Dr. Robert Hargraves – Summary of Presentation to BRC August 30, 2010

Liquid Fluoride Thorium Reactor: *Aim High!*
The liquid fluoride thorium reactor (LFTR) is an alternative energy source that uses inexpensive thorium as a fuel, transforming it to uranium-233 which fissions, producing heat and electric power at a cost less than from coal. Undercutting the economics of coal power will reduce CO2 emissions without contentious carbon taxes that developing nations will not accept.

Resource demands. The US annually imports $350 billion of oil from the unstable Persian Gulf. Global warming is destroying glaciers that provide fresh water critical to millions and shrinking the cold polar seas essential for algae that start the ocean food chain. Fisheries for tuna, cod, swordfish, and other food are collapsing. 24,000 people in the US alone die each year from particulate emissions from coal power plants.

Population and prosperity. The world population of 6.7 billion people is growing unsustainably, leading to tragic competition for dwindling food, water, and energy resources that may lead to famine, plague, and war. Yet US and other OECD nations' birth rates are less than the population replacement rate, illustrating that prosperity can lead to a sustainable world population. Prosperity depends critically on energy. Electrical energy powers water supplies, sanitation, lighting, refrigeration, cooking, communications, and machines. Nations with annual per capita electric energy of just 2,000 kWh per year (1/6 the US) achieve the necessary prosperity for population stability.

LFTR history. Molten salt reactors were developed and tested at Oak Ridge National Laboratories in the 1960s and 1970s. In 2006 the Oak Ridge research records were scanned and posted on the Internet, and a collaboration of physicists, engineers, and professional volunteers began developing updated design ideas for LFTR.

Advantages. In LFTR thorium and uranium are dissolved in circulating molten salt, allowing continuous fueling and waste removal. LFTR produces less than 1% of the long-lived radioactive waste of today's nuclear power plants. It can consume nuclear waste now stored at nuclear power plants. It uses an inexhaustible supply of inexpensive thorium fuel. One ton of thorium costing $300,000 provides 1 GW-year of electric energy, enough for a city. LFTR operates at high temperature and can achieve 50% thermal-electrical conversion efficiency, so LFTR needs half the cooling of today's coal or nuclear plants -- critical where water is scarce. No plutonium or other fissile material is ever isolated or transported from or to the LFTR, except for importing the material at start-up.

Cost. LFTR has low capital costs. It operates at atmospheric pressure without massive pressure vessels and containments. It has a compact high power density reactor, heat exchangers, and gas turbine. A $200 million 100 MW size unit allows incremental capital outlays, affordability to developing nations, and suitability for factory production.

Recommendation: *Aim High!* LFTR can provide safe, nonpolluting energy to address global warming, pollution, and resource depletion caused by excess CO2 emissions and burgeoning world population. We can launch a NASA-style "shoot the moon" project to complete development of inexpensive, safe, clean LFTR power. President Kennedy's moon-shot vision was accomplished in eight years. The Manhattan Project took three years. Develop LFTR in

five years and start a $70 billion industry.