# *INTERNATIONAL NUCLEAR ENERGY RESEARCH INITIATIVE*

## Hydrogen Production Using High Temperature Electrolysis

**PI (U.S.):** Stephen Herring, Idaho National Laboratory; Richard Doctor, Argonne National Laboratory

**PI (Canada):** Sam Suppiah and Donald Ryland, Atomic Energy of Canada Limited

**Collaborators:** University of Ontario Institute of Technology

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### Project Abstract

This project has three primary objectives: 1) economic analysis of electrolysis processes; 2) handling of high-temperature oxygen in HTE systems; and 3) high-temperature materials for the cell stack and heat exchangers. The team will address research and scale-up issues associated with energy efficient, high temperature solid-oxide electrolysis cell for hydrogen production from steam. Researchers will use a detailed economic model developed at ANL to compare the economics of high- and low-temperature electrolysis cell designs.

HTE systems operate at high temperature, presenting significant technical issues and hazards in handling the hot gas streams, especially oxygen. An Integrated Laboratory Scale (ILS) experiment will dilute the 850°C oxygen stream with air and cool it to room temperature before being exhausted. Researchers will develop methods for safely handling the 3 $Nm^3 \cdot h^{-1}$ (2.1 kg $O_2$/hr) of hot oxygen produced, along with processes for recovering heat from the oxygen stream. Proper selection of materials for the key components—high-temperature heat exchangers, cell stack components, and interconnecting piping—is critical to achieving high performance of the overall HTE process. Researchers are conducting a series of corrosion tests to analyze material performance in both the high temperature electrolysis cell and the balance of the plant.

### Workscope

The following tasks comprise the main elements of this project:

- Provide input for safe handling of oxygen streams
- Conduct economic analysis of low temperature electrolysis systems
- Identify suitable materials for HTE systems and analyze their performance
- Develop process for heat recovery from hot oxygen streams
- Conduct economic analysis of low temperature and high temperature electrolysis systems