Nuclear Reactor Technology Subcommittee of NEAC

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NRT Subcommittee Meetings

- Subcommittee met on September 29, 2014.
- Briefed on the March 2014 DOE "Big Idea Summit", where Idaho National Laboratory (INL) led a break-out group that discussed more rapid advanced technology deployment in nuclear power plants and more rapid commercialization of advanced nuclear power technology.
- That group outlined an approach that allows taking advantage of scientific advances for nuclear energy applications:
  - Develop and maintain small-scale state-of-the-art experimental facilities with easy access through an integrated user-facility approach;
  - Develop and maintain up-to-date computational frameworks for the development and use of modeling and simulations in practical but high fidelity applications;
  - Establish knowledge-based centers to support access to past and current experimental data and computational results;
  - Introduce engineering-scale capabilities to allow for final validation of new innovations under prototypical conditions.

What Engineering-Size Capability?

- Subcommittee thinks this approach is workable and would maintain significant capability in the US to develop and deploy new technology for enhancing nuclear energy.
- A question arises as to whether test and/or demonstration reactors should be considered within the engineering–size capabilities needed.
  - It has been more than 40 years since the US built a new test reactor of any size.
  - Many parts of the World are, or will soon be, commissioning new test reactors (France, China, Netherlands, and Russia).
- The Subcommittee is assessing the need for new capabilities, in light of the existing US and international reactors.
- Today's report summarizes preliminary thoughts on this subject.

The Reactor Type Options

- A demonstration reactor that would be a prototype to evaluate several aspects of a selected advanced reactor technology, e.g., licensing process, safety case, operating characteristics, etc.;
- A test reactor to obtain data to support more rapid RD&D of innovations for the existing fleet of LWRs and/or advanced reactors concepts; e.g., new fuel forms, new cladding or advanced materials.
- A dual purpose reactor that employs new technology for the reactor itself, and also enables testing of concepts/materials that might apply to reactors other than the test/demo reactor itself.

Desirable Capabilities

Specific capabilities, not fully provided in current DOE test reactors, that could be incorporated into a new test reactor include:

- Large test volumes allowing real-time data to be obtained from lead test assemblies or substantial portions thereof;
- Well-instrumented standardized test rigs for irradiating fuel and materials
- An ability to have multiple spectra, in specific regions or with differing core configurations;
- Loops with a variety of coolants (boiling water, helium, molten salt, or sodium) allowing materials to be tested in prototypic coolant conditions under normal and to the extent possible, under accident conditions;
- Ability to act as a magnet for talent among the university research community by involving them in design, instrumentation and associated computational modeling of test rigs, protocols and analysis of test results; and
- Ability to incorporate new test reactor design innovations with LEU fuel as a desirable upgrade.

Reactor Safety and Licensing

- If the reactor is built on a non-DOE site, it must be licensed by NRC. Furthermore, the Atomic Energy Act requires that a prototype or demonstration reactor be licensed by NRC (even if it is built on a DOE site).
- If a test reactor were built on a DOE site, it can be licensed by NRC, by obtaining a 10 CFR50 Class 104 license, or authorized by DOE orders.
- Although the Subcommittee is still collecting information, preliminary discussion suggests that an NRC licensing option would be preferred
  - The DOE, written to cover a broad range of nuclear facilities, have not been applied to large new facilities of this type for a long time and likely to require updating.
  - The NRC is better staffed, and is more current than DOE on new reactor licensing and operations;
  - Detailed guidance, requirements, and experience exists for reactors licensed using NRC Class 104 license process;
  - The NRC licensing process, as opposed to DOE using a self-regulatory process, would offer additional benefits with respect to public acceptance.

Next Steps

- A meeting will be held to review
  - the existing US reactor capability (ATR and HFIR) and the new and advanced capability in other countries on Dec. 11.
  - Gap analyses done by NE Laboratories.
- The same meeting will include an NRC presentation on the 10CFR50 Class 104 of the regulation of test reactors.
- The NRT will discuss possible process structure and identify the criteria that should be applied to select the test or demo reactor with the best potential to lead to practical applications in the future.
  - Both near term and long term needs are to be included in these considerations.
  - Comments on potential process and criteria will be solicited from a wide range of stakeholders.
- Will reach conclusions in the Spring of 2015.