

We recognize the need to recruit young engineers and scientists and to ensure that they have the necessary technical skills and training. But, in doing so, we run into a second problem that is just as acute as that of our aging staff. Nuclear power has not been perceived as a thriving field by technically inclined students looking for professional challenges. As a consequence, the number of nuclear engineering programs in the U.S. has declined sharply over the last decade, and the enrollment in the ones that remain has fallen over the same period. This trend has been reported in several surveys, including the report of the blue-ribbon panel from the Nuclear Energy Research Advisory Committee.[1] This report, published in May of last year, indicates that while the decline in the number of programs and students began in the 1970s, the rate of shrinkage increased sharply in the early 1990s and has just recently begun to level off. Another report with a similar focus, published last year by the Nuclear Energy Agency of the OECD, indicates that these trends are international in scope, as well.[2]

We are now seeing, at long last, a small but perceptible increase in student interest and enrollment. But it will take several years to get enough people into the pipeline to fill the need for nuclear engineers, especially if recent industry interest in the possibility of building new plants ultimately results in actual new orders. Needless to say, nuclear engineering is not the only technical discipline from which the NRC draws its staff, but the general reduction of interest in nuclear power as a career choice also has affected our ability to recruit mechanical, electrical, and chemical engineers, as well as those with training in other key scientific and engineering fields.

The shortfall in new nuclear engineering graduates creates a "double whammy" when it comes to recruiting for the NRC staff. The number of available candidates is very limited. But the fact that there are too few people to fill the entry-level slots across the industry tends to put

---

[1] M. L. Corradini, et al., "The Future of University Nuclear Engineering Programs and University Research and Training Reactors," commissioned by DOE's Office of Nuclear Energy, Science and Technology (May 2000).

[2] "Nuclear Education and Training: Cause for Concern?" OECD/NEA (June 2000).

upward pressure on starting salaries, and it is difficult for the NRC to compete with utilities, vendors, and other engineering firms. The NRC has recently undertaken an initiative to identify key technical needs in our staffing profile and to recruit aggressively to attract new staff members to fill those needs. We have revitalized our intern program, entry into which is based on academic achievement. Recent graduates are selected for an extensive training program that includes formal instruction and rotational assignments. When they have completed their training, the interns are then assigned permanently to key positions throughout the agency. We expect these people to be prominently represented among the next generation of leaders at the NRC.

Several management training programs are offered for more experienced staff, as well. For example, the NRC also sponsors a graduate fellowship program, through which staff members can obtain advanced degrees at the agency's expense. We are hopeful that the availability of these types of programs will make NRC more attractive as an employer. It is through these efforts that we strive to ensure ourselves of an adequate supply of highly competent staff to meet future challenges.

As is true with virtually all issues that affect the NRC, concerns about the availability and technical competence of scientists and engineers in nuclear-related disciplines extend to the international community, as well. The international reach of the issue is illustrated by an October 1999 workshop, sponsored by the Committee on Nuclear Regulatory Activities of the OECD's Nuclear Energy Agency.[3] CNRA's report, released in February 2000, takes note of many of trends that are now shaping the nuclear technology community on a global scale, and includes a list of short-and long-term challenges, many of which are similar to the ones I have already outlined.

The themes of personnel demand and technical competence are closely linked, both in terms of attracting the brightest science and engineering students to study nuclear technology and in being able to transfer the experience and accumulated knowledge of veterans in the field to the new generation. It should come as no surprise, particularly to this audience, that strong, state-of-the-art research programs are seen as a key element in confronting this need. Let me then move on to address another of the aspects of "infrastructure" that I mentioned earlier: experimental facilities.

Experimental Facilities

The development of nuclear technology in general and nuclear power in particular is highly dependent on the use of experimental facilities in almost every discipline that contributes to the field. Whether we consider reactor physics, thermal-hydraulics, the effects of radiation on materials, or fundamental knowledge in numerous other areas, the great wealth of information that is available to us today is built on the foundation of experimentation. In addition to their role in developing the technological base, research programs in general, and experimental programs in particular, also serve to attract bright young engineers and scientists into the field.

---

[3] "Workshop on Assuring Nuclear Competence into the 21st Century," NEA/CNRA/R(2000)1, OECD/NEA Committee on Nuclear Regulatory Activities (February 2000)

Some consider the period from about the early 1970s to the mid-1980s as a "golden age" of experimentation in the U.S., particularly with respect to reactor safety research. In the area of water reactor technology alone, for example, we had the benefit of facilities like SEMISCALE, LOFT, MIST, THTF, and FLECHT -- most of which were sponsored in full or in part by the NRC (or its predecessor, the AEC). These facilities provided the data to support accident assessments and the development of analytical models, some of which are still in use today. It is no coincidence that this was also the time when the number of nuclear engineering students was at its highest – even accounting for a slight drop right after the accident at Three Mile Island. When they graduated, many of those students were employed in the national laboratories that ran or used these facilities. Many of you in the audience probably were drawn to nuclear engineering and related disciplines in just this way.

Advances in nuclear safety research based on experimentation are, of course, not limited to the United States alone. Major facilities were built in France, Japan, and in many other countries. Much valuable water-reactor-related data have come from programs such as BETHSY at the CEA's Grenoble laboratory and ROSA at the Japan Atomic Energy Research Institute. In fact, confirmatory testing in the ROSA Large Scale Test Facility played an important role in the NRC's certification of the AP600 design.

Although experimental facilities have played a pivotal role in advancing nuclear technology, it is also true that they can be extremely expensive to build, maintain, and operate. As government and private support for nuclear research has fallen, particularly over the last decade in the U.S., we have seen many of our test facilities shut down and dismantled. Once such facilities are closed, it is virtually impossible to resurrect them and a valuable resource is gone.[4] Even more dismaying is the fact that the state of the art in data collection and retention has advanced so rapidly that the tapes and other media used to acquire and store the information gathered from previous test programs can, in some cases, no longer be read or are deteriorating to the point that the data are at risk of being irretrievably lost.

Another related resource that has suffered a similar fate in the U.S. has been non-power and testing reactors, particularly those at universities. This issue is also discussed in the report of NERAC's blue ribbon panel, to which I referred earlier. Just as the number of nuclear engineering programs and students has declined sharply over the past 10 years, we have seen a drastic decrease in the number of operating research reactors as well. This decline is a matter for concern for several reasons. University research reactors are often seen as an integral part of a successful nuclear engineering program and closure of the facility may be interpreted by students as a sign that the program is in trouble, which could serve to diminish enrollment further. Moreover, these reactors serve two important purposes. First, they help in the training of nuclear engineering students in aspects of reactor technology. And second, they provide important facilities for both basic and applied research, contributing to a wide range of projects from materials behavior to forensic investigation to the treatment of cancer. Many of

---

[4]This issue is also a matter of international concern, and is the subject of another NEA report, developed by the Committee on the Safety of Nuclear Installations (CSNI) and released earlier this year, "Nuclear Safety Research in OECD Countries: Major Facilities and Programmes at Risk," OECD/NEA Committee on the Safety of Nuclear Installations (2001). The report addresses research facilities and programs that are in danger of being lost and ways in which these key resources can be maintained.

our research reactors, both at universities and elsewhere, are quite old and are increasingly difficult and expensive to maintain. Their declining number is a source of real concern, particularly since no new facilities of this type have been built in the U.S. for many years.

Although much of the news from this sector of the nuclear technology community has been discouraging, I was recently pleased to learn that the University of Missouri-Columbia, home of the largest university research reactor in the U.S., has decided not to close its reactor, rather, the university will create a Nuclear Science and Engineering Institute, of which the reactor will be the centerpiece. We can only hope that this positive sign will encourage other universities struggling with similar issues to keep their reactors operating as long as it is safe and practical to do so.

The loss of both in-reactor and out-of-reactor experimental facilities is a serious threat to the maintenance of our regulatory infrastructure. I have already alluded to the impact on attracting new, technically competent technical staff members to the field. Moreover, when important new research must be undertaken to address emerging technical issues, the facilities may not be available to respond quickly to the need. Thus, we may not have the necessary capability to develop and validate the third aspect of infrastructure: state-of-the-art analytical codes.

Let me turn to that subject now.

Analytical Tools

In the early developmental stages of nuclear reactor technology, much of the basic knowledge about how reactors work was gained by building small reactors, testing them, and observing what happened. As reactors got larger and more complex, it became clear that direct observation would have to be replaced by analysis, using mathematical models derived from experiments. For more than 30 years, researchers in government, industry, and academia have designed and operated experimental facilities that simulate reactors and their associated systems, structures, and components. Researchers have used these facilities to acquire data, to understand more fully the physical phenomena that are important to nuclear reactor safety, and to develop the analytical models that enable the accurate prediction of the behavior of the actual reactors and power plants.

The sophistication of these models has increased as computer technology, instrumentation, and data acquisition techniques have improved, and today we have literally dozens of codes and models to calculate thermal-hydraulics, neutronics and kinetics, fuel performance, severe accident phenomena, the behavior of materials and structures, and the dispersal of radioactive material in the environment, just to name a few. The art and science of designing experiments has grown more sophisticated as well, with formalized scaling methodologies such as the hierarchical, two-tiered scaling process, and techniques like the CSAU methodology for assessing the uncertainties associated with complex thermal-hydraulics codes.

Even analytical methodologies that are not directly associated with testing depend to a substantial degree on data from either testing or plant operations. For example, probabilistic safety assessment techniques rely on information on causes and rates of component and system failures as input to event and fault trees, and the establishment of success criteria for event sequences depends on accident analysis codes derived and validated using experimental results. Indeed, the NRC's evolution to a more risk-informed regulatory paradigm demands that our analytical tools be as realistic as possible, so that we can make sound, technically defensible judgments as to what is safety-significant and what is not.

The interrelationship between the different elements of the research infrastructure should be clear from this discussion. We need creative, well-trained people to design, operate, and analyze sophisticated, cutting-edge experiments that will help us develop the state-of-the art analytical tools to support critical regulatory initiatives, such as risk-informed regulation, safety reviews of advanced reactor designs, license renewal, and power uprates. Those creative, bright, and energetic engineers and scientists will be available to us only if we are able to establish experimental and analytical research programs that will attract them to nuclear engineering and associated fields as professionals.

Unfortunately, as I noted earlier, it is an undeniable fact that experimental facilities can be extremely expensive to design, build, operate, and maintain. With the NRC's research budget falling from more than $200 million in the mid-1980s to $40-to-50 million today – not accounting for inflation – it is clear that the NRC does not have the wherewithal to maintain the infrastructure by itself. We must look for other ways to tackle these critical issues.

Possible Approaches to Enhancing Infrastructure

In my view, the answer to the problem of maintaining and enhancing infrastructure is broad cooperation among all of the various sectors of the nuclear technology community. I realize that there are challenges to be faced in this regard, particularly with respect to cooperative work with the regulated industry, in view of conflict-of-interest concerns. Nonetheless, we have to find ways in which such obstacles can be successfully negotiated. The NRC's research program has been assessed many times by various groups: the National Academy of Science, the Advisory Committee on Reactor Safeguards, the former Nuclear Safety Research Review Committee, and most recently, a panel of experts drawn from across the community and chaired by former Commissioner Ken Rogers. In virtually every instance, the NRC has been advised to find ways to work cooperatively with the Department of Energy and the nuclear industry to provide adequate support for major research programs.

Cooperation does not necessarily refer solely to jointly funded research. For example, universities struggle to find adequate funds to operate their reactors and to upgrade them when necessary. DOE provides some funding for university reactor operations, and is looking at ways to do more. But the nuclear power industry – utilities, vendors, their contractors, and organizations like EPRI – should realize that they have a stake in keeping these facilities operating too. Research funding and outright grants should be available so as to ensure the continued viability of university reactors and nuclear engineering programs.

Cooperation extends beyond national borders, as well. International cooperation is a key element of enhancing the regulatory infrastructure, not only in the United States, but also everywhere that nuclear power is used. The international nuclear community already does much in the way of cooperative programs, through bilateral and multilateral programs and through organizations like the NEA and the IAEA. But we must do more. Various NEA reports contain many valuable suggestions in this respect, such as establishing international centers of excellence, exchanges of staff, and collaborating on defining core competencies and means for assuring that they are maintained. This does not mean that all countries will end up regulating nuclear power in the same way – I recognize that there may be many different paths to a successful outcome. But we should all strive to ensure that, whatever path we choose, our decision-making is informed by the best information that can be brought to bear from wherever in the world the information can be found.

Conclusion

My objective this morning has been to provide a vision of the direction in which I would like to see the NRC and the nuclear technology community move in order to ensure that our regulatory infrastructure is up to the task of establishing the technical bases for current and future challenges. I hope that you share this vision. I look forward to working together with you to reach our common goals.

Thank you.

NRC NEWS

UNITED STATES NUCLEAR REGULATORY COMMISSION

OFFICE OF PUBLIC AFFAIRS
Office of Public Affairs
Washington, DC 20555-001
Telephone: 301/415-8200
E-mail: opa@nrc.gov
Web Site: http://www.nrc.gov/OPA

No. S-01-025

[PDF Version (42 KB)]

"New Direction in Research"

The Honorable Greta Joy Dicus
Commissioner
U.S. Nuclear Regulatory Commission

Nuclear Safety Research Conference

October 22, 2001
Washington, D. C.

Welcoming remarks

Good morning everyone!

I would like to welcome you to the Nuclear Safety Research Conference, or what was formerly known as the Water Reactor Safety Meeting. I see some familiar faces in the audience. To them, and to all of you who have been to previous Water Reactor Meetings before, welcome back. To those who are at this meeting for the first time, I hope you would find this meeting insightful, and informative. We expect to benefit from the new ideas and new information, which you bring along with you.

Finally, I want to extend a warm welcome to our foreign guests who have come from far. Most issues critical to the industry today, whether it is a need to improve the security of our facilities, extend the life of our plants, or develop advanced reactors which are safe as well as cost-competitive, are multinational rather than national issues. Therefore, your presence and participation in this meeting are a benefit to all of us.

In addition to the meeting, I hope you would enjoy the fine October weather in Washington, D.C. I also hope you had, or will have time to enjoy the many national monuments and museums in the city, before you return. All of them are only a short train ride from this hotel.

We all recognize from history that issues which confront the nuclear industry are not static. The issues that were critical have been changed, and will continue to change. The directions of research, must change to accommodate the changing needs. History also shows that the Office of Research and the NRC have successfully changed direction to address the issues which were contemporary to the time. Many of us may not have been part of the nuclear community when issues were confronted relating to emergency core cooling, in the 1970s. The Office of Research's focus on code development and experiments helped NRC address these issues and enhance the regulatory process. In the 1980s, continuation of research activities on probabilistic risk assessment lead to publication of NUREG-1150, issuance of Generic Letter 88-20, and the development of many tools and methods to enhance the regulatory process through the use of probabilistic risk assessment. During the 1990s, NRC did a fair amount of research on ageing of equipment in our plants, thermal hydraulic analysis in advanced reactors, and even more research in the area of probabilistic risk assessment. This research is helping us address key questions relating to plant license renewals, an improved reactor oversight process, and risk-informing our regulations.

Before your minds wonder off to the exciting topics which will be discussed this afternoon, I want to describe what I will be speaking about today. First, I will address some of the initiatives we have undertaken to improve the effectiveness of NRC. Second, I will discuss present challenges to industry. Finally, I will discuss some of the new directions which NRC may be heading toward, specifically in the area of international standards on radiation protection. In that respect, I will share with you recent advancements in this area and my vision of how these advancements should, or should not, affect U.S. regulations.

Initiatives; to improve Effectiveness of NRC

Over the last several years, the agency, in part using significant contributions from the Office of Research, has made major strides to be more effective. We have done this by changing the regulatory framework to allow the NRC to shift resources to address issues which have the highest impact on public health and safety. The new reactor oversight process is an excellent example of this changing framework. Even though we are still experiencing some growing pains, NRC has created a process that assesses the risk significance of events or issues, and NRC uses this risk significance to guide us in our interactions with licensees.

In the area of changes to regulations, the Commission has been looking at staff's proposals to risk-inform 10 CFR 50.44 which reduces requirements on hydrogen recombiners. The Commission is also looking at Staff's proposals to risk-inform 10 CFR 50.46 which will reduce unnecessary burdens on the licensees in their loss-of-coolant analysis (LOCA). The progress we have made to improve effectiveness may not be as fast as NRC like it to be. However, NRC has made these fundamental changes with public safety as our number one priority, and sometimes that involves taking extra time. We look for ways to improve effectiveness, and I commend the staff on their accomplishments, and thank the industry for continuing active, constructive dialogues.

Present challenges

Even though a good safety level for nuclear facilities and applications has been achieved in most countries, there are areas where improved knowledge will be necessary to efficiently and effectively regulate and operate the current fleet of reactors as they age, and to provide the scientific and technical basis for the development of innovative nuclear reactors and novel means for high-level waste management and disposal. History indicates that new issues will continue to emerge from operational experience, and an enterprising and dynamic industry together with an efficient and effective regulator will continue to propose innovative initiatives to improve or maintain safety in a cost-effective manner. Further, new designs are being proposed which have many characteristics that differ from those of the current fleet of plants. Availability of knowledgeable and well-trained human resources is necessary to sustain and improve the safety of nuclear power and provide effective regulation of it through all its phases from research and conceptual design, through operation, to and finally to waste management and decommissioning.

Some examples of areas where novel emerging issues have been identified follow. For each example, emphasis must be placed on understanding the uncertainties involved and highlighting those needing attention; as well as the role of risk information in identifying safety and regulatory needs.

Economic conditions are leading to extension of the operating cycle, higher fuel burnup and increased power levels. As in this country, initiatives have been identified in several other IAEA member countries to explore use of mixed oxide fuel either because of non proliferation considerations or to recycle fuel to use it more efficiently. These are being evaluated by the regulatory authorities in member states. The combined effect of these considerations must be evaluated to determine the overall safety impact.

Economic deregulation has had many influences on plant performance. It could create the potential to lead to degradation of existing safety principles, if the impacts of deregulation on plant performance, are not fully understood and monitored by the plant operator and an independent regulator to provide early warning of changes in culture and operations. Similarly, extending the effective operating life of nuclear power plants will bring great benefits, but requires effective programs for mitigating or managing the deleterious effects of plant ageing.

Life extension, decommissioning, introduction of new technology, and aging workforce pose unique challenges in the area of human performance. We must be prepared to understand these challenges and develop means to measure, monitor and trend organizational and management performances with regard to safety as well as individual human performance.

New reactor concepts (e.g., Pebble Bed Modular Reactor, and advanced LWRs) are under development that appear to have advantages in both economics and safety over existing plants. Where there is a reasonable prospect that such new designs may be proposed to a country's regulatory authority, it is essential that the regulatory authority prepare in advance for such a proposal, ensuring it has the proper mix of technical skills and experimental facilities to thoroughly evaluate the safety of such new designs.

Similarly, in the fuel cycle, new concepts are under consideration for both the enrichment of new fuel and the disposal of radioactive waste. Because of these initiatives, research expertise is needed. The application of risk analysis techniques to nuclear materials manufacturing or processing facilities is well underway, but these facilities differ from reactors and it may be necessary to adopt a different technique for risk assessments.

The analysis of the risk associated with both interim aboveground storage of spent fuel and the transportation of high level waste to final repositories requires detailed analyses of cask designs and evaluation of material behavior. Similarly, the long-term storage of radioactive waste will require monitoring as operational information begins to be assembled. Experience from reactors and other industries using advanced technology indicates operational observations may require mid-course corrections by the regulatory body as well as by the operator of the facility to maintain safety.

New enrichment and recycle approaches as well as consideration of transmutation of high level waste wi require careful evaluation of the need for safety research in parallel with developmental analyses.

The complexity of these techniques, and the safety, non proliferation, and operational concerns will require a cadre of nuclear safety experts to evaluate future research needs. We must be prepared to understand these challenges and develop means to measure, monitor and trend organizational and management performances with regard to safety as well as individual human performance. Adequate research must be conducted to understand these new technologies, their associated risks to public health and safety, the uncertainty in the risk estimates, and to evaluate where controls are needed for public protection or where further research is needed to reduce uncertainties.

Let me turn now to the core topic. The essence of what NRC does pertains, of course, to protecting public health and safety and the environment. In accomplishing this mission we rely on many processes, procedures, and regulations. During the remaining part of my speech, I would like to contribute to this meeting by talking about (a) the evolution of new recommendations which may be developed by International Committee on Radiation Protection, and (b) my perspectives on how these recommendations should or should not affect the near-term and long-term policies of the NRC.

As you all know, technology evolves with the advancement of science and science advances through research and study. These advancements occur at academic institutions, laboratories, and other research and development facilities through the efforts of many dedicated members, like you, in the scientific community. Regulatory agencies are faced with the challenge of how to translate our current knowledge of radiation health effects into a regulatory framework, via regulations and with regulatory guides, that are protective of not only the workers, the public, and the environment, but, at the same time, strike a balance between the uncertainties in that knowledge and the beneficial applications of radiation. For example, we certainly are all aware of uncertainties which have lead to controversy over whether the present uses of the linear non threshold model to describe radiation health effects at low doses and dose rates are appropriate for establishing regulatory standards in radiological protection.

Many factors influence decisions in the business of setting regulatory standards for radiation protection. Historically, NRC's regulatory approach for radiation protection has considered new scientific information on radiation health effects as one important input into this complex business. The NRC has also depended upon a process in which first, independent bodies of experts evaluate information on radiation health effects and then other bodies of experts, drawing upon this collective knowledge, develop recommendations for systems of radiation protection. Examples of the first set of bodies are the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the Radiation Effect Research Foundation (RERF) and the U.S. National Academy of Sciences Committee on Biological Effects of Ionizing Radiation (BEIR). The second set includes The National Council on Radiation Protection and Measurements (NCRP), in this country, and the International Council on Radiation Protection (ICRP). After considering recommendations from these scientific bodies, if the Commission agrees that revisions to NRC's radiation protection regulatory framework are needed, then the changes are proposed through an open and inclusive process that provides for public input. Finally, NRC is subject to statutory requirements to follow the generally applicable radiation protection standards issued by the U.S. Environmental Protection Agency.

This then moves us from science into policy decisions. In the final analysis, the flexibility and direction that agencies have in making these policy decisions are dictated by a number of considerations including the underlying legislation for regulatory agencies and, in some cases, by court decisions on the implementation of the legislation.

For those who are not familiar with the activities of the ICRP, and how ICRP influences NRC Regulations, let me say a few words about some key activities of ICRP and how they relate to NRC's regulations.

ICRP updates models to reflect new biokinetic information and to achieve greater predictive accuracy through the application of physiologically realistic model structures like the respiratory tract model described in ICRP Publication 66 (1994). Furthermore, using these models, ICRP provides recommendations to the international radiation protection community. The ICRP models and recommendations provide significant input in formulating the regulations which NRC adopts, after incorporating stakeholder concerns. For example, the current 10 CFR Part 20 which establishes standards for protection against radiation adopted models and recommendations from ICRP Publication 26 published in 1977 and Publication 30 published in 1978.

Since the 1970s ICRP has made major changes to ICRP recommendations and models-- and --- they are continuing to evaluate many more changes.

Let me first discuss proposed changes to the ICRP models and how we might begin using them. During the last few years the ICRP has updated many of the models in ICRP Publication 30 which were published in 1978, to reflect new biokinetic information and to achieve greater predictive accuracy. Because the models of Publication 30 often reflected overly cautious parameter values chosen in the absence of physiological constraints, it is common for the newer models to yield lower dose coefficients. For example, the updated effective dose coefficient for the inhalation of 232Th by a worker is about a factor of 15 lower than the earlier value. However, for a few radioisotopes, the new models have led to substantial increases in dose estimates. Some licensees have made requests to use these new models, and on a case-by-case basis, since these models clearly reflect advances in knowledge, we have granted a few exemptions to the rules.

Unlike models which are purely scientific correlations based on experimental or other information, ICRP recommendations must be evaluated in light of other factors such as cost-benefits, perceptions, and political ramifications. Since 1978, the ICRP has made major revisions to its basic radiation protection recommendations. These were published in ICRP Publication 60 in 1990. This publication has recommendations which supercede those of the ICRP Publication 26. Because of timing and other considerations, NRC adopted only some of the ICRP recommendations into Part 20. As an example, NRC adopted the ICRP-60 recommendation to lower the dose limit for the general public from 5 mSv (500 mrem) per year to 1 mSv (100 mrem) per year. However, with respect to the occupational exposures, even though ICRP-60 recommended a new occupational dose limit of 100 mSv (10 rems) in 5 years with a 50 mSv (5 rem) maximum, NRC believed that a reduction in the annual dose limit was not required since the annual average radiation dose to most occupational workers in 1987 was already well below 20 mSv (2 rem). Furthermore, as a part of the revised regulations, NRC included the concept of maintaining radiation exposures as low as reasonably achievable (ALARA).

It is my view that some facts and figures based on recent information must be fully evaluated before considering a rulemaking change to reduce occupational exposure as recommended by ICRP-60. For example, in 1999, out of approximately 150,000 monitored individuals at commercial power reactors, only twenty-four individuals received doses exceeding 20 mSv (2 rems), and only 2 individuals received more than 30 mSv (3 rems). No individual exceeded 50 mSv (5 rems). When you consider the fact that even ICRP-60 allows a maximum of 50 mSv (5 rem) per year, as long as the average over five years is below 20 mSv (2 rems), even if NRC adopts ICRP-60, there would not be any savings of dose. Furthermore, there would be substantial cost for implementing the new regulation, with uncertain or any added benefit.

For example, the cost of record keeping and managing radiation protection programs, may increase considerably due to loss of operating margin. Most plants operate with administrative controls which are lower than 10 CFR Part 20. If we lower the Part 20 annual dose limits, the administrative margin may have to be lowered further to ensure compliance. That may mean more situations of individual doses come close to administrative limits, more bookkeeping may be necessary, and more management involvement may be required with questionable additional benefits.

ICRP met in early September of this year to discuss additional changes. One area which has been discussed by ICRP is the value selected for limitation of a dose to a member of the public. Current NRC regulations in 10 CFR Part 20 specify 1 mSv (100 mrem) for this annual dose limit. This was derived from ICRP-60. Internationally there may be an interest to drop the public limit per se, and rely solely on a source related constraint of approximately 0.3 mSv (30 mrem) as the point of specifying whether a source (licensee) is appropriately controlling their material. This could potentially be a factor of three reduction in the dose limit from an individual facility, if ICRP were to adopt this recommendation.

The 1 mSv (100 mrem) to 0.3 mSv (30 mrem) reduction could have significant ramifications with respect to public perception, even though actual doses encountered by public would unlikely be affected. The pressure on modeling and in verifying compliance would increase because the industry would have to demonstrate compliance with lower margins. As far as ramifications on public perceptions, comparison of a 0.3 mSv (30 mrem) rather than a 1 mSv (100 mrem) limit against thresholds in other regulations, such as thresholds allowed for routine emissions, could lead to the belief that NRC is allowing too much radiation exposure to public via routine emissions.

ICRP is considering even more changes to get rid of some complexities. The system of radiological protection set out in ICRP Publication 60 evolved over 60 years. ICRP acknowledges that the current system is complex and difficult to explain and consequently, is attempting to develop a new system that is more coherent and less confusing. The new controllable dose concept will be debated by the ICRP over the coming years.

Another major shift considered by ICRP is going from utilitarian to egalitarian ethics. The historic optimization process in radiation protection has been based on utilitarian ethics applying classical cost benefit analysis to address the question - "How much does it cost and how many lives are to be saved?" The use of collective dose emphasized the protection of society because of the difficulty in taking into account individual risk in any quantitative manner for the general public. A utilitarian ethic is the doctrine that the greatest good of the greatest number should be the guiding principle. In developing the recommendations for the 21st century, the shift continues from utilitarian values, so as to include the recognition of individual rights by using egalitarian ethics. Egalitarian is the principle of equal treatment for all individuals.

In summary, considering (a) the ICRP recommendations are still being debated and (b) the benefit to the general public and licensees is relatively low, there is, in my view, no pressing safety issue, to revise Part 20 to adopt ICRP-60 standards. We must, however, remain diligent to new concepts and be prepared to make whatever modifications to our regulations deemed worthwhile to meet our statutory responsibilities.

When and if the NRC decides on revising regulations, we will pay significant attention to the recommendations provided by the ICRP. But we must also consider insights from other scientific communities as well. There are other ongoing studies, such as BEIR VII, which will also be taken under consideration, before any rule changes are made. In September 1998, the National Research Council was awarded a 3-year grant to conduct a comprehensive reassessment of the health risk resulting from exposure to low levels of ionizing radiation. This reassessment (BEIR VII) will include a review of data that might affect the shape of the dose-response curve at low-doses, in particular, evidence for threshold in dose-response relationships and the influence of adaptive response and radiation hormesis on radiation exposure. In September 2000, the EPA requested a 2-year extension of the BEIR report and re analysis of the Japanese heath effects data. Assuming both reports are completed on schedule, the final BEIR VII report should be published in late 2003.

Conclusions

In closing, I would like to make two remarks, the first on my vision on the role of the Office of Research and the second, on my vision of ICRP and other ideas which it is currently considering on the near- and long-term impacts to NRC regulations.

My vision has not changed from last year. My vision of the NRC Office of Research would be a center of excellence and source of expertise. This center would maintain a cadre of reactor and materials safety specialists in various key areas, with independent and unbiased expertise across a broad spectrum of advanced nuclear technology, to provide the technical basis for robust and transparent regulatory decisions. Experimental facilities and resources would be maintained to ensure our ability to respond in a timely manner to new or emerging issues. The office would complement the front-line regulatory activities of the agency and independently examine evolving technology and anticipated issues. I would expect that we do more and focus on making what we produce more timely and more useful.

On ICRP recommendations and many other changes which are currently being considered by the Commission, I believe the following. In the near-term, although considerations of the ICRP-60 recommendations are still being debated, I believe that this is not a pressing safety issue in the US. It is premature to consider changes to 10 CFR Part 20, which would require use of recommendations of ICRP-60. However, in the long-term, because ensuring public health and safety is as it should be our primary focus, --- and--- because through ICRP we receive the global benefits of the advancements in science and technology in the area of radiation protection, we should monitor and prepare to consider any new ICRP recommendations, -- after-- a careful evaluation of their merits to the society.

Thank you for your attention, I would be pleased to answer any questions you might have at this time.

[NRC Home Page | News and Information | E-mail]

NRC NEWS

UNITED STATES NUCLEAR REGULATORY COMMISSION

OFFICE OF PUBLIC AFFAIRS

Office of Public Affairs Telephone: 301/415-8200
Washington, DC 20555-001 E-mail: opa@nrc.gov
Web Site: http://www.nrc.gov/OPA

No. S-01-024

[PDF Version (39 KB)]

Radiological Protection, Nuclear Energy and the Environment in the 21st Century

Resurgence of Nuclear Power by The Honorable Greta Joy Dicus
Commissioner
U.S. Nuclear Regulatory Commission

National Congress of Professional Societies
Mexican Nuclear Society
Mexican Health Physics Society

Zacatecas, Mexico
October 8, 2001

Buenos Dias. Let me try some more Spanish. **Es un gran placer estar aqui.** This is a lovely setting to participate in the Annual Conference of the Nuclear Mexican Society and the Annual Reunion of the Mexican Society of Radiological Protection.

Before I begin my presentation, let me say a few words about the September 11, 2001, terrorist attacks in New York, Pennsylvania, and Washington, D.C. Latin America and the rest of the world have expresse their sympathy. We greatly appreciate our friend's words of support and sympathy. These are difficult times for us but we will recover. Concerning our nuclear plants, since September 11, the United States Regulatory Commission (NRC) has been working with our licensees (around the clock) to ensure adequate protection of nuclear power plants and nuclear fuel facilities. The NRC is prepared to make any adjustments as may deemed necessary to continue to protect the public health and safety.

When Mr. Raul Ortiz invited me to speak, I welcomed the opportunity to come and tell you how nuclear power is doing in the United States. As you may be aware, the number one responsibility of the United States NRC is to ensure public safety in the operations of our licensees. The NRC does not promote the nuclear industry. It is from the regulatory view point that we are involved with the nuclear power industry. This is a very important point that needs to be underscored. I mention this because the structure in other countries may differ from the United States and because this responsibility will continue as new nuclear power plants are built.

There has been a tremendous amount of nuclear power developments in the past twelve months. Never since the inception of nuclear power have such monumental movements occurred in the United States. These are movements that may eventually lead to building new nuclear power plants. Specifically, I would like to discuss three very important current topics in the resurgence of nuclear power that cut across international borders. The first topic is the new **Regulatory and Industry Activities** - if the resurgence is to take place, the various industry efforts need to be consistent and supported by a new regulatory framework and infrastructure. The first topic leads to the second topic, the realization that we have a **Human Capital Crisis** - we are finding that there are not enough nuclear professionals to meet the demand. The third topic is the **High-Level Waste Repository** - spent fuel was never meant to be stored permanently at the plant site. I will talk more about topic one than the other two topics but believe that for completeness the other two topics need some discussion.

Regulatory and Industry Activities

There are many factors that have lead to the potential nuclear power resurgence in the United States. In many ways, the NRC planned for the future over a decade ago by establishing the regulatory framework (i.e., Part 52 and Part 54) needed to accommodate the nuclear power resurgence. But that is not to say that we had a crystal ball that predicted precisely what has happened or is happening. In fact, the rules that were promulgated for the new framework may need to be reviewed now that some of those rules are being exercised. In addition to the regulatory framework, the regulatory infrastructure needs to be established. Some of the other factors deal with timing and external factors, such as, the California power crisis and the deregulation of the electrical industry. Let me discuss some of these factors, some may be very obvious and some may not be so obvious.

Part 52 and New Reactor Designs

The current fleet of 103 operating nuclear power plants was licensed many years ago under 10 CFR Part 50. Part 50 served its purpose well for that time but the processes were eventually criticized for being slow. The NRC started to lay the foundation for a new way of licensing reactors in the late 1980s. While new nuclear plant applications were not foreseen in the 1980s, the move to improve the effectiveness and efficiency of the processes in Part 50 prompted the development of 10 CFR Part 52. Part 52 was promulgated to provide an alternate process for licensing that differs from Part 50. Part 52 allows for the certification of standardized designs and the early approval of sites for reactor construction, either or both of which may be referenced in an application for a combined construction permit and operating license.

By the late 1990s Part 52 had been exercised when the NRC certified three new reactor designs - Combustion Engineering's System 80+, General Electric's Advanced Boiling Water Reactor, and Westinghouse's AP600. The industry is currently working with the Nuclear Energy Institute to develop plans for the applications of early site permits, advanced reactor design certifications, and combined operator licenses.

The potential nuclear power resurgence has also brought new ideas in design. Due to the economics, some of the new designs are modular facilities where multi-units can be combined to supply the amount of power needed. Each modular unit by itself produces only a fraction of today's operating nuclear plants. Two of the modular designs of interest are the Pebble Bed Modular Reactor and the Gas Turbine Modular Helium Reactor. Two other designs receiving attention are the AP1000, a modified version of the certified AP600, and the International Reactor Inherently Safe Design, normally called IRIS.

The consolidation of the nuclear industry has resulted in licensees like Exelon that owns several nuclear power plants being in the forefront of building new power plants with new reactor designs. Exelon along with other parties in South Africa is in the process of designing and building a pebble bed modular reactor. Depending upon on-going feasibility assessment, Exelon will decide by the end of the year to either proceed or drop its plan to build a new reactor in the United States. If they decide to proceed, Exelon could potentially apply for a combined license for the pebble bed modular reactor as early as 2003.

California Power Crisis

The California electrical power crisis influenced the plans to build new power plants including nuclear ones. The deregulation of the electrical industry began its final stage of implementation in California this year. This fact, the business factors associated with deregulation, and California's resistance to build new power plants due to plant air emissions, combined to create a power crisis in late winter 2000 and spring o this year. Among the many issues identified, the California crisis pointed out the shortage of generation capacity in California and, in general, the western United States. In many cases, it was not the cost of electricity that escalated to extreme level that was the problem but that excess power was just not available in the western United States to sell to California. The nuclear industry noted that new nuclear plants could meet the electrical demand and satisfy the strict requirements of air emissions. As it turned out, the crisis c the lack of power did not materialize this summer when it was believed that California would experience many blackouts. Fortunately, conservation and a mild summer averted the power crisis.

National Energy Policy

In the Spring of this year when the shortage of electrical power in California was being experienced, a special group commissioned by President Bush was in the process of assessing the federal energy supply for its report - the National Energy Policy. The report was submitted to President Bush in mid-May. The National Energy Policy was designed to help bring together business, government, local communities an citizens to promote dependable, affordable and environmentally sound energy for the future. The report envisions a comprehensive long-term strategy that uses leading edge technology to produce an integrated energy, environmental and economic policy. The report states that to achieve a 21st century quality of life, the United States must modernize conservation, modernize infrastructure, and increase energy supplies. In addition to hydro, coal, and oil, the report specifically recommends that the President support the expansion of nuclear energy as a major component of our national energy policy.

While the report was a well-thought out assessment of the energy situation and carries a lot of influence, there are still very powerful opponents to nuclear power in the United States. This points out that the nuclear industry still has to overcome resistance if the nuclear power resurgence is to occur. Nevertheless, we have seen increased interest in Congress to pass laws that would facilitate the nuclear energy resurgence.

License Renewal (Part 54)

It is not necessary to build new nuclear plants to generate more electricity. The United States nuclear industry generated more electricity by being more effective and efficient in their operations. In addition, in recent years the NRC has approved power uprates. These approved power uprates have increased the power output by a few percentage points, and there is interest in the industry to increase the power up to 20%. Nevertheless, the biggest factor for the industry to produce more electricity has been to extend the years of the existing operating licenses. The Atomic Energy Act (AEA) limits the initial license term for operation to 40 years. This term limitation was not established by technical considerations, but rather was driven by antitrust and financial factors. However, AEA did allow for license renewal, and the Commission has established regulations to implement this option.

In the 1990s, the NRC promulgated 10 CFR Part 54, Renewal of Operating License. Part 54 has provided the option for licensees to renew their license for an additional twenty years. A few years ago, it was believed that this option would not be used by many of the licensees. The first application for license renewal was received in 1998, long before the potential nuclear power resurgence. Since that time, the NRC has approved operating license extensions for three plants and there are five more pendin; applications. The NRC expects to receive twenty more applications for license renewal in the next four years. Furthermore today, it is believed that most current licensees, if not all, will ultimately seek to extend their licenses.

NRR and RES New Design Organizations

In March of this year, the Office of Nuclear Reactor Regulation (NRR) established the Future Licensing Organization which was staffed by temporary assignments. In August of this year, the temporary organization was replaced with a permanent office called the New Reactor Licensing Project Office (NRLPO). The permanent staffing for this new office is currently on-going. NRLPO has responsibility for coordination of all NRR activities with new reactor licensing, including design certification, early site permits, and combined license applications. NRLPO will also be responsible for reactor regulatory infrastructure development, and will coordinate all its activities with other NRC headquarters and regional offices.

In July of this year, the Office of Nuclear Regulatory Research (RES) also established the Advanced Reactor Group (ARG). ARG will serve as a focal point for RES advanced reactor activities. Responsibilities for ARG include managing, in coordination with NRR and the Office of Nuclear Material Safety and Safeguards, non LWR advanced reactor pre-application activities, and supporting NRR in activities related to advanced LWR's . Current activities include a pre-application review of Exelon's Pebble Bed Modular Reactor and interface with the United States Department of Energy on the Generation IV reactor program. ARG will use a matrix approach to capitalize on the technical expertise across RES, such as thermal hydraulic analysis, severe accident analysis, and high temperature performance of materials, components, and systems.

These two NRR and RES organizations are needed to support the industry activities. As I have previously mentioned, industry representatives are developing plans to submit applications for early site permits, advanced reactor design certifications, and combined licenses. In addition, the industry is assessing the potential to restart suspended construction projects over the next one to two years. Stakeholders have also expressed an interest in working with the NRC to resolve regulatory issues affecting possible new reactor licenses, and to make improvements to increase the efficiency and effectiveness of regulatory processes. The NRC has also begun efforts to reactivate the construction inspection program in anticipation of these potential projects. While there is still considerable uncertainty regarding what activities the NRC will be called upon to support, and when this support would be required, it is essential that the NRC continue the efforts already underway to prepare for future applications so that the NRC can fulfill its safety mission.

Human Capital Crisis

For the past decade, the number of college graduates in nuclear engineering, health physics, and in general, engineering and sciences has been declining in the United States. When the number of operating nuclear power plants was decreasing, this fact was not as troublesome as it is today with the potential nuclear power resurgence. That is not to say that we did not worry a few years ago, we did. The private industry and the government were competitors then and now in attracting new graduates. This competition for engineers will continue but with more urgency. The human capital crisis is exacerbated when we consider that many of the nuclear professionals are near retirement age.

To say the least, the NRC has been affected by the diminishing supply of new engineering graduates. As we found out, this has been a problem not only for us but all of the federal technical agencies. There have been recent reports that this decline in science and engineering graduates has stabilized. But even if the downward trend is stopped, it will take years to reverse the declining trend. I say this not because it involves only students but institutions who continue to shut down their research reactors. Not only are these reactors important in training the graduates but additionally providing the opportunity for further reactor research. Today, we believe that the supply of nuclear engineering graduates at most only meets 50% of the demand.

If this deficient supply of graduates was not enough of a problem, the industry and the NRC are now facing an aging work force. The large number of near retirements will aggravate the problem. I have recent data that demonstrates some of our concerns specifically for the NRC. As of May 2001, the average age of the NRC professional staff was 48.5. In September 2000, the NRC had six times as many staff over the age of 60 as it had staff under the age of 30. Today, because of our effort to aggressively recruit, the ratio has been reduced to five times as many staff over the age of 60 as for the staff under the age of 30. I do not have the exact comparable data for our licensees but the numbers would closely resemble the NRC figures.

The supply outlook for health physics professionals is no better than for engineering professionals. In August of this year, the Health Physics Society (HPS) published a position statement on this topic. In this position, the HPS recommends significant financial support by the US Congress and federal agencies for health physics programs in academic institutions. This support would assist faculty, students, and research associated with these programs and thus ensure an adequate supply of qualified radiation safety professionals.

The HPS position paper goes on to point out a critical shortage exists in the supply of qualified radiation safety professionals throughout a broad spectrum of activities including medical practice and research, regulatory oversight, academic research, environmental protection, occupational safety, and the research and application of nuclear technologies. A recent survey conducted by HPS indicates that present supply o radiation safety professionals is approximately 77% of the demand. Supply during the next five years will only be 63% of the demand. One again, the retirement of the radiation safety professionals is the big factor in meeting less of the demand in the next five years.

As I have stated, this human capital crisis is across the industry and the government. In testimony before Congress, the NRC has also asked for help from the federal government and we have pointed out specific remedies - for instance, allowing the NRC to fund fellowships and scholarships, and supporting specific colleges that provide the training in skills needed by the NRC. The whole federal issue of the human capital problem is being addressed by the United States Office of Personnel Management.

High-Level Waste Repository

With respect to the progressions that are before us in a path toward new reactor designs, license renewals, and potential new reactor applications, we should pursue these progressions methodically and with the end-in-mind. Along this critical path there is one essential element that remains to be resolved. That element being a national policy decision on where spent fuel and other high-level waste will be emplaced for final disposal.

We are all well aware of the Department of Energy's efforts regarding siting and characterization activities at the proposed Yucca Mountain site, as mandated by law. Along these lines, both the Environmental Protection Agency and the NRC have recently finalized our environmental protection standards and implementing regulations. With the site characterization and sufficiency aspects drawing to closure, the United States government is rapidly approaching a policy decision, that I believe, will forever impact future decisions of the commercial nuclear industry. This decision will yield impacts well beyond the U.S. borders. After two decades of data compilation and spending more than $6 billion dollars, I believe that a final decision whether to move forward with Yucca Mountain or not, is needed, so that energy generators and suppliers can fairly evaluate and determine their future. With more than 100 commercial nuclear reactors now in operation in the United States, and with projections of more to come, we are faced with two very fundamental issues.

The first being, do we conduct final waste disposal operations at one location or do we plan for continued storage at over 50 individual locations; and the second being, when does continued storage become in-place disposal. Whatever decisions are made, they will unquestionably have lasting global implications.

Although the technical and safety aspects of any major policy decision are inherently critical, spent fuel and other high-level waste disposal will always remain a political decision. It is time to make that decision.

Conclusion

In summary, the nuclear industry has many on-going activities that could lead to a new nuclear power resurgence. The NRC has begun to establish the framework and infrastructure to accommodate the potential nuclear power resurgence. There are many challenges ahead including the shortage of nuclear professionals and the long term storage of the high-level waste.

UNITED STATES
NUCLEAR REGULATORY COMMISSION

Announcement No. 062

Date: October 19, 2001

To: **All NRC Employees**

SUBJECT: ORGANIZATIONAL CHANGES IN THE NRR DIVISION OF INSPECTION PROGRAM MANAGEMENT

The NRC's Office of Nuclear Reactor Regulation (NRR) has reorganized its Division of Inspection Program Management (DIPM) to address changes in the current and projected workload. The reorganization also provides for improved support for the continued implementation of the reactor oversight process and an increased role in regional interface activities. NRR completed the major organizational changes as of September 9, 2001, and will complete additional personnel shifts beyond the major organizational moves in October 2001.

To address changes in the current and projected workload in the reactor safeguards area, NRR added a second reactor safeguards section to the Reactor Safeguards, Radiation Safety, and Emergency Preparedness Branch (formerly the Operator Licensing, Human Performance, and Plant Support Branch). Over the next several years, major tasks in this area will include developing and responding to lessons learned from the terrorist attacks on September 11, 2001; 10 CFR 73.55 rulemaking for reactor physical protection requirements; fitness for duty rulemaking; oversight of the Safeguards Performance Assessment Program and the current Operational Safeguards Response Evaluations program; emerging issues in cyberterrorism; and design-basis threat assessment activities. In addition, the reactor safeguards sections will provide continued support to the reactor oversight process; conduct licensing and decommissioning reviews; and interact with industry, Congressional, and public stakeholders.

To provide continued support for reactor oversight process implementation and address changes in workload, NRR combined the Reliability and Maintenance Section and the Quality Assurance and Safety Assessment Section into the Quality and Maintenance Section within the Equipment and Human Performance Branch (formerly the Equipment Quality and Performance Branch). NRR has also moved the Operator Licensing and Human Performance Section into this branch. In addition, an Allegation Team will report to the Chief of the Equipment and Human Performance Branch.

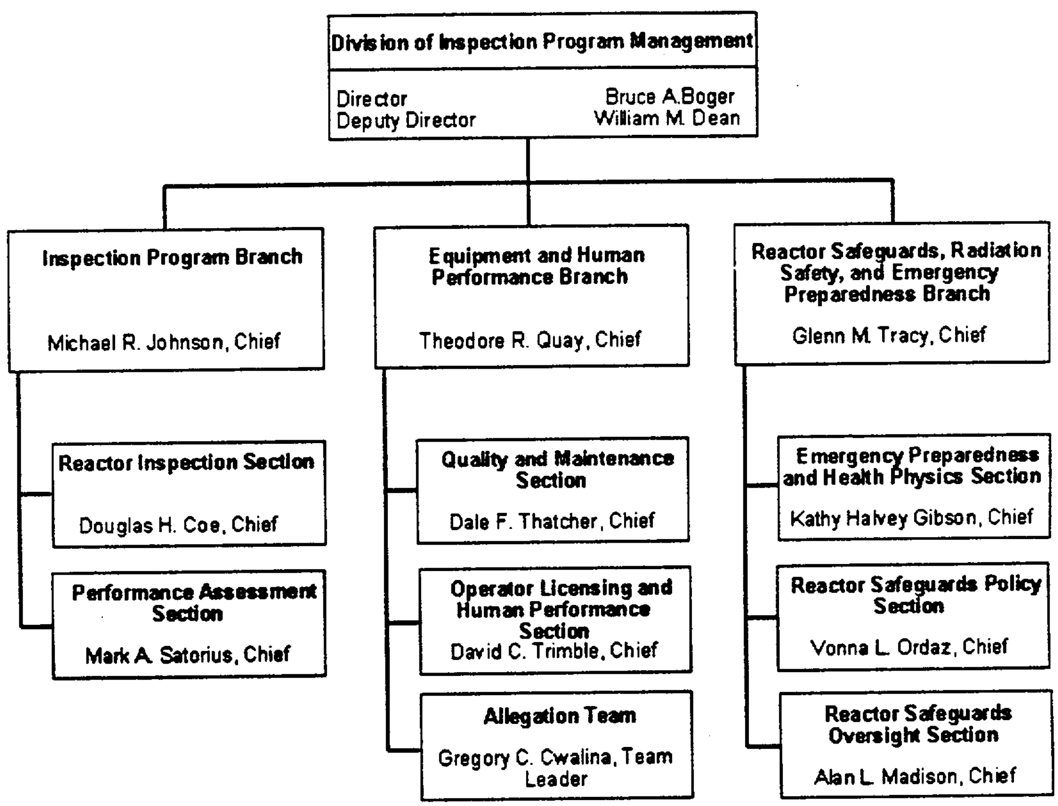
To support an increased role in regional interface activities, NRR has added a second technical assistant position under the Division Director. This position will assume the enforcement-related functions that were previously assigned to the Senior Enforcement Coordinator, who reported to the Associate Director for Inspection and Programs. In addition, the second technical assistant will support divisional and office activities to facilitate regional interface issues.

These changes have been designed with the goal of improving organizational effectiveness and efficiency in implementing NRR programs. The attached organization chart and functional descriptions provide additional details of the realigned NRR/DIPM organization for your information.

/RA/
Samuel J. Collins, Director
Office of Nuclear Reactor Regulation

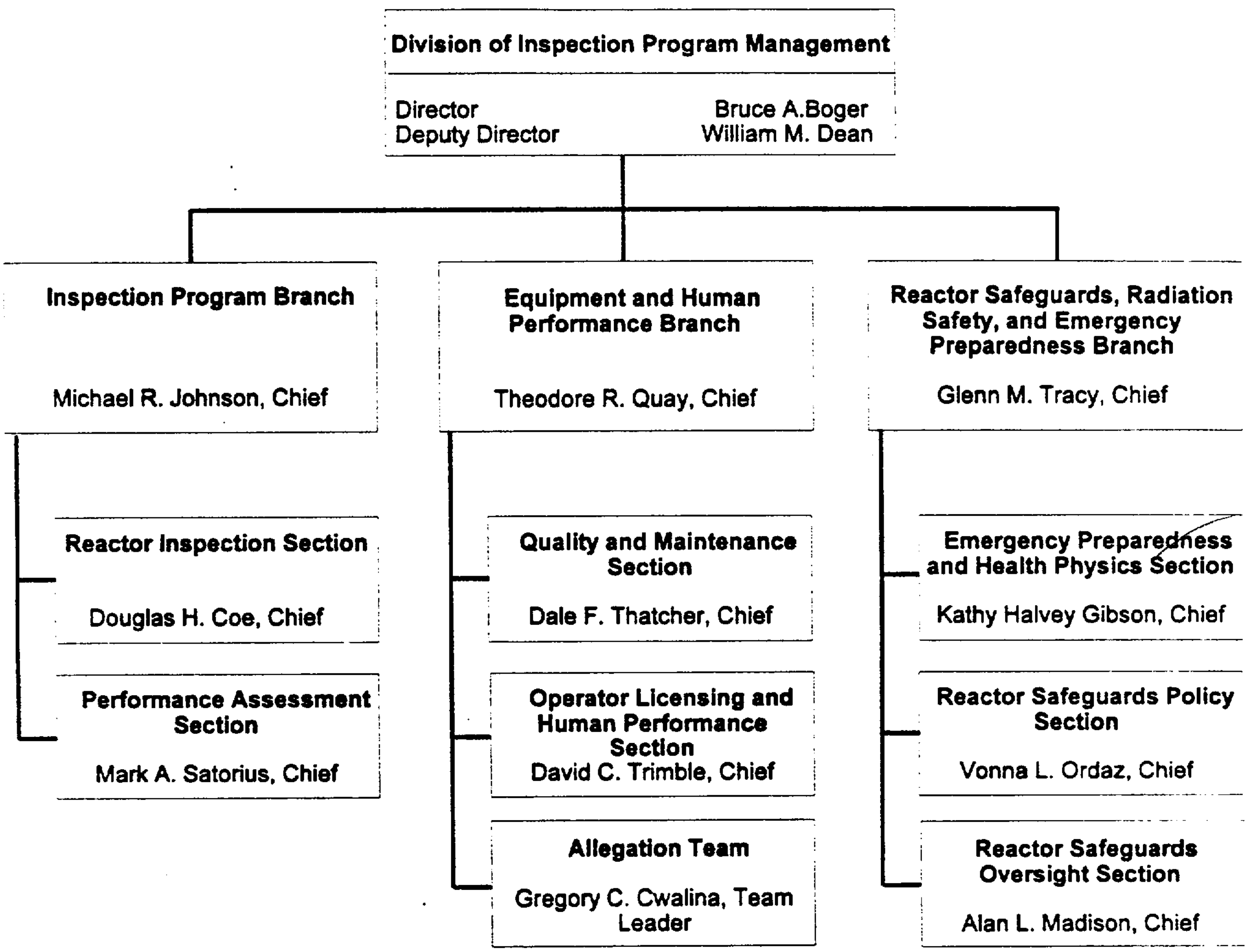
Attachments:
1. Organization Chart
2. Functional Descriptions

Attachment



Attachment

Attachment



Division of Inspection Program Management
Director Bruce A.Boger
Deputy Director William M. Dean
Inspection Program Branch
Michael R. Johnson, Chief
Reactor Inspection Section
Douglas H. Coe, Chief
Performance Assessment Section
Mark A. Satorius, Chief
Equipment and Human Performance Branch
Theodore R. Quay, Chief
Quality and Maintenance Section
Dale F. Thatcher, Chief
Operator Licensing and Human Performance Section
David C. Trimble, Chief
Allegation Team
Gregory C. Cwalina, Team Leader
Reactor Safeguards, Radiation Safety, and Emergency Preparedness Branch
Glenn M. Tracy, Chief
Emergency Preparedness and Health Physics Section
Kathy Halvey Gibson, Chief
Reactor Safeguards Policy Section
Vonna L. Ordaz, Chief
Reactor Safeguards Oversight Section
Alan L. Madison, Chief

Functional Descriptions

Division of Inspection Program Management, NRR

Develops policy and provides overall program management and planning for the reactor oversight process, including the inspection and performance assessment programs. Develops programs and conducts reviews to ensure the effective consideration of human factors engineering in nuclear power plant design and operation and the adequacy of facility training programs and emergency operating procedures. Develops policies and guidance and implements the national program for licensing nuclear reactor operators. Develops and oversees the reactor safeguards, emergency preparedness, and radiation protection inspection and licensing programs. Responsible for the development, maintenance, implementation and oversight of the NRR allegations management programs.

Inspection Program Branch

Provides overall management for the reactor oversight process, including the inspection and performance assessment programs. Develops policies, practices, procedures, and necessary infrastructure to support implementation and continuous enhancement of the reactor oversight process. Analyzes and evaluates program effectiveness and implementation. Participates in oversight activities as necessary to coordinate policy, procedures, guidance, and programs. Responds to external policy-related inquiries and requests. Participates in the establishment of regional operating plans for NRR's regulatory programs, and reports to the Executive Director for Operations on regional performance against the plans. Provides overall program support for the activities of senior reactor analysts and the use of risk information in the reactor oversight process.

Equipment and Human Performance Branch

Monitors and evaluates industry maintenance initiatives and performance. Coordinates agency activities associated with the implementation of the Maintenance Rule. Develops policy and guidance for future reactor reliability assurance programs, and reviews and evaluates licensees' quality assurance programs. Reviews and evaluates nuclear power plant administrative controls for safety committees, audits, independent engineering groups, procedures, and records. Provides programmatic support on issues related to Part 21 and commercial-grade item dedication. Reviews and evaluates initial, pre-operational, and restart test programs for nuclear power plants. Develops overall licensing and regulatory policy pertaining to licensing operators pursuant to 10 CFR Part 55, including the initial examination, licensing, and requalification programs for power reactor operator applicants and operators, and oversight of regional implementation. Develops overall regulatory policy and provides assessments for human performance, including manual operator actions, fatigue, and emergency procedures; monitors and evaluates industry initiatives regarding personnel training; reviews and evaluates human factors engineering design and design changes to the control room and control centers outside of the main control room; reviews staffing and organizational issues at operating reactors; and coordinates with and oversees the Institute of Nuclear Power Operations' accreditation programs. Processes, controls, reviews, manages and resolves allegations and takes or recommends appropriate actions to address safety concerns.

Coordinates with the NRC's Office of Investigations on issues involving discrimination and wrongdoing. Performs inspections in response to allegations and reports of defective or substandard components, equipment, and services. Coordinates with other Federal agencies on misrepresented and substandard products.

Reactor Safeguards, Radiation Safety, and Emergency Preparedness Branch

Develops policy, programs, and procedures for the safeguards area, including fitness for duty. Conducts technical and regulatory safeguards reviews related to power and non-power reactors, reviews physical security programs and approves licensee requests for changes in those programs, and develops and oversees the reactor safeguards inspection program carried out by the NRC's regional offices. Develops policy, programs, and guidelines for health physics and emergency preparedness areas; provides technical expertise for health physics and emergency preparedness issues and interpretations; and conducts technical and regulatory reviews of applications and amendments for these areas. Coordinates with the Federal Emergency Management Agency (FEMA) on emergency preparedness matters, and reviews and evaluates FEMA findings and determinations related to offsite preparedness of State and local governments.

NRC NEWS

UNITED STATES NUCLEAR REGULATORY COMMISSION

OFFICE OF PUBLIC AFFAIRS, REGION II

61 Forsyth Street SW, Atlanta, GA 30303
Web Site: http://www.nrc.gov/OPA

No. II-01-042 October 16, 2001

CONTACT: Ken Clark (404)562-4416/e-mail: kmc2@nrc.gov
Roger D. Hannah (404)562-4417/e-mail: rdh1@nrc.gov

NRC STAFF PROPOSES $88,000 CIVIL PENALTY AGAINST TVA BASED UPON DEPARTMENT OF LABOR FINDING OF DISCRIMINATION

The Nuclear Regulatory Commission staff has proposed an $88,000 civil penalty against the Tennessee Valley Authority based upon U. S. Department of Labor findings that TVA wrongly discriminated against a nuclear power plant employee because the employee had raised safety concerns at the Watts Bar nuclear power plant near Spring City, Tennessee.

NRC officials informed TVA in a letter dated October 15 that DOL findings related to a discriminatio complaint, filed by the employee, indicated TVA discriminated against the employee in 1995 and 1996, because the employee had engaged in protected activities, by arranging the employee's transfer to TVA Services and failing to re-employ the employee once the employee had been transferred, resulting in the employee's eventual lay-off from TVA.

Based on NRC review of the DOL findings and TVA's responses, the NRC has determined that a violation of NRC requirements occurred.

NRC officials said that because TVA has filed an appeal of the DOL decision in the U.S. Court of Appeal: TVA may defer payment of the civil penalty until the appeal process has been completed.

###

[NRC Home Page | News and Information | E-mail]

28

NRC NEWS

U.S. NUCLEAR REGULATORY COMMISSION

Office of Public Affairs
Washington, DC 20555-001

Telephone: 301/415-8200
E-mail: opa@nrc.gov

Web Site: http://www.nrc.gov/OPA

No. 01-124

October 18, 2001

THREAT TO THREE MILE ISLAND NUCLEAR PLANT DEEMED NON-CREDIBLE; NRC MONITORING CONTINUES AND WEBSITE RESTORED

A potential terrorist threat directed at the Three Mile Island nuclear power plant near Harrisburg, Pennsylvania, has been determined by the intelligence community to be non-credible.

However, when the threat came into the Nuclear Regulatory Commission, it was taken seriously, resulting in a number of security measures taken by TMI's licensee, Exelon, as well as by other Federal and State authorities.

The Nuclear Regulatory Commission is continuing to closely monitor security at all nuclear reactors and nuclear fuel facilities around the country.

Contrary to some rumors, the agency has not ordered any plants to shut down for security reasons. Some plants are, as usual, shut down for normal refueling and maintenance.

All nuclear power plants have remained at the highest level of security since September 11. Subsequently, the agency has advised all of its licensees of additional actions considered prudent and appropriate to strengthen security further. The NRC is closely monitoring the actions being taken to enhance security.

In the aftermath of the terrorist attacks and the continuing uncertainty about future terrorist intentions, the agency is conducting a comprehensive review of its safeguards and physical security program at the direction of Chairman Richard A. Meserve, with the support of the Commission.

On September 26, Chairman Meserve sent letters to the governors of 40 states that have nuclear power plants or other NRC-regulated nuclear facilities, advising them that it would be prudent to establish clear liaison between nuclear facilities and state authorities in the event that state security forces might be needed to augment security. Clear lines of communication among the State, the NRC and licensees have been established.

The NRC continues to maintain close contact with the Federal Bureau of Investigation, other intelligence agencies and other law enforcement, military and state authorities to assess the latest threat information and to discuss current conditions and plans.

NRC's website, which was closed down last week, was restored Wednesday with a limited amount o information. Taking down the agency website was a precaution to make sure it did not contain information that could be helpful to terrorists. As the agency's review continues, other information and documents deemed non-sensitive will be added to the site.

###

[NRC Home Page | News and Information | E-mail]

NRC NEWS

UNITED STATES NUCLEAR REGULATORY COMMISSION

OFFICE OF PUBLIC AFFAIRS, REGION I

475 Allendale Road, King of Prussia, Pa. 19406

No. 1-01-063 October 29, 2001

CONTACT: Diane Screnci (610)337-5330/ e-mail: dps@nrc.gov
Neil A. Sheehan (610)337-5331/e-mail: nas@nrc.gov

NRC SENDS SPECIAL INSPECTION TEAM TO TMI

A Nuclear Regulatory Commission special inspection team has arrived at the Three Mile Island nuclear power plant to review the circumstances surrounding the separation of a steam generator tube. The plant is located in Middletown, Pa., and is operated by Amergen Energy Company, LLC.

During an in-service inspection of the steam generator tubes at TMI last week as part of the refueling outage, Amergen found that a plugged tube had separated from the tube-sheet and caused wear on several adjoining tubes. During the prior period of operation, there was no indication of a problem. The cause of the separation is still being evaluated.

Steam generators are components that transfer heat from the reactor systems to the power-generating portion of a nuclear power plant. In accordance with NRC requirements, Amergen conducts inspections and tests of the tubes in the plant's two steam generators during plant outages to assess the structural integrity of the tubes. Tubes with flaws or degradation above specified limits are plugged (taken out of service by installing plugs in both ends of the tube) or repaired in another manner.

The four-member NRC team will independently develop an understanding of the separation, and review the company's root cause determinations and corrective actions. The team also will perform an independent risk assessment. NRC inspectors also will ensure appropriate corrective actions are taken before the plant restarts from its refueling outage.

An inspection report will be issued about 45 days from the end of the inspection.

As a separate matter, NRC inspectors are also reviewing Amergen's work to identify and repair small cracks associated with control rod drive mechanisms (CRDM) nozzle penetrations in TMI's reactor vessel head. CRDM leaks have occurred at other B&W plants. That work also will be completed before the unit restarts.

###

NRC NEWS

UNITED STATES NUCLEAR REGULATORY COMMISSION

OFFICE OF PUBLIC AFFAIRS, REGION III

801 Warrenville Road, Lisle IL 60532

No. III-01-048

October 29, 2001

CONTACT: Jan Strasma (630)829-9663/e-mail: rjs2@nrc.gov
Pam Alloway-Mueller (630)829-9662/e-mail: pla@nrc.gov

NRC CITES NUCLEAR MANAGEMENT COMPANY FOR SAFETY VIOLATION AT PALISADES NUCLEAR PLANT

The Nuclear Regulatory Commission has determined that a violation of NRC regulations at the Palisades Nuclear Power Plant should be characterized as "white," meaning that it is an issue with low to moderate safety significance, but one which may require additional NRC inspections. The plant, located near Covert, Michigan, is operated by the Nuclear Management Company.

The violation concerned the inadequate number and spacing of smoke detectors in the plant's cable spreading room.

Under the safety significance determination process, NRC officials classify certain conditions at nuclear power plants as being one of four colors which delineate increasing levels of safety significance, beginning with green and progressing to white, yellow or red.

The violation was identified during an NRC inspection that was completed on August 17, 2001. The Nuclear Management Company did not contest the "white" characterization of the safety significance of this finding and officials chose not to meet with the NRC staff.

The Nuclear Management Company has taken compensatory measures to address the problem until permanent corrective actions are completed. The NRC plans to conduct a follow-up inspection on this issue early next year.

The company has until November 9 to appeal the NRC's finding.

###

[NRC Home Page | E-mail]

How to do a Power Uprate

- Insert and burn more fresh fuel (more fissile loading)
- New fuel management strategy
  - Different Gd loading and control rod patterns
  - These techniques in use for last 10-15 years
- For EPU, new fuel types
  - 9x9 to 10x10
  - Increase maximum bundle power and not increase local maximum values (more fuel pins)
  - Enhanced CPR performance confirmed by prototypical testing
  - culmination of incremental fuel design changes

Fuel Licensing

- Governed by local conditions
- Maintain LHGR(fuel temperature), MCPR (clad heat transfer), and Average Planar LHGR (LOCA) below limits
  - this is achieved through new fuel management techniques (Gd loading) and improved CPR performance (reduce in-bundle peaking, allow higher bundle power)
- All fuel assembly behavior predicted for new cycles
- All assemblies monitored during operation to confirm compliance with thermal limits by using in-core instruments and on-line predictions