# DOE-ID NEPA CX DETERMINATION



CX Posting No.: DOE-ID-21-064

**SECTION A. Project Title: Gallium Nitride-based 100-Mrad Electronics Technology for Advanced Nuclear Reactor Wireless Communications – Oak Ridge National Laboratory**

**SECTION B. Project Description**

Oak Ridge National Laboratory proposes to address the NEET (Nuclear Energy Enabling Technologies) 2 requirements of specific critical need areas for monitoring in advanced reactors: 1) develop wireless technology to measure and transmit data on system temperature and pressure, by using improved radiation-hardened and temperature-tolerant wireless sensing electronic systems capable of multi-sensor transmissions enabled through the effective use of AlGaN/GaN circuits, and 2) increasing system cost-effectiveness and reliability fabrication, by reducing lengthy cabling and penetration costs and integrating with advanced control modules through a wireless base station capable of receiving and multiplexing data from multiple sensors. These are both critical to the stated DOE NE mission to advance U.S. nuclear power by enhancing the long-term viability and competitiveness of the existing U.S. reactor fleet. The specific goals of this project will be addressed through completion of the following tasks: 1) GaN-based device, cell, and circuit fabrication and SPICE modeling; 2) Wireless dual sensor transmitter circuit and software defined radio (SDR) architectural design and simulation; 3) Radiation and temperature testing, modeling, and shielding study of GaN devices and sensors; 4) GaN-based sensor interface and wireless electronics system fabrication, integration, and laboratory testing; 5) Radiation dose and temperature testing of the combined sensing/communications system; and 6) Radiation and temperature system evaluation, analysis and GaN modeling. This technology development and validation project will provide a robust, wireless communications link prototype suitable for placement immediately outside of the core and will have sufficient transmission distance enabling commercial-based, minimally rad-hard wireless systems to be employed in containment.

**SECTION C. Environmental Aspects / Potential Sources of Impact**

Circuits will be neutron irradiated that will result in some degree of neutron activation. Up to 5 units (printed circuit boards of less than 5 square inches area with attached components including custom GaN circuits) will be neutron irradiated. Irradiated units will be tested in an ORNL hot cell and disposed of following testing using standard ORNL procedures. An initial study will be performed to choose materials to minimize neutron activation, wherever possible.

**SECTION D. Determine the Level of Environmental Review (or Documentation) and Reference(s):** Identify the applicable categorical exclusion from 10 CFR 1021, Appendix B, give the appropriate justification, and the approval date.

Note: For Categorical Exclusions (CXs) the proposed action must not: 1) threaten a violation of applicable statutory, regulatory, or permit requirements for environmental, safety, and health, including requirements of DOE orders; 2) require siting and construction or major expansion of waste storage, disposal, recovery, or treatment facilities; 3) disturb hazardous substances, pollutants, contaminants, or CERCLA-excluded petroleum and natural gas products that pre-exist in the environment such that there would be uncontrolled or unpermitted releases; 4) adversely affect environmentally sensitive resources. In addition, no extraordinary circumstances related to the proposal exist which would affect the significance of the action, and the action is not "connected" nor "related" (40 CFR 1508.25(a)(1) and (2), respectively) to other actions with potentially or cumulatively significant impacts.

References: B3.6 Siting, construction, modification, operation, and decommissioning of facilities for small-scale research and development projects; conventional laboratory operations (such as preparation of chemical standards and sample analysis); and small-scale pilot projects (generally less than 2 years) frequently conducted to verify a concept before demonstration actions, provided that construction or modification would be within or contiguous to a previously disturbed or developed area (where active utilities and currently used roads are readily accessible). For purposes of this category, "demonstration actions" means actions that are undertaken at a scale to show whether a technology would be viable on a larger scale and suitable for commercial deployment. Demonstration actions frequently follow research and development and pilot projects that are directed at establishing proof of concept.

Justification: The activity consists of an investigation to develop, fabricate, and demonstrate a gallium nitride (GaN) HEMT (high electron mobility transistor)-based radiation hardened wireless communication link for advanced nuclear reactor monitoring.

Is the project funded by the American Recovery and Reinvestment Act of 2009 (Recovery Act) ☐ Yes ☒ No

Approved by Jason Anderson, DOE-ID NEPA Compliance Officer, on 09/07/2021.