

NEAC REACTOR TECHNOLOGY SUBCOMMITTEE Progress Report*

M.Corradi, A.Bhatnagar, T.Cochran, M.Kazimi, R.Matzie,
D.Chapin, J.Rempe, H.Ray

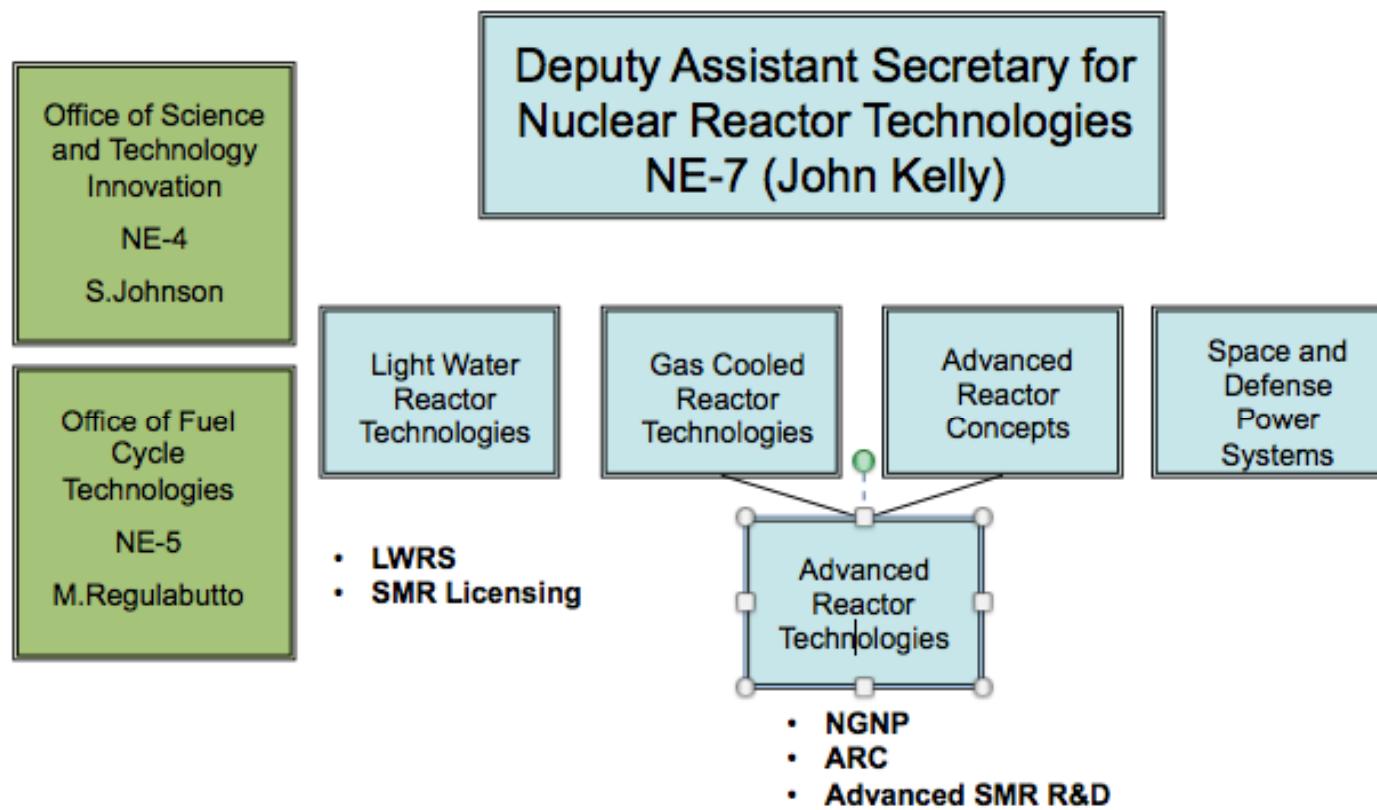
June 13, 2013

**Organizational COI Issues limited the participation on LWRS*

Background

Under the current NEAC Nuclear Reactor Technology Subcommittee charge, the NRT met with NE-7 staff on:

- June 2012 to review the reorganized structure and NE-7 program overview;
- Sept. 2012 to review Advanced Reactor Technology program (Oct. 12 report);
- May 2013 to review LWR Technologies program and IRP program.



Topics for May 2013 Meeting

Updates on NE-7 Program (Dr. J. Kelly)

Small Modular Reactor Licensing Support Prog. (T.Beville)

Light Water Reactor Sustainability (LWRS) Program

Overview and Program Details (R.Reister)

TIO Review Corrective Actions (Dr. K. McCarthy)

Integrated Research Projects (IRP)

IRP Program Overview (C.Welling)

Fluoride Salt IRP Status (Drs. P.Peterson & C. Forsberg)

Nuclear Reactor Technology Subcommittee Discussion

Light Water Reactor Sustainability

Program Goals

- Develop the fundamental scientific basis to understand, predict, and measure changes in materials and systems, structures, and components (SSCs) as they age in environments associated with continued long-term operations of the existing reactors
- Apply this fundamental knowledge to develop and demonstrate methods and technologies that support safe and economical long-term operation of existing reactors
- Research new technologies to address enhanced plant performance, economics, and safety.

Light Water Reactor Sustainability (2)

Nuclear Materials Aging and Degradation (MAaD)

Develop scientific basis for understanding and predicting long-term environmental degradation behavior of materials in nuclear power plants

Risk-Informed Safety Margin Characterization (RISMC)

Develop and demonstrate a risk-assessment method that is tied to quantification of safety margins and associated assessment tools (e.g., RELAP7)

Advanced Instrumentation, Information, and Control System Technologies (I&C)

Develop, demonstrate, and deploy new digital technologies for I&C

Advanced Nuclear Fuels (being moved to Nuclear Fuel Cycle)

Systems Analysis and Emerging Issues

Address high impact emerging issues; e.g., needs in response to Fukushima

Light Water Reactor Sustainability (3)

LWRS Technical Integration Office reviewed by Industry Advisory Committee (IAC). IAC posited two opposing goals: 1) Support of life extension and first and second license renewal of the operating plants, or 2) Provide systems, analysis tools and technologies generally attuned to improving and modernizing the operation of the fleet. Settling this question effects R&D project selection throughout the program.

IAC suggests that LWRS identify and engage owner/operator decision-makers, explain LWRS and get their input (recognize that these positions would be different between merchant plants versus regulated utilities)

LWRS program will reassess priorities based on input received from decision-makers, and make changes in funded activities based on that input, balanced with input from other stakeholders

LWRS plans to leverage its connections with industry senior level management; additional decision-maker engagement activities are taking place in each area.

NRT SC encourages DOE-NE to consider these IAC recommendations

Light Water Reactor Sustainability (4)

The highest priority pathway in the LWRS Program is the MAaD program, followed by the RISMC and the II&C. The percentage of available funding to each of these three pathways depends on the actual budget.

In low budget years (compare to the \$25M/year budget in the LWRS Integrated Program Plan), over 60% of the funding has typically been allocated to the MAaD Pathway to enable completion of high priority activities.

In high budget years, that allocation is over 50% because funds are available for additional activities in the RISMC and II&C Pathways.

If future budgets are even lower than budgets to date, a higher percentage of funding would likely go to the MAaD Pathway to ensure completion of high priority activities.

NRT SC concurs with this funding strategy at this time

Light Water Reactor Sustainability (5)

NRT SC: specific comments that are individual and not consensus

- The big impact is to focus on MAaD effort. However, there may be practical limitations to doing more work in this area given that finding suitable experimental materials may be limited.
- Risk-informed safety margin characterization is an important area, which should continue to receive emphasis. While this is interesting work, don't underestimate difficulties of getting NRC to accept the approach and its use.
- The II&C needs to be refocused on implementation rather than hardware and systems. Some disagree with this characterization. Industry understands the incentives to do this work. Program is focused on implementation: how will partial replacement with digital I&C interact with remaining analog instrumentation. Program is set up to examine a wide variety of control room configurations, which is what the real world is offering today. Other work (aid for outage management) is well received with the folks in industry actually involved in the work; it could be important for economics.
- The technical focus area of “Systems Analysis and Emerging Issues” is broad. Focus on a few high impact topics that are not being addressed by others.

Integrated Research Projects (IRP)

IRPs are part of the NE University Program (includes R&D grants, fellowships and infrastructure awards to University programs)

IRP's are to provide R&D solutions that are most directly relevant to the near-term, significant needs of the NE R&D programs

IRP's intended to develop a capability to address specific needs, problems, or capability gaps identified and defined by NE

IRP's may include a combination of evaluation capability development, research program development, experimental work, and computer simulations

Multidisciplinary, multi-institutional partners (3yr and > \$1m/yr)

Integrated Research Projects (2)

Topics for IRP were developed by NE staff on yearly basis:

- **2011 - Advanced Thermal Reactor Concept (to be discussed next)**
- 2011 - Fuel Aging in Storage and Transportation (FAST): Accelerated Characterization and Performance Assessment of the Used Nuclear Fuel Storage System
- 2012 - Accident Tolerant LWR Fuels - Engineered Zircaloy Cladding Modifications for Improved Accident Tolerance of LWR Nuclear Fuel
- 2012 - Accident Tolerant LWR Fuels - Advanced Accident-Tolerant Ceramic Coatings for Zr-Alloy Cladding
- 2012 - Integral Inherently Safe Light Water Reactor
- 2013 - Simulation of Neutron Damage for High Dose Exposure of Advanced Reactor Materials (still being competed in Spring 2013)

NEAC NRT SC recommends:

- ***Develop a set of metrics to evaluate IRP benefits (and NEUP generally)***
- ***Involve the universities in research topic selection (and NEUP workscopes)***
- ***Develop strategy for continuing/graduate the successful IRP's (and NEUPs)***

Integrated Research Projects (3)

2011 IRP (FHR concept) has been underway for 18 months and has engaged an Advisory Panel (AP) to help focus project efforts. The advisory panel has issued three interim letters with observations and initial recommendations.

NEAC NRT SC initial observations:

- *SC concurs with FHR-IRP AP initial observations/findings*
- *This first IRP seems to be well-organized and has enormous student participation and a very good system analysis basis*
- *The FHR-IRP's own advisory panel and the NRT subcommittee agree that in the remaining time for the IRP and any subsequent work, the FHR concept needs to focus on major scientific challenges for the overall concept; e.g., tritium control, advances in molten salt Chemistry/Corrosion/Heat-Transfer*
- *DOE-NE needs to develop a strategy to transition successful IRP (and NEUP) research into base program (i.e., prog. extension)*