# Report and Recommendations of
# NEAC Nuclear Reactor Technology (NRT) Subcommittee
# On the Planning Study of Future Test/Demonstration Reactors
## March 2, 2015 Final

Given direction from Congress and interest of several stakeholders, the Department of Energy's Office of Nuclear Energy (DOE-NE) requested that Nuclear Energy Advisory Committee (NEAC)-NRT Subcommittee help define the scope and process for conducting a planning study for an advanced test/demonstration reactor in the United States. The NRT Subcommittee held three meetings to consider various aspects of this topic: on September 29, 2014, December 11, 2014 and January 15-16, 2015. In the first two meetings, the committee reviewed information from DOE and the national laboratories on the existing testing capabilities, nationally and internationally, and on the gaps in the needs to develop advanced nuclear power technologies. In addition, the NRT Subcommittee heard from representatives of the Nuclear Regulatory Commission (NRC) and DOE's Office of Nuclear Safety on the options for safety review and licensing of a new test/demonstration reactor. At the third meeting the subcommittee invited nuclear technology representatives to address the needs and best approach to conduct the planning study. This included representatives of potential users of the advanced technology, potential providers of the new technology (both large and small companies) as well as representatives of nuclear engineering academia, think tanks, professional nuclear associations and entrepreneurial organizations. The agendas for all three meetings are attached.

Taking into consideration all the provided information, our subcommittee reached the following conclusions and recommendations for the planning study.

## I. SCOPE and OBJECTIVE

The study should first review the national needs and public policy impacting nuclear energy development. Then, the study should consider and evaluate a wide range of technology options and associated test and/or demonstration reactors that support innovation in nuclear technology[1]. The outcome of the study is to provide information to facilitate a decision by DOE about whether to construct a reactor, or a small number or reactors, and the technology features on which it should be based.

---

[1] As used here, a test reactor provides neutrons to study the behavior of fuel and structural materials and components of different technology concepts in a radiation environment. Borrowing the definition by NRC, a prototype reactor is similar to a first-of-a-kind or standard plant design in all features and size, but may include additional safety features to protect the public and the plant staff from the possible consequences of accidents during the testing period. A demonstration plant attempts to duplicate many features in a proposed design but possibly at a reduced power level. These definitions might be at variance with the way others use them, and the reader should exercise caution when reference is made to various types of test reactors in documents by other groups.

This implies that the study should consider both reactors that are capable of testing components of advanced technology options with one or more coolants, as well as those of integrated concepts. The study should offer a limited number of alternatives and evaluate their benefits and costs. This is the best way to meet the Congressional request as stated in the appropriated budget, which states*“$7,000,000 is for an advanced test/demonstration reactor planning study by the national laboratories, industry, and other relevant stakeholders of such a reactor in the U.S. The study will evaluate advanced reactor technology options, capabilities, and requirements within the context of national needs and public policy to support innovation in nuclear energy.”*

## II. POTENTIAL GOALS FOR ADVANCED NUCLEAR TECHNOLOGIES

For advanced nuclear technologies to remain an option in the U.S. future energy mix, new advanced technologies should be sought to enhance the desirability of nuclear energy as an energy supply option. The advanced technology options should lead to reactors with lower cost, higher safety margins, and designs suitable to meet conditions of the evolving electric grid or other energy applications. New testing capabilities are needed for the timely development of advanced technology options for nuclear energy. The study should recognize the key goals that nuclear energy development efforts can facilitate for the United States. The main ones being:

**Diverse Low Carbon Energy Source:** Nuclear energy can be a major source of low-carbon energy production. Curbs on $CO_2$ emissions as well as other regulated, emissions will remain a long-term source of business and policy debates. A key goal for U.S. energy policy should be to maintain a diversity of ‘low-carbon’ energy sources. Such diversity protects against short-term energy scarcity, price volatility, impacts of severe weather conditions, and single-source influence on energy supply. Nuclear power currently is the single largest low-carbon emitting electrical energy source, and thus avoids the adverse climate and health effects of fossil fuel emissions. With nuclear energy’s ability to provide a reliable source of low-carbon emitting electrical power, DOE should explore ways to enhance its economic and safety performance..

**Global Leadership:** Nuclear energy will continue to be a major energy option outside the United States. The International Atomic Energy Agency *Annual Report 2013* (released in November 2014) estimates that already over 430 operating reactors exist in 31 countries (providing 12.5% of global electricity). Over 70 nuclear power plants are under construction internationally, mostly in Asia, and even more are being planned. The United States needs to “stay in the game” internationally to maintain its influence and its leadership in this technology. Export of U.S. technology can enhance our international influence and leverage our expertise, both in nuclear safety and security. The U.S. regulatory system is the “Gold Standard” internationally, with many advanced nuclear reactor designs currently being evaluated for certification by the NRC. The United States is known for its expertise and innovation in nuclear reactor systems, fuel development and enrichment services. To maintain its influence to positively affect global non-proliferation policies (such as plutonium disposition), the U.S. should play an important part in development of advanced nuclear energy technologies and with broad international engagement. Therefore, DOE should assist the U.S. industry to compete effectively in the world market.

**Human Infrastructure:** Maintaining highly educated and skilled personnel is crucial to ensuring the long-term viability of advanced nuclear technologies as a major resource for energy, as a means for diagnostic and therapeutic health care, as a pivotal component of national security, and advanced tools for research and development in the U.S. and beyond. The development and maintenance of this specialized workforce, and its related educational needs, is a major national need. The continued use of nuclear energy in the United States and its growth worldwide, coupled with an aging workforce, will require a new supply of appropriately educated individuals in order to

- maintain safe and reliable operation of nuclear energy facilities;
- continue development and construction of new nuclear facilities;
- continue necessary research and development in power and manufacturing;
- address and provide nuclear medicine needs;
- provide high-quality nuclear education and the recruitment of students to nuclear engineering fields.

It is imperative that DOE-NE continue to attract a new generation of human talent in advanced nuclear technologies.

**Accelerate Innovation in Nuclear Technologies:** An important goal is accelerating key innovations in nuclear technologies. The DOE-NE is focused on investigating new reactor technologies and advanced fuel cycles that can play an important role in meeting the goals stated above and thereby improve U.S. economic prosperity. The development of test or demonstration reactors is one important facet of an overall strategy to accelerate innovative nuclear science and engineering technologies. Potential benefits are discussed below.

## III. POTENTIAL BENEFITS FROM NEW TEST REACTORS TO NUCLEAR ENERGY INNOVATION.

A new advanced test reactor and/or demonstration reactor(s), would provide the opportunity to develop new technologies that could benefit society and the environment in many ways. Only through testing and demonstration can new reactor technologies be successfully developed and deployed. This has been the situation with light water reactors (LWR) for over 60 years. LWRs have been on a progression of advancement, starting with the early Generation I demonstration reactors, through the Generation II reactors that make up the vast majority of operating reactors worldwide, to the Generation III and III+ reactors that are under construction today. At each stage in the development process, testing was required to verify the performance of fuel, materials, systems, and components, and to benchmark the computer codes that are used to simulate the operation of the new fuel and/or reactor once it is built. This testing represents a necessary part of the regulatory process to assure safety and obtain licenses for advanced fuels and/or reactors for power production.

Development of materials that can be used in reactors requires many years of testing for irradiation tolerance and chemical compatibility with the other reactor materials, particularly the coolant. Today, the United States relies mostly on irradiations carried out in the Advanced Test Reactor (ATR) at Idaho National Laboratory (INL) and High Flux Isotope Reactor (HFIR) at Oak Ridge National Laboratory (ORNL) for accelerated testing of radiation tolerance. These reactors are decades old and are called on for many other missions besides commercial nuclear power applications. Some capability exists in smaller reactors at a few universities to test under prototypical conditions in thermal neutron reactors, but not in fast neutron reactors. Should a new facility with fast neutron irradiation capability be available, it could lead to acceleration of the testing of materials, particularly of reactor fuel materials.

Examples of innovations that could benefit the existing and future light water cooled reactors, including Small Modular Reactors (SMRs), that could be accelerated are:

- Additives for higher fuel conductivity, which allow for larger extractions of energy from fuel
- New cladding materials to enable reduced reactions with water under normal conditions and under high temperature conditions during accidents. This includes accident tolerant fuels that might reduce or eliminate the production of hydrogen during accidents in LWRs.
- Higher density fuels, which would allow the extraction of more energy from the core without requiring higher enrichments than 5%, the current limit on most licensed fuel fabrication and transportation facilities.
- Advanced burnable absorbers, which have smaller residual reactivity penalty at end of life and therefore require lower initial fuel enrichment.

For advanced reactors that use other types of coolants, including liquid metals, helium gas, and molten salts, the implementation of their resulting technologies can have significant benefits relative to economy and safety. These features enable:

- Higher power densities and lower operating pressures, which can result in smaller components and structures, and thus lower capital cost;
- Higher fissile fuel conversion, which promotes longer fuel cycles and larger energy extractions from the same fuel; this includes reactors that may not require refueling for more than 10 years, with derived benefits for both spent fuel reduction and enhanced proliferation resistance.
- Opening of new energy markets, such as process heat and hydrogen production, as a result of much higher operating coolant temperatures.

Generally, advanced reactors operate at coolant temperatures higher than light water reactors (LWRs). Higher operating temperatures will result in improved power cycle efficiency, which will have positive impacts on the environment in multiple ways, including:

- Reduced heat rejection,
- Reduced cooling water requirements, and
- Improved fuel utilization.

Higher operating temperatures can also allow the implementation of advanced thermal conversion cycles, such as the Super Critical $CO_2$ Brayton cycle. The significantly higher thermal efficiency of this cycle could be a game changing technology improvement facilitated by advanced nuclear technology deployment.

## IV. POTENTIAL CAPABILITIES OF NEW TEST FACILITIES

The NEAC-NRT Subcommittee considers there might be wider benefits from a new test reactor that advances many technology options. At this time, DOE-NE is cost sharing in the development of two light-water cooled SMRs. Subsequent demonstration reactor facilities based on other technologies may require government funding in the future; but at this time, no advanced reactor technology clearly stands out as superior for competing in the commercial energy market in the 2025-30 time period. However, it appears that all advanced reactor designs based on non-water coolants, as well as SMRs, advanced LWRs, and the current commercial fleet, could benefit from a new test reactor if it includes appropriate capabilities. For example, if irradiation test data could be used to validate reactor component simulation models, a versatile test reactor could be a significant accelerator for advanced nuclear reactor deployment, providing an early indication of the issues that may be encountered with advanced reactor designs, expediting the licensing process, and reducing the amount of subsequent required safety testing.

While there will be inevitable tradeoffs, based upon stakeholder input obtained during our three meetings, the NRT Subcommittee identified the following test reactor capabilities for consideration:

- ***Reliability and cost.*** The reactor technology, e.g., the driver fuel and coolant, should be based on proven technology. The objective is to reduce the cost, the development time and most importantly, to ensure the reliable operation of the test reactor. We observe that a high neutron flux, in addition to high reliability, is desired so that target fluences (cumulative neutron presence in a unit volume) can be accumulated in a timely and cost effective manner.
- ***Large test volumes***. Although it is agreed that the test reactor should include a range of test volumes, the maximum test volume size desired by stakeholders varied. Some stakeholders suggested test volumes that are 15 to 20 cm in diameter and up to 1.1 m in length. Other stakeholders, including a vendor that has supplied several operating commercial power reactors, emphasized their desire for test volumes capable of irradiating a prototype 3x3 fuel assembly (e.g., a 5.1 cm x 5.1 cm x 1.8 m volume). The ability to irradiate prototype assemblies would significantly expedite the time required to deploy new fuels, eliminating the need for testing of lead test assemblies in commercial power reactors. This test volume is larger than what currently exists in operating Material Test Reactors (MTRs) (e.g., the ATR) or proposed new MTRs [e.g., the French Jules Horwitz Reactor (JHR), the Russian Multipurpose Fast Neutron Reactor (MBIR), and the Belgium Multipurpose Hybrid Research Reactor for High-Tech Applications (MYRRHA)].
- ***High Temperature Testing Capability in Independent Loops Containing Different Coolants.*** In order for new fuels, materials and components to be evaluated in prototypic conditions, this new test reactor should include loops containing prototypic coolants (e.g., molten salt, helium, sodium, boiling water, pressurized subcooled water, etc.). The coolant loops should be able to include new small novel components, such as pumps, whose performance in a radiation environment must be evaluated. In addition, the reactor must be able to test fuels, materials, and components under operating and accident conditions. Stakeholder input indicated a desire for peak temperatures ranging from 700 to 1000 °C with independent temperature control and instrumentation in each loop so that multiple users can be simultaneously accommodated.
- ***Broad Energy Spectrum Reactor with High Neutron Fast Flux.*** Several stakeholders desired a domestic fast neutron flux test facility for studying the effects of neutron damage on materials, claddings, and fuels. In order to achieve the desired neutron

damage rate, several stakeholders requested that the facility be able to provide some test locations with peak fast fluxes of at least $10^{16}$ n/cm$^2$-s (neutron energies > 0.1 MeV). Fast flux reactors with this value of fast fluxes are limited, worldwide. In some cases, the ability to use fast flux facilities can be affected by international policies. We observe that the maximum fast fluxes for operating or proposed international facilities are less than the stakeholder requested value and that features would be needed at some locations in the reactor to 'thermalize' the flux, allowing the facility to accomplish thermal and fast flux testing missions.

- ***Rapid Insertion and Removal Capabilities***. Pneumatic hydraulic shuttles, at times referred to as “whales” or 'rabbits' in nuclear reactor jargon, are available in several U.S. test reactors (e.g., ATR, HFIR, the National Institute of Standards and Technology (NIST) reactor, and certain university reactors). These shuttles provide an inexpensive path for rapid sample insertion and removal while the reactor is at power. Stakeholders emphasized the need to include this feature in the new test reactor.
- ***Steady State and Transient Testing Capabilities***. Some existing and new test reactors (e.g., ATR and JHR) include capabilities to test at steady state and transient conditions. Inclusion of this capability allows these test reactors to simulate control rod withdrawal and loss of coolant events.
- ***State-of-the-art Instrumentation in Standardized Test Rigs with Real-time Data Measurement.*** Stakeholders observed that some international test reactors have the capability to irradiate fuels and materials in standardized test rigs that provide real-time measurements of critical parameters such as fuel expansion (e.g., changes in diameter and elongation), neutron flux, fuel centerline temperature, and fission gas release pressure and composition. Data from this instrumentation are essential for validating modeling and simulation tools; and the use of standardized test rigs reduces the one-of-a-kind engineering costs and schedule impacts associated with irradiation testing. In order to attract users, this new facility must offer comparable, if not superior, instrumentation than currently available at international test reactors at competitive costs.
- ***High Availability (> 85% of the time)***. The importance of high test reactor availability for civilian applications was stressed by several stakeholders, and should be a key feature in the new test reactor. In the existing U.S. test reactors, the DOE Naval Nuclear Propulsion Program has priority at the existing ATR at INL, and the DOE Office of Science operates the HFIR at ORNL. This limits the availability of these reactors for DOE's civilian advanced reactor development program.
- ***Accessibility and Close Proximity to State-of-the Art Post-Irradiation Examination Facilities***. In addition to real-time data from state-of-the-art instrumentation, post-irradiation examinations with state-of-the-art examination capabilities provide essential data for characterizing the end-state of irradiated fuels and materials. It is desirable for the new test reactor to be co-located with state-of-the-art PIE facilities for easy access and to minimize transportation costs from the reactor.

A multi-purpose test reactor with capabilities to accommodate multiple users and technology (coolant) loops could reduce the costs of subsequent demonstration reactors required for deploying advanced reactor designs. However, a test reactor that tries to meet all stakeholder requirements will be expensive and may end up not providing the full range of conditions of any proposed technology. It is important to prioritize and economically balance mission needs. The study should complete an evaluation to ensure that the test reactor is affordable and reliable and meets the needs of a wide a group among potential users in the post-2025 time period.

## V. NON-TECHNICAL CONSIDERATIONS

Besides the technical characteristics and capabilities of the test/demonstration reactor, there are important additional consideration that should be addressed by the study. Among the more important considerations are:

**Affordable build costs:** Advanced test/demonstration reactors come in many different configurations and sizes depending upon the technology that they are intended to support. If a reactor is to support a single technology, the test /demonstration reactor approach can be cleanly defined. If not, then a multipurpose facility is required, and will be more costly. Such facilities, such as the past MTR, the Engineering Test Reactor (ETR) and the current ATR offer good examples of this approach, each intended to address different aspects of emerging reactor technology. It will be important to review that history to ensure that the proposed new reactor is not saddled with unsustainable build costs. For example, the current ATR provides important irradiation services but is now in its fifth decade of operation. How long could it be expected to remain in service and what aspects of the mission can it not fulfill? What would an advanced MTR facility provide today? In summary, the study should address financial and technical risk for the new test/demonstration reactor options. Tradeoffs are certainly required including an appropriate complement to existing capability, both foreign and domestic.

**International Collaborations:** Some participants in the international community are aggressively pursuing advanced reactor technologies and are building test/ demonstration reactors to support the activity. Notable among these are China, India, Russia and France. In addition, traditional players in nuclear technology development have test facilities that are available or proposed. Addressing these capabilities and their availability will be an important aspect of the study. The goal should be to provide unique capability needed for US developers that will also interest the international community. It should be recognized, however, that even though capability may exist in the international community, reliable and cost-effective access (such as to the Halden reactor in Norway) is an important consideration when addressing foreign capability and cooperation. Access is not just directly to the test facilities but also to the information that they provide. This is especially important for emerging technologies such as the molten-salt concepts being vigorously pursued in China. Cooperation in technology development and its assessment can better inform the need for test facilities in the United States.

**Sustained funding for operations and experimental suppor**t: Operating and utilizing a test reactor is an expensive, complicated endeavor. Often, proposing and executing experiments in a test reactor is beyond the capability of individual experimenters. To be successful, it is important that sustained funding be provided to ensure that both the operations and experimental support personnel are fully engaged, fully trained and sustained through continuous service at the facility. This is true not only for the test reactor itself but also the facilities that support it, such as hot cells necessary for post-irradiation examination. This will require continued sponsorship of the basic reactor operation needs by DOE or a combination of U.S. and international sources.

Attention of the experimenter should be focused on the experiment itself while irradiation service costs and technical support are provided by the facility. A lesson learned is that a test facility should be designed to lower those costs, namely by a relatively simple system to access and operate, a safety envelope that can encompass a wide variety of experiments, and ease of transfer of experiments into and out of the reactor.

**Broad User Community:** Consistent with significant support for the traditional user community and a relatively simple system to access, the broader user community can be interested in services that do not require them to become expert in nuclear irradiation technology. There are many important examples of this, especially with university reactors that host a wide variety of users in their own community and from industry. There are important lessons to be learned from this experience, and efforts should be made to better understand it. The broader user community can provide important support for a new test facility if they are engaged.

**Policy Constraints:** The study should seek out and address policy constraints applicable to the design and operation of the new test/demonstration facility. For example,

- Licensing is tightly constrained by a variety of regulations. Understanding fully the licensing options available for a new test facility will be an important aspect of its design (and cost).
- Fuel for a new test reactor must meet the requirement that it be less than 20% enriched in U-235. This constraint may limit the flux levels that can be obtained, requiring new fuel designs. Implications of this constraint will be an important consideration in design, again to ensure flexibility at reasonable cost.
- In addition, export controls will impact technology choices if international partners are involved, and a thorough understanding of possible constraints is important.

## VII. SAFETY AND LICENSING CONSIDERATIONS

If the DOE chooses to move ahead with the construction of an advanced test or demonstration reactor, the DOE will have to determine whether the reactor will be licensed by the NRC—the recommendation of the NEAC NRT Subcommittee—or whether safety reviews and regulatory oversight during construction and operation will remain primarily a DOE in-house function.

Licensing options available to DOE will depend upon where the reactor is sited, whether it will be designed to produce electricity and be connected to the grid, and the size of the reactor. Some of the licensing options are constrained by legal requirements:

- 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 the reactor is connected to the grid, regardless of whether it is on a DOE site, it must be licensed by the NRC.

If the DOE chooses to build a small test reactor on a DOE site that is not connected to the grid, DOE could conduct the safety reviews in-house, authorize its operation under DOE Orders, and regulate its operation by the DOE staff. DOE would have the option of using the NRC as a technical support organization (TSO) to conduct safety reviews and make recommendations to the DOE under an interagency agreement. This approach is used by DOE's Naval Reactors Program to review advanced naval reactor designs. This approach offers the potential of a speedier less costly licensing process for test reactors. The NEAC NRT Subcommittee, however, sees several disadvantages to this approach:

- NRC licensing offers additional benefits with respect to public acceptance. The NRC licensing process, as opposed to DOE using exclusively a self-regulatory process for safety reviews and operational oversight, would be perceived as more independent and more open to public scrutiny, as it would provide the public with an adjudicatory process for participating in the licensing process.

- The NRC is better staffed, and more current than DOE to conduct new reactor licensing and operations oversight. The NRC regulates 42 research and test reactors of which 31 are currently operating.

- DOE currently does not have the staff with recent experience to make the required startup reviews and authorize startup. Building up the DOE staff to complete such activities would be unnecessary duplication of NRC capabilities.

- The DOE orders for authorizing startup of a new reactor would require careful review as the current orders, which were written to cover a broad range of nuclear facilities, have not been applied to a new test or demonstration reactors (All existing DOE reactors were licensed prior to the separation of the AEC into DOE and NRC).

- More detailed guidance, requirements, and experience exists for reactors seeking a NRC Class 104(c) license.

- The NRC could specify more requirements if a subsequent similar design were built and connected to the grid. Thus, authorization of operations under DOE Orders would not provide as many insights about NRC licensing requirements for follow-on reactors of a similar design.

The NRC offers several licensing approaches for test reactors. Under 10 CFR 50.20, the NRC offers two classes of licenses—a Class 103 license and a Class 104 license. A Class 103 license applies to facilities where " more than 50 percent of the annual cost of owning and operating the facility is devoted to the production of materials, products, energy for sale or commercial distribution, or to the sale of services, other than research and development, or education and training" [See 10 CFR 50.22]. This is unlikely to be the case here, so realistically DOE would pursue a Class 104 license, namely a Class 104(c) license, since Class 104 (a) and 104(b) would not apply. [See 10 CFR 50.21]

In sum, the realistic options for licensing are by the NRC as a Class 104(c) license or under DOE Orders where the NRC acts as the TSO for design safety review. As indicated above, the NEAC NRT Subcommittee favors the former—licensing by the NRC as a Class 104(c) license.

## VI. PROCESS FOR EXECUTING THE STUDY

The study should begin shortly, perhaps in March 2015, and be completed no later than August 31, 2016; and it should result in a report in early fall 2016.

The work scope should involve the national laboratories, industry, universities and other relevant stakeholders, as well as interaction with the NEAC and the NEAC Nuclear Reactor Technologies (NRT) Subcommittee.

The study scope is broad, must be done on a relatively tight schedule, and involve the efforts of a large number of organizations. Therefore, an overall plan needs to be defined in reasonable detail at the beginning of the study, and then used for the duration of the study to keep the process on track.

The major elements of this process are:

- Establish the desired goals, capabilities and evaluation criteria to be used in assessing technology options, capabilities and requirements for test and/or demonstration reactor(s), as well as associated facility conditions and capabilities. Our NRT Subcommittee has provided its suggestions for each of these topics above, (Sections II – V).

- Establish milestones including completion of a draft report in spring of 2016 for final review and independent verification of the technical content. Both the final review and technical verification need to be completed by May 30, 2016, so the report can be submitted for review and discussion by the NEAC at its June 2016 meeting. Final resolution of comments, and then final submittal to DOE senior management should be completed by August 31, 2016, for their eventual submission as a final report to Congress.

- In March 2015, at the start of the first month of the schedule, identify the leadership team for the project and the responsibilities of the leadership team members. Immediately, the leadership team should assign smaller working groups of its members to produce a first draft outline of the scope and contents of the final report to be produced and to lay out the overall project plan, schedule and sequence of events to complete the study. A first draft of the report outline and project plan should be completed by mid-March 2015. The report outline and overall project plan, schedule, and sequence should then be reviewed and approved by the project leadership team by the end of March 2015 with NEAC NRT review, and then become the basis for proceeding and tracking the work of the project. As work subsequently proceeds, any lessons that are learned, or necessary changes, should be reviewed and approved by the leadership team and then promptly made.

- The overall project plan should identify the relevant organizations involved in conducting the study, needed participation, scope, schedule and deliverables, and their various interactions to achieve a successful result. The organizations that may be addressed in the plan should include:

    - Overall Steering Committee—scope and schedule; assigned membership from labs, vendors, universities, think-tank groups, and stakeholders.
    - NEAC NRT Subcommittee—scope and schedule, including Reviews every 2-3 months as the work progresses, and review of the final draft report prior to submittal to the full NEAC.
    - Independent Review Experts—for review of the pieces of the report draft to assure technical correctness. This could be organized by each working group (discussed next), as members of the group are dedicated to review of products of that working group.
    - Working Groups— These should have membership from national laboratories, vendors, and academia to provide technically accurate and clear information to be used as evidence in the evaluation process of various reactor and facility possibilities. For each working group, specify the work scope, schedule, structure of deliverable, and applicable criteria to assure the results are technically accurate and clear so that they can be used in the process. The NRT Subcommittee suggests the following topical areas for potential working groups:
        - Evaluation of new test reactor options
        - Evaluation of demonstration reactor options
        - Methodology development for summing up the capabilities and benefits
        - Siting and licensing options
        - Affordability of the test program (each facility) and potential sponsors,
        - Economic impact of the range of technologies that would be tested.