NEAC Facilities Subcommittee Report, Meeting on 2-25-2014

NEAC Facilities Subcommittee Members

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Summary

A meeting of the NEAC Facilities Subcommittee was held in Washington DC on 2/25/2014 to address the role of the National Scientific User Facility (NSUF) in coordinating use of nuclear facilities for R&D. Representatives from the NSUF, INL and DOE-NE gave presentations regarding the history and future of the NSUF, opportunities for expansion and R&D challenges for the future.

The emphasis on the NSUF follows the recommendations given to the full NEAC committee in December, 2013, namely

1) **That the DOE-NE pilot program for a virtual user facility (ATR-NSUF) which began in 2007 be expanded to include the use of all facilities important to DOE-NE's programs in nuclear technology R&D,**

2) **That the scope of the user facility be expanded beyond its present emphasis on materials development,**

3) **That the user facility be prominent in the next update of the DOE-NE Roadmap for nuclear technology R&D as the coordinating mechanism for nuclear facility use and prioritization.**

The presentations given to the Subcommittee and subsequent deliberations of the subcommittee ***reinforced these recommendations*.**

Consistent with these findings, it is recommended that the name of the user facility be changed to reflect its expanded role, namely **the Nuclear Scientific User Facilities (NSUF).**

The Subcommittee was subsequently made aware of the DOE Infrastructure Assessment Study initiated at the beginning of the year by which a comprehensive study will be made of DOE facilities across the complex. It is anticipated that the approach recommended herein will be effective and useful to DOE-NE in this study and we recommend close coordination between efforts to expand the scope of the NSUF and those who are participating directly in the Infrastructure Assessment Study.

Discussions

History of the ATR-NSUF - Todd Allen

Before 2007 there were no user facilities to address the unique challenges of nuclear energy research. The ATR-NSUF was created to merge the national nuclear research infrastructure with intellectual capital and to pair the best ideas with needed capability. While the initial emphasis was on ATR and supporting hot-cells, a network of capability across the U.S. was added to include both national laboratory and university capability. Partner facilities include 8 universities, 2 national laboratories and 1 industry representative with additional institutions applying to be partners.

The model includes outreach to train and interest students and faculty in using facilities for nuclear science R&D. Outreach is accomplished through faculty seminar lectures at universities, colloquia at the INL, workshops at the annual American Nuclear Society student meeting, and an annual user's week. A user's organization was established in 2011 to provide a clear channel for the exchange of information.

There are also programs that seek to engage industry using a cooperative R&D model. The model attempts to prioritize research with industry input and to build specific capability consistent with industry interest. The model offers a forum for research collaboration among universities, industry and national laboratories and provides a hub for collaboration with other test and research reactors and post-irradiation examination equipment.

There have been many innovations in development of the NSUF, including a library of irradiated specimens that are available for PIE, closer coordination with other university research programs and purchase of significant upgrades in examination equipment. The NSUF is one of multiple coordination points for NE equipment purchases.

NSUF Going Forward - Rory Kennedy

Leadership of the NSUF has recently changed, with Rory Kennedy appointed as the director. He has broad experience in both the university and national laboratory environments, including international. He supports expansion of the NSUF scope to include fabrication capabilities, thermal-hydraulics, criticality, computation and to assist NE in understanding the current resource availability. In the course of his review of this expansion, there are many issues to be addressed; including managing user

expectations, commitment from facilities, schedule adherence, identification and prioritization of facilities, enhanced use of sample library and transport and receipt of shipments of irradiated material.

This latter issue, namely transport and receipt of irradiated material is seen as a major challenge. Increased availability of partner facilities brings little benefit if irradiated samples cannot be easily transported to available hot cells and examination facilities. Standards for cask receipt and transport is sorely needed in the complex.

In the long term, expansion of the NSUF as the center for NE R&D coordination would enable best use and integration of facilities, implementation of NE priorities, focused direction for NE solicitations, and better coordination with other DOE organizations and industry. If successful, many benefits will be realized.

Facility Needs for Nuclear Energy R&D – Kemal Pasamehmetoglu

Streamlining the use and enhancing capabilities of existing facilitates is as important as building new facilities; the NSUF can facilitate this. The NE implementation strategy is an engineering-driven, science-based approach, requiring a flexible and efficient analytical and experimental framework. Development of new fuels & materials is traditionally a highly-empirical, lengthy and expensive process; modeling and simulation supported by quality verification and validation is increasingly important if efficiencies are to be gained. The science-based approach couples experiments and modeling for multi-physics phenomena spanning across more than four decades in scale. This requires a fleet of small, medium and large test facilities to support the work. Investments in state-of-the-art equipment and facilities at the INL have created world class PIE capabilities. Restart of the TREAT reactor will add significant needed capability.

Nationally, better integration of facilities/equipment/capabilities in various institutions is needed. NSUF can provide that integration through evaluation of equipment and test facility availability, status and usage, easier access for researchers to existing capabilities and sharing of irradiated samples among different institutions and facilities. A standard cask system for transport and receipt of materials is needed.

NE's Priorities on Facility Utilization - Shane Johnson

The Office of Science and Technology Integration has the responsibility for coordinating research across a broad spectrum, including university and national laboratory resources. The office is responsible for the NSUF and support of the Idaho National Laboratory (INL). The total budget for these activities is on the order of $140M and includes the NSUF, crosscut technology R&D, advanced modeling and simulation, reactor research infrastructure, SBIR/STTR and the INL laboratory directed R&D. The office is in a good position to coordinate expansion of the scope of the NSUF and supports doing so.

As always, budgets constrain what can be done and priorities must be established. There is a disciplined process for establishing those priorities and expansion of the NSUF is seen as a means of facilitating the process as well as creating efficiencies by enhanced cooperation between programs.

University Programs and Facility Utilization - Mike Worley

Since FY09, NE has awarded $290M to 89 schools in 35 states and the District of Columbia. The Office of Nuclear Energy has a well-established competitive process for awarding R&D, infrastructure and scholarships/fellowships supporting the university research workforce. Universities, national laboratories, industry and foreign research entities are strongly encouraged to actively engage and collaborate with the associated NE R&D programs. NE applies multiple means to ensure that university-led research has access to state-of-the-art facilities and other capabilities to optimize research results. Increasingly, the NSUF is facilitating that process.

Commencing in FY2012, university researchers were encouraged to submit joint proposals through both NSUF and NEUP. The goal is to facilitate access to partner research facilities. By encouraging diverse partnerships and allowing up to 20% of university-led research funding to be provided to domestic non-university collaborators, universities are provided access to expanded capabilities located at national laboratories, industry, other universities, and overseas.

NE is coordinating with NSUF to establish the staff resources and processes to develop and maintain an accurate understanding of the nuclear energy-related facilities, capabilities and their schedule status. NSUF will apply this knowledge to subsequent NE competitive infrastructure investment evaluation and award decisions to avoid redundancy and better ensure efficient utilization.

Modeling and Simulation V&V -Trevor Cook

Modeling and simulations activities of NE are centered on advanced multi-scale, multi-physics computational methods for reactor design. These activities occur through the NEAMs & Hub (CASL), with CASL focused on applied solutions to industry defined challenges and NEAMs focused on developing insights into performance and safety. Both require facilities for validation and verification of the computer models developed.

New data from contemporaneous experiments is essential to fill important knowledge gaps specific to nuclear energy applications. NE must find ways to provide the opportunity for experimentalists and analysts to work together to understand origins of differences, improve experiments, and improve engineering models. DOE has a rich history of experiments that could provide important data for V&V and limited work is underway to mine that data and create bench-mark data sets.

There are many facilities across the complex that could be used for V&V experiments. The Nuclear Energy University Programs (NEUP) and the Integrated University Program (IUP) have a well-established competitive process for awarding R&D, including infrastructure enhancements. The need for V&V experiments has been included in the last two calls and 43 pre-proposals have been received this year for NEAMS V&V. The need is recognized and interest is growing; the NSUF can provide an important role in facilitating those interests.

Discussion

Dana Christiansen – The NSUF is on the right track. It leverages the nation's capability in nuclear facility supported R&D. The user's organization is especially important and needs to be emphasized. More

encouragement needs to be given to the user community to support the organization and grow. Need to involve industry fully and am encouraged by the new leadership of the NSUF. The emphasis on engineering-based approach is good. TREAT restart is very important to the future of nuclear R&D. Would like to see a strong push by NE to more fully integrate programs, including placing the NSUF squarely in the NE roadmap, erasing the potential for double jeopardy between NEUP and NSUF and connecting with the main-line R&D programs. High performance computing is important to the future of nuclear R&D and approaches being taken are encouraging. It would be useful to more fully understand and engage industry in their approaches and tools in modeling and simulation.

John Ahearne – Recommend the name change to Nuclear Scientific User Facilities

Mike Corradini – There are many moving parts and coordination is essential, especially between facilities, development of computational tools and experiments. It is important to find ways to better involve industry, involving them in early definition of work-scope along with universities. The key is integration; the NSUF can be an important force in accomplishing this.

Paul Murray- A master plan for research facilities needs to be created and maintained. This should record facilities over a predetermined size, when they were built, original purpose and current use and status. A separate list of industry capabilities should be identified. For all research projects within DOE NE a more effective way of prioritizing university programs should be found, monitored and a way of terminating of programs that are no longer succeeding or that are no longer needed.

In general much closer relationship with industry should be encouraged. For example industry should be approached for generic problems that they are facing and that could be solved as part of the NEUP program. This should include the willingness of industry to supply supporting R&D and data to support and validate the program of work. From industries perspective the current NEUP program is very ineffective. Murray reported that in 2013 AREVA had been approached to support more than 100 pre-proposals. Many of the proposals were interesting however with the low success rate of the universities in winning the project there is very little support from management to expend the time to support the universities to submit.

Denis Beller – The communications and interaction between the INL and the university community is subject to misunderstanding and conflict; this issue needs to be addressed early. This will be a major challenge for the new leadership and every effort must be made to understand the university research community interests and concerns. An academic in senior leadership at the NSUF would be helpful and is recommended. A means should be found to formalize the advice and involvement of the university community. In addition, there is a pressing need for more active industry communication. The new leadership should take the opportunity to more fully reach out to these communities as the future of the NSUF is being defined.

In particular, Communications and interaction between DOE and INL leadership related to recent/current university programs (NEUP, CINR, etc.) and the university community has been subject to misunderstanding and conflict; if the NE NSUF will be managed by INL, this issue needs to be addressed early. Currently some nuclear engineering academics perceive that DOE/NE has lost focus on nuclear

engineering and turned most of its focus to materials issues, fuels, and computer sciences, which creates the impression that nuclear engineering is being orphaned again as it was before the development of the ANS Special Committee's report "Nuclear's Human Element."* This will be a major challenge for the new NSUF leadership and every effort must be made to understand the interests and concerns of the university research and education communities, both in the sciences and in engineering. NSUF leadership should include a senior academic who understands the needs of faculty and students and the processes ongoing at university, college, and department levels. A means should be found to formalize the advice and involvement of the university community.

In addition, there is a pressing need for more active national laboratory and industry communication. The new leadership should take the opportunity to more fully reach out to these communities as the future of the NSUF is being defined. Just as the ATR NSUF has an external user's group to provide advice and support, the NE NSUF should have a user's group, but it should also have a higher level internal group consisting of senior academics, industry representatives, and managers from non-INL national laboratories that form an advisory body for the NSUF and DOE/NE leadership.

* *Nuclear's Human Element*; Warren Miller, Denis Beller, Michael Corradini, James Duderstadt, Audeen Fentiman, Marvin Fertel, Andrew C. Klein, and Craig H. Piercy; report of the ANS Special Committee on Federal Investment in Nuclear Education, American Nuclear Society, IL (2006).

Dave Hill – Technical integration is a priority, especially with limited budgets, and the NSUF is in a position to facilitate the process.

The Office of Nuclear Energy (NE) has limited resources at its disposal and, in all likelihood, will continue to function with limited resources for the indefinite future. As a result NE must operate in a fully integrated fashion to ensure that the country gets full value from its investment. For example, the country has many legacy nuclear (energy) facilities which are widely distributed and the responsibility of different program offices (NE, EM, SC, NNSA…). The largest and best supported concentration of facilities is at Idaho National Laboratory (INL) which is why, in part, that INL is the lead lab for nuclear energy and the responsibility of NE. Operating these facilities in a user facility arrangement ensures the most efficient and effective use of these facilities. In essence, NE takes an integrated view of facility usage to ensure that the country gets the maximum value.

Integration is not just a facility issue, nor can it be the province of each program office in isolation, or there is a real risk of capability duplication and lack of programmatic coherence. In a resource-constrained environment it is essential that programmatic technical integration be combined with facility usage. Such technical integration is best carried out by federal officials and dedicated teams of technical SMEs whose responsibility is to the program not their host institutions. These entities are best called Technical Integration Offices (TIOs). Above that, a critical federal responsibility is to look across the programs and ensure that local decision-making does not create duplicate capability.

The Office of Nuclear Energy plays many roles, and one that is often misunderstood is its role vis-à-vis the domestic nuclear industry. The nuclear industry, as a mature industry, has the responsibility for its own welfare. On the other hand NE has the responsibility to ensure that nuclear energy is available as a

possible energy source for the future needs of the country, i.e. a national responsibility. Originally this national responsibility led NE, or its predecessors, to play a large and successful role in developing nuclear energy through public-private partnerships. Today the situation is more complicated but, as an example, allows for research in the long-term performance of the existing fleet, essentially guarding against future shocks. Another example is the investment in University-based R&D which helps preserve the capability to provide a nuclear-trained workforce.

As such, the budget of the Office of Nuclear Energy should not be viewed as dependent on the health of the nuclear industry or its competitive position in the market place but rather as one that should be broadly constant at a level which the country feels is adequate to fulfill this national responsibility and other purely federal responsibilities placed upon the office such as spent fuel management science.

Andy Klein – Supports what has been said previously with the addition that DOE needs a better inventory of test facility capability, especially as the scope of the NSUF is expanded to include thermal-hydraulic facilities. This is especially true for V&V of simulation and modeling. Doing code development in an experimental vacuum is a mistake and there is an imperative to link modeling and experiments very early in the process.

John Sackett – Expanding the scope of the NSUF is appropriate, given its proven success and growing needs in the research community. Increased pressure on budgets, increased need for U.S. involvement in nuclear technology research and its importance to U.S. influence internationally underscore the need for a more efficient means to prioritize test facility support and use. The NSUF can significantly improve the current process. It is anticipated that overall savings can be achieved with more integration of program and facility support and it is hoped that those savings can be reflected in an increase in the NSUF budget.

International facility collaboration is also important. There is much capability outside the U.S. and we need to leverage access to those capabilities to optimize the U.S. NE research dollars.