Appendix B

Workscope for Program Support – University, National Laboratory and Industry

NUCLEAR ENERGY ENABLING TECHNOLOGIES (NEET)

ADVANCED METHODS FOR MANUFACTURING: (NEET – 1)

(FEDERAL POC – ALISON KRAGER & TECHNICAL POC – JACK LANCE)

(Up to 2 years and $400,000 total project cost, estimate up to 2 awards)

The Advanced Methods for Manufacturing program seeks to conduct research and technology development to improve the methods by which nuclear equipment, components, and plants are manufactured, fabricated, and assembled. The initial focus and emphasis will be placed on Small Modular Reactor (SMR) technologies. Proposals could draw upon innovative and successful manufacturing and fabrication practices found in related industries such as oil, aircraft, and shipbuilding. These proposals should pursue innovative methods to manufacture or fabricate components faster and with better quality; and to improve factory assembly of plant modules, thereby reducing the cost and schedule requirements for new nuclear plant deployment. Specific goals include:

- Accelerate deployment schedule by 3 to 6 months compared to new plant construction estimates;
- Reduce component fabrication costs by 20% or more;
- Increase performance of key subsystems without cost increase or schedule delay.

The program seeks to develop manufacturing and fabrication innovation, assembly processes and materials innovation that support the "factory fabrication" and expeditious deployment of SMR technologies. Potential areas for exploration can be found in the NEET 2010 Workshop report (http://www.ne.doe.gov/pdfFiles/Neet_Workshop_07292010.pdf) and include:

- Factory and field fabrication techniques that include strength assistance tooling, heavy lift and load leveling equipment;
- Assembly and material innovation to enhance modular building techniques such as advances in high strength concrete and rebar, inspection equipment, and pre-assembled rebar systems;
- Advances in modular construction to include improved design codes, improved methods for transport and delivery and advancements in integrated prefabrication.

Through innovation in manufacturing, fabrication and assembly, significant advancements in nuclear technology quality, performance and economic improvements will be achieved. One of the key success criteria for the program is the development of products or components that will gain acceptance by the appropriate regulatory or standard-setting bodies and licensed for commercial nuclear plant deployment.

ADVANCED SENSORS AND INSTRUMENTATION: (NEET – 2)

(FEDERAL POC – SUIBEL SCHUPPNER & TECHNICAL POC – DWIGHT CLAYTON AND RICHARD WOOD)

(Up to 2 years and $400,000 total project cost, estimate up to 2 awards)

The Advanced Sensors and Instrumentation program seeks to develop the scientific basis for sensors and instrumentation to address critical technology gaps for monitoring and controlling advanced reactors and fuel cycle technologies.

The goal of this program is to provide crosscutting research that:

- Contributes to the success of the NE R&D programs by obtaining the needed I&C technologies that support experiments, deliver unique sensors and related technologies for each reactor technology concept and fuel cycle facility;
- Enables the broader mission of the Office of Nuclear Energy, by supporting common ASI technology development objectives; and

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- Can overcome current barriers to nuclear energy system deployments.

Improvements and advancements are needed in the technical area of Advanced Sensors and Instrumentation technologies to enhance economic competitiveness for nuclear power plants and promote a high level of nuclear safety. Specific ASI research and development proposals are sought for the following topics:

- Design of a custom radiation tolerant electronics system, using the best available commercial or near-commercial technologies necessary for operation in a severe nuclear environment. The proposed system should provide observable evidence that the technology is capable of being implemented in a radiation-tolerant multi-functional robot for in-containment reconnaissance under severe accident conditions.
- Methods to quantify software dependability characteristics that can facilitate the resolution of factors that inhibit the expanded use of modern digital technology by the nuclear power industry. The current reliance of process-oriented software quality assurance programs and the resultant subjective evaluation of digital system safety drive the nuclear industry to choose between maintaining legacy technologies that have proven licensable or embarking on costly, non-optimum implementations that are constrained to pose the least amount of licensing risk. Development of an objective technical basis for evaluating the suitability for software-based instrumentation and control (I&C) systems in safety applications at nuclear power plants would enable a science-based safety case to be demonstrated and thus reduce regulatory uncertainty. Demonstration of measures, metrics, and methods and/or development of design support and analysis tool are sought to permit science-based quantification of the safety, quality, dependability, and reliability characteristics of software-based I&C systems.
- Development of highly secure, wireless communication infrastructures that support flexible, expandable I&C architectures that can reduce the cost of expensive cable runs; enable greater information access and plant automation; and allow add-on sensors and instruments to be introduced as needed. With cable runs costing up to thousands of dollars per foot, there is incentive to adopt wireless technologies in nuclear power plants where possible. However, security, reliability, and electromagnetic compatibility concerns limit its use by the nuclear power industry. Therefore, the proposed wireless communications technology should demonstrate communications resiliency by providing acceptable performance characteristics such as security, data integrity, interference resistance, and quality of service.

Organizations performing this research will be expected to produce concepts, techniques, capabilities, and equipment that are or can be demonstrated in simulated or laboratory test bed environments representative of nuclear plant applications.
Successful applications will describe truly innovative sensors and instrumentation that offer the potential for revolutionary gains in reactor and fuel cycle performance and that can be applied to multiple reactor designs and fuel cycle concepts.

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REACTOR MATERIALS: (NEET – 3)

(FEDERAL POC – SUE LESICA & TECHNICAL POC – JEREMY BUSBY)

(Up to 3 years and $1,000,000 total project cost, estimate up to 5 awards)

The NEET Crosscutting Reactor Materials program seeks applications for advanced reactor materials characterization techniques and tools. Successful completion of awards will provide advanced methods for sample preparation and new tools and techniques for examining and understanding material microstructures in a variety of conditions ranging from as-received to treated or irradiated.

Developing an extensive understanding of reactor material behavior in extreme environments is vital to the development of new materials for service in advanced nuclear reactors. This understanding is also needed for the extension of the operating lifetimes of the current fleet of nuclear reactors. Advanced characterization methods utilizing advanced tools and techniques, coupled with modeling and simulation and advanced sample preparation tools will further the understanding of the effects of irradiation, temperature, pressure and corrosive environments on material microstructures and mechanical behavior. Modern sample fabrication tools could also allow for more efficient use of existing irradiated materials and enable fabrication of smaller specimens from previously examined materials.