

**SECTION A. Project Title:** Near Real-Time Radio Intelligent Controller Based Secure and Resilient 3D Aerial Networks with Spectrum, Interference, and Handover Management

**SECTION B. Project Description and Purpose:**

Idaho National Laboratory's (INL's) core mission is to discover, demonstrate, and secure innovative nuclear energy solutions, clean energy options, and critical infrastructure. The INL Laboratory Directed Research and Development (LDRD) program engages researchers, leadership, and infrastructure to convert scientific and engineering ideas into scientific discoveries, research capabilities, research and development (R&D) programs, and deployed technology solutions. INL uses the LDRD program to develop core capabilities and achieve strategic initiatives in science and technology (S&T). This project will be covered under initiative 5.3 Secure and Resilient Cyber-physical Systems: Secure Fifth Generation (5G) and Beyond Wireless Communications.

Unmanned aerial vehicles (UAVs) have attracted increasing attention for various wireless network applications by utilizing UAVs reliable line of sight (LoS), paths in air-to-ground connections, and their flexible placement and movement. As such, the wireless network architecture is becoming three dimensional (3D), incorporating terrestrial and aerial network nodes, which is more dynamic than the traditional terrestrial network. This project develops solutions to overcome the challenges of UAV communications to realize integrated air-to-ground networks such as spectrum sharing, air-to-ground interference management, and energy efficient and cost-effective UAV assisted communications.

The project aims to develop a secure aerial network for nation wide drone operations with spectrum sharing using the Open Radio Access Networks (O-RAN) controller for controlling the trajectories of multiple unmanned aerial vehicles when those UAVs are connected to a cellular 5G network. The project will utilize the (i) O-RAN base station of INL Wireless Security Institute, and the (ii) Aerial Experimentation and Research Platform for Advanced Wireless (AERPAW) Platform of North Carolina State University (NCSU).

**Tasks include:**

INL (Lead):

- Task 1: Development of accurate Radio Maps of 3D-Aerial Networks to create trajectories used by drones.
- Task 2: Designing algorithms for sharing available spectrum by intelligent spectrum allocation and interference management.
- Task 3: Developing handover management using intelligent control mechanisms.

North Caroline State University (Support):

- Task 3: Developing handover management using intelligent control mechanisms. The project will utilize the O-RAN base station of INL Wireless Security Institute and the AERPAW Platform of NCSU.

No waste is expected to be generated in association with this project.

All off-site partners will comply with their local procedures and state/federal regulations as identified in contract agreements.

**SECTION C. Environmental Aspects or Potential Sources of Impact:**

**Air Emissions**

NA

**Discharging to Surface-, Storm-, or Ground Water**

NA

**Disturbing Cultural or Biological Resources**

Cultural: Pursuant to the 2023 Programmatic Agreement, the proposed action does not meet the threshold of a federal undertaking and there is no effect to historic properties.

**Generating and Managing Waste**

**DOE-ID NEPA CX DETERMINATION**  
**Idaho National Laboratory**

No waste is expected to be generated in association with this project.

**Releasing Contaminants**

NA

**Using, Reusing, and Conserving Natural Resources**

NA

**Environmental Justice**

none of the proposed activities taking place on site or off have a reasonable potential to impact environmental justice.

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

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, or similar requirements of Department of Energy (DOE) or Executive Orders; (2) require siting and construction or major expansion of waste storage, disposal, recovery, or treatment or facilities; (3) disturb hazardous substances, pollutants, contaminants, or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-excluded petroleum and natural gas products that pre-exist in the environment such that there would be uncontrolled or unpermitted releases; (4) have the potential to cause significant impacts on environmentally sensitive resources (see 10 CFR 1021). In addition, no extraordinary circumstances related to the proposal exist that would affect the significance of the action. In addition, the action is not "connected" to other action actions (40 CFR 1508.25(a)(1) and is not related to other actions with individually insignificant but cumulatively significant impacts (40 CFR 1608.27(b)(7)).

**References:** B3.2 "Aviation activities", B3.6 "Small-scale research and development, laboratory operations, and pilot projects"

**Justification:** Based on the purpose and need and description of the proposed action and potential environmental impacts, the proposed action fits within the class of actions that is listed in Appendix B CX B3.2 and B3.6. There are no extraordinary circumstances related to the proposed action that may affect the significance of the environmental effects of the proposal. The proposed action has not been segmented to meet the definition of a categorical exclusion. This proposal is not connected to other actions with potentially significant impacts (40 CFR 1508.25(a)(1)), is not related to other actions with individually insignificant but cumulatively significant impacts (40 CFR 1508.27(b)(7)) and is not precluded by 40 CFR 1506.1 or 10 CFR 1021.211 concerning limitations on actions during preparation of an environmental impact statement.

Authorizing the proposed action will not (1) threaten a violation of applicable statutory, regulatory, or permit requirements for environment, safety, and health, including DOE and/or Executive orders; (2) require siting of new facilities or expansion of existing facilities; (3) disturb hazardous substances, pollutants, or contaminants; (4) adversely affect environmentally sensitive resources; or (5) involve genetically engineered organisms, synthetic biology, governmentally designated noxious weeds, or invasive species.

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

Approved by Robert Douglas Herzog, DOE-ID NEPA Compliance Officer on: 8/15/2024