7. Industrialization of Cold Fusion Technology

Cold Fusion is discussed on this website as one of several renewable energy technologies that should be pursued to help address climate change. When industrialized, cold fusion generators could be distributed around the world to provide non-polluting energy in many venues. Local, community-based electric power plants is an example.

Present Status

Earlier blogs have implied technical subtleties that need to be taken into account in a program of industrialization and have indicated that steps to develop cold fusion generators will be technically challenging. As example, it is shown that as few as 10^{15} atoms reacting per second should be able to produce about a kilowatt of power; but, research to date seems to have been able to produce only a few watts or less of power per cubic centimeter of cathode material. Concepts presented indicate that early generators will be able to provide relatively low quality (i.e. temperature) heat compared with generators that burn hydrocarbon-based fuels. The reason for this limitation is that operating temperature will be influenced by Debye temperatures of materials (e.g., nickel, palladium or titanium) from which present-day, research program cathodes are made. Heat produced in cathodes will need to be removed to maintain a relatively constant operating temperature within the cathodes. In addition, only a portion of the potential reaction sites (see an earlier blog) can be expected to host reactions. The present efficiency could be as low as one in a thousand. Subsequent research will hopefully be able to develop improved cathode materials and power output. Second, the quantity of deuterium and/or hydrogen provided to cathodes must be provided in small amounts, e.g., high pressure gas puffs, containing only a millionths of the quantity of gas ordinarily dealt with in power and heating systems. High gas pressure components and gas valves that can be rapidly opened and closed will be needed. Third, it appears that several kinds of nuclear reaction might occur at the potential reaction sites within the cathodes, producing various energies and types of reaction products such as protons, neutrons, helium, and gamma radiation. The particles can deposit their energies locally and damage the reaction sites. Only a few nuclear reactions (e.g., less than 20 for each million atoms of cathode

material) can be permitted to occur at each reaction site for cathodes to last during long periods of operation. Fourth, for continuous generator operation, helium produced in the reactions will need to be removed from the cold fusion generators so that there is room to add more deuterium/hydrogen gas. Methods will need to be developed to remove the helium but enable deuterium gas to remain in the generators. These types of technically complex concerns appear to be manageable through dedicated and focused research and development (R&D) that is part of a program to industrialize cold fusion technology.

Comprehensive Statement of Need

The proposed industrialization program should be undertaken even though there is technical risk to be addressed. The Earth needs a revolutionary transformation in production of energy. Oceans are eroding land at an increased rate. The rapid acidification of the oceans from dissolved carbon dioxide places at risk the entire chain of sea organisms. Expanding populations and rapid industrialization have fostered massive reliance on and competition for fossil fuel. The result is cities choked with crippling pollution. In other countries with enormous growing populations, millions are without even minimal amounts of clean water, easily supplied if suitable energy sources were available. Populations have been increasingly reliant on fossil fuels, which are known not only to pollute our planet, but also will be depleted or too expensive to use over the long term. Disasters have shut down the nuclear power industry and forced an increased reliance on fossil fuels. Many scientists warn of worldwide catastrophic effects of climate change from global dependence on fossil fuels, while sources of these polluting and increasingly costly fuels are rapidly being depleted. The costs and competition for energy are a source of international conflicts, fomenting warfare and human destruction.

Downsides of Conventional Nuclear Power

Conventional nuclear power was a hopeful alternative in the last half of the twentieth century. Now there is evidence of the downside - possible catastrophic accidents, unsolved problems of high-level waste requiring secure storage for thousands of years, weapons proliferation and susceptibility to natural disasters, terrorism, and war. The fracking process to increase oil supplies is severely detrimental to the

environment, and harmful to our health. Other alternatives have been pursued - solar power, wind power, and others. One of the difficulties in the success of these approaches is the intermittent nature of the source, and no suitable energy storage technology has emerged that can overcome or compensate for these disadvantages.

Producing Energy From Hydrogen & Deuterium

For the past 25 years, scientists have been working to discover how we can use hydrogen and deuterium gas as a fuel source to produce energy. Small systems developed over the last few years indicate this is possible. This technology could address all of the above problems, and could do so at reasonable costs, in safety, without hazardous waste, and without pollution or climatic damage. This is possible because of the enormous energy yield produced by nuclear reactions of a type that are not the same as those in conventional nuclear power plants that have produced hazardous radiation and by-products from fission. This other type of nuclear reaction now being investigated occurs at low energies and has been studied in an array of configurations with many differing materials and under different operating conditions. Unlike conventional nuclear fission reactors, this technology has no critical size and can be built to any practical scale. The most amazing facet of this new technology is that its typical fuel is derived from water and that this fuel source could supply the entire energy demands of the earth for thousands of years. Additionally, the process has no application in weaponry, and the universal access to fuel could prevent political and military rivalries that accompany access to energy.

Elements Proposed for Program to Industrialize Cold Fusion

Basic research on cold fusion has been conducted by many scientists, individual researchers and organizations over the last 30 years. This work has demonstrated that nuclear reactions can be made to occur in a chemistry laboratory environment, including fusion in particular environments at temperatures that are much lower than for hot fusion. An industrialization program should begin from this point of knowledge and proceed deliberately through the typical steps of Advanced Research and Development though Manufacturing and Production.

R&D Efforts by Industry Leaders

Leadership by industry is important, whether altruistically interested in the technology due to the crisis of climate change or with an objective of making a profit through manufacturing and selling generator components. The activities of the program must be performed by seasoned R&D companies and include scientists having knowledge of cold fusion from their work to date. The program should be a team effort and include strong international participants. U.S. government support should be thorough the Department of Defense (DoD) and appropriated into the Defense budget. It is recommended that DoD's portion of the effort be managed by the Office of Naval Research due to its previous support and understanding of the technology. The Navy has an urgent requirement for new energy sources to replace fuel for ships.

Cold Fusion Program Activities

Early program activities might include, for example:
(a) physical design of the cold fusion generator system - expected to be straightforward as based upon knowledge of other high pressure and high temperature gas systems;
(b) early research to determine the rate at which high pressure deuterium gas can be absorbed at high temperature into and through manufactured cathodes;
(c) system design to provide small quantities of gas to cathodes;
(d) system design to remove heat produced in cathodes;
(e) research and system design to remove helium and enable deuterium gas to remain in the generator;
(f) computer modeling activities to demonstrate the manner in which cold fusion nuclear processes can be enhanced by changes in operational parameters;
(g) computer modeling to demonstrate the manner in which heat flows through the rest of the system.

R&D Acquisition Management Procedures

Streamlined R&D acquisition management procedures must be used. This involves processes that shorten the phases of research and development, such as use of parallel or overlapping activities in each program phase. All activities of the program should be coordinated by a single technical assessment and analysis group and should also be

responsible for providing progress reporting to funding agencies and the public.