Nineteen Labs, Universities and Industries Collaborating To Produce Energy From 'Z-Pinch' Inertial Confinement Fusion

Nineteen organizations from national laboratories, industry, and academia are collaborating in a program aimed at producing inexpensive energy through the use of inertial confinement fusion. A road map for the Congressional initiative, called the Z-Pinch Inertial Fusion Energy (IFE) Program, aims at accomplishing a full-scale demonstration of the technology between 2025 and 2035.

Fusion – through inertial confinement fusion (ICF) or the better-known magnetic confinement fusion (ITER "tokamak") approach – is considered a promising adjunct to future energy needs because of the virtually limitless abundance of its fuel and the relatively low amount of radioactive waste it produces. In ICF, pellets filled with deuterium-tritium are bombarded with x-rays (produced by lasers, z-pinches, or ion beams); the pellet implodes, resulting in a process in which the fuel atoms are fused together. In a successful operating system, many times more energy will be released than is used to trigger the process. Deuterium, an isotope of hydrogen, is abundant in seawater; tritium is bred in the fusion power plant process. When deuterium/tritium is fused, a heavier element (helium) is formed and the energy that bound the extra neutron is released.

Sandia's Z-Machine between tests.

The Z-Pinch IFE program builds on a process developed at Sandia National Laboratories, which heads the partnership. It is an outgrowth of the U.S. Department of Energy National Nuclear Security Administration's research into the physics of the fusion

National Nuclear Security Administration

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Sandia National Laboratories

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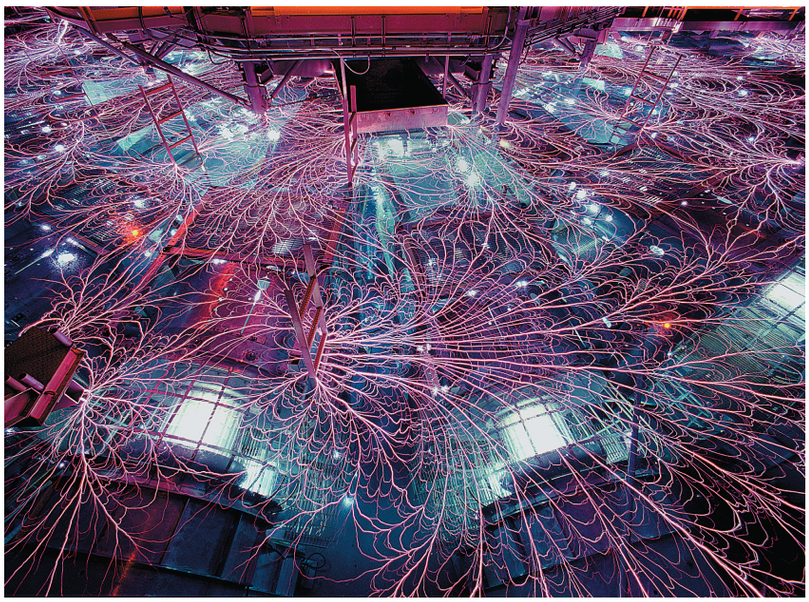
Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

process, which uses a number of large-scale facilities typified by the National Ignition Facility (NIF) now being built at Lawrence Livermore National Laboratory. Whereas NIF is driven by neodymium-glass lasers, the Z-pinch is driven by applying an extremely high-current electrical pulse to a cylindrical wire array. (A "pinch" along the z axis occurs when the electrical current generates a strong magnetic field that compresses the wire array onto the z axis.)



The Z-pinch principle of generating x-rays has been demonstrated in a large number of single-shot experiments with Sandia's Z accelerator, where very large energy output (1.8 megajoules of x-rays) and power levels (up to 230 trillion watts) have been achieved by imploding wire arrays with the high magnetic field pressures that are associated with high load currents (20 megamps). An industrial-scale IFE power plant would work at much higher energy levels to drive high-yield fusion capsules (yielding about 3 gigajoules of energy per shot), and to implode fuel capsules about once every 10 seconds in each of several chambers.

The program is funded by Congressional initiative for $4 million in Fiscal Year 2004, and for $4M in Fiscal Year 2005, through NNSA's Office of Deputy Administrator for Defense Programs. The partnership includes: Sandia National Laboratories, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Naval Research Laboratory, University of California-Berkeley, University of Wisconsin, University of California-Davis, University of California-Los Angeles, Georgia Institute of Technology, University of Missouri-Columbia, University of Alabama, University of New Mexico, General Atomics, ATK - Mission Research Corporation, EG&G, Omicron, Science Applications International Corporation, Institute of High Current Electronics (Tomsk), and Kurchatov Institute (Moscow).

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