

Nuclear Reactor Technology Subcommittee of NEAC

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Nuclear Energy Advisor Committee Meeting
Department of Energy
June 5, 2014

Meetings in the last 6 months

- Committee met on half day each of May 29 and May 30.
- Presentations covered
 - **Update** on NE-7 by John Kelly
 - **Supercritical Transformational Electric Power (STEP)** Generation Program by Brian Robinson
 - **Nuclear Space and Defense Program**: Overview, Systems Development, Pu238 production, Transition to Full Cost Recovery, Fission Systems Development, and Key Challenges to Interagency Collaborations by Alice Caponiti and key members of the NE-75 office.

Developments of Note

- INL conducted a TRISO fuel test at the high temperature of 1800 C for 300 hours, with no release of fission gas. May open the design window of such fuel in high temperature reactors.
- The NNGP program has been merged with the Advanced Reactors Program, with the technical coordinators of the former two activities assuming co-leadership of technical coordination of the combined program.
- NE-7 has initiated a program, with NRC agreement, regarding developing an approach to regulation of non-water cooled reactors. They will be developing (1) General Design Criteria (GDCs) for all concepts and (2) specific GDCs for metal cooled reactors and high temperature reactors. Workshops are being held with invitees from all interested parties.
- Review has been initiated of a new round of advanced reactor development proposals by industry, which will lead to selection of some for funding by DOE.

The STEP Program

- The subcommittee is pleased that DOE is undertaking a coordinated demonstration plan for an advanced power cycle.
 - Avoids duplication
 - Develops systems for a wider market
 - Has potential for higher payoff for dollars invested
- Demo System has to be of sufficient size to incorporate features representing the eventual commercial units - 10 MWe appears to be a reasonable lower limit.
- It is appropriate to consider two demonstrations; to bridge between the current experience of 1MWe to the the commercial unit size (about 100MWe).

Nuclear Space and Defense Program

- DOE-NE has provided **radioisotope power systems (RPS)** that safely enabled deep space exploration for NASA as well as for national security missions for five decades. (APOLLO in the 1960-70s and CASINI in 1990s were such programs)
- RPS uses **heat from the decay of Pu238**, which may be converted to electricity, and lasts for decades (half life of 88 years).
- The program also conducts analyses of designs of **fission systems** meant to provide power and propulsion for space vehicles.
- The DOE **NSDP program is responsible for safety of the nuclear systems** throughout the space missions.
- While NASA funded the hardware development for each mission, DOE funded the infrastructure enabling development and testing of new technology.

Committee Observations -1

Radioisotope Power Systems

- In FY14, the funding for the infrastructure was transferred to **NASA**. This left little funding at DOE to directly manage the maintenance of the facilities and expertise.
- It is important for **DOE and NASA to continue to work as partners** in providing these power systems for specific missions within this new infrastructure arrangement.
- This partnership has allowed in the past the NE-75 staff to work with the laboratories to maintain their technical depth by development of new advanced RPS power system designs between the periodic long-term NASA missions
- **We would emphasize that, as the primary customer for these capabilities maintained by NE-75, NASA should continue to recognize the responsibilities associated with maintaining a strong infrastructure for this important activity.**

Committee Observations -2

Pu-238 Supply

- In 2007, the NEAC review of NE-75 programs expressed concern about long-term supply of Pu-238 for satisfying the needs of NASA for its deep space missions.
- In its presentation to the subcommittee, the NE-75 staff described how the DOE and NASA partnership has addressed this issue. There is now a funded program to produce Pu-238 via Neptunium irradiation in ATR and HFIR by 2020.
- Given the current inventory of Pu-238, the planned rate of production should be sufficient to satisfy NASA mission needs.

Committee Observations -3

Fission Power Systems

- Fission Power Systems effort is currently a small part of NE-75 activities, but is attracting increased attention.
- The staff expressed concern that, in contrast to the partnership for RPS development, NASA is not fully utilizing the expertise of the NE-75 staff and National Laboratories. NASA seems to be developing a separate expertise within its organization and at NASA Centers and NNSA labs.
- The subcommittee recommends that the NE-75 staff seek to **re-establish a DOE-NASA partnership in this area and propose an MOU to clearly delineate the scope and task details for the Fission Power Systems efforts.**
- This MOU would emphasize the importance of DOE's role in integration of the components to ensure safe and reliable operation of the system, developed over years of experience.
- To ensure adequate safety margins, DOE must retain this responsibility during development of any new fission power system and its components, and eventually its implementation for a particular mission. **Otherwise design modifications at a late stage may become necessary.**