Licensing of Advanced Nuclear Energy Technologies

Assistant Secretary for Nuclear Energy
Dennis R. Spurgeon

February 20, 2008

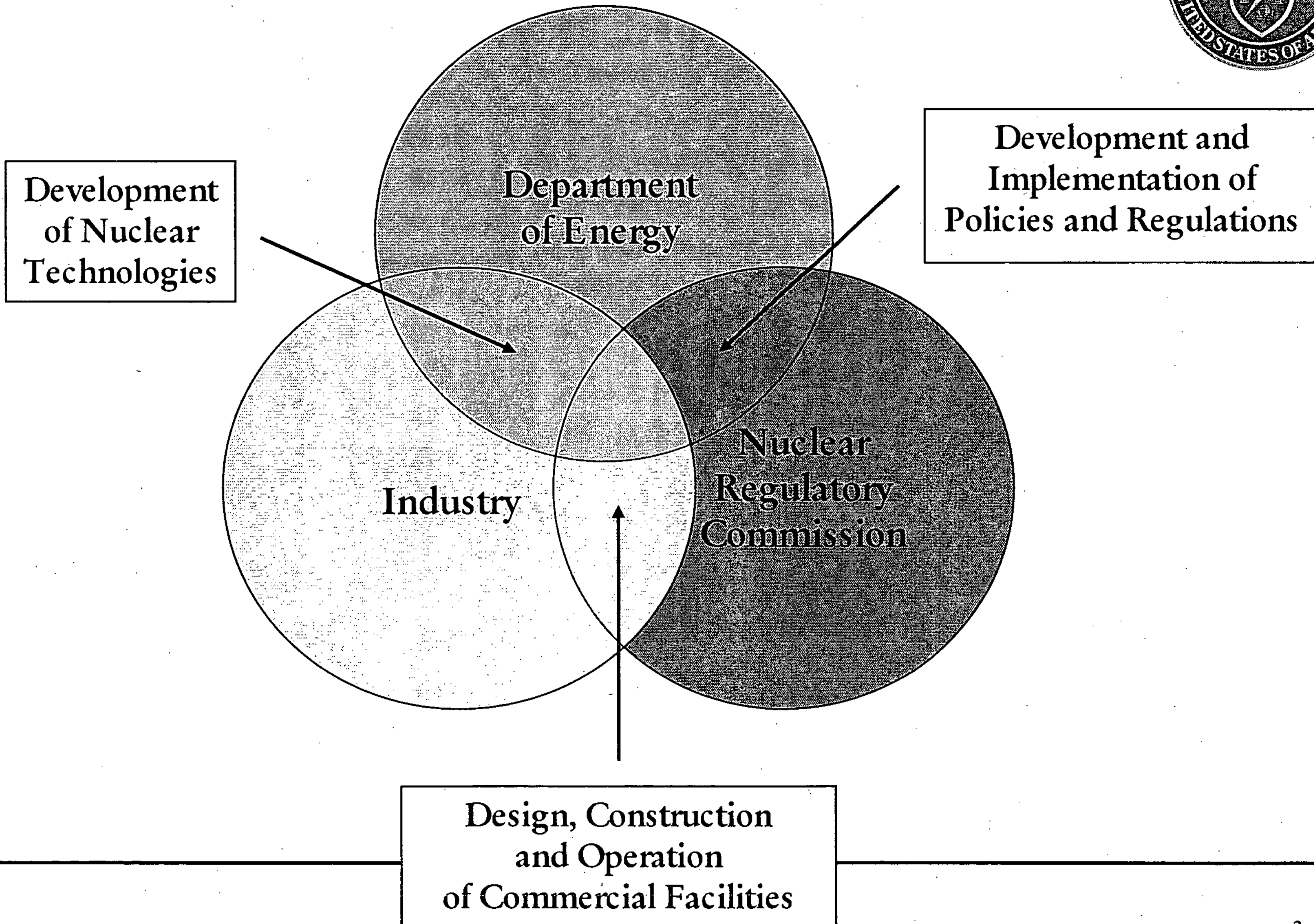
Enabling Use of Advanced Nuclear Energy Technologies

- **U.S. Department of Energy**...advance energy security through development, demonstration and promotion of scientific and technological innovation...

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

- **Industry**...commercialize new technologies and invest in and operate energy systems, including nuclear, as a responsible business...

The Big Picture



The Energy Future

- **The GOAL**: Improve energy sustainability and domestic energy security, reduce volatility of energy prices, while reducing environmental effects of energy production.

- **The Opportunity**: Increased use of nuclear energy

Advanced Nuclear Energy Technologies

- Advanced Light Water Reactors
  - The new fleet for electric power generation

- Next Generation Nuclear Plant
  - High Temperature Gas-Cooled Reactors (HTGRs) for industrial process heat

- Advanced Fast Reactors
  - Fast neutron spectrum liquid metal-cooled reactors for actinide consumption and nuclear resource sustainability

- Fuel Recycling Facilities
  - Deployment of technologies that enable recycling and consumption of long-lived radioactive isotopes

What are the Barriers to Deploying Advanced Technologies?

- Incomplete Technology Development
- Undefined Licensing Regime
- Cost Uncertainty

Removing Licensing Barriers

- Must establish an efficient and effective regulatory approval process for siting and licensing non-LWR commercial nuclear facilities

- Build-off of lessons learned from Part 50 and Part 52 processes for LWRs

- Reduce regulatory uncertainties for first-time applications for advanced nuclear energy technologies

Removing Financial Barriers

- Resolve licensing issues before project commitment
  - Prevent open-ended licensing process to avoid delays in construction and start of operation
- "Time to Market" is the key factor for economic competiveness
  - Long lead times prior to construction coupled with long construction times increase project risk and reduce economic competiveness

Focusing on High-Temperature Gas-Cooled Reactors

- **Growing interest**—the hydrocarbon industry sees HTGRs as an alternative to fossil fuels to produce high-temperature process heat.

- **Developing business model**—dedicated modular HTGRs co-located with, and providing energy to, a hydrocarbon processing facility

Can the nuclear enterprise (DOE, NRC & Industry) demonstrate that licensing of HTGRs can support a viable business alternative to fossil fuels?

- The opportunity to use nuclear power in this business sector will be missed unless the nuclear enterprise can answer this question

Action Required

- NRC and DOE, working together with industry, have a opportunity to develop and implement the policies and regulatory path for licensing advanced nuclear energy technologies that:

  - Ensure timely execution from a business perspective
  - Values innovative approaches to the regulatory process
  - Separates regulatory risk from commercial risk

- The development of the regulatory infrastructure for advanced nuclear energy technologies needs to occur as soon as practical

- NGNP licensing strategy report, mandated by EPACT 2005, provides an opportunity to establish a viable path forward for deploying advanced nuclear energy technologies

Next Generation Nuclear Plant Technical Issues and Licensing

February 20th, 2008
Michael Corradini

Background

- NGNP: a dual mission of electricity and process heat source by 2021 as authorized by EPACT 2005
- NGNP reviewed in 2005 (NERAC) and 2007 (National Academy Rev.)
- NGNP program funding has been problematic before FY08 delaying technical progress

NGNP Review (NERAC & NAS)

- Accelerate NGNP program to encourage industry partnerships
- Establish realistic technical goals (T_{GAS}< 850C; UO_2 Triso fuel kernel)
- Process heat => H2 flexible technology
- Use GENIV evaluation criteria to maintain NGNP connection to GENIV

NGNP Research Program

- **DOE and NRC have completed a comprehensive PIRT process for all aspects of NGNP technology**
- **PIRT => key items to address:**
  - **Fuel qualification testing (in-reactor)**
  - **Materials studies (graphite/structures)**
  - **Development of computational tools to allow for design & safety analysis**

NGNP Licensing Strategy

- **NRC staff and DOE staff are considering a range of options for a NGNP licensing approach**
  - **Part 50 or Part 52 licensing path**
  - **Deterministic and/or Risk-informed**

    (Review of white papers on gas-cooled reactor technologies)
- **ACRS to comment on approach**

Acronyms

DOE	Department of Energy
EPACT	Energy Policy Act
H2	Hydrogen
GENIV	Generation IV
NERAC	Nuclear Energy Research Advisory Committee (Established by DOE)
NGNP	Next Generation Nuclear Plant
PIRT	Phenomena Identification and Ranking Table
Triso	Tri-Structural Isotropic Fuel Particle Coating
UO_2	Uranium Oxide

Entergy®

The NGNP – An Essential Energy Source

February 20, 2008

Dan Keuter
Vice President, Planning & Innovations
Entergy Nuclear

The Priorities

- Current Fleet Operations
- Advance Light Water Reactor (AWLR) Deployments
- High-Level Waste Resolution
- Next Generation Nuclear Plant (NGNP)
- Global Nuclear Energy Partnership (GNEP)

Entergy's Perspective

NGNP is Essential Energy Source:

- Helps Reduce Foreign Energy Imports
- Reduces Greenhouse Gas (GHG) Emissions
- Preserve Fossil Fuel for Future Generations
- Nuclear Applications Beyond Electricity Production for Use in Chemical, Petrochemical and Fertilizer Industries
  - High Temperature Process Heat
  - Hydrogen Production
- Long Term Fuel Supply for Hydrogen Economy

Emerging Industry Alliance

- Interest in NGNP Shared by Others:
  - Technology Developers
  - Reactor Designers & Vendors
  - Petrochemical & Chemical Companies
- Representative Have Been Meeting for a Year
  - Development Needs
  - Development Path
- Memorandum of Understanding (MOU) Amongst Parties Being Developed

Alliance Acknowledges Challenges

- Technology Development
  - Fuel Development and Qualification
  - High Temperature Materials
- Industrial Infrastructure
  - Fuel Supply
  - Large Component Fabrication
  - Plant Design and Construction
- Licensing
  - Regulations for Gas Reactors
  - Dedicated Staff Resources

NRC PERIODIC BRIEFING ON NEW REACTOR ISSUES

NUCLEAR REGULATORY COMMISSION

February 20, 2008

Oral Statement: The NGNP in Perspective

Submitted By:

Danny R. Keuter

Entergy Nuclear

Good morning, Mr. Chairman and Commissioners. My name is Dan Keuter, and I am the Vice-President, Planning & Innovations with Entergy Nuclear. In that capacity I am responsible for evaluating and supporting the implementation of new technologies and concepts that can enhance the performance of our current nuclear fleet. My responsibilities also include the evaluation of new nuclear technologies beyond the advanced light water reactors currently under active consideration by the industry.

Entergy Nuclear is the second largest nuclear owner/operator in the U.S. We understand the demands associated with as well as the benefits of nuclear energy. As a company with a substantial vested interest in nuclear power, it is important that I begin my remarks about the Next Generation Nuclear Plant (NGNP) by reiterating the broad priorities that we use to guide our actions.

Our first priority, as you might expect is maintaining the safety and excellent operational performance of the current Light Water Reactor (LWR) fleet. There can be no compromise in this regard.

Our second priority is the deployment of the next generation of Advanced Light Water Reactors or ALWRs. The industry's interest in these deployments is considerable and laying the foundation for nuclear deployments through use of Part 52 is essential to any future growth of nuclear energy in the private sector.

Third on our list of priorities is achieving a resolution to high-level waste disposal. Our industry has adopted, by necessity, what I believe to be an interim solution to high-level waste. A permanent solution, such as a deep geologic depository is necessary if growth in nuclear power over the long term is to be realized.

Our fourth priority is development of the Next Generation Nuclear Plant (NGNP) and associated technologies. Although we currently place the NGNP fourth in our priorities, its importance and our interest in seeing it move forward in a timely manner should not be diminished. We genuinely believe that it is an essential element of the future energy mix in the U.S. and efforts to ensure its timely development should be initiated or continued as the case may be.

Fifth on our list of priorities is GNEP – or at least the domestic spent fuel reprocessing element of the GNEP program. The reduction in waste volume, in particular the long-lived waste products, coupled with the recovery of unused fuel make development the GNEP spent fuel reprocessing technologies a logical step forward if commercial nuclear power is to be sustainable well into the future. Because implementation of GNEP will impact the commercial nuclear industry, we support a collaborative effort between government and industry to ensure viable deployment of the technologies.

Our perspectives on priorities notwithstanding, we believe that development and subsequent deployment of the NGNP technologies is vital to our nation's energy security. Within our service territory, particularly along the Gulf Coast and in the Mississippi River Corridor, there are numerous industrial facilities that consume large amounts of energy in the manufacturing of their products. In these facilities, a large portion of the incoming feedstock (primarily fossil fuels) is consumed in powering the processes used in the manufacturing of the products. Our evaluations indicate that the characteristics and capabilities of the high-temperature gas reactor are well suited for such an application and could reduce and perhaps even eliminate the consumption of incoming feedstock to power the processes. This preservation of feedstock would serve to reduce our nation's reliance on foreign energy imports and could substantially reduce the carbon footprint of these industrial facilities.

Entergy has a clear and vested interest in the future of nuclear power. With respect to the NGNP, we see a potential business model where we as an owner/operator might co-locate an NGNP type plant at industrial facility to supply the process heat, hydrogen, and/or electricity needed to power their processes. Our interest in the NGNP technologies, however, goes beyond the market opportunity. The security of our nation's energy supply and the threat of global climate change make it imperative that viable alternative energy sources such as nuclear be actively developed and utilized. Our interest in the NGNP is shared by a broader community of end users that goes beyond the traditional utility industry. Because the characteristics of the high-temperature gas reactor are well suited for meeting the process heat needs in large chemical, petrochemical, and refining processes, there is a growing interest in the NGNP from firms within these industries. Over the past year, representatives from firms in these industries have met periodically with nuclear technology developers and nuclear operators to discuss and assess the commercial viability of the NGNP and to outline strategies for bringing the technologies to the marketplace. A core group of companies, comprised of technology developers, reactor designers and suppliers, nuclear operators, and large industrial energy users, has come together with the intention of forming an industry alliance to support the development and eventual commercialization of the NGNP technologies.

Members of this emerging alliance have, in fact, already drafted a Memorandum of Understanding (MOU) as the first step toward the formation of a legal entity. This MOU is under internal review by the individual member companies and should be signed by the interested parties within the near future. Members of the emerging Alliance have met individually with additional firms in the chemical, petrochemical, and refining industries to discuss the NGNP and its possible application in their respective operations. The level of interest is growing and it is likely that other companies will opt to participate in the Alliance as the effort progresses.

Our CEO, Wayne Leonard, in his presentation at the 2007 Annual Shareholder meeting, noted the potential of high-temperature gas-cooled 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 his message has relevance for us today.

We, at Entergy, as well as the members of the emerging Alliance, acknowledge the challenges we face in achieving our goal of commercializing the NGNP technologies. One of the more obvious challenges that lies ahead is the technology development that must be achieved in order to support commercialization. This development includes such things as fuel development and high temperature materials development to name but two. Another challenge we face is the need for industrial infrastructure to support such activities as fuel supply, large component fabrication, plant design, etc. We appreciate that in this area of infrastructure, the competition for resources will be considerable.

Perhaps the greatest challenge we face is the licensing effort that will be required for the NGNP, particularly if we are to achieve the target deployment date of 2018. We anticipate that the effort required for licensing the NGNP technologies will go beyond that required for the ALWR technologies. This is largely because the current set of requirements used in implementing the regulations have been established for light water reactor technologies. Although a substantial effort will be necessary to establish gas-cooled reactor specific requirements, it is our belief that such a strategy is the preferred course of action. This strategy will result in the establishment of clear bases for licensing subsequent deployments of the NGNP technologies in the commercial sector.

In conclusion, Entergy believes that the NGNP technologies are an essential element in our energy mix of the future particularly as we move forward toward a hydrogen economy. Thank you and I look forward to any questions you may have.

NRC PERIODIC BRIEFING ON NEW REACTOR ISSUES

NUCLEAR REGULATORY COMMISSION

February 20, 2008

Oral Statement: Need for and Interest in NGNP

Submitted By:

Frederick L. Moore

The Dow Chemical Company

Good afternoon, Mr. Chairman and Commissioners. My name is Fred Moore, and I am the Global Director of Manufacturing & Technology for Energy with The Dow Chemical Company. In that capacity I am responsible for assuring that Dow's businesses are provided with safe, reliable and cost effective power, steam, and other utilities. We operate more than $6 billion in Energy assets globally.

Let me begin by setting the degree of our interest in solutions to the nation's security of supply for both energy and feedstocks.

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 almost 4000 MWs of electricity and consume in excess of 22 million pounds an hour of steam. At $8 per MMBTU equivalent fuel cost, our fuel bill alone would be in the $5 billion per year range.

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 the chemical reactions consume the equivalent of more than 800,000 barrels of oil per day. Globally, our 2007 combined fuel and feedstock bill is likely to be in excess of $24 billion dollars. By comparison, we spent just $8 billion dollars in 2002. In other words, we had a $16 billion dollar jump in energy and hydrocarbon costs in just 5 years.

Is it any wonder that the U.S. Chemical industry went from a trade surplus of more than $20 billion to a deficit of more than $9 billion in the past decade? U.S. manufacturing is the leading edge of demand destruction in the face of high energy prices. U.S. Energy Administration data show that since the run up in high energy prices in the late 1990's, more than 3 million high paying manufacturing jobs have been lost.

And let's not forget that more than 95% of everything we touch in our daily lives relies on chemistry and our industry – from drinking water, to toothpaste, to the food we eat, to computers and phones, to the 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 national call to arms on the joint and inseparable issues of energy security and climate change. We see at least 4 specific goals:

- First, we must reduce our energy demand. The cheapest energy is that which we do not use.
    - And at Dow, we are relentless in driving energy efficiency. Between 1995 and 2005, we reduced our energy intensity by 22%, saving more than 900 trillion BTUs. Enough to power all the homes and businesses in the state of California for an entire year. And we saved nearly $4.5 billion in fuel costs. And we have committed publicly to reduce our energy intensity by another 25% between 2005 and 2015.
    - Such an improvement, if replicated across the country, would be dramatic. If the U.S. reduced its energy intensity by 25% between

2005 and 2015, and assuming GDP grows at the expected 3% rate, we would eliminate the oil equivalent of all the Persian Gulf imports today.

- But that is not enough.

- Second, we must pour more money into national research programs to make coal a sustainable energy source while increasing our work on renewable and alternatives such as biomass and nuclear.
- Third, we must diversify our energy supplies here in the U.S.
- And fourth, we must accomplish all the above within the framework of reducing our impact on global climate change.

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

Our CEO, Andrew Liveris, recently noted is a speech to the Global Automotive Conference in 2007 that there are currently plans to build more than 80 large scale chemical plants across the globe in the coming decade ... with price tags of a billion dollars or more and creating thousands of good paying jobs. Not a single one is planned for the U.S.

He went on to say that, and I 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 a 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 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 that at least 50% of the energy it consumes globally will be non-carbon emitting by 2050. The energy mix will include renewables such as wind and 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 will provide an avenue to produce synthetic diesel, gasoline, and other feedstocks via gasification of coal.

Coal is estimated to have known global reserves of 165 years, while natural gas is 70 years and oil is just 45 years.

More importantly, generation of synthetic diesel, gasoline and other feedstocks will allow the U.S. to utilize the existing infrastructure that we have built to support core needs such as transportation and home and business heating. This infrastructure has taken close to a century to develop and construct and any alternative approaches for fundamentally new fuel source consideration, such as hydrogen, have enormous safety, infrastructure and efficiency hurdles.

As we understand the Next Generation Nuclear Plant program technology, it 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.

Thank you and I look forward to any questions you may have.

PBMR PROGRAM UPDATE

February 20, 2008

Ed Wallace

Sr. GM– US Programs

PBMR (Pty) Ltd

P B M R

Purpose of PBMR Program

- A South African strategic national project
- Energy and environmental goals
- National capacity building
- Component of nuclear vision with ALWRs

Current Program Elements

- Demonstration Power Plant
- Pilot Fuel Plant
- Extensive Test Facilities
- US Design Certification
- Process Heat Co-Gen Plants including NGNP

Project Status in RSA

- ~750 RSA staff / ~1700 globally
- > $600M invested; next $800M committed
- Manufacturing long lead items
- First fuel from full size coater in 2008 available for testing
- Construction start in 2009
- Initial Criticality - 2013

US Design Certification

- Began pre-application in 2005
- Most topics generic to htgrs
- Paced by NRC resources and RSA progress
- End tied to demonstration plant operations date
- Highly applicable to NGNP

Process Heat Plants

- Working with industrial users
- From demonstration plant base, developing designs that match market needs:
  - Process heat industry needs
  - NGNP advanced requirements
- Lead NGNP pre-conceptual engineering team

Necessay NRC Support

- Effective engagement in key issues
- Solutions sets appropriate to non-LWR designs
- Embrace risk informed process at outset; not at end
- Recognize synergy with NGNP
- Qualified resources matching agreed schedule

Statement of

Dr. Arkal S. Shenoy

Director, Modular Helium Reactors

General Atomics

On

Prismatic High-Temperature Gas-Cooled Reactor Design & Development

February 20, 2008

Presented to the U.S. Nuclear Regulatory Commission

Good morning Chairman Klein, Commissioners, panellists, Ladies and Gentlemen.

I am Arkal Shenoy, Director, High Temperature Gas Cooled Reactor Programs at General Atomics. Thank you for the opportunity to speak with you.

General Atomics has a long history with gas reactors and our interest in revival of gas reactors in the U.S. 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 governments. Currently gas cooled reactor programs 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 reactor plants

Gas reactors or more precisely, Modular Helium Reactors (MHRs) 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 US regulatory agencies. In early 1980's as a result of congressional house science and technology committee guidance the Modular Helium reactor concept was developed which incorporated high degree of safety features based 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 temperature of the gas-cooled reactor, high thermal efficiency of the Brayton cycle power conversion system, high fuel burnup, and expected low operation and maintenance requirements.

The high temperature gas-cooled Modular Helium 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 the 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, Process Heat for transportation fuel development and Hydrogen Production for various energy applications.

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

1) **NRC 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 can not melt down – but they don't have to be designed this way. There is a penalty in performance to achieve this. If the Nuclear Regulatory Commission considers this 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 reactors where basic physics ensure safety. What is a strong incentive? When an end user knows that he can get a license for a gas reactor in fraction of the time as 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 inherent safety.

2) **NRC can take advantage of this new type of advanced reactor to provide a new approach to 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 talk about 'the public good' and 'protect the environment.' The NRC should recognize the pressing needs of energy security and environment require an urgent move toward expansion of nuclear power use in the United States and the High Temperature Modular Helium Reactor is a needed component of this movement.

How urgent? Some call for the U.S. to reduce its carbon emissions by 50% by 2030. Assume this burden was to be achieved through nuclear power in the electricity generation and other industrial process heat applications. This would require every future electrical generation facility plus almost 90% of current electricity and industrial process heat requirements to be converted to nuclear. 2030 is only 22 years away. The Next Generation Nuclear Plant program shows 13 years to build one plant. How many plants would be constructed? The answer varies based on 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 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 fiscal uncertainty for the DOE's contribution and 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 or total time involved results in the 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 can not support an extended list of sequential emerging requirements. To achieve that end, General Atomics recommends that the NRC consider

1) Once its review has satisfied the inherent safety of gas reactor design, descope the associated and not needed reviews. "Because water reactors do it" should not be a permitted statement.
2) Outsource the majority of the effort to a qualified private reviewer, with a strong incentive to the reviewer for timely performance and incentive for developing processes that reduce total effort required while ensuring adequate safety. Focus government effort on what is inherently governmental – final review and approval.

In closing, General Atomics strongly endorses a 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 reduce numbers may provide more margin above 'adequate protection' but is not in the best interests of public health or 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 the opportunity to provide our views on this important subject.

PLANS AND SUPPORT FOR A PRISMATIC HIGH-TEMPERATURE GAS-COOLED REACTOR DESIGN

Finis H. Southworth
Chief Technology Officer
AREVA NP Inc.

February 20, 2008

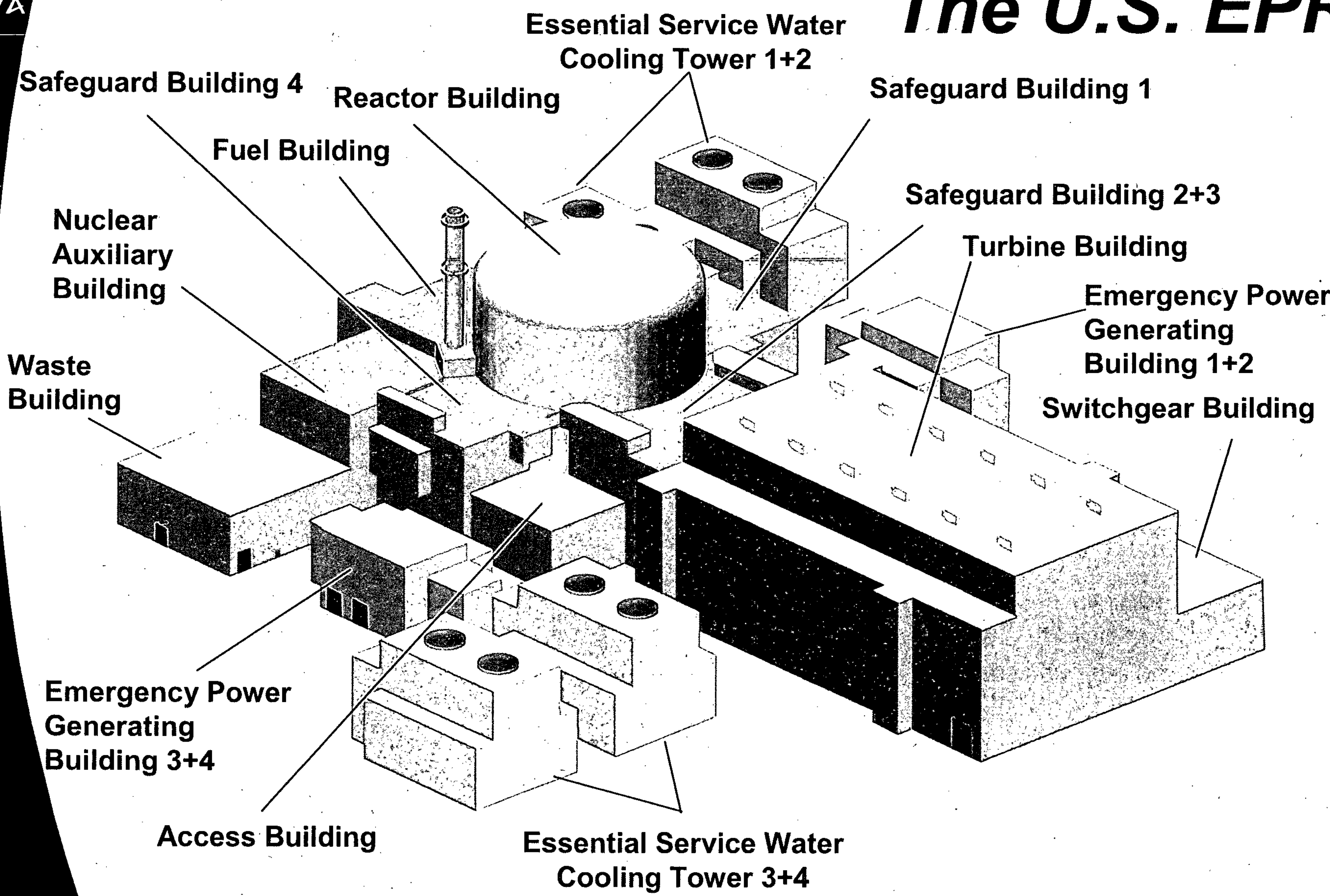
AREVA

AREVA'S Near-Term Strategy

> Deploy new nuclear baseload generation

- ◇ EPR plants under construction at Olkiluoto and Flamanville
- ◇ Application for U.S. EPR design certification submitted December 11, 2007
- ◇ Four Combined License applications in preparation

The U.S. EPR



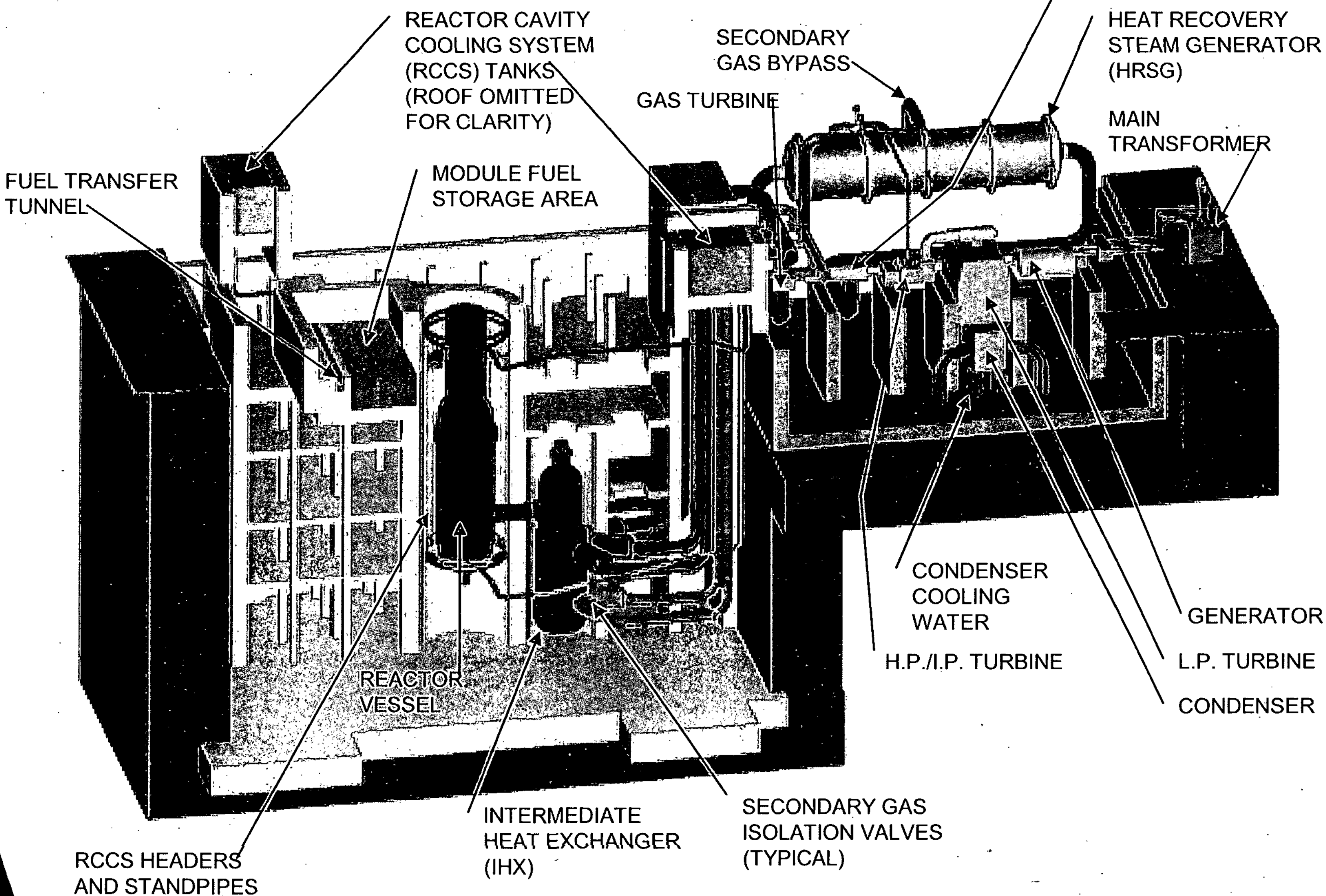
Essential Service Water
Cooling Tower 1+2
Safeguard Building 4
Reactor Building
Safeguard Building 1
Fuel Building
Safeguard Building 2+3
Nuclear
Auxiliary
Building
Turbine Building
Emergency Power
Generating
Building 1+2
Waste
Building
Switchgear Building
Emergency Power
Generating
Building 3+4
Access Building
Essential Service Water
Cooling Tower 3+4

AREVA

AREVA'S Long-Term HTR Strategy

- Develop ANTARES high-temperature, gas-cooled, prismatic reactor design
- Plan for deployment consistent with market demand for CO_2-free energy for electric and non-electric applications

ANTARES



CUTAWAY VIEW OF REFERENCE PLANT

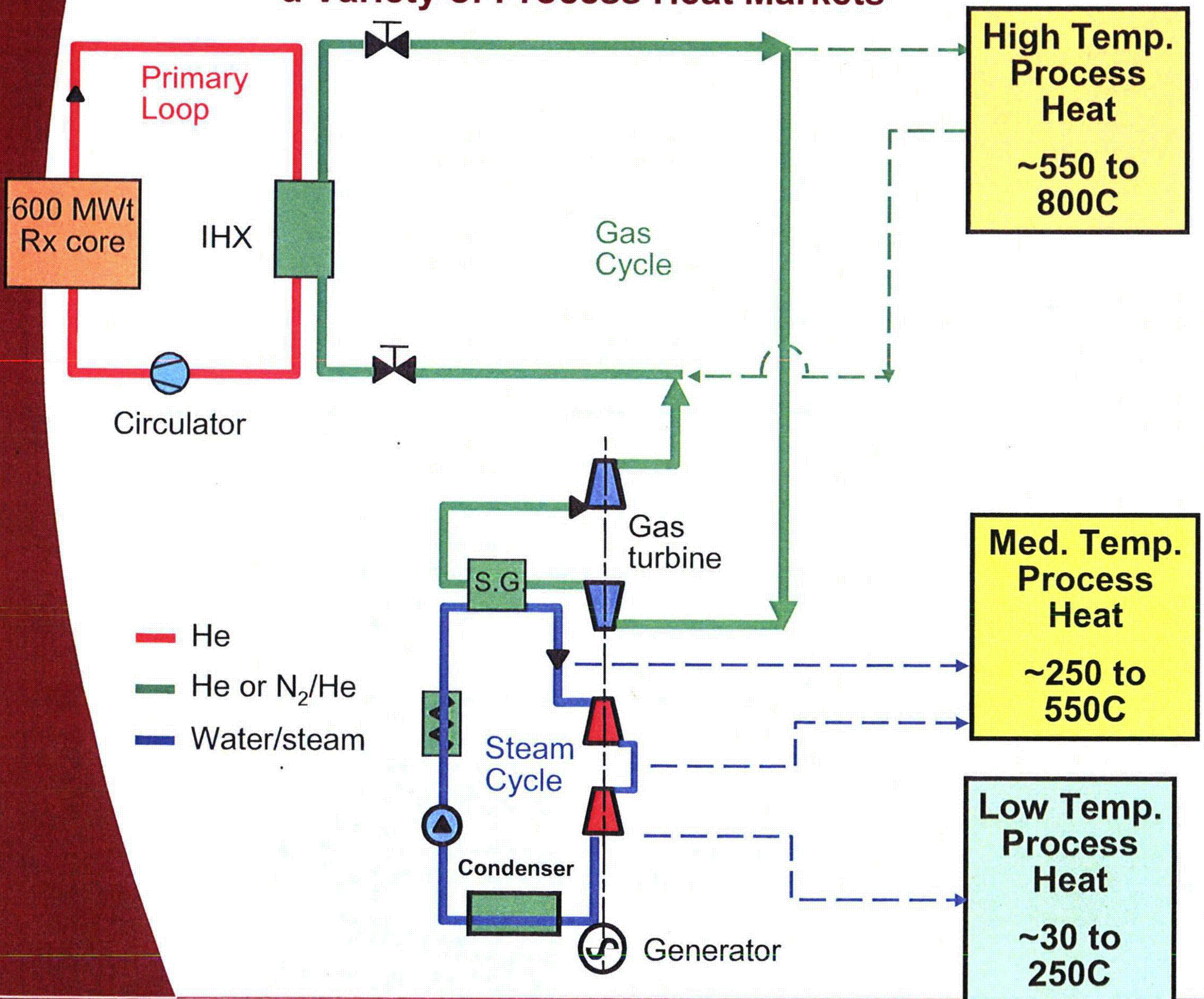
AREVA

Benefits of HTR Technology

> Small efficient electrical output
  - ◇ Low cost power for small markets
  - ◇ Incremental capacity tailored to growth

> Flexibility for multiple process heat applications
  - ◇ Petroleum extraction from shales or heavy oils
  - ◇ Chemical processing
  - ◇ Hydrogen production

AREVA HTR Concept Can Serve a Variety of Process Heat Markets



Market Applications

- Hydrogen-SI or HTE
- Hydrogen-SMR

- Oil Shale
- Oil Sands
- Coal Gasification
- Coal Liquefaction
- Biomass

- District Heating
- Desalination

Future HTR Development

- AREVA supports HTR technology and licensing strategy development
- NGNP Program contributes to technical, infrastructure, and regulatory progress
- ANTARES deployment will support commercial demand for HTR capabilities

IRIS and 4S: Support and Plans

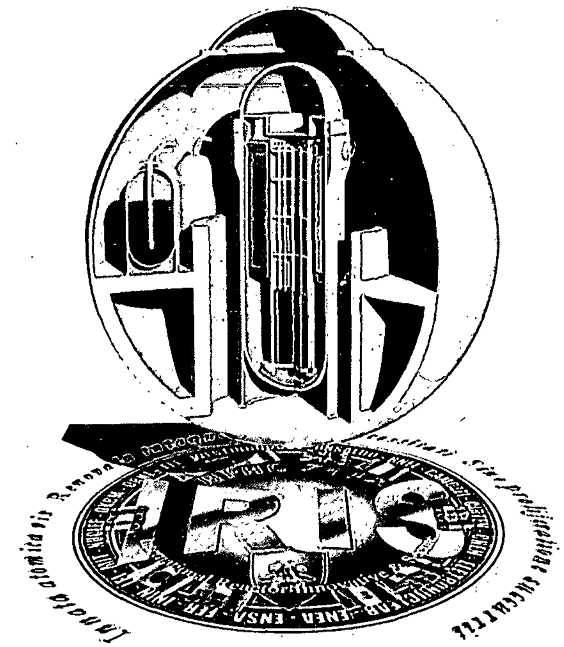
February 20, 2008

John Goossen, Director
Science & Technology Dept.
Westinghouse Electric Company

IRIS:
International Reactor Innovative and Secure

IRIS: Design and Main Features

- Advanced integral light water reactor
- 335 MWe/module
- Enhanced Safety-by-Design™
- GNEP near term grid appropriate reactor
- Design Certification testing program underway



IRIS: Development Team

- 9 countries
- 18 organizations
  - 6 industry
  - 5 laboratories/ government organizations
  - 6 universities
  - 1 power producer

IRIS: Enhanced Safety

Safety-by-design approach seeks to eliminate accidents rather than cope with their consequences. It has yielded:

- Simpler design
- Reduced number of safety systems (e.g., no HP ECCS)
- CDF of the order of 10^{-8}/yr

IRIS: Type of Market

- Smaller/developing countries or regions with limited grids/power needs
- Limited financial resources and capital at risk
- Cogeneration
- Several countries have already expressed interest

IRIS: Status and Schedule

- Preliminary NSSS design complete
- Pre-application licensing underway
- Complete DC testing – 2011
- Submit DC application – 1Q 2012
- Obtain FDA – 2014
- Available for commercial deployment in the 2015 – 2017 timeframe

IRIS: Licensing Status

- Completed as part of pre-application:
  - Design description
  - Preliminary safety analyses
  - Planned testing program
  - Integral testing scaling
  - Test facility design
  - Test matrix
- The Croatia Regulator has asked for MDEP.

IRIS: Licensing Status (cont.)

- Planned 2008 submittals:
  - Conformance with regulation (SRPs)
  - Revised plant description
  - Risk informed licensing
  - EPZ re-evaluation
  - QA plan
  - Complete scaling analyses
- DOE proposed FY09-FY13 budget will help Industry obtain DC for first US Grid Appropriate Reactor

IRIS: NRC Support Needed

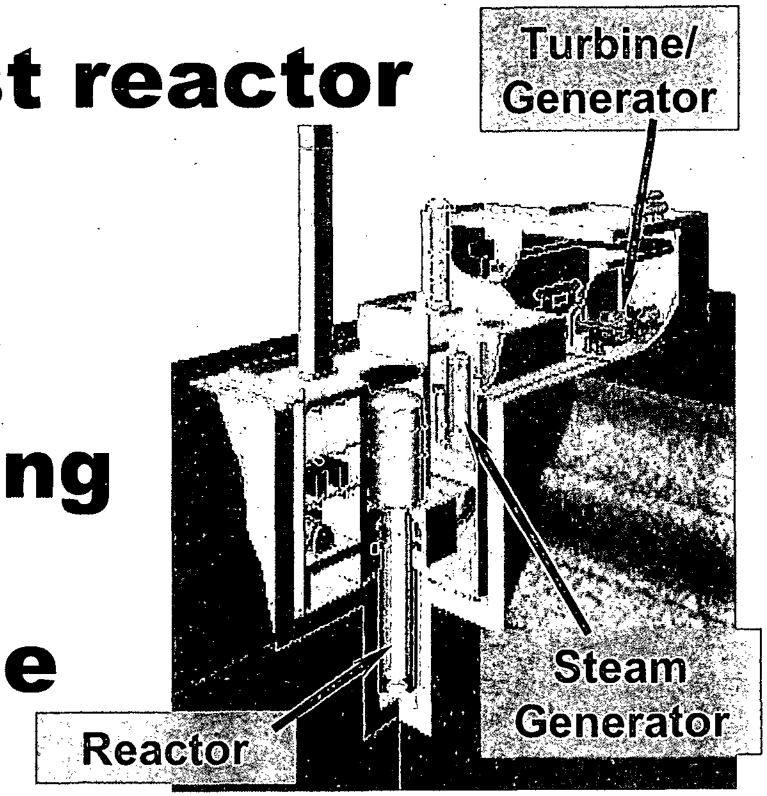
- Revitalize pre-application process
- Have periodic meetings following review of submittals

  (First scheduled for early April)
- MDEP: Finalize with Croatia and pursue with other interested countries
- Coordinate with DOE to provide sufficient resources for a timely IRIS FDA

4S:
Super-Safe, Small and Simple

4S: Design and Main Features

- **Sodium cooled fast reactor**
- **30 MWt (10MWe)**
- **Main features**
  - **Passive safety**
  - **No onsite refueling for 30 years**
  - **Low maintenance requirement**
  - **High inherent security**



4S: Development Team

- Design, Safety Analysis, R&D: Toshiba
- Licensing: Westinghouse
- Safety Analysis, Seismic Isolation, R&D: CRIEPI
- Fuel: Argonne National Laboratory

TOSHIBA

Westinghouse

CRIEPI

Argonne NATIONAL LABORATORY

4S: Type of Market

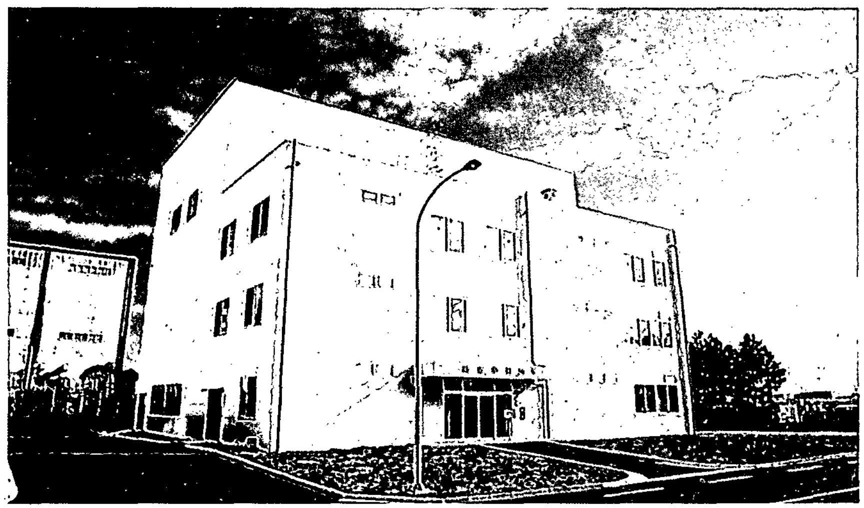
- Remote areas of small power demand (e.g., Galena, Alaska)
- Considered a candidate for GNEP grid-appropriate small and medium reactor design
- Further applications:
  - Natural resources development (oil sand/shale, mining), desalination, hydrogen production

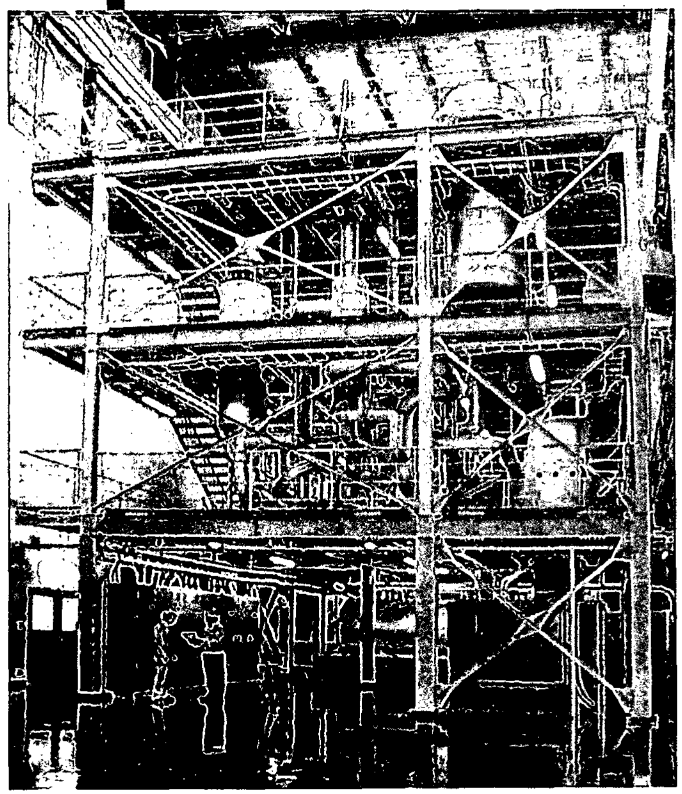
4S: Status of Development and Licensing

- Familiarization to the NRC staff started (first meeting Oct. 2007; next meeting Feb 21, 2008)
- Major sodium components developed
- Further verification testing will be identified through the pre-application review using PIRT
- Application for Final Design Approval (FDA) planned 2009

4S: Test Facility for Future Tests

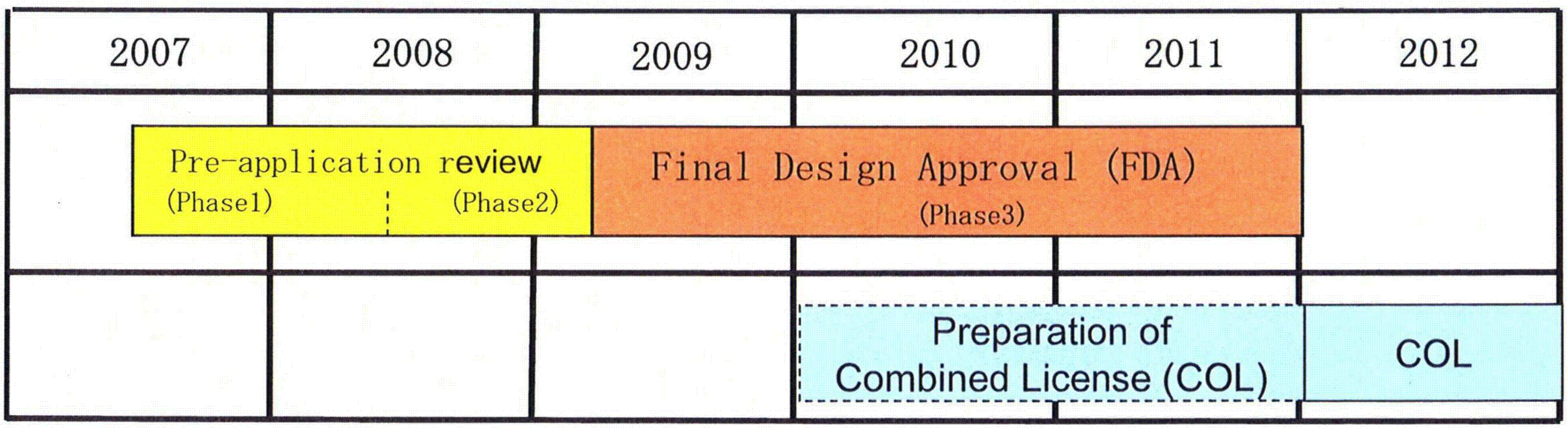
- Toshiba Sodium Component Test Facility
- Completed in December 2007





4S: Proposed Licensing Approach

- **FDA application in 2009**
  - –Phase 1: Design Familiarization
  - –Phase 2: Submit technical reports
  - –Phase 3: FDA application



4S: Next Step / NRC Support

- Continue pre-application review process
  - Familiarization with design and key issues
  - Review of Technical Reports
  - Supply additional information as needed
- Provide sufficient resources and support for FDA process

Acronyms (in order of appearance)

- MWe: Megawatt-electric
- GNEP: Global Nuclear Energy Partnership
- HP ECCS: High Pressure Emergency Core Cooling System
- CDF: Core Damage Frequency
- NSSS: Nuclear Steam Supply System
- DC: Design Certification

Acronyms (in order of appearance)

- FDA: Final Design Approval
- MDEP: Multinational Design Evaluation Program
- SRP: Standard Review Plan
- EPZ: Emergency Planning Zone
- QA: Quality Assurance
- MWt: Megawatt-thermal
- R&D: Research and Development

Acronyms (in order of appearance)

- CRIEPI: Central Research Institute of Electric Power Industry
- PIRT: Phenomena Importance Ranking Table
- COL: Combined Construction and Operating License