SAFETY AND ENVIRONMENTAL STUDY OF THE ALUMINUM/AIR VEHICLE SYSTEM

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This study investigated the potential environmental, health, and safety concerns of the aluminum/air battery and its overall fuel cycle. The objectives of this environmental analysis were to:

- Identify and assess relevant environmental, health, and safety concerns related to the use of the battery as a power supply for electric vehicles;
- Quantify the consumption of natural resources and the generation of environmental residuals for each part of the battery's fuel cycle;
- Examine methods of mitigating potentially adverse impacts associated with the fuel cycle; and
- Identify areas of future environmental, health, and safety research and point out gaps in existing environmental data.

The environmental analysis focused on the consequences of aluminum production, hydrargillite recycling, manufacture of the aluminum/air battery, and operation of the battery in an electric vehicle.

The contract was completed in October 1981 and a final two-volume report was published in November 1981. The conclusions of this study are summarized as follows:

- The aluminum/air electric vehicle (AAEV) fuel cycle poses no serious health, safety, or environmental problems.
- Air emissions for the AAEV fuel cycle are principally due to aluminum-reduction and fossil-fueled electricity generation with these sources generally located outside critical air basins.
- Fluorides are the most serious pollutants generated during aluminum smelting but are presently under strict control.
- Lower hydrocarbon emissions associated with the AAEV are significant because of the presence of polycyclic aromatic hydrocarbons, some of which are carcinogenic.
- Carbon dioxide and sulfur oxides are the largest emissions (by weight) of the aluminum industry and are presently unregulated.
- Sulfur oxides and nitrogen oxides are the major, significant emissions of concern of electrical generation assuming the use of western coal.
- Compared to coal-derived automotive fuel, the AAEV coal-based fuel cycle presently produces almost 18 times more sulfur oxides and almost

4 times more carbon dioxide emissions, but at least 8 times less hydrocarbon emissions.

- Using hydroelectric or nuclear electricity generation, the AAEV fuel cycle can produce negligible amounts of nitrogen oxide emissions (aluminum is now produced using 41 percent hydro, 38 percent coal, 14 percent oil and gas, and 7 percent nuclear).
- Sodium hydroxide represents the major hazard of the aluminum/air battery because of its corrosive nature.

The overall indications are that the proposed aluminum/air electric vehicles present no unusual environmental hazards and that the potential health and safety problems will be manageable.

The contract was completed in October 1981.

Recent publications

1 L. B. Gratt, K. J. Berger, P. A. Forster-Day *et al.*, Environmental, health and safety impact analysis of an aluminum–air battery for vehicular applications and impact analysis associated with its overall fuel cycle, *LLNL UCRL-15434*, IWG Corp., San Diego, CA, *IWG-FR-082-02, Volume* 1: *Battery and Fuel Cycle, Volume* 2: *Aluminum Industry*, November 1981.