and points to the more advanced possibilities, such as polarized fusion, as providing a general backup.

Why fusion is cheaper

Dr. Nuckolls begins by taking nuclear fission, which is significantly cheaper than coal, at its best, i.e., by assuming an infinite fuel supply, possibly provided by a fission-fusion hybrid breeder, and with an advanced reactor design which can be constructed within five years: "Fusion has two principal assets which could potentially confer a factor of two advantage. First, the typical fuel cycle cost for a light-water [fission—CBS] reactor is approximately 20 percent of the total busbar cost [cost at the point of transmission] of fission energy. With the hybrid 20 percent escalation factor, the fission fuel costs would give fusion a 40 percent advantage since its fuel costs are negligible. Second, there is another possible 40 percent advantage which derives from a combination of two factors: the high quality of fusion energy and the fluid insulation of fusion reactor walls [the magnetic fields in magnetic fusion reactors and liquid jets of lithium in ICF reactors—C.B.S.]. These two factors taken together make possible a 40 to 50 percent increase in the electrical generating efficiency. Multiplied together, fusion's two 40 percent assets provide a twofold advantage over fission."

Dr. Nuckolls goes on to show that these assets far outweigh fusion's liabilities.

MHD electricity generation

The most important new point raised by Dr. Nuckolls in his London presentation is that inertial fusion can utilize the far more efficient MHD method of electricity generation in a manner that is not only technologically feasible but also simultaneously successful in overcoming the difficulties inherent in high energy neutrons produced in Deuterium-Tritium (DT) fusion, that form of fusion involving two isotopes of hydrogen. While Dr. Nuckolls presents two reactor designs which make use of MHD electrical generation, here only one of them will be described in detail: the "neutron pillbox MHD" system.

It has often been pointed out that if there existed some process for directly converting high-temperature
ergy output into electricity, then efficiencies of 99.99 percent could be achieved. Dr. Nuckolls has detailed a process which can attai
the potential electrical output of an inertial fusion reactor. This process is technologically straightforward and solves the neutron damage problem.

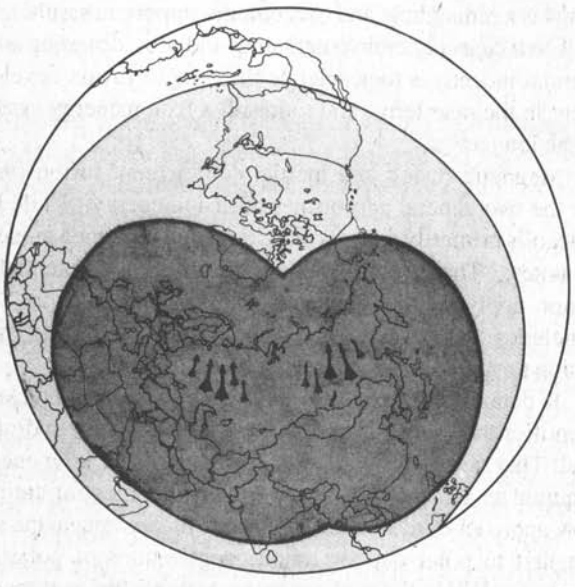
Dr. Nuckolls and his collaborators at Lawrence Livermore have turned the neutron problem on its head. The solution is to surround ICF exploding pellets with a pill-shaped mass of solid lithium. The fusion-generated neutrons are then captured within this solid mass, causing it to blow up. But because neutrons deposit throughout the volume of the lithium pillbox, the second explosion can be shaped by properly arranging the geometry of the pillbox. For example, the neutron deposition can be made to generate converging shock waves. And the energy density of the neutron deposition is still sufficient to transform the pillbox lithium into a high temperature plasma. The final result is that the vast majority of the fusion energy output can be transformed in straightforward manner into directed plasma jets.

High-temperature plasma jets greatly simplify MHD electricity generation. And, in general, plasma jets are ideal for all kinds of energy transformations, such as microwave generation. The reasons are easy to detail in the specific MHD case, but it should be noted that the general point of transforming a high temperature "thermal" fusion output into a slightly lower temperature "directed" plasma jet has profound theoretical implications.

Beam weapons and ICF

An important point not reviewed by Dr. Nuckolls is the close connection between ICF and the entire beam-weapons technology of energy concentration—pulsed power. One leading member of the President's special task force on beam weapons stated to this author last May that "ICF is in the bag, given the President's beam weapon program." The beam-weapon program is directed toward developing efficient high-power lasers and particle beams, which are the drivers for inertial fusion.

CORRECTION: Due to a production error, the following map appeared with an incorrect key in our Oct. 25 Special Report. The map should be read as follows:



Deployment of Soviet ICBMs and IRBMs

ICBM concentration and range

IRBM concentrations and range