UNITED STATES NUCLEAR REGULATORY COMMISSION

PERIODIC BRIEFINGS ON NEW REACTORS - PART 1

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Wednesday

February 20, 2008

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The Commission convened at 9:30 a.m., the honorable Dale E. Klein, Chairman presiding.

NUCLEAR REGULATORY COMMISSION

DALE E. KLEIN, CHAIRMAN

GREGORY B. JACZKO, COMMISSIONER

PETER B. LYONS, COMMISSIONER

Panel 1: Department of Energy

DENNIS SPURGEON, Assistant Secretary for Nuclear Energy, DOE

Panel 2: Industry Representatives

MICHAEL L. CORRADINI, National Academy of Engineering, University of Wisconsin, and Chairman of ACRS Subcommittee on Future Plant Design

DAN KEUTER, Vice President, Planning And Innovation, Entergy Nuclear

FRED MOORE, Director Manufacturing and Technology, Energy, The Dow Chemical Company

EDWARD WALLACE, Senior General Manager, U.S. Programs, Pebble Bed Modular Reactor Limited

ARKAL S. SHENOY, Director, Modular Helium Reactor Division, General Atomics

FINIS SOUTHWORTH, Chief Technical Officer, Areva NP Incorporated

JOHN GOOSSEN, Director of Science and Technology Department, Westinghouse Electric Company.

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

CHAIRMAN KLEIN: Good morning. This will be a long day. It's a three part session, so we get to start with you this morning, Dennis. Obviously, the topic of advanced reactors is certainly one that's important for us as an agency and for the nation as a whole and certainly your activities with the NGNP has been very active.

The second part of the morning we'll hear from ACRS and also from some of the industrial applications and then this afternoon we'll hear from our staff.

So, we look forward, Dennis, to hearing from you this morning. Obviously, the Energy Policy Act of '05 had some initiatives for both of us. And so I expect that we will both be challenged by these activities. So, before we start, any comments Greg?

COMMISSIONER JACZKO: No, I just appreciate -- well, I guess yes. I appreciate Dennis being here. We had a nice opportunity to chat this morning before the meeting and look forward to hearing what you have to say and the rest of the panelists this morning. And then I think in particular this afternoon, I'm looking forward to hearing from the staff and updating us on where we are with the current generation of new reactors rather than the next generation of new reactors. And we're in the middle of reviewing some applications there and so I look forward to hearing the update on that this

afternoon

CHAIRMAN KLEIN: Commissioner Lyons?

COMMISSIONER LYONS: Well, Dennis, as with my colleagues, I really appreciate your being here today and I am truly looking forward to the discussion on NGNP as well as lots of other interesting candidates.

I guess I have to say in my own mind there really is a clear distinction between NGNP and the other candidates in the sense that with NGNP, we're working with a Congressional mandate and I think pretty strong evidence of very, very strong Congressional support.

So, I don't question the importance of NGNP at all. For the other reactors as we get to those discussions, I will be asking questions just to give folks a hint. I'll be asking questions about the likelihood of U.S. partners and interests. But for NGNP at least in my mind, I put that quite separate and very, very high.

And just to give a bit of a hint of a direction that I'm going to be trying to explore, Dennis, and some questions with you and also with staff and with some of the industry later on. In my mind, I truly am confused about what is the best path for moving towards licensing on the NGNP. There is no doubt in my mind that an eventual goal commercialization, Part 52 design cert makes great sense, but there is a tremendous question in my

mind about how best to get to that end goal and whether a Part 50, perhaps a modified Part 50, maybe it's a modified Part 52. I don't know, but I'm quite concerned and I'll be quite interested in discussions with you as to how we can perhaps explore ways to move together as expeditiously as possible both from your technology standpoint, what we need of the technology and a licensing strategy that can provide the adequate public health and safety but still allow this project to move ahead as expeditiously as possible.

So, I will try some questions on 50 versus 52 and maybe versions of 50 and 52, but I'm very much looking forward to the whole day. Thank you.

CHAIRMAN KLEIN: Thank you. Dennis?

MR. SPURGEON: Thank you and with that introduction, I look forward to the conversation. So, perhaps most of what I have as I would call it a little bit of background and so I'll try to go through that fairly rapidly in order to get to the point where we can begin talking about some of these areas that are pretty -- very pertinent to today's discussion. We can go to the first slide.

Really, just -- and this is just by way of background, the Department of Energy, the Nuclear Regulatory Commission, industry, we all have our separate missions. The Department of Energy: advance energy security through development, demonstration and promotion of scientific and technical innovation.

Nuclear Regulatory Commission: protect the public health and safety, promote the common defense and security, protect the environment through regulation of nuclear technologies.

Industry: commercialize new technologies and invest in and operate systems including nuclear, as responsible businesses. And there "industry" is sometimes a plural word because it's not only the manufacturers, but I really want to focus on what we need to do is involve the users early on and I'm very pleased that you have both Dan Keuter from Entergy and Fred Moore from Dow Chemical that can give you a perspective on how can they pull this technology into the marketplace.

But even though we have our separate roles, there is a lot of overlap. You can't separate us. You can't put any of the circles out on its own. There is an intersection of our various roles and responsibilities. And it is that intersection that I think we have to pay close attention to as to how we interact in order to make sure that these technologies do move forward to the commercialization stage.

So and again, I'm sorry for the person flipping. I'm going to go fast through these so that I can -- next one.

Improving -- in our energy future, improving energy sustainability and domestic energy security, reducing the volatility of energy prices and reducing environmental effects of energy production. Those are becoming

more and more pertinent as we move along. We've always looked at the need to have some energy security and resource availability especially as we look at nuclear energy. That's been a driver, it's been resources, but we're also now really paying a lot of attention to the whole idea of environmental impact, greenhouse gases and so forth, which are becoming integral to our long range energy planning.

All of those then lead us to increased used of nuclear energy. You've all heard the statistics. Nuclear energy makes up a little less than 20 percent of our total electrical production, but is over 70 percent of our clean energy of our non-emitting energy sources and some 24 percent of the rest is hydro.

So, when you look at it, there's not much we can do with hydro, but nuclear energy is the dominant clean energy source. So, if we are going to achieve the kind of growth that we are projecting we need an electric supply, which is 50 percent by the year 2030.

We're going to have to have a substantial amount of new nuclear capacity just to maintain that 20 percent. That means some 45 or so reactors, depending on the size of plant, are going to be needed between now and 2030 just to sustain our output. But if we're going to go 30 percent and above, to get to 30 percent by the year 2050 for example, we're going to need some 300 gigawatts of new capacity unless we can get a little help

from extending life times to 80 years as opposed to 60 years and we're not even to 60 years for all of our plants yet. So, it's a big challenge, but we've got to find a way to address that challenge.

Looking at advanced nuclear energies technologies and your discussion today is focused on NGNP, but to me the challenges that we have are common or very similar across the board whether it's a new gas cooled reactor, whether it's a liquid metal cooled fast reactor or whether it's a new reprocessing and recycle facility.

We need to look at how we can customize our process for licensing these plants in order that we can encourage and foster the introduction of new technology. And that we don't find from a regulation standpoint that we are creating a barrier to entry of new technology into the marketplace.

We've got to find a way to break down that barrier so that we have the safe and secure system that we all want to be in place, but that it doesn't create a barrier that in effect would inhibit the introduction of these new technologies that we really need to have as we look forward.

So, advanced nuclear energy technologies basically, I list the four we focus on at the Department of Energy. Advanced Light Water Reactors, I think that's moving along well. There's been a great deal of good cooperation through the 2010 program. We now have four applications and maybe you are getting another one here shortly. Did it come in? Okay.

So, if Harris came in, then you've got five and you're going to have -- you keep these numbers better than I do, but a dozen or so at least coming up in the balance of the year. So we're moving along well.

Next Generation Nuclear Plant. That's what we're talking about; high temperature process heat. Advanced Reactors. We've been here before on all of these actually and recycle facilities. One thing that I like to remind people of is that every advanced technology that we're currently talking about for the future, we've already had through the licensing process.

And we've already constructed in one case, the recycle facility was constructed, but didn't go into operation for reasons associated with policy back in that time frame.

So, basically, what -- and this is my definition of barriers to deploying advanced technologies. One certainly, in today's environment, we do not have complete technology development and that's number one. That is DOE's responsibility to foster, to encourage, to be a catalyst for complete technology development.

I'm saying undefined licensing regime; yes, you have a licensing regime, but how we're going to apply it to each of these new technologies requires a customization of that because one size does not fit all in terms of any rulemaking or licensing process across the spectrum of these advanced technologies.

And then, certainly cost uncertainty and that's driven by a lot of things, including the first two above. The status of technology and where we are and where we perceive we would be relative to time to establish these technologies into the marketplace. Next slide.

Establishing an efficient and effective regulatory approval process for siting and licensing non-LWR commercial nuclear facilities. This is all under the heading of removing these licensing barriers. And I know from the discussion, your opening remarks, that that is one we perhaps would like to talk about a bit, so I won't say any more here and get into the discussion.

We obviously can build off the lessons learned from both our Part 50 and Part 52 processes for Light Water Reactors. And also, I would say they are going through, albeit a somewhat different process, a different Part 50 if you will, from our experience in licensing both the gas cooler reactors back in the Peach Bottom/Fort St. Vrain era and today.

And finally, this just basically the how do we then reduce that barrier; reduce that regulatory uncertainty for first time application for advanced nuclear technologies? Because looking to the future -- and one thing I'll say again at the end here, this is probably not going to be a government kind of a plant. It is going to be something that's done in some sort of a public/private partnership and therefore the idea that we can perhaps get started until we have some of these uncertainties limited is perhaps not the

way we're going to be able to go.

We're going to have to reduce these uncertainties before we get started rather than letting them evolve and work out along the way. Next page.

Removing financial barriers. We're all seeing even in the current generation of Light Water Reactors, one thing is to get the standardized plants, another thing is get the combined operating license in and through and whatever, but the big key here is not just that any longer, it's where you're going to get the capital to be able to finance and build these kind of facilities.

And removing those financial barriers or limiting them or confining them, or defining them perhaps better said is going to be even more significant as we move along. We've got to just -- from a licensing standpoint, there has to be some sort of known certainty that does not allow us to get into an open ended process.

And no one is talking here about not having to have things designed well, not to be built well, but we've got to be able to clearly define the other risks associated with licensing and provide a way that those can be contained.

Time to market. Anyone and I presume you'll hear this later today that's going to make these kind of major investments wants to have some

degree of promptness, if you will, and when you can be able to achieve the technology so that it doesn't get so far out in time that it's no longer relevant to near term business needs.

So, long lead times prior to construction, coupled with long construction times, increase project risk and reduce the economic competitiveness of whatever kind of advantaged technology project we're going to look at.

So, having said that, and again somewhat background, let's focus on high temperature gas cooled reactors. You will certainly -- Fred Moore I'm sure will talk about this a little more later, but there is growing interest. The hydrocarbon industry sees the HTGR as an alternative to fossil fuels to produce high temperature process heat and Fred can give you the statistics as to how much he spends on producing heat on an annual basis and it's a huge number. It dwarfs anything that we're talking about here in these developmental costs.

We need to develop a business model. Dedicated HTGR is co-located with, or providing energy to, a hydrocarbon processing facility and all the issues that that develops, especially as it relates here to the regulatory process.

But the real question is and that's the next point. I don't know where that slide is, but can you put it up there? Not that one; the one before that.

There we go. Thanks.

The real question then is can we -- can the nuclear enterprise and that's all of us, DOE, NRC, industry, demonstrate that licensing HTGRs can support a viable business alternative to fossil fuels? That's really the question.

We have a great opportunity to do that and I think for our nation's energy future, for our nation's energy security, that it's incumbent upon us, it's imperative that we do that because the last bullet, the opportunity to use nuclear power in this business sector, I think could be missed unless the nuclear enterprise can really answer that question.

As an aside, we all talk about national security. We talk about energy security. Many people do, but not everyone makes the connection between the two. There is a very real connection between national security and energy security. And the job that we do, the job that we're starting to be able to try and implement nuclear energy in a broad scale, safe, secure manner both in the United States and around the world is extraordinarily important.

We have something like 31 countries around the world that have nuclear power today. When we look at what we're hearing through the Global Nuclear Energy Partnership, we're looking at something like perhaps 86 countries having nuclear energy by the middle of the century.

You think about the challenge that that presents in infrastructure and developing the kind of regulatory regime that's going to be needed internationally to be able to accommodate that kind of increase in the number of plants that are going to be built. Not just the number of plants, but the diversity of capabilities of the countries that would have these plants.

You then kind of get a sense of why we're paying so much attention to these global partnerships because what happens around the world can impact us a great deal.

So, we need to make sure that countries getting into this business have an adequate infrastructure to be able to support it. I know it's not part of our discussion here today, but it really ties that that's why we're paying so much attention to international efforts and to supporting not only the IAEA, concentrating on out bilateral and our tri-lateral and our multi-lateral agreements because we need to be able to all be on the same page when it comes to emphasizing the importance of nuclear energy being expanded, but expanded safely and securely so that it's not used for non-peaceful purposes along the way.

There's a lot more words that I have with a couple of these slides, but I'd much rather have a conversation with you gentlemen here.

Let me go to the -- I have to admit that our good folks from the Gas Cooled Reactor Program, I've got about three pages of single space things

here for me to read to you. I will be glad to give to you, but I'll not do it. The old thing about the speechwriter when you see that page and you throw it away. Well, I'm not throwing it away because the gentleman is behind me and I don't want to have him shooting me down the backside. But there is a great deal of good positive things that we're doing in the Gas Cooled Reactor Program today that we do have confidence can lead to our having an initial plant on the schedule, lots of things have to happen, on the schedule which is laid out in the 2005 Energy Policy Act.

But I don't need to tell you all that there are some things that are needed to get there. One is money and we don't have all of that yet. Two is being able to work out what we're required to do with you all and we're, I think, going down that path and developing okay, how are we going to license it.

But then, three is establishing the kind of public/private partnership that can truly pull this thing through the knot hole and gain the kind of support that perhaps allows us to move forward. It's a-- we have to walk forward together.

We can get a certain amount of money and go a certain distance, but then we have to show that well, somebody wants to come along with us and they want to help pull the wagon and then we can take the next step and then keep going down stream.

So, if I come to my last slide, Action Required. It's what we're doing and we have to keep doing it and we have to be flexible. Because it's going to require NRC and DOE working together with industry because we do have an opportunity to develop and implement the policies and regulatory path for licensing advanced energy technologies that do ensure timely execution from a business perspective; that do have value; that do value innovative approaches to the regulatory process; that do separate the regulatory risk from the commercial risk.

There's always going to be commercial risk. There's always going to be regulatory risk. We've got to find a way where they don't overlap one another. And then what we get to is the development of the regulatory infrastructure for advanced nuclear energy technologies. And from our perspective that needs to occur as soon as possible.

And finally, the NGNP licensing strategy report that is a mandated by EPAct 2005. I don't know, Pete you may have written that part for all I know, but does provide an opportunity to establish a viable path forward for deploying advanced nuclear energy technologies.

And my final thing here is that I think -- remembering my past history when we did license Fort St. Vrain, it had to be done because Part 50, and Part 50 was different then, it didn't exactly fit. We had to use a lot of common sense as to what applied; what didn't apply; what we could do;

what we couldn't do; and how we could move that forward, but it was all based on cooperation and understanding that yes, we want the plant to be online, but we want the plant to be online and operate safely.

And all of us believe in that, whether you're on the regulatory side as you are or whether you're on the development or promotion side as I am. I have always said that the people who are the strongest advocates for nuclear energy are the ones who are the strongest advocates for nuclear energy safety. Thanks. Be glad to have a conversation.

CHAIRMAN KLEIN: Well, thanks, Dennis, for those opening remarks. I think your comments on the close tie-in to energy, security and national security certainly are relevant and I've always said that if we look at the true cost of oil, we never factor in the Sixth Fleet that keeps those oil lanes open and so sometimes we should look at what the real costs of oil may be in our energy activities.

I think the challenge that we have as you indicated, we're having a lot of countries that are coming and visiting us expressing interest in nuclear and looking at the regulatory framework. We hope as these other countries develop nuclear concepts, they start with a strong independent regulator first and build the plant second and not the other way around.

So we've been very active in that area. I think the challenge as you indicated for us in terms of reactors, we are a light water agency. That's

where our experience is. That's what we've done. And so we're moving into that era. As Commissioner Lyons indicated, how do we do this for these first of a kind or non-standard light water reactors and you indicated the three: the gas reactor, the fast reactor and recycling.

So, whether we look at a Part 50 modified or a Part 52 light or something that lets us get to those objectives, I think will be a challenge for us to take.

So, being an organized structure, we start off with our questions today and we'll start with Commissioner Lyons and I'll go second and then Commissioner Jaczko. So Pete, start with you.

COMMISSIONER LYONS: Dennis, I really did appreciate your comments. I found many, many things to resonate with during your remarks. You did perhaps ask if I wrote that particular section on the licensing report. I don't remember. It's been a long time ago. I do have to admit that there are a number of things in the Energy Policy Act that I did have a hand in that I had no idea I would end up on the receiving end.

MR. SPURGEON: Be careful what you ask for, you just may get it.

COMMISSIONER LYONS: Yes, be very careful what you ask for.

On that one, I don't think I'm guilty. But in any case, I wanted to

particularly highlight one of bullets on your last slide, Dennis, by way of starting the conversation. You noted valuing innovative approaches to the regulatory process and the fact that we jointly have the responsibility to report to Congress in August. I will be very interested in the discussion with you and the discussion with the number of your colleagues during the rest of the day.

I'm trying to ask if our staffs are focusing on, as you put it, innovative approaches to the regulatory process. This is a very, very complex issue. And I started to share some of -- I'll just admit to my own confusion. I shared some of that in my opening comments.

On the one hand as I indicated, I have no doubt that we want to eventually get to a design certification and a Part 52 COL type of approach, but I am very, very nervous whether we're going to have enough information in sufficient detail to define, let me say at least a traditional Part 52 approach on a timely basis.

Particularly -- and this would be a question that you might also address in here -- particularly, some of this will depend on whether or not you're envisioning containment for the NGNP and I don't honestly know if you are or aren't.

On the one hand, I can imagine that containment would dramatically help the safety case and perhaps enable a number of, I would anticipate,

very robust experiments that will need to be conducted with the NGNP. Experiments that in my mind would work toward developing the future of a licensing case perhaps for Part 52.

But, again, in my mind, I wonder if, again, a modified innovative Part 50 perhaps with containment would get us more quickly to a successful, and by successful in my mind, is moving ahead with a strong national research program on the NGNP that has a clear commercial focus as an end goal.

I've just shared some of my confusion on this, Dennis, and I just wonder if you would care to share some of your thoughts in this area.

` MR. SPURGEON: Well, I'd be glad to and I will tell you that they happen to be mine. Some of my staff behind me may not agree with me, but I'll tell you what I feel about this. The issue of containment, sometimes we don't have the right -- in my words, we have to define containment. We used to say containment and confinement.

But for a Gas Cooled Reactor, we have to look at what our objective is. With a light water reactor, if you have some sort of a breach, what you're going to get is a whole lot of steam and steam you can condense and you can contain it within a containment system that doesn't allow anything to get out.

Gas cooled reactor system has got helium and helium doesn't compress -- helium doesn't condense rather. So, the issue is different. So,

if we're talking about something that's a need to provide some sort of a barrier to prevent an external force, airplane or whatever, from being able to get through, that's one objective. But if you're talking about containment meaning that everything that's inside has to stay inside and you're not allowed to vent, that gets you into another issue.

So perhaps it's a definition of containment that perhaps is needed. Yes, there's going to have to be something around it, but for a gas cooled reactor, I would think that you want to have a means of letting that material out, albeit through filters and so forth to be able to trap the radioactive isotopes.

So, I would think we need to use -- I would call it a different definition of containment when you're talking about a gas cooled reactor; that we're not talking about -- it might be the kind of definition, but maybe it's called a robust confinement. I'm not going to try to make up different words here, but that can answer that question.

And of course the ultimate answer for some of these plants which may be very appropriate is to put it underground. And so, that in effect gives you I think what you need.

But anyway, it's a long answer to your short question, but I think again, it falls in the area of using common sense as to how we apply and you talked to Part 50, Part 52. I obviously like what I hope turns out to be

when we get into actual implementation, the Part 52 process relative to the certainty that if you do build it in accordance with the construction and operating license that you have that you don't get -- and going through the ITAAC process, you don't get hung up for things other than true, "Did I build it the way I was supposed to issues?

COMMISSIONER LYONS: I fully agree that's the end state.

MR. SPURGEON: So, that's where we want to be. But with a gas cooled reactor or with a liquid metal reactor, we're going to have to -- there's going to have to be modifications to that process. That's how we did it when we licensed Fort St. Vrain, for example. Back then, we didn't have Part 52 and Part 50 was different as I mentioned before, but there were a whole lot of exceptions. There's certain things that apply. There are certain parts that don't apply and those have to be worked through in a common sense way in order to achieve the objective of getting the plant licensed.

Design certainty. Yes, you want to have as much design certainty as possible going into any new construction project. You don't want to be designing it as you're building it.

On the other hand, with a first of a kind, you kind of know that you're going to learn some things along the way and so the idea that you can in effect have a certified design going into the process when it's first handed in and that the same standards for accepting that license application for review

for a gas cooled reactor would be applied to a gas cooled reactor as you would apply and what you would expect when you get a light water reactor application as the ones you are getting into now may need to be different and we need to recognize that.

So, I think we all have the same objective and to get to the point where we would use exactly the same, albeit different sections, but modified where we would have exactly the same standard for quality and completeness in a gas cooled reactor application as we do a light water reactor application that may not be possible in the first plants.

Now, I'm less concerned about whether I call it 50 or 52. I like 52 only because I don't want to have the uncertainty of the operating license at the end and I'm sure that most of my colleagues in industry would say the same thing.

But you may not be able to get the level of detail that you and your staff would normally expect to see in an application when it comes in for one of the early advanced reactor systems. I don't know if that touched on your question or if I need to go more.

COMMISSIONER LYONS: That does help a lot, Dennis. I'm guessing others will have questions perhaps along that line or we can come back to it. But I would only emphasize the point you made that I think all of us, the staff on both sides needs to be looking at -- I like your words

"innovative approaches to the regulatory process" because this is not going to be the -- whether it's Part 50 pr Part 52, it's not going to be the standard stamped out model that we're used to, at least not in my mind. I'm way over time.

CHAIRMAN KLEIN: We'll come back. Thanks for your comments, Dennis. I think the challenge that we have -- one thing that's good is we all agree safety, number one and so at least there's no argument there.

So then the question is how do we get to that end state? If you look at Part 52, it was designed essentially for a system that we had decades of experience in and we don't have that with the gas reactors although as you indicated, we have gone through Fort St. Vrain under the Part 50.

Do you have any suggestions as how we strike this balance between flexibility, but yet some certainty?

MR. SPURGEON: Well, it's going to be using what you have, but recognizing up front that we need to modify it and we need not to be afraid of modifying it. We need not to be afraid of being innovative as we start through that process and that's where I think our respective staffs and working with our industry partners can develop a proposed way to skin this cat.

That's what we did back in the Fort St. Vrain timeframe and it worked

and it worked quickly. The Fort St. Vrain from construction permit application to construction permit was two years. So, the process can go fairly fast but, that was a different era. I understand that, but nonetheless, I think we can somewhat learn from history as to how we managed to do this before.

I think I mentioned to you at breakfast, we might have to go into some of the old age homes to find some of the folks that have actually -- that went through this licensing process before. But we've done a reprocessing plant with a modified materials license. We did Fermi; Fermi 1 in the 1950's was actually licensed. So, we have gone through this.

It's just we need to learn from history, but not be afraid to be innovative, not be afraid to be flexible and that's where the close working relationship comes in and we just can't allow ourselves to get so bound by "No, doggone it. Here's the boundaries. We can't get outside those boundaries. This is the mechanistic approach that we have to use and it never can be changed."

We've got to figure out how to do that, otherwise what we create -- as I was saying before -- is we create a barrier to entry of new technology. It's pretty easy after we, hopefully it's going be pretty easy, after a few more years here.

We know the process for getting a light water reactor through. After

the first few go through the COLA process, we'll be able to do it fairly quickly and all of a sudden, well, if you build a light water reactor, you can build it fast. You want to build a gas cooled reactor it's going to take you forever. Guess where industry, where business is going to come down on that? You've created a barrier for these new technologies that you may really want in the marketplace, but we're kind of keeping them out.

CHAIRMAN KLEIN: One of the things that I think is good is that we have a lot more tools now than we had earlier; computational, a lot more knowledge and so that should help us in the process. Although sometimes it seems like our regulatory structure might have gotten a little more challenging along the way.

One of the questions I guess in terms of timing. If you look at the first NGNP and the second NGNP what are you sort of hearing from industry as to the time line between the first one and the second one?

MR. SPURGEON: Well, I'll let those folks answer when they're here because we are going to be driven a lot by industry in this. I can only repeat again that I see the Department of Energy being a catalyst, but we do need to have industry out pulling this wagon. I think the days where we can have -- and I'd like to be wrong on this by the way. I'm not advocating that the Department of Energy can't go out and build all by itself the kind of demonstration plants that we once did.

I'd like to be able to see us do that, but the budget reality that we have seen is that that's probably not realistic at least in the near term. We are starting from zero in the nuclear energy R&D Program. We went from zero in 1998 and we're looking at a billion dollars this year. We have increased the R&D budget every year in the last eight years.

So, yes, we are doing well, but we've got a long way to go before we're going to be able to fund as we used to the kind of major nuclear facilities. We need to. We're planning that now. We're looking at what are the research tools that this industry needs going forward. And what research tools do we have and where's the gap and how do we fill that gap and what are the resources that are going to be needed for that gap?

And I'm optimistic that we'll continue to do better. The challenge is can we do better enough that we can do this by ourselves? I don't think so and perhaps we don't want to.

If the user is going to really be responsible for commercializing a technology, they have to be in on the front end and that's what I think you're going to hear here, is that we have people that want to be in on the front end; want to be part of a public/private partnership. So, I think I went in circles on that answer, but nonetheless it's a challenge.

CHAIRMAN KLEIN: Thanks. Commissioner Jaczko?

COMMISSIONER JACZKO. I heard some of the discussion

and I think it's important that we maybe are a little careful with terms and I think when you talk about barriers to licensing and these kind of things I don't think we have barriers to licensing right now. I think we have a very clear process and I think suggesting that doing well with light water reactors is creating a barrier to gas reactors, I think, is not really appropriate.

I think if we do well with light water reactors, that's a good thing. Gas reactors are potentially inherently more unique technology and I think the challenge is the barriers that I see. They're not regulatory barriers. They're barriers on the applicant side on developing the designs, developing the infrastructure, doing the confirmatory research to be able to come in and make a clear safety case to the regulator.

I don't think in this process we need to reinvent the regulatory wheel. We have Part 52 which came out in the late 80's as a result of what was by and large, I think fair to say, a failed process for licensing nuclear power plants. We would go into this with the same kind of hopes and expectations that you know what, the designs are new, let's not require finality, let's get into the construction, we'll learn things. Well, that didn't really work.

And I think if anything, the lesson we need to learn is that that process in and of itself didn't work; that Part 52 came out of that and it was an attempt to give certainty to the legal aspects of the regulatory process to ensure that we had a process that could begin and it could end with some

finality and some certainty.

So, I think when we talk about these ideas of modifying Part 50, modifying Part 52, I think we need to be clear about what we're talking about. Clearly, the technical requirements have to be modified. There are technical aspects of Part 50 which are reflected in Part 52 which do not apply to gas reactor technology.

And I think from what I've seen from the work that the staff has done in looking at this, they are prepared to move forward with those modifications. There are ways to do it. Either we exempt Part 50, issue other requirements as necessary to add to Part 50 where necessary, but from the legal standpoint, I strongly believe that the process we want to use is a Part 52 process for the very reasons that you suggested; that it gives you certainty when you have a license of how to move forward and get a plant operating.

That is the issue that I think we learned in the past with Part 50 was not always clear. And if we go down that road, I don't think we'll ever get this project done. We will be in litigation for years. We will potentially be in court for years after that trying to figure out what exactly we were doing throughout this process.

And I think on top of that Part 52 doesn't require design certifications. You can come in with a custom design, but let's also keep in mind, it give

you an early site permit option. People could go out tomorrow and begin work on an early site permit with a design envelope for a gas reactor and get that aspect of the environmental review done today.

So there are tremendous advantages to Part 52 that I think we shouldn't lose site of but the advantages exist on the process side. The technical side will be the same regardless of whether we do a Part 50 or Part 52 approach. We're going to have to come up with technical requirements to license these facilities.

So, I think it's something that when we talk about these things, I'm not so sure that there is an issue here. I think the staff is being creative. The staff is looking at how this process needs to be modified and I don't see there being any real problems there.

What I would suggest -- certainly from my perspective, one of the challenges that I think we're having is there is a bit of moving target in terms of what the expectations will be from the DOE side of this and I guess we are looking at August for coming up with a licensing strategy.

At some point, we need to lock down things like the technology; those kind of things. Maybe you can give a sense of what you see the time lines are for having a sense of whether it will be a private government partnership and what kind of form that would take; who would be responsible for speaking for that partnership in terms of design decisions

and all those kind of things; and what you see the time lines for that being?

MR. SPURGEON: That's something that's moving forward now. We've had a conceptual design process underway that has more than one technology option, as you well know. That will move toward, but not by August by any means. A technology down select that would be made, but I don't see that as being solely a Department of Energy issue.

We obviously want to have the user community have a big say in where we move forward because we need them to kind of poll the process. So, when we get to what our strategy will be by August, we're going to have to take into account that the design isn't done. That we --

COMMISSIONER JACZKO: We don't need a design by August. Again, looking at the schedule right now that has been laid out, we are looking at early 2009 as the earliest that pre-application review would begin and there is about a three or four year time period built into the schedule to do all of that kind of fleshing out what the design would be, what kind of changes we would need to Part 50.

So there is a tremendous amount of time and I'm not suggesting we need a design by August, but certainly, I think what we need is some sense of the basic parameters of who we interact with, who speaks for the project, and what kind of approach we need to be taking so that we can move forward on getting into this licensing process?

MR. SPURGEON: Well, as you know in carrying out NGNP, we have the Idaho National Laboratory that is managing the program for us. And so in terms of these interactions unless and until such time as we have an industrial sponsor who would move into that position, they are the ones that will be the appropriate body, if you will, to do that interaction with you all.

We are -- the Department of Energy in terms of our Federal staff is obviously supporting that. They're obviously working for us, if you will, but we do not have and probably will not recreate the kind of technical staff that once existed within the old Atomic Energy Commission where those things are done internally to the Department by Federal employees.

That's really going to be the, in this case if you talk about the gas cooled reactor, the province of the laboratory. And they will then make recommendations as to how we can move that to the next stage and have the industrial component.

COMMISSIONER JACZKO: I know I'm well over on time, but I just have one brief question. Do you think it's realistic right now for us to do the licensing strategy by August? Are we going down a path of being premature in trying to make these decisions about Part 50 versus Part 52 and then, maybe a year from now there will be an industrial lead entity working on this who might want to use a different approach?

Do you think we are really at the decision right now to be able to make -- maturity to make that decision?

MR. SPURGEON: I will admit to you, I have not been involved in the detailed discussion that our two staffs have had. So, I don't know that I'm in a position to make a judgment as to how far along they really are. My guess would be that there's a lot of details we won't have worked out by August, but hopefully, we will be able to have the general pathway worked out in terms of how we can approach this issue.

I'd like not -- I'm one that doesn't like to kick the can down the road relative to schedule. I'd rather get as far as we can and define a pathway as firmly as we can and leave open those items that we don't know and just identify what's remaining to be resolved.

COMMISSIONER JACZKO: Okay. Well, thank you. I appreciate that.

CHAIRMAN KLEIN: Commissioner Lyons?

COMMISSIONER LYONS: I think there has been a good discussion on different licensing options and I wouldn't propose to continue that discussion now, but I would just make the observation that I think with using different words perhaps all three of us have said something fairly similar. That we are interested, as you said, in innovative approaches; recognizing that there needs to be some changes in the hard and fast,

whether it's 50 or 52 or something else. I didn't find myself disagreeing with comments from my colleagues.

It doesn't change the fact that I'm still puzzled as to what the best way is, but just to get to a couple of other questions.

In the '08 budget cycle, Congress increased the DOE funding substantially in this area. I am nervous that from the NRC perspective that we're not going to be, if you will, keeping up with the progress that your team is going to be making.

Now, there's some funding - I don't know how much - that will come from DOE over to NRC but I wonder if we need to reexamine perhaps how that is done, whether we need both be talking to Congress, whether we should be asking you for additional resources? Again, I'm open for suggestions.

MR. SPURGEON: Well, you're somebody that knows the budget process probably a lot better than certainly I do in terms of how is the best way to approach this. But clearly in the advanced technology area, our respective resources need to be marching ahead in lock step.

As we proceed forward, again, whichever advanced technology it is; whether it's the gas reactor, whether it's the liquid metal reactor, whether it's a recycle facility, we are going to be needing to develop the licensing basis, the licensing strategy, if in the case of, the words are for the HTGR, now

rather than later.

And I would think that somehow since we go through the same committees that we could find a way that when budgets are put together for development, that they also put together the requisite funding for research and development. I know most of your budget is reimbursed by the applicant. In this case, that is really not appropriate. You need to have the resources so you're working at the same time we're working and we're not getting into this thing.

I would like to have you have your own source of funds so that we're not then trying to say, "Well, okay, what do we do? Do we spend this dollar for R&D? Do we spend this dollar for regulatory preparation?"

COMMISSIONER LYONS: I hope we can work together on that in '08. I think we may need some help since it's past.

I'd like to cram in one quick question that's going to come up repeatedly during the rest of the day, I think. We've talked very little about GNEP, but I believe one area of GNEP involves development of reactors suitable for developing nations. That's going to be an appropriate question for a number of reactor designs that we're going to be hearing from later in the day. Is that a focus in GNEP and how do you see it developing in GNEP?

MR. SPURGEON: Well, yes it is. It's one that as you well

know has been a focus without funds. I thought I said something wrong there.

CHAIRMAN KLEIN: Any time you mention funding --

MR. SPURGEON: Is that what that -- but no, we are beginning to put some funds associated with that. It's certainly one -- our terminology for that is "grid appropriate reactors". But the idea being that in many countries beginning the nuclear process, the size of plant they their grid can actually accommodate is somewhat smaller.

And their capabilities for -- their infrastructure capabilities may be somewhat less and therefore, if we can move toward not only a smaller size reactor that could be more -- let me say less fuel directed and more shop fabricated and as well as something that could have a larger -- a longer core life and less refueling.

Those are those all bode well toward our objectives to provide for -- and I have to be careful how I say this because I want to say more proliferation resistant. That doesn't mean that everything isn't proliferation resistant, it's just that it's perhaps easier to manage.

COMMISSIONER LYONS: This is another area where I think from the NRC's perspective we need to be careful that we don't take funds for this area off the fee because this one strikes me as really inappropriate to put on the fee base.

MR. SPURGEON: I think it's the same as the advanced technology. You're absolutely right and again, we're learning to march down this path. We're trying to educate our colleagues in Congress. We in some cases have done okay with that and in some cases we haven't done a very good job because they don't understand the value of some of these programs yet and we need to make that clear.

CHAIRMAN KLEIN: Dennis, if you look at even an area we know a lot about, light water reactors and we had this path of complete design certification, complete designs finished and then we would start the early site permit and then we would do the COL. So, even light water reactors had its challenges. Could you talk a little bit about siting?

And clearly at the present time, unless its changed, INL is the lead Lab, but if it's going to be a reactor that's industry funded they may prefer a location where they would need process heat. Could you talk a little bit about siting and when that might happen because I could see we might have to do things in parallel much like we're doing on this current generation of light water reactors under Part 52? We're moving in parallel rather than series. Could you talk a little bit about siting?

MR. SPURGEON: I think going back to the Energy Policy Act of 2005, our focus for the site for the initial next generation nuclear plant, the initial light water -- gas cooled reactor, rather, is Idaho. And it's going to

remain that unless and until there would be an industrial applicant come along and say, by the way, here's my check and you get into the “he who pays the piper calls the tune” kind of an issue relative to siting. But our plan and what we've been proceeding down is based on the plant being at Idaho. And unless or until something changes, that is the plan.

CHAIRMAN KLEIN: Do you envision the NGNP being used for testing as well and development as well as the sort of final design?

MR. SPURGEON: Well, things can always evolve. My vision for NGNP is more of a prototype than a test bed. I mentioned earlier on, maybe I didn't go through it clearly enough, we're trying to do that now -- we are doing now, not trying to do, an inventory of the test facilities that we believe would be required for a nuclear energy looking as best we can into the crystal ball out for the next 50 years or so.

Then from that, match that with what capabilities we have and then develop what we would need in order to adequately support the future development of nuclear energy.

There is no question that our physical infrastructure for research and development and testing in the nuclear arena has atrophied a great deal over these last 30, 40 years and much of it needs to be rebuilt, but it needs to be rebuilt based on the needs of the future.

So, that's a long answer to a yes, we need test facilities, but I'm not

looking at this stage the NGNP as being a test reactor of the ATR type variety as opposed to a prototype.

CHAIRMAN KLEIN: Great, thanks. Commissioner Jaczko?

COMMISSIONER JACZKO. I have one question. This really -- part of some of the discussions have happened on the licensing framework and it has to do with really the back end, the fuel cycle for this reactor.

It's my understanding right now the approach would be that DOE, if it were a DOE facility, DOE would maintain title to the fuel and in many ways that question will be resolved when other questions about DOE fuel are resolved. Do you see any changes in that if you were to go to a model that would involve more of an industry component?

Would industry have title to the fuel then and own fuel or would DOE continue ownership of the fuel throughout the operation and then ultimate disposition of the fuel?

MR. SPURGEON: In any event, if we're talking about the back end, we would hope that the Department of Energy -- actually in the not too distant future - is able to put together and sign contracts with industry to take title to fuel.

So I don't see it being any different than a light water reactor from that standpoint. Who would own the fuel at the time it's in the reactor? That's another issue as to whether or not DOE would own it and that would

be dependent, I think, on how this eventually gets funded.

COMMISSIONER JACZKO: Okay. I appreciate that. I don't have any other questions.

CHAIRMAN KLEIN: Well, thank you Dennis, for your comments. And as we go down this path together, I would like to compliment both our staffs; the NRC and the DOE working groups to come up with this strategy have been hard at work and so I think both sides are working together to try to formulate the best way ahead for the nation. And so thank you for your participation and we look forward to the next panel coming up.

MR. SPURGEON: Thank you very much for having me.

CHAIRMAN KLEIN: I think we'll take about a five minute break while we shuffle chairs. I think we probably almost set a record for the number of people at the table making presentations this morning.

So, we're now going to hear from a variety of individuals. We'll start off with Mike Corradini representing the ACRS and I realize it's hard for Mike not to talk in 50 minute increments being a faculty member.

MR. CORRADINI: I thought you were going to tell me I had only five minutes instead of ten. The cast of characters is growing.

CHAIRMAN KLEIN: We'll also hear from Dan Keuter who's with Entergy. And then we'll hear from Fred Moore from Dow Chemical. Ed

Wallace on PBMR and we'll also hear from Arkal Shenoy with GA. And we'll then hear from Finis Southworth from Areva and then from John Goossen with Westinghouse. So, thank you all for coming.

And as you probably heard this morning, we're all looking at these innovative technologies expanding our capabilities from the typical Light Water Reactors that we spent a lot of time on. So for reactor technology, it's exciting for a lot of our staff in these new innovative activities, so we look forward to hearing from you all today.

Any comments before we start?

COMMISSIONER JACZKO: No I look forward to the panel. I think this will be very interesting.

CHAIRMAN KLEIN: Commissioner Lyons?

COMMISSIONER LYONS: I will look forward to the panel. You heard some of the thoughts that at least are going through my mind and I will ask some of you for comments on them as we get to questions.

CHAIRMAN KLEIN: Okay. We will begin with Mike. Thanks for coming.

MR. CORRADINI: Thank you very much. So, I'll start off with a statement, which is that I am not necessarily representing the ACRS. I'm a member of ACRS, but I'm not representing the committee. I was told by my committee members they will hang me out to dry if I dare do that. Part

of it is because I'm a member of the NERAC, the Nuclear Energy Research Advisory Committee for DOE as Dale was a while back. And because of that, we did a review of NGNP a couple of years ago and also with the National Academy. I was on the National Academy Study Committee. So, if I could have the second slide, please.

And I will try to reduce my time if I can because we have a group of people. I want to make sure we get through. This has already been said, but let just me emphasize a few points first. NGNP is really a duel mission technology both for electricity production and process heat and it was actually authorized that way within the Energy Policy Act of 2005 with a start date no later than 2021.

It was reviewed in a number of settings. First of all, I should say last, we'll go backwards in time. The National Academy was asked to review all of the Nuclear Energy -- the Department of Energy's Nuclear Energy Office via the EPAct 2005 and within that construct, the NGNP was reviewed as part of the Generation IV program.

Secondly, NERAC itself reviewed the NGNP back in 2005 also because of the Energy Policy Act. It required within the first six months of the passage of the Act that we look at what NGNP, we look at the milestones, the program and see how it all fit together and if we would make some recommendations.

And then, just to go back further in history, some of the folks in the room that I saw around were part of it. There was an interim technology review group in 2003 which also reviewed NGNP. That kind of goes back to the first history is this really part of the GENIV program; one of the first out growths of the six types of reactors that were viewed as advanced reactor for Generation IV.

One last point, I guess, on this slide that I wanted to make is that progress has been good. It has been somewhat hesitant because of funding. Before FY06, funding has been a bit up and down and I think Pete made this mention that in '08 there has been some fairly solid funding, but it has been up and down over the last five or six years and that's part of the reason that some of the progress has been limited. So if you go to the third slide, please.

Let me give you a few points about -- from the various reviews, primarily the NERAC review of 2005 and the National Academy review of 2007. First of all, one of the major comments made by both groups and actually back in the ITRG report was that it's quite important to accelerate the NGNP program to encourage industrial partners.

So we have a lot of industrial partners down here, so I'll let them say more about that. But I think the key point here is you can't generate a time horizon that is so long that you can't involve industry in it because there

really would be a mismatch relative to how industry looks on a project versus how the government may look on project.

Second point that was made in all of these reviews was that it's very important to establish realistic technical goals. I give you two examples. Here, one that the outlet gas temperature in the machine should be less than 850 degrees C. And I say "should be less" because that was the recommendation from the panels. And that one you consider UO2 Triso fuel kernel.

I will point out that at the time when we had these reviews there was some interesting discussion between the DOE and the review panels about this. As it sits now and as I understand it, this is now part of the plan as back up positions; that is, they're maintaining a good deal of flexibility and you can ask the others on the panel as to what the outlet temperature is.

The review panels felt that to get the machine properly designed with good amounts of reliability and safety that we don't want to push necessarily the temperature limit. Similarly for the fuel, we want a back up if the UCO kernel does not work out relative to fuel qualification.

Third point is process heat; a flexible technology there. I think the other members of the panel will talk to that. Right now, there are two parallel paths of thermal chemical as well as high temperature electrolysis.

And then the last point is that all the panels made the point that the

Generation IV Program evaluation criteria looking at schedules, looking at cost, looking at off ramps as technologies may or may not pan out should be continued as you continue the NGNP program. Next slide, please.

Recently, there has been a completed PIRT process which stands for Phenomena Identification Ranking Table process where all aspects of the NGNP research R&D plan is looked at and key things that need to be done have been listed and this finished the process itself.

I was part of one of the panels of that and some of -- I think other folks in the room have been also. That finished approximately a year ago, maybe ten months ago. The reports have been issued and that was presented actually to the ACRS last month. Staff made some initial presentations of that.

Some points to note here are key items that the PIRT is addressing and is focused on is fuel qualification testing, particularly in-reactor and the ATR. I think that will be discussed by others, but right now the first fuel qualification test, I think, was loaded in 13 months ago.

Material studies looking at graphite, particularly under large amounts of effluents and irradiation dimensional changes and how that would affect things relative to bypass flows in the reactor.

And then also development of computational tools. I think Dale made a point of this which is important, which is we're in a situation now where we

can do things much more carefully. Hopefully, engineers don't do things more carefully then turn out to do it more slowly, but we do have the opportunity to have advanced tools to look at heat transfer effects in a multi dimensional aspect and try to do a better job on the design. Next slide, please.

So the last thing that I really have to say is on a licensing strategy. This is a work in progress and so because it's a work in progress, I simply can only say here that staff and DOE -- both staffs of the NRC and DOE are considering a range of options. In the first half of the panel this morning, Part 50 and Part 52 was discussed enough. I'll simply say that that's one of the things and there's a range in between.

I think Commissioner Jaczko made this point that there's variations and just calling the two numbers, there's variations within that.

The second part I guess I did want to emphasize is that the technical regulations that under pin whether you choose 50 or 52 also have to be considered. And staff has done a very nice job at least in the initial meeting we had with them discussing that; whether it be deterministic, whether it be risk informed; whether it be a blending of this to try to get the best of both and try to move forward.

And in the process of that, the ACRS members, their staff and the NRC staff is reviewing the white papers on gas cooled reactor technology at

this point.

Other than that, I really cannot say much more other than we are in the process of listening to the staff and we plan to comment on the approach back to the Commission in the next month or two when we have a final draft that we can look at and discuss things with the staff.

So that's kind of how I'll leave it for now.

CHAIRMAN KLEIN: Great, thanks. I'm sure we'll have questions as they come along. Dan?

MR. KEUTER: Good morning, Mr. Chairman and Commissioners. I had an oral statement, but to save time I'm just going to talk from the slides and hopefully it will go faster. My name is Dan Keuter. I'm the Vice President of Planning and Innovations for Entergy Nuclear. Basically, I'm the head of our R&D part of our nuclear division. I'm responsible for evaluating new technologies and concepts in support of our existing plants, but I'm also responsible for looking at new technology beyond even light water reactors and the implementation of that within our company. And this includes next generation nuclear power plants. If I could have the first slide.

To start with, though, I want to emphasize our priorities. Our highest priority is and always will be our current fleet of operating reactors. We have to focus on those and make sure they're operating and operating

safely.

Our next priority is advanced light water reactors and deployment of new advanced light water reactors. We are investing a lot of time, effort and money into this and we want to make sure that that is successful because if that's not successful, there is no need in looking at anything beyond that.

Third priority is high level waste resolution. We think that's critical and we want to make sure that that continues on.

Fourth is Next Generation Nuclear Power Plants. Even though this is fourth, we still think it's a very, very high priority. If we don't start the process today, we won't be ready when it's really needed in the future.

And then the last is the Global Nuclear Energy Partnership which we think eventually we will need, not only for resolution of high level or recycled fuel, but also for the uranium supply of the future. Next slide.

From Entergy's perspective, the Next Generation Nuclear Plant is essential energy source. It helps reduce our foreign energy imports, reduces greenhouse gases, preserves our fossil fuel for future generations. Next applications go beyond electricity and that's one of the areas where we are located, we're very interested in. We could use it for production and use of chemicals, petrochemicals, fertilizer and industry.

It has an advantage of high temperature process heat and hydrogen production. If we were looking just for electricity, we would continue on with

advanced light water reactors, but we feel that the high temperature reactor has a significant advantage in not only addressing potential electricity, but also energy uses in commercial industry and hydrogen production for transportation.

And if you look at the energy consumption in those two areas that's more than the consumption of electricity. So there's a huge market potential. There's a huge ability to reduce our carbon footprint in transportation and commercial use.

And then, I think the last thing is long term fuel supply for hydrogen economy. That is not there right now, but I think that's essential to develop a method for pollution-free production of hydrogen. The next slide.

We do have an emerging industry alliance. We have an increasing interest in Next Generation Nuclear Plants by others. This includes technology developers, reactor designers and vendors, petrochemical and chemical companies. So, as people find out more and more about it, there's more interest and there's an increasing desire to be involved. They see this technology as helping them to solve some of their problems and energy supply of the future.

Representatives have been meeting over the last year. We've been developing needs; what kind of things do we need out of the reactor, including size, temperature, whether they're looking for electricity, high

temperature heat or hydrogen. Right now, there seems to be a focus on using these reactors at a refinery to produce high temperature process heat originally and eventually getting into hydrogen and electricity.

We are working on a Memorandum of Understanding amongst the parties and we are making progress. There are still some questions on how we're going to be organized and what kind of entity we're going to be, but we are making progress and hope to sign that in the near future.

The last slide: our alliance acknowledges the challenges. There's technical development, including fuel development and qualification. There's technical issues concerning high temperature materials, but we think those are solvable. The sooner we get started, the sooner we can resolve those issues.

Industrial infrastructure. That needs to be addressed. Fuel Supply. This will be a different fuel supply. We want to make sure that fuel supply is economical and available. Large component fabrication, design and construction. These are all infrastructure items that is we need to address.

But the last item is licensing. What we really need is a predictable and timely licensing process to go forward because the real bottom line of whether we build or not is going to be the financials. And the longer it takes and the more cumbersome the licensing process, the more costly it will be.

The licensing process -- we need regulations for gas reactors and we

need a dedicated staff to work on this. This is something that if we are really going to do, we want to do it and do it seriously.

CHAIRMAN KLEIN: Just a clarification. Is that dedicated staff at Entergy or dedicated staff at the NRC?

MR. KEUTER: Both. And that concludes. Any other questions I can answer at the end.

CHAIRMAN KLEIN: Thanks. Fred?

MR. MOORE: Thanks very much. First of all, good morning Mr. Chairman and Commissioners. My name is Fred Moore. I'm the Global Manufacturing Director and Technology leader for the Energy Business with Dow Chemical. In that capacity I am responsible for assuring that all of Dow's businesses are provided with safe, reliable and cost effective power and steam and other utilities.

Just to give you an order of magnitude, we operate more than $6 billion in energy assets globally, roughly 10 percent of all of Dow's asset base.

Let me begin by setting the degree of our interest in solutions to the nation's security of supply for both energy and feedstocks. And I want to make a point that they are in our view, inseparable.

No industry is more acutely aware of the needs to reduce our dependency on oil and natural gas than ours. In fact, Dow is one of the

largest industrial consumers of power and steam in the world. Globally, we require nearly 4,000 megawatts of electricity and consume in excess of 22 million pounds an hour of steam. At $8 a million BTU, we consume an equivalent fuel cost of roughly $5 billion dollars a year.

More importantly for DOW is the fact that the majority of our feedstock demands are met by fossil fuels, principally natural gas liquids. These feedstocks along with the energy to power our processes and drive our chemical reactions consume the equivalent of more than 800,000 barrels of oil per day. That's just for Dow Chemical.

In 2007, our energy and feedstock costs are in the neighborhood of $24 billion. By comparison, we spent $8 billion in 2002. So, in other words, we've had a $16 billion jump in energy and hydrocarbon costs in just five years.

Is it any wonder that the U.S. Chemical industry went from a trade surplus of more than $20 billion to a trade deficit of $9 billion in less than a decade? The fact of the matter is that we're on the leading edge of demand destruction in the face of high energy prices.

The U.S. Energy Administration data shows that since the run up of energy prices in the late 1990's that more than 3 million high paying manufacturing jobs have been lost. Let's not forget that more than 95 percent of everything we touch in our daily lives relies directly on chemistry

and our industry - from drinking water, to toothpaste, to the food we eat, to computers, to phones, to cars we drive and the medicines we take. All of these are made possible by the science of chemistry and the products derived from our chemical industry.

We must have a call to arms on the joint and inseparable issues of energy security and climate change. We see at least four specific goals. First, we must reduce our energy demands. The cheapest energy is the energy we don't use in the first place. At Dow, we are relentless. Between 1995 and 2005, we reduced our energy intensity by over 22 percent. In that process we saved over 900 trillion BTUs. That's roughly equivalent to all the energy that the residential consumers and businesses in the State of California use in a year.

In the process, we also saved about $4.5 billion in fuel costs. And we committed to reduce our energy intensity between 2005 and 2015 by another 25 percent. To put it in perspective, if that 25 percent reduction was replicated across the U.S.; that is they reduced their energy intensity by 25 percent between '05 and 2015 and you assume GDP grew at an average rate of three percent, the nation could eliminate the oil equivalent of all the Persian Gulf imports today. But that's not enough.

Second, we have to pour money into national research programs to make coal sustainable while increasing our work on renewables and

alternatives including bio mass and nuclear.

Third, we must diversify our energy supplies here in the U.S.

And fourth, we must accomplish all of the above within the framework of reducing our impact on global climate change.

Given these duel and inseparable problems, the necessity of a coherent energy strategy and policy is paramount. We need security of supply, a sustainable supply and a competitively priced slate of energy.

Our CEO, Andrew Liveris, recently noted in a speech to the Global Automotive Conference in 2007 that there are currently plans to build more than 80 large chemical plants around the globe in the coming decade each with a price tag of well in excess of a billion dollars creating thousands of jobs. Not a single one of those is planned for the U.S.

He went on to say and I'll quote, "I am not worried about my industry's and my company's future per se. We will continue to produce essential products and continue to do well. What concerns me is this question. Will the chemical industry and other manufacturers continue to be part of the American economy?"

The U.S. must understand that until alternative technologies become a larger part of the energy mix, traditional fossil fuels (oil, natural gas and coal) will remain critical to meeting energy demand and feedstock needs. Efficient use of these limited resources with an emphasis on carbon

management must be a strong component of any climate change strategy.

Dow also believes that nuclear power is an essential technology that must be expanded as more R&D is done on safe handling and fuel reprocessing.

Dow has committed publicly that at least 15 percent of its energy globally will be non-carbon emitting by 2050. The energy mix will include renewables such as wind, solar, alternatives such as nuclear and carbon sequestration technologies.

Nuclear can provide a route, via a multi-generational approach for technology which will allow decades of coal use in the U.S. without CO2 production. Nuclear generation of steam, power and hydrogen provides an avenue to produce synthetic diesel, gasoline and other feedstocks via gasification of coal.

While one might argue about the exact numbers, these are relative. Coal is estimated to have global reserves somewhere in the neighborhood of 150 to 200 years; natural gas less than half of that; and oil less than half of that.

More importantly the generation of synthetic diesel, gasoline and other feedstocks will allow the U.S. to utilize existing infrastructure that we have built to support our core needs such as transportation and home and business heating. This infrastructure has taken us nearly a century to build

and develop. Any alternative approaches for fundamentally new fuel source consideration, such as hydrogen, have enormous safety, infrastructure and economic hurdles.

As we understand the next generation nuclear program technology is likely to be significantly safer than current technologies and provide process heat at temperatures that unlike current light water reactors can be suitable for chemical processing.

Dow believes it can help frame this technology development by helping to show the potential benefits of this technology if it is effectively integrated with large petrochemical plants.

For the U.S. to turn its back on nuclear energy and coal is not only illogical, but it defies the power of economic reason. I look forward to questions at the end. Thank you.

CHAIRMAN KLEIN: Thanks, Fred. Ed?

MR. WALLACE: Thank you. Good morning, Chairman Klein, Commissioner Lyons, Commissioner Jaczko. My name is Edward Wallace and I am the Senior General Manager of U.S. Programs for PBMR, Pebble Bed Modular Reactor Company of South Africa. It's a pleasure to be able to brief you today on the continuing progress of the PBMR Modular Reactor program in South Africa as well as the relevance and importance of that program in the United States. First slide, please.

The purpose of the PBMR program is to develop an indigenous design in South Africa; first for local energy needs and then for exporting to developing countries as well as industrialized countries that can use the unique attributes of a smaller, very safe, high temperature nuclear plant.

Those needs recognize the importance of distributed generation in South Africa and the importance of energy diversification using the only local energy resource other than coal, uranium. They also recognize the value of such projects and developing new jobs that can further up lift the additional elements of the South African population.

For these reason, the PBMR project in 2004 was declared a national strategic project of South Africa; one of only a handful of such projects in the country.

It is also a significant part of the South African nuclear vision, which was published in 2007 in the National Policy on Nuclear Energy, a broad statement about the role of nuclear power in the South African energy future.

PBMR's along with the light advanced light water reactors make up half of the 40 gigawatts of electricity needed over the next 20 years in South Africa. Next slide, please.

The current PBMR program contains five elements: the demonstration power plant in Koeberg near Cape Town, is a full scale direct

cycle, Brayton cycle electric plant normally of 400 mega watts thermal and 165 megawatts electric.

A pilot fuel plant that will provide the fuel for the demonstration plant and up to four additional plants that follow the first unit. That plant contains many of the key full scale components of a large scale fuel facility, but lacks the maximum automation and scale that's necessary for a commercial fabrication facility.

The program includes multiple large scale integral and separate effects test facilities to understand the more unique thermal dynamic operating maintenance component reliability and other performance characteristics of most of the PBMR reactor and auxiliary systems.

The program also includes a full-scale fuel laboratory capable of making preproduction fuel with the same equipment and quality steps as the pilot fuel plant.

PBMR has commenced pre-application interactions with the NRC in anticipation of obtaining design certification in parallel with the ongoing South African program.

And lastly, PBMR has begun development of process heat designs up to 500 megawatts thermal for co-generation plants that will utilize the basic PBMR reactor technology in various ways that go beyond electricity generation. Next slide, please.

The project today is steaming full ahead in South Africa. Currently, there are many approximately 750 people in our headquarters offices near Pretoria and approximately 1,000 more around the world working on this project.

To date, over $600 million have been invested and the next $800 million of funding have been committed by the South African Government. Manufacturing of long lead items for the reactor vessel core barrel and core graphite structures is under way.

COMMISSIONER JACZKO: I'm sorry. Can I just ask you a quick question? Is that the total projected cost, that $1.4 billion or is there an additional?

MR. WALLACE: No, sir, there isn't any additional amount beyond that. The first fuel of PBMR origin to be to the final highly successful German specifications for Triso fuel will be available later this year for initial irradiation testing by PBMR Manufacturing.

Construction of the demonstration plant in Koeberg is scheduled to start in 2009 and if all goes well, initial criticality can take place in 2013. Next slide, please.

The U.S. Design Certification Project was initiated in 2005 to begin the long process of establishing prerequisites for licensing PBMRs in the United States. Nineteen different topics were identified by PBMR and NRC

staff in the initial planning discussions.

Early emphasis was placed on the licensing approach using a risk informed and performance based process that brings to life earlier NRC policy statements on advanced reactor safety risk in a manner that meets the NRC safety goal policies.

Progress on pre-application program is being set by both PBMR progress in South Africa and the availability of NRC resources for non-light water reactor work. PBMR's end objective is to have the design certification complete shortly after initial operation of the South African demonstration unit.

In the intervening periods since the design certification project began, PBMR has been very active with DOE and the Idaho laboratories in the development of the NGNP program. All parties involved recognize the generic value of most of the early PBMR licensing work to modular gas reactors of all types and realize that close cooperation can benefit the NGNP program as well as lead to a more efficient and effective NRC process that supports both projects. Next slide, please.

The focus of PBMR process heat plant effort is on the earliest industrial applications of high temperature reactor technology. These designs adapt the basic reactor system and fuel from the demonstration power plant and indirect cycle configurations suitable for various uses.

We're developing a heat transport and co-gen designs that match market needs and fit into industrial long range planning windows today. The different process heat industry needs that we've identified that can be met include high quality heat, steam, electricity, hydrogen and desalinated water, but little or no CO2 release.

Depending on the application, this requires high temperatures and that is 900 degrees Celsius or what I would term intermediate temperatures in the vicinity of 750 degrees Celsius, but still well above the light water reactor conditions of 320 degrees Celsius.

The value proposition for these applications centers on displacing fossil fuels, avoiding emissions, and ensuring diversity and predictability of primary energy supplies for the end users.

In this regard, the eight companies of the PBMR based design team have been in the forefront of pre-conceptual design work for the NGNP project. From this unique vantage point, we can more readily see the synergy and opportunity in working closely as an industry with the NRC to establish the proper regulatory conditions for bringing modular reactor -- high temperature gas reactor technology to an entirely new part of the energy use spectrum. In order to achieve a result, the NRC is an essential component of that picture as we all know.

The NRC immediate priorities for gas reactors should focus on

effectively engaging on the key issues that have already been identified that establish the proper framework for applications and subsequent acceptance of modular HTGRs. I think this is very consistent with the comments made earlier today.

Selecting regulatory solution sets that are necessarily appropriate at this new technology and not attempt to force light water reactor solutions where they are not applicable, they are inappropriate or would diminish the value of these new designs.

Embracing the risk informed and performance based processes that are outlined in existing NRC policy statements from the start. These processes level the playing field for reactor types different than LWRs, allow better insight into the design and safety issues involved with them and set the stage for establishing the proper regulatory submittal and acceptance criteria to license modular high temperatures gas reactors.

And finally, assuring that there is a commensurate plan for development of enough qualified NRC resources necessary to match the schedules that are being discussed that are driving industry, whether due to Government programs like NGNP or private projects driven by industrial necessity.

Thank you very much for the opportunity for these brief comments and look forward to your questions later.

CHAIRMAN KLEIN: Thanks, Ed. Arkal?

MR. SHENOY: Good morning, Chairman Klein, Commissioners, panelists, ladies and gentlemen. I'm Arkal Shenoy, director of the high temperature gas reactor program at General Atomics. Thank you for the opportunity to speak with you today.

General Atomics has a long history with gas reactors and our interest in revival of the gas rectors in the United States differs from my colleagues in some important ways. General Atomics is not pursuing concurrent water reactor efforts. We are a wholly U.S. owned company and neither our company nor our gas reactor effort is largely supported by any foreign companies or foreign governments. Currently, gas reactor programs at General Atomics are mostly supported by U.S. Department of Energy.

Gas reactors are a necessary part of the nuclear fission solution to the U.S. energy and environmental challenge. General Atomics does not see gas reactors as competition to water reactors for two reasons. First, gas reactors can meet needs such as process heat and hydrogen that are not well suited to water reactors. And second, the energy needs of the country over the next decades will be so great that there is more than enough room for both types of reactors.

Gas reactors or more precisely, Modular Helium Reactors has evolved from Peach Bottom and Fort St. Vrain reactors designed and built in

1970's by General Atomics. Prior to the collapse of the nuclear power business, GA had sold, but later cancelled 10 HTGRs and had extensive licensing interactions with U.S. regulatory agencies. In early 1980's as a result of a Congressional science and technology committee guidance, the Modular Helium Reactor was born, which incorporated a high degree of safety features built on inherent physics of Reactor Core and not requiring engineered add on systems.

This required to limit the module power and power density and therefore increased cost of heat generation. The MHR is expected to be economically competitive with alternative electricity generation technologies due to the high operating temperatures of gas reactor and high thermal efficiency of the Brayton cycle power generation system and also because of high burn up and expected low operation and maintenance requirement will provide the cost advantage.

The high temperature gas reactor can play a vital role in meeting the future energy needs of the United States by contributing not only to the generation of electric power, but also non-electric energy traditionally served by fossil fuels.

The MHR can be integrated to provide different non-electric applications such as process steam cogeneration for industrial applications including coal conversion and process heat for transportation fuel and

development and hydrogen production for various energy applications.

Rather than detailing the modular helium reactor developmental history, I will focus my time allocation remaining for two fundamental themes for your attention today. These themes apply to commercial gas reactors and not to any demonstration reactor designed under NGNP which may have additional proof of concept requirements.

First, the NRC should consider providing incentive for safety based on inherent physics principles instead of layered active safety systems. The modular helium reactor is not an extension of light water reactor technology. It is its own class of fission energy generation. Current gas reactor design strategies are focused on a reactor core that cannot melt, but they don't have to be designed that way. But we've chosen to do that.

There is a penalty in performance to do this. If the Nuclear Regulatory Commission considers this as an important feature, it must provide a strong incentive for this feature through significantly reduced requirements and timelines for licensing. This is the only viable incentive source that will result in construction of gas cooled reactors where basic physics ensures safety.

What is a strong incentive? When an end user knows that he can get a license for a gas reactor in a fraction of the time as for a water reactor and he factors that into his purchase decision, then the NRC has provided a

strong incentive for inherent safety. Otherwise, the lack of such incentive will push reactor vendors to provide a more cost effective design that meets current licensing safety thresholds; a step below the inherent safety.

Second, the NRC can take advantage of this type of advanced reactor to provide a new approach for licensing. General Atomics applauds the NRC's recent efforts to reduce and provide more certainty in the licensing process. The NRC's mission and vision talks about "the public good" and "protect the environment". The NRC should recognize the pressing needs of energy security and environment to require an urgent move towards expansion of nuclear power use in the United States and the high temperature gas reactor is a needed component for this movement.

How urgent? Some call the U.S. to reduce its carbon emissions by 50% by 2030. Assume this burden was to be achieved through nuclear power in the electric generation and other industrial process heat applications. This would require every future electrical generation facility plus almost 90% of the current electricity and industrial process heat requirements to be converted to nuclear.

2030 is only 22 years away. The Next Generation Nuclear Power Plant program shows 13 years to build one plant. How many plants would be constructed? The answer varies based upon assumptions, but the number of applications would be overwhelming to the NRC given the current

review requirements.

One of NRC's strategic outcomes is that no significant licensing or regulatory impediment to safe and beneficial use of radioactive materials. General Atomics is hopeful that the recent progress will result in this strategic outcome being achieved.

The DOE's strategy for Next Generation Nuclear Plant development relies on an alliance of vendors and the end users to partially fund the development of the Modular Helium Reactor. With all of the technology and fiscal challenges involved, the two risks that worry the potential alliance members the most are the fiscal uncertainty for the DOE's contribution and second the licensing uncertainty for the NRC. At least the NRC didn't make the top of the list.

This can be solved with a new approach that recognizes that public good is not served if the licensing uncertainty of the total time involved results in a reactor not being constructed. An understanding that the environmental and other impacts of continued reliance on fossil fuels allows for an evaluation to a set of reasonable standards, but cannot support an extended list of sequential emerging requirements.

To achieve that end, General Atomics recommends that the NRC consider: once its review has satisfied the inherent safety of the gas reactors has been met, descope the associated and unnecessary reviews.

"Because the water reactors do it" should not be a permitted statement that should be used for the gas reactor.

Second, when the number of applications increase on a gas reactor, one should consider outsourcing the detailed review of the licensing of the gas reactor because of its inherent safety.

In closing, GA strongly endorses NRC philosophy in line with its mission "to ensure adequate protection of public health and safety". Setting the licensing bar so high that reactors, especially advanced gas reactors, are not built or built in severely reduced numbers may provide more margin above adequate protection, but is not in the best interest of the public health and safety.

General Atomics supports NRC understanding that it is fundamentally important to our country to move forward decidedly on nuclear power expansion.

Thank you for this opportunity to provide our views on this important subject.

CHAIRMAN KLEIN: Thank you, Arkal. Finis?

MR. SOUTHWORTH: Thank you, Chairman Klein, Commissioner Jaczko and Commissioner Lyons. I'm Finis Southworth, Chief Technology Officer of AREVA NP, Inc. I'm pleased to be here this morning to discuss our future plans to support high temperature gas cooled

reactor technology which is a part of our long term strategy for the development and deployment of new generating capacity.

As an integrated nuclear energy supplier our business strategy is based on three fairly simple objectives: one, satisfying our utility and operating customers; two, strengthening our technology leadership; and three, anticipating future trends in CO2 free energy markets.

In the U.S., AREVA provides nuclear energy plant services, components, fuel and transmission and distribution to the current fleet of operating power reactors, also to the U.S. Government and other customers. We also know an expansion of the use of nuclear powers as an essential element of our future non greenhouse gas emitting power generation in the U.S. Next slide, please?

AREVA's near term priority in the addition of new nuclear generation is the deployment -- all apologies to Arkal -- of advanced light water reactors for base load capacity. As you know, we are currently constructing our Generation III EPR reactor in Olkiluoto in Finland and in Flamanville in France. In the U.S. we are working also to deploy the USEPR. Next slide, please.

That's the last light water reactor I'll show. On December 11, 2007, as you know we submitted our application for design certification, which is currently in the final stages of acceptance review by your staff. We're also

working with customers to prepare four combined operating license submittals.

In the medium term, AREVA also foresees significant market needs for light water reactors beyond the EPR. To address these perspective needs, we are developing a medium sized reactor in partnership with Mitsubishi Heavy Industries. We are also developing a medium sized boiling water reactor, the SWR 1250. Next slide, please.

As I have indicated, high temperature reactor development is an element of our long term objectives. In order to meet global goals for reduction of CO2 and the climate change, the HTR may suit the electric generation and non-electric application markets because of its potential siting flexibility, i.e., inherent safety and smaller capacity than our LWR offerings.

For the HTR to be competitive, however, two conditions are needed. One is the stable and imputed or actual cost of CO2. The second is continuing higher oil and natural gas prices. In our view, both are going to be true. As an element of that, mass production of hydrogen may, beyond the large production that's growing now, may also evolve in the coming two decades. Nuclear may be needed to help produce that mass hydrogen production.

High temperature reactors presently in two variants; a pebble bed

core and a prismatic block core. We have considerable background in both technologies, probably more in the pebble or longer anyway. More recently we elected to base our current ANTARES concept for study and design on the prismatic concept. Next slide.

This is a cartoon of that pre-conceptual design. We started this process by participating with General Atomics in the conceptual design of the Russian GT-MHR in the late 90's. AREVA has also been a contributor and participate throughout the Generation IV activities and the subsequent VHTR steering committee and the related project management boards.

During the past five years internally and with our affiliates, we've been developing this ANTARES concept for the high temperature reactor. Using our internal R&D funds, we developed this pre-conceptual design which allows us to examine trade offs and applying this concept to various markets.

We've also been working with various elements of the market to determine when and if they would be interested in such an alternative. We've also invested in internal research and development in such things as intermediate heat exchanger design and materials, advanced pressure boundary materials, steels and fabrication technologies as well as TRISO fuel manufacturing. Next slide, please.

We envision that the market for HTR is to gradually become stronger,

certainly after 2012 if not before. Particularly as that is when pressures for CO2 direction become greater, fossil fuel prices continue to rise and during this time large scale hydrogen production will likely increase as well as synthetic means of producing liquid fuels, such as kerogens, from oil shale or others.

We see it as likely that significant markets will exist by 2025 for the diverse process heat applications. In fact, offsetting fossil fuel consumption and non-electric gasification is probably the most compelling promise of high temperature reactors. They are uniquely suited to supply process heat as illustrated in the next slide. Slide seven, please.

Here you see one possible variant and all I've done is shown a loop diagram with an indirect combined cycle and then down the right hand side a table from high temperature to lower temperature of various process heat applications that you might apply this capability of the prismatic gas cooled reactor to.

Our investigation in ANTARES is designed to see if we can meet these future markets and our vision is ultimately the deployment of number of such reactors worldwide with a significant fraction of those plants hopefully in the U.S.

Our plans, however, do not involve near term engagement with the NRC and our specific ANTARES design; however -- last slide, please -- we

believe that early and continuing industry engagement in design and licensing strategy are essential to the future deployment of these reactors.

AREVA therefore intends to participate in broad industry programs associated with the development of the technology and related regulatory approaches in preparation for U.S. certification and licensing of our HTR design in the coming decade. In this regard, I would like to say a few words about our support for the NGNP program.

In our view, the costs overall of developing a new reactor technology can be prohibitive for a single company or perhaps even for a single country -- the investment required for research and development and first of a kind engineering, manufacturing capacity and other infrastructure costs for international preparation, such as that envisioned in the establishment of the GENIV international forum.

Moreover, a government industry partnership that is vital to address the goals of this advance the need for technology. For prismatic HTR, demonstration reactors are required to overcome these various technical, infrastructure and licensing hurdles for the first of a kind power technology in the U.S.

The NGNP can potentially accelerate therefore the commercial deployment of this technology by reducing this perceived risk in the U.S. AREVA therefore believe that NGNP should be aggressively pursued.

Markets for this technology are now emerging, especially in process heat production. You've heard from Fred. He's a strong example of that, maybe the largest that I've talked to, but not the only.

Given the long time needed to bring any nuclear and chemical technology to market, we must now start to make steady visible progress in order to create the market confidence that there will be some alternative to meeting their energy needs in the 2020's.

To conclude, AREVA currently supports the entire fleet of the current 104 reactors in the U.S. Internationally, we are now building new nuclear plants. In the U.S., we have plans to build new nuclear plants and we intend to be a large part of the nuclear power resurgence in the United States.

High temperature reactor technology is a part of the energy technologies we should be working on now to achieve future national energy goals, but in the long term, we anticipate the commercial deployment of our high temperature reactor designs and engagement of the NRC at an appropriate time in that process. Thank you for the opportunity to talk to you.

CHAIRMAN KLEIN: Thank you, Finis. John?

MR. GOOSSEN: Good morning, Mr. Chairman, Commissioners. My name is John Goossen. I'm the Director of the

Science and Technology Department at Westinghouse, our central R&D organization and we have responsibility for next generation reactor designs.

I'm going to talk about IRIS and 4S; IRIS is being led by Westinghouse, 4S by Toshiba, but its part of our broader portfolio of reactors: the AP1000, the ABWR and we participate in the Pebble Bed reactor as well.

Let me talk about IRIS first. International Reactor Innovative and Secure. This program was started -- slide three, please -- this program was started in 1999 under a contract with the DOE. It's an advanced integrated light water reactor, 335 mega watts electric, and it has a four-year fuel recycling period. It's been designed for safety, so we've removed a lot of the accident conditions be designing it that way.

It's part of the GNEP program for the grid appropriate. If you go to the DOE website, you will see this reactor posted. And the design certification testing program is under way with the Italians. Next slide.

This has been truly an international program from the beginning. It has nine countries, 18 organizations, including industries, labs, universities and a power producer that's working on IRIS since the very beginning. Between the groups, we estimate there's been $100 million invested in IRIS up to this point in time through these different organizations.

Slide 5 – IRIS enhanced safety. As I said, it's been designed for

safety; seeking to eliminate the accidents rather than trying to cope with them. We made a simpler design. We think it will reduce the cost. It's reduced a number of safety systems. They're now passive. We have five passive systems and the core damage frequency is the order of 10 to the minus 8 per year, which in comparison to the current reactors are 10 to the minus 5 or 10 to the minus 6. Next slide.

It's the type of market that we're looking at; small developing countries which have limited power needs and grids. Limited financial resources and capital at risk. It has possibilities for cogeneration and desalination and some process heat applications. Several countries have already expressed interest. Most of these are part of the consortium right now; Croatia being the one right now that's really been talking to the DOE and to the NRC.

The schedule. The preliminary design was completed in 2005. Pre-application licensing is now underway. We'd like to complete the design certification testing by 2011 and that's working with our Italian partners. Submit the design certification application in the first quarter of 2012 and try to obtain the final design approval in 2014.

We believe if we meet this type of schedule, we would be commercially able to deploy in 2015 to 2017 with potential customers I talked about before being the first overseas.

The licensing status. As I said, we have completed parts of the pre-application; design description has been completed, preliminary design safety analyses, planned testing program, integral testing scaling. That's been the biggest part of this testing is the integral relationships for this reactor with all the components being inside the reactor. Test facility is being built and designed in Italy and we have a test matrix put together.

The Croatia Regulatory Group is working on the Multinational Design Evaluation Program. They're overseeing the tests that are going on in Croatia and interacting back with the NRC on those tests.

More of the status. Plant submittals for 2008; conformance with the regulation, the Standard Review Plan; revised plant description. There's been changes made in the design since it was originally submitted. We're working at risk informed licensing. We believe that the emergency protective zone can be reevaluated for this design because of its inherent safety that might be able to be placed closer to populations.

We put together a QA plan and we're completing the scaling analyses right now. The DOE has proposed and we are very thankful for this for the fiscal year '09 through '13 a budget which would help us with the licensing and help with the interaction with the test in Italy as part of the GNEP program for the grid appropriate reactors.

What we need or like from the NRC is revitalization of the pre-

application process. It's been kind of on hold for about a year, year and a half because of the testing. We've been putting together a test matrix and working on the layouts for the test. We have scheduled a meeting now for early April to begin those discussions again and we would like you to continue working with Croatia on the MDEP program. We think this is important for this type of reactor because it is so multinational.

And we would like to coordinate with the DOE providing sufficient resources for the IRIS final design analyses -- or design approval.

I'd like to shift gears now and go from water now go to sodium and talk about the 4S design, which is being led by Toshiba. The 4S is super-safe, small and simple. It is -- going to slide 12 -- it is a sodium cooled fast reactor. It has a 30 mega watt thermal capability and it's rated at 10 megawatts electric.

Features are its passive safety. One of the key attributes is it has a 30-year refueling cycle. So, this is ideal for remote areas for developing countries that we want a long fuel cycle for. Low maintenance requirements and high inherent security and safety, I should say because this is completely underground; the reactor. If you go to the next slide; slide 13.

The development team has been broad. Toshiba has been working on the safety analysis and R&D designs, 4 to 4S licensing. Westinghouse is helping Toshiba with the licensing activities. CRIEPI has been supporting

us through funding and is working on the safety analysis, the seismic isolation system.

COMMISSIONER JACZKO: I'm sorry, who is CRIEPI?

MR. GOOSSEN: They are the Central Research Institute for Electric Power Industries. It's similar to the EPRI the U.S. I'm sorry; I should have spelled that out more.

And the fuel is actually being designed -- the metal fuel is actually being designed by Argonne National Laboratories. So it has been very diverse team.

If we move to slide 14; the type of market; remote areas that require small power. Galena, Alaska has indicated that they would like to be the first customer for this design. Other applications would be remote areas; mining type of organizations would be interested in this type of small reactor that they wouldn't have much maintenance concerns. They could just let it operate.

It does have process heat applications. It has an outlet temperature of around 500 degrees C, so it's ideal for oil sand/shale mining, desalination and for hydrogen production.

The current status of the licensing is we had our first meeting with the NRC in October of 2007 and familiarized the NRC with the design. We actually had a scale model that was brought in that showed the operation of

it; how the reflector worked and the shut down mode.

The next meeting is actually scheduled for tomorrow. There's an all day meeting that will talk more about the design and we'll talk about the fuel. That will be the focus for that meeting.

Further verification tests will be identified through the pre-application review using the PIRT process, which we've started. And application for the final design approval is planned for 2009. We are on a very aggressive schedule with this due to the customer's desire to have this on line.

The test facility for future tests. Toshiba has built a sodium component test facility, which I happened to visit last year. It was completed in 2007 and they just unveiled it yesterday in a ceremony in Yokohama. So, they're ready to start testing on this. And they'll use this for components such as the electrical magnetic pumps and some of the major components, such as the double-walled steam generator tubing.

The proposed licensing approach, which is slide 17. This was proposed to the NRC in the meeting we had back in October. Looking for final design approval application in 2009. We're in the first phase right now, which is design familiarization which will take us through mid this year. Submittal of technical reports for phase two and then the final phase three being the final design approval application which would be first quarter of 2009 and extending through 2011, hopefully running in parallel with a

combined operating license starting 2010 and running through 2012.

Where we would like NRC's support is to continue pre-application review. The process familiarization of design and key issues; review of technical reports; supply additional information as needed at the request of the NRC; and help provide sufficient resources and support for the FDA process.

We believe this is important to do this now for the sodium pool. The resources as we all know in that area are limited and I think there was a comment made that we may have to go to some of the nursing homes to find these individuals. So I think it's key to the success of the sodium pool that we act now for both the industry and the NRC for capabilities and this is a good lead-in for if we're looking at the advanced reactors like the ARR in the future.

So, thank you very much, gentlemen.

CHAIRMAN KLEIN: Thanks, John. Well, obviously, this was a very diverse panel. A lot of non-light water reactors under discussion and we'll start the questions with Commissioner Lyons?

COMMISSIONER LYONS: Well, I would only second your comment, Mr. Chairman, that it's a very diverse panel and I hardly know where to start. However, needing to start somewhere, Ed you proposed or you used dates that would have commercial operation. I believe it was

2013; something of that order in South Africa.

I'm curious in the confidence in those dates and whether there's any specific tie between what you're doing and NGNP?

MR. WALLACE: First to the dates. The 2013 date that I used was initial criticality. It's about a year to 14 month program of slow start up opening inspections before commercials so our commercial date is probably more 2015 when we completely release it for commercial operation.

The challenge of that is significant for a variety of reasons. It's a first of a kind reactor. We're dealing in a regulatory process in South Africa that is different and less well defined than here. And I think something that is affecting all of the reactors whether they're advanced or not, we see real challenges in the supply chain for heavy vessels and things like that and meeting schedules.

So it is the schedule with all the foibles that normally come with the schedule for something that you haven't done before. So I will characterize it in that manner.

The other issue -- substantial amounts of work in the reactor its auxiliary safety analysis and so forth; all of the fuel work is directly applicable to the NGNP. It's also very consistent with the papers that we intend to submit by and large in the 19 that I mentioned in the design certification pre-application period because they deal with principally generic

matters.

In some cases we are dealing with high temperature materials and I'm sure for slightly different designs there may be a few other materials, but the fundamentals of high temperature materials of graphite, the codes and standards for graphite and so forth which are all being developed for the purpose in South Africa are transportable to the applications in NGNP and reflective of what we would also include in our pre-application work.

I think those graphite standards and the ASME work that is ongoing today are critically important to establish an industry consensus foundation for design inspection, testing material specifications and the like for reactor graphites today.

COMMISSIONER LYONS: Thank you. A question for Dan and Fred. I was curious if you could discuss a little bit about what the industries that you represent are doing now to support NGNP. And then to the extent that you might be willing to comment, how you see the time scales as proposed for NGNP -- well, frankly being consistent with what Ed is talking about. Since Ed is talking about dates that are well ahead of the 2021 that NGNP is aiming for?

MR. KEUTER: First question. What Entergy's doing for probably the last five years. In fact, I met with you before on seeking funding, but we're providing technical input into almost all of the vendors

into Idaho National Lab, into the Department of Energy and we've pretty much had a fulltime person working on this trying to get the industry inputs, the needs into it, technical information into it. That's what we have been doing.

What we are trying to do now is broaden that support into an alliance. Not -- well, it's not the same as, but not too different than what we did for NuStart and try to bring an alliance to do this together versus us going forward individually.

And with that, we're trying to bring in the chemical companies and refineries. So, we're kind of supporting Idaho National Lab and doing that effort.

As far as time frames, a target out there of criticality by 2018, Energy Act by 2021. If you look at the pure technical ability and follow what's happening on Pebble Bed, technically and physically, you've got to design and construct it by 2018.

I think the real question is the licensing process. When you add that on top of that, so we're assuming that we have a very efficient and timely licensing process and if we have that, we do think we can make it in 2018 to 2021 time frame.

MR. MOORE: Commissioner Lyons, I guess let me just start a little bit -- perhaps a bit of a background about why we're interested. We're

interested because obviously as a company and as an industry we have very significant issues that are facing us and I want to reemphasize the fact that we view that energy and feedstocks are inseparable.

The fact of the matter is most of our country views energy as oil and natural gas. The fact of the matter is oil and natural gas is our feedstock. And so, they truly are inseparable.

Our support is largely to try and help the NGNP group understand how this technology might best integrate with a petrochemical complex. First of all, it brings something that is inherently valuable to us, which is high temperatures so we can produce 1200 and 1500 pound steam which are critical to our processes.

The other thing it brings to us is the fact that due to the smaller megawatt thermal, megawatt electric design characteristics, one can envision that these would be modularized and you would have multiple; four, five, or six that might integrate at a large petrochemical site. You have to understand that in large part, we produce power as a by product of the need to produce reliable steam.

If you take a cracker that's cracking ethane and you take steam away from it, it crashes. So, we have to have reliable steam. One of the advantages is, again, if you have multiple small reactors you can be refueling one, you can potentially trip one if they're tripping at a rate of .7

times year and you would still maintain your reliable steam supply. So that's really important.

So, ultimately what we're -- what I view our role today having been and what it would be in the near term is to continue to help this group understand our heat and material balances generically and how they might be applied and integrated into any typical petrochemical complex and ideally to influence a design. Size is important to us. Too big makes it not very useful to us. So, that's our role.

Relative to the time scale, to be honest, I'm very new to the nuclear regulatory process. My desire would be that we can push this along sooner than later. The realities of the fact that we continue to rely more and more on imported oil and natural gas. We're seeing more LNG terminals built. The U.S. is going to rely more on imports. Those, in my view, tie directly to national security.

At what point do we start worrying about our children and our grandchildren and how much of our basic raw materials -- chemicals that we rely on for food and pharmaceuticals and the like are going to have to be imported because we're unable to support our industry here in the U.S.

MR. KEUTER: I will just follow a comment that was in my oral statement, but I didn't make it during my slides. Our CEO, Wayne Leonard, last year in a presentation to our 2007 annual stockholder's meeting noted

the potential of high temperature gas reactor technology in traditionally non-nuclear applications.

His message in the presentation highlighted the fact that there are solutions to our energy needs that are compatible with our environmental stewardship, but we have to make it happen. I believe this message is relevant today because we're not doing it because we think we're going to make a lot of money. We're doing it because we think it's the right thing do for the country and the environment.

COMMISSIONER LYONS: I'm over my time.

CHAIRMAN KLEIN: You may get another chance.

COMMISSIONER LYONS: I'd appreciate that.

CHAIRMAN KLEIN: Well, starting my question with Mike. Realizing that you've got a diverse background both academic, NERAC, and ACRS and you don't speak for any of those.

MR. CORRADINI: They won't let me. The University I speak for.

COMMISSIONER JACZKO: I would appreciate you speaking for.

CHAIRMAN KLEIN: Well, we heard this morning about the approach to licensing and Dan mentioned that as well; the licensing uncertainty with these new technologies. Could you comment a little bit

from your perceptive how you think one should proceed with the licensing of a new technology like NGNP versus Part 50, Part 52; hybrids of those. What's your thoughts on how we proceed, again, with no compromise on safety?

MR. CORRADINI: I guess in preparation for this, I look back in history. So, I guess I'd suggest the Commissioners look back about 20 years. The ACRS sent a 7/20/88 letter to Chairman Zech essentially on advance reactors; so 20 years ago, plus or minus a few months. And almost all the same issues that we talked about here have been laid out there. So, I guess I was prepping for this so I make sure I don't -- if the members get to me that I don't kind of misinterpret past precedent, but I guess on a personal basis the thing that was mentioned -- I guess I'm going to key off of what was said when Secretary Spurgeon was here and you were asking questions of him.

I don't think necessarily that 50 or 52 is the issue to worry about because there is a whole range. I think Commission Jaczko made this point. There's a whole range between those. I think it's the next level down on the technical requirements. Do you want to take a deterministic approach with exceptions such as you might have seen in the licensing for Fort St. Vrain?

Do you want to take a risk informed or do you want to blend it? My

personal view - personal - and so, only what I've been thinking about is I think some sort of blending of that has to be done. You see that already now and how pragmatically you're going forward with advanced reactors; GENIII Plus, right? The ESBWR which we're in the middle of; the AP1000 which has been certified, et cetera.

And so you see this blending where you want to look at some sets of accidents within the design base that you choose to worry about and design for and then simultaneously look from a probabilistic standpoint what the risk is and how you might have to modify what you worry about. Particularly with a new technology, you're not going to necessarily pick deterministic sets of accidents nor are you going to do a PRA, whatever level of PRA and use those independent or use those exclusively.

You're going to have to look at both and decide by these two tools what are the things you're worried about; what fits into the design base; what is outside, what you want to protect from a defense and depth standpoint.

So, I think it will be a blending more in technical requirements. I guess I don't -- except for the structure on how you go through the licensing with 50 or 52, I think that next level down is quite important. So that's my quick answer.

CHAIRMAN KLEIN: Thanks, Mike. A question, I guess, for the

chemical or industrial side. And you may not have gotten to this point yet, but do you envision operating the heat source yourself or having outside companies run them?

MR. MOORE: At this point, I'll offer my own personal opinion. I do not envision the industry taking ownership of the technology or operating them. It would be analogous to the relationship we have today with an external utility.

The reality is just that folks on either side of me have been in this business for a very, very long time and I think that most in the industry, if not all, would look at the industry to provide kind of an owner/operator arrangement and we would look at an economic fence line arrangement.

Now, one of the advantages of a high temperature gas reactor is the fence line is real close. When you're looking at transporting high temperature process heat at 800 degrees, you're looking at high nickel alloys or whatever having a closer less heat loss, less capital cost; OSBO capital cost. Therein lies some advantages, but I don't envision the industry being owner/operators.

CHAIRMAN KLEIN: Thanks. Ed, just an update. When do you expect to have your design cert to the NRC for the Pebble Bed?

MR. WALLACE: Our current plans are in 2010.

CHAIRMAN KLEIN: 2010?

MR. WALLACE: Yes, sir.

CHAIRMAN KLEIN: Okay, thanks. Commissioner Jaczko?

COMMISSIONER JACZKO: I guess I'll just start with a comment and then I have a couple of questions. I think the one thing to keep in mind -- we are facing very limited resources for all of this activity, to be quite honest. The one project that we really are prepared to support although really not even very far into the future is NGNP.

Right now in 2008, the budget -- I went back and looked at the budget last night and what the Commission had approved which was to move forward essentially on NGNP activities and any activities that were dealing with advanced reactors that didn't have a applicant or a buyer or a utility involved were things that the Commission were not intending to support and I think certainly that's the case in '09 and I believe although staff is working on 2010 so that's something that is up for discussion.

But that's been the Commission's position for a long time and hearing a lot of the discussion, I certainly -- not as a regulator, but would share some of your interest and your concerns and desire to move this technology forward, but for to us invest the resources to be able to deal with multiple advanced reactors requires a tremendous investment here.

We are already busting at the seams, so to speak, with our personnel and are probably getting close to the right size that we want to be for an

agency. We have a long queue of light water reactors in the pipeline to be licensed. So, this work will have the fit somewhere within that.

So I raise this not to necessarily be the one who diminishes the optimism here, but really just to say that NGNP is the way we're probably going to go forward. So, the more that you're involved with NGNP, the more that you provide that direction through NGNP, the more likely we will be able to process one or many of these applications in a reasonable time frame.

So, I think it's something to keep in mind, and as I said, these are ultimately not our decisions. We request budgets and then Congress approves our budgets. So, a lot of those decisions are made beyond us. You certainly heard from Dennis earlier that DOE is limited in their resources as well and the allocations they've been given for their budget.

So, a lot of this is going to have to be, I think, focused around NGNP.

Having said that, I do have a couple questions. Maybe, Fred, this is following up a little bit on the question that the Chairman asked about the business model that you would have if you were to pursue a project like this. And I guess the question I had in the way expands on what you said which largely seems to be the logical thing is that you'd have somebody else's operator and perhaps owner.

To what extent do you see Dow involved in the financing of a project like that or would you simply be there as a customer with a guaranteed

purchase?

MR. MOORE: You're way in front of where Dow is in any of the thought process. So I will go back and I will say -- I will share with you my opinion. My opinion is that in all likelihood it will end up as a commercial fence line arrangement where you would agree on some economic characteristics for that contract to supply process, power, heat, potentially hydrogen.

And again, I'll just take an opportunity to very briefly to reinforce -- a generic ethane cracker in the life cycle of most products is probably at least 50 percent of the energy consumption if not more. Flanging up a high temperature gas reactor to that process, first of all, it gets within about 150 degrees C of actually being able to crack ethane with no additional fuel.

Secondly, if you assume that you supply the power and process heat alone just from that and you just top off with natural gas to get to the temperatures you need for cracking, you've reduced the greenhouse gas potential for that process by 90 percent.

COMMISSIONER JACZKO. And again, I don't this is necessarily the issues that are in front of us. Unfortunately, or fortunately, I guess it depends on how you look at it, we're a regulatory body and a lot of those decisions are really beyond the scope of our requirements.

For us what is most important is to see real concrete evidence that

there will be people who will submit a COL application to license one of these facilities because before we get to that point, we need to do research. We need to hire individuals. We need to do all the planning that would go into that process

That's the signal that I don't see here. That's the sign that I don't see. I ask the question about what your role would be in the financing because certainly from what you were suggesting is you'd like to have four reactors to be able to use, two, to have two backup.

That's a potentially costly investment that would have to be made by someone who is willing put up the capital to go forward and get those facilities built and licensed. Again, in my view, that's been a substantial threshold to reach and for the private sector to be willing to invest in.

So here again, the focus is to try to get a better understanding of what we're going to see in the future and what is the reality that there will be applicants who will come in for COL's to build and operate some of these facilities.

I don't disagree certainly on some of the advantages that can be gained by this and I think they're all very worthy and certainly applaud your company in the efforts it's making, but in term of planning we need something more concrete right now than I see.

Certainly anyone who is willing to comment on that.

MR. MOORE: Just one more comment. The fact that you have more assets, more individual modular units to produce steam reliability doesn't mean that there's an economic penalty from having that because basically what you're going to do is set up with a Brayton Sterling cycle and you're going to produce power.

So you're going to be able to move power to the grid. So it is not like you're going to be making energy and tossing it out the window. I don't think that necessarily leads to an economic penalty in that respect.

COMMISSIONER JACZKO: And I certainly don't think that -- I guess the question is right now we certainly have a large number of people moving forward with light water reactor technology predominantly for electricity production and there are certain advantages to that. One, in five or six years we will have gone through that process; have that process fairly well established.

As you heard and many of you have said, licensing and regulatory certainty is an important part of the process. I expect once we're through with this current generation of light water reactors have reduced to a very small regulatory risk that's involved in any of these technologies.

So, if we're going to go the route of the high temperature gas reactor it seems like the advantages are in the process heat and these other types of applications. And again, it seems that so far there's interest, but I don't

see any concrete examples of places where facilities are going to be constructed and sited and licensed and all of that. Like I said, that's what we need to see to move forward.

Certainly, if anybody else wants to comment. I don't mean to direct it strictly at you.

MR. SHENOY: Let me make some comments. I think what's happening in this country now is now the customers are going forward to buy a gas reactor because they like to see one operated. The last one operated was from so long back. And in order to see one operated, it has to be built and nobody wants to build the first one.

I heard many people saying I want to be the first one to build the second one. So the question comes up is: How do we have first one built?

COMMISSIONER JACZKO: And I think if I can answer that, that's what NGNP is for; is to build the first one so we can then demonstrate the technology.

MR. SHENOY: The current model is really one of alliance of end users and the vendors and that's really not going forward in my opinion, mainly because there's a significant amount of risk both in terms of where the funding will come from, will the DOE and Congress be able to continue funding year after year, and regulatory uncertainties.

And so given that model, it's important in my opinion to be able to

have a government take a more leadership role to build a complete prototype of a gas cooled reactor on its own like we had done the 30 years back. The first reactor built in this country we were not looking for the customers. The government, AEC at that time, took the initiative to build one and demonstrated it and showed it to the industry, so the industry went forward. The last 30 years of gap in our nuclear history is a long time.

COMMISSIONER JACZKO: I guess what I'm hearing from you then is that you don't see a public/private partnership as a way to move forward. You see it more as strictly a public project and that the private component won't necessarily be there?

MR. SHENOY: That's my opinion. If the private people have to come in to it, they want to see one operated. This is not only national; it's international. I have been to many of the IAEA meetings, 80 or more countries want to go for a reactor. They understand all the safety aspects of the gas reactor, but they'll say, "Show me one operating."

COMMISSIONER JACZKO: Well, I appreciate that and I'm well over my time. So, certainly we'd do another round if anybody else wants to comment on that. I'd be more than happy to hear from anyone.

CHAIRMAN KLEIN: Commissioner Lyons?

COMMISSIONER LYONS: Well, the direction that Greg was going really was the direction that I wanted to go too. So, let me just

continue Greg on the direction that you started. I very much appreciate your comments, Arkal. And I appreciated Ed's comments earlier and I understand Ed's role, I guess I would say with a specific non-U.S. customer.

I guess I would be curious probably particularly for Finis since you haven't commented yet or for others if you want to jump in on where you see the prospects for commercialization of the high temperature gas technology separate from NGNP, which was I think some of the direction that Greg was going.

That separate could be other international interests. It could be other domestic interests.

And a similar question for John down at the end. We heard a little bit from Dennis this morning about their focus on grid appropriate technologies. Now, as he said, that has been an unfunded interest, but that's about to change.

It strikes me that to the extent that so-called good appropriate technology were to become a priority and recognized by Congress, et cetera, that could provide some of the motivation to the NRC that we would need, and hopefully funding too, to move ahead in licensing some technologies that specifically don't have a U.S. focus.

But until then, I see that our role needs to maintain that strong U.S. focus. So, Finis -- maybe Finis and John can comment and hopefully I

won't be too much over my time and I think it continues the path you were on, Greg.

MR. SOUTHWORTH: I'd be happy to, thank you, Pete. Let me just say over the past several years in addition to spending maybe 70 or so million on developing this ANTARES design, that was really a thought for design process to see what the capabilities and potentials were and if we were to go forward with a more aggressive design effort and get into preliminary detail design, we would adjust it somewhat. I'll just say that up front, but certainly learn a lot about materials and the flexibility of the technology.

On the other side, we've been working with a large number of potential industries like Dow, but I'll say others also, both in the chemical, petroleum, steel, cement and compressed gas companies. I can't name any of them because we have agreed not to talk about who they are in particular over the past couple of years.

I guess a couple of things occur in all of those discussions. One is this is important. We've got to do something. If we had one today, we'd buy it, we'd use it, we'd sign a contract for power, whatever; that's one.

Certainly, the compressed gas companies that's the case. Anything to get an edge in that very competitive market, for example and growing 13 to 30 percent a year in hydrogen. But they all say they're not operators.

They're not owners of nuclear. A different business model will be needed to work with them and we see that.

The second is in terms of technical requirements; some of them are very tightly coupled, like the ethane crackers. Others can be fairly uncoupled. An obvious example that I mentioned in my talk was the shale process for in situ retorting of kerogens in the oil shale. If that process works out and they approve the process, that's a very uncoupled process.

If you shut your reactor down for three months; so what? It's a three year process of heating the shale oil in situ. So there is a range of issues that affect feasibility and so on.

I'll just say that we're actually putting a larger amount of R&D dollars now in looking at how to apply this technology because we do have great deal of confidence in our ability on the nuclear technology. What we don't have confidence is do we understand how to apply the technology to say to the ethane cracker or the cement plant or others.

So, I'll say that, for example, one of our largest investments in R&D that's been over the past couple of years and will continue into the next decade is in hydrogen production technologies because we want to see how to tightly connect, what are the ideal technologies and where are the technologies going that will connect with nuclear power rather than having others who know nothing about nuclear power just developing that

technology.

So we are partnering with others. I won't tell you what the technologies are, but I'm just telling you it's a huge investment for us. Another one that I'll mention that we've been investing in is coal to liquids; how to eliminate production of greenhouse gases during the production of coal to liquids. Liquid fuel shortage will be a significant issue in the next decade. Certainly will grow and many are interested in this area, so we are investing in how to do coal to liquids with nuclear power.

So, that having been said, the point is very well taken. None of these end users are currently ready to step up. They're not going to tie their name to nuclear per se, but we need a new business model also in order to go forward with this.

To some extent, what you heard Arkal say I think -- and I apologize for the term, but we're all playing a game of chicken. Who's going to step up and do this? And I think to a large extent, the vendors are going to have to step up; the government is going to have to step up. I would not say that the NRC has to lead the way; they really shouldn't, but DOE should lead the way and then the NRC should be aggressive in helping meet those who step forward. That would be what I would offer.

MR. GOOSSEN: I think it's a very good question. I don't believe that an IRIS size is going to be the first initial light water reactors in

the U.S. They're going to be looking for base load big plants.

With that said, though, when you're looking at developing countries such as Croatia, this is the size reactor that they need. And the influence, as you know the NRC has for the rest of the world to see that they're involved in looking at the licensing of IRIS carries a lot of weight when we talk to places like Croatia to get something like this started.

And I believe once we get these started internationally, there could be a market in the U.S. for this size reactor. There is some process heat applications like bio fuels and that you can use IRIS. The U.S. Air Force is looking for smaller reactors. Maybe IRIS is too big for all of its power, but it can be used for other things for that type of application.

So, there are areas in the U.S. where IRIS can be used, but I think it's important if the NRC could stay involved and keep it in the forefront for first builds that would be international because it is very important for us to see that.

Also I think with the 4S as grid appropriate applications down the line and there are customers in the U.S. and the remote areas that would like a design of that size. So I think it would be worth the NRC to have some investment in looking at that technology going forward with some resources to keep in the game because as I said, the resources are limited right now and we need to keep them involved in these type of designs because when

we do get to the future, we won't have these resources. We won't have this capability.

So, I don't know if I answered all your questions.

COMMISSIONER LYONS: Well, yes, you certainly helped. My main point was to the extent we want to talk about grid appropriate short of having an actual customer. And Galena, while they've expressed interest, I think I'm correct in saying they are not exactly in the nature of an actual customer, right?

From the standpoint that the NRC is fee supported or largely supported by fees, I think we need to be able to show a clear rationale for why we go into support of any one of these reactors and that could come from a government focus starting within DOE on grid appropriate reactors recognizing that that doesn't mean necessarily U.S. In fact, it probably means non-U.S. But, until we see that happen, I have difficulty seeing how in face of face of tremendous pressure that Greg has referred to, how we do it within the framework of fee basing. But I'm way over my time and I should shut up.

MR. GOOSSEN: I do appreciate it. It's resources for the whole industry now being stretched. But I do appreciate it.

CHAIRMAN KLEIN: Well, I think as Finis and Arkal and others have indicated no one wants to be first. They want to be second. So,

someone will need to be first somewhere and at the current rate we're going, it may by South Africa.

If you look at the schedule for which you're on compared to NGNP that one may be operating before any others. And I guess if you look at an approach for the fusion community where everyone sort of internationally focuses funds, I don't see that same effort coming in -- that same funding level coming in for NGNP. Have you seen that in terms of interest from Entergy's standpoint?

You look at NGNP going forward it looks like it's mainly DOE funded at the moment.

MR. KEUTER: And currently, it is. I listed out our priorities and advanced light water reactors is definitely the priorities of the electric utility industry, but the alliance that we're trying to put together is trying to put together this public/private partnership. And it might start off at 20% industry and 80% government and eventually get into construction of 50/50 and to that point.

But we are trying to put an alliance together to pull -- the industry just isn't one person. You've got the reactor vendors. You've got the reactor operators like ourselves and then you have the end users. But I think its going to have to bring all those together into an alliance so we can group together to be the first one with government support, especially in the

beginning, but that is the intent of the alliance.

CHAIRMAN KLEIN: How big is the alliance currently?

MR. KEUTER: We meet periodically. I would say it's 10 to 15 different companies and a lot of them aren't willing to raise their hand yet and be publicly recognized. There's two of us that do, plus the reactor vendors. So there's a substantial number. It's just a step process that we're going through. And it's kind of like the chicken or the egg. If the DOE has some funding and we can support that and we can show the NRC that we are making progress going forward.

But there is definitely interest, but it's a diverse -- it's several different vendors, operators and users trying to get together. I don't think any of us can do it by ourselves and I don't think any of us can do it without some kind of government support.

CHAIRMAN KLEIN: Getting to the 4S. John, has anyone expressed significant interest -- we know about Galena. Are there others that have a strong interest in 4S?

MR. GOOSSEN: There's been market studies done of different communities in the Alaskan remote areas in mining areas. I don't know the specific names. I could ask our colleagues here because they know, but I don't have the names. But they have done a market survey of applications for it.

CHAIRMAN KLEIN: I guess when you're looking at that design, security is certainly an issue and then because sodium is chemically active, you have those kind of issues. I assume you're addressing those in your design?

MR. GOOSSEN: Yes, we are. In fact, the double-walled steam generator is a design that Toshiba is testing -- has tested and will continue to test and it has a monitoring feature with it to tell if there's any type of leak into the tubes or outside the tubes before anything would happen.

So with this type of design, it can eliminate the intermediate heat exchanger with this type of design. They are looking at it quite heavily and that's why they've built this test facility to look and test these components to make sure it's safe. So, they've made a commitment, a serious commitment to this technology.

CHAIRMAN KLEIN: Okay, great. Thanks. Greg?

COMMISSIONER JACZKO: Just one question I had. We've talked a lot about the reactor side of this. Obviously, with advanced reactors we're moving into different fuel supply and fuel disposition. To what extent does that -- for any of you who wants to answer -- factor in right now in your technology development into your discussions about licensing issues and all of these issues that we've talked about today?

MR. WALLACE: Let me start and hopefully the others will chime in. Gas reactor fuel, TRISO fuel in particular, has the potential for very high burn ups. And so the economics of backend reprocessing shifts some and the very nature of creating the TRISO fuel to begin with creates a very robust form. So, it's not easy to separate.

Because of nature of the reactors, you get an isotopic mix that makes it more challenging as well. So it's unclear to me whether or not that would necessarily be an answer for gas reactors.

The issue of disposal because of the relatively low power density of these modular reactors, you end up volumetrically with quite a bit of fuel for the number of megawatts that you get out, but there's technology development where, we're in the middle of the testing phase right now, that looks at substantial volume reduction of the finished spheres or it would be applicable to compacts as well to reduce the volume so that you could have a very compact permanent repository without disturbing the substantial advantage of the TRISO coatings for retaining fission products in the waste.

I think our energy is focused on that because I think the economics of the reprocessing will focus first on other kinds of fuel before they get around to gas reactor fuel.

COMMISSIONER JACZKO: Anybody else?

MR. SHENOY: The fuel performance is a very important part

of the gas reactor program. I think if you really look at it, the water reactors where you try to put any resistance to protect the fuel, but as in the HTGRs, at least the modular helium reactors, the fuel is sitting there and that's the most important element in the whole reactor.

The qualification of the fuel is very important and General Atomics had a facility to make this fuel in the past. We're decommissioned now and nothing exists there. And we had kind of a -- not manufactured fuel for the last 20, 30 years because there's no demand, but DOE has initiated an excellent program, the AGR program at Oak Ridge and we are helping out there.

And they are making some fuel and it will be qualified in radiation and ultimately when commercial reactors come into being, the thing that NRC needs to watch out is not the plant, but the fuel. Is the fuel that really going to be loaded every 18 months so the new load comes in and need to make sure that's in tact.

But on the other hand it, the performance of the fuel in the gas reactor is very interesting. Things happen so slow. I mean when it is so slow, like days. So you really have -- if you have some kind of a measurement in the primary circuit to do the gas, you know long before the fuel fails.

And so, I think the monitoring of the fuel, during the manufacturing

and the operation is the most important part. That's why the load should go away from licensing the reactor being the focus, to focusing on manufacturing the fuel and how do you operate the plant and what are the instrumentation you need.

So it is an entirely different animal in the sense that you would license a gas reactor both in the plant and the fuel.

COMMISSIONER JACZKO: Well, thanks. I appreciate that. I just have one last question for Mike; a two-parter. ACRS is going to be reviewing the NGNP licensing strategy or licensing framework in the next upcoming meeting.

MR. CORRADINI: That's an upcoming meeting. We had the staff come in with an initial draft of the report. There was some discussion with the members. We had questions back and forth, I think staff is -- and you'll talk to them today; I'm sure this afternoon. Staff is going back continuing to refine the report and also getting some industrial and laboratory DOE feedback on it.

COMMISSIONER JACZKO: Okay. And I just wanted to give you an opportunity to clarify when you talked about number 12, you were referring to Wisconsin's ranking in basketball.

MR. CORRADINI: Second in the Big Ten. Not for long; we'll be one.

COMMISSIONER JACZKO: I just wanted to make sure everyone was clear on that. Thank you.

CHAIRMAN KLEIN: Well, I would like to thank all the members for your participation. We probably have a lot more questions than we have time since we still have our third panel at 1:30 to hear from. But I would like to thank all of you for your comments today and you can tell we have a lot of interest and a lot of challenges ahead of us, but I think our glass is half full, it's not half empty. We just have to figure out how to proceed in a logical way. So thank you again for your participation.