fore, should be expected on the broad questions of new energy sources and their applications, and the priorities with which they are pursued.

The DLF program has been presented as one in which "accomplishment of the major program milestones will provide immediate benefits in weapons technology development, near-term future benefits in weapons effects simulation, and lay the groundwork for potential long-term benefits in civilian power technology development.

The program is structured so that the majority of the *base* program is in the weapons laboratories where weapons technology can be applied to fusion research while nuclear weapons concepts are protected...Within that program structure, the major role for industry will occur after success in the core program demonstrates the feasibility of Inertial Confinement Fusion.

The DLF program has been characterized as an "orderly low-risk approach to feasibility demonstration." We agree, and we believe that this program structure in the Division of Laser Fusion, under the Assistant Administrator for National Security, is ideally suited for the objectives as outlined.

KMS Fusion, has from its inception had a broader view of the short-, mid-, and long-term goals of laser fusion, and the resources that should be brought to bear on solving the problems. We feel that the current energy crisis, the potential of laser fusion for providing a viable solution for that crisis within our life time, as well as possible short-term benefits from applications other than weapons-related, all call for a more-aggressive, vigorous, higher-risk approach than is proposed.

And because we believe the national program should be broader, with adequate emphasis on civilian applications, we believe the program should have an administrative base that reflects civilian interests. We suggest this without rancor. We raise the issue, however, because it is inevitable that the primary interests of the responsible administrative group will have great influence on the goals selected and priorities established.

The justification for the administration of the national laser fusion program as part of the weapons complex is the potential for early military application. There is, however, equally valid potential for early civilian application.

We foresee, in addition, other civilian uses arising from the exploration of new physical, chemical and biological phenomena that can be observed as neutron output rises. And finally, and more important, is the potential for production of inexpensive chemical fuels by conversion techniques using the laser-fusion driven sources.

We recognize the need for security, but this is hardly a new situation. There is ample experience. A strong collaborative and competitive effort is needed so that information can be transferred in ways that the whole effort benefits and moves forward.

KMS Industries has in the past brought industrial resources and financing into the laser-fusion field far in excess of any other private group in the country. We firmly believe that *if* the national laser-fusion program had a more clearly defined mission for the development of civil energy resources, along with the early development of other applications suitable for the civil economy, and *if* this civil mission had the firm support of the government, industry will join with the government to develop and commercialize laser fusion.

U.S. E-Beam Research In Breakthrough

While details are still being withheld under top secret classification wraps, testimony by officials of the federal Energy Research and Development Administration (ERDA) indicates that U.S. electron-beam pellet fusion researchers at Sandia Weapons Lab in New Mexico have duplicated what Soviet researchers, led by L.I. Rudakov accomplished one year ago: experimentally producing controlled thermonuclear fusion reactions, utilizing the electron-beam pellet approach.

Preliminary analysis, based on what scanty information has been released, points to the fact that the Sandia researchers utilized the same method which Rudakov revealed to U.S. scientists last year. With this new experimental breakthrough, U.S. electron-beam pellet fusion scientists can demonstrate the feasibility of this approach to harnessing the vast energies of nuclear fusion reactions with the completion of the construction of their next planned experimental facility by 1980.

In his testimony today before the House Science and Technology subcommittee on energy, Dr. C. Martin Stickley, the director of the ERDA Laser Fusion Division, reported that researchers at the Sandia Laboratories "produce measurable numbers of thermonuclear neutrons...on Proto I." Furthermore, he went on, "the most important achievement has been the experimental and theoretical observation of enhanced electron beam energy deposition in thin shells over what had been predicted from simple models. This order-of-magnitude enhancement reduces the requirements on the design of targets and generators for electron beam fusion. New target designs are yielding evidence of thermonuclear neutron production." The success in enhancing the energy deposition in electron beam targets was also reported in an article in the Feb. 21 *Physical Review Letters* by the Sandia group.

Researchers at Sandia have also developed a new method of getting around the chief technological roadblock to realizing economic and reliable power reactors based on e-beam pellet fusion. Under normal conditions the diode which generates the electron beam must be within a few feet of the pellet. This would lead to its rapid deterioration in a power reactor in which up to 10 microexplosions per second must be obtained if significant power output is to be reached.

Sandia researchers recently demonstrated that if the electron beam is enclosed in a separately produced plasma, the electron beam can be transported over several meters (up to 10) and be kept stable and focused.

These developments, together with utilization of disposable plasma anodes in the electron beam diode, brings the technology needed for power reactors within the existing state of the art. A similar situation does not presently exist for laser fusion since the only existing high power laser systems are very inefficient. High power laser systems convert less than one percent of their input energy into the actual laser beam output, while electron beams convert up to 50 percent of the input energy into the output beam. Therefore much lower pellet gains can produce net energy output with e-beam systems.

At the present time inertial confinement research in general and e-beam work in particular is being hampered by top secret government classification of the research. This was most clearly demonstrated by the Rudakov success and the hysterical reaction on the part of Rockefeller agents in ERDA to its unilateral disclosure last July. The most significant recent development, which is intimated in the Stickley testimony — especially by his emphasis on the short term weapons applications of inertial confinement for simulation of H-bombs — is the fact that the recent success at Livermore Lab in obtaining isentropic compression obviates the need for more underground H-bomb tests to check new weapon designs. This is why Carter has offered to unilaterally halt these costly underground tests — they can now be done in the laboratory. The object obviously is to get the Soviets to go along with the charade and thereby fall behind U.S. weapons development.

Ironically, the e-beam research, which lends itself to more rapid development of peaceful applications and reactor development, is being cut back, but at the same time provides the means for much better weapons simulation.

First CO_2 Laser Fusion Achieved At Los Alamos

Researchers at the U.S. Los Alamos Scientific Laboratory reported yesterday that they have obtained laser pellet fusion utilizing a carbon dioxide gas laser. The scientists stated that these experimental results indicate that as much as "ten to twenty years could be lopped off" previous projections for the time it would take to develop commercial laser fusion power plants. It is now expected that a proto-type fusion generator could be operating by the early 1980s. This significant breakthrough in harnessing the virtually infinite energy of nuclear fusion reactions is based both on major technological and frontier scientific advances. Like the hydrogen bomb, laser pellet fusion is based on inertial confinement. Laser beams can only compress and heat very small quantities of fusion fuel and therefore only produce microexplosions like those in a gasoline engine.

Until now the only high energy laser system capable of producing the conditions for inertial confinement fusion have been solid glass lasers. But these glass lasers do not appear to meet the minimal technological needs of actual power plants. First of all they are very inefficient. Furthermore, they must be cooled down after each "shot." For a power reactor the laser must be shot at least once a second. Also glass lasers, while developing sufficient power levels and total energy outputs for demonstrating the scientific feasibility of laser pellet fusion, cannot be straight-forwardly scaled up to the sizes needed for power plants.

Carbon dioxide gas lasers, on the other hand, have efficiencies of up to 5 percent, and very high repetition rates. According to scientists at Los Alamos, scaling carbon dioxide lasers up to the sizes and shot rates needed for power plants is within existing "state of the art" technology. The main problem has been that carbon dioxide laser light has a wavelength (10 microns) 10 times that of glass lasers (1 micron). From the initial linear physics analysis it appeared that the long wavelength carbon dioxide could not be efficiently coupled into the pellet. But, more recent theoretical and experimental work had pointed to the fact that non-linear laser-plasma interaction led to efficient coupling of the laser beam into the pellet regardless of the wavelength.

In experiments beginning in Oct. 1976, scientists at Los Alamos demonstrated that these new non-linear theories were indeed correct. A two-beam, carbon dioxide laser system with a total energy of 200 joules delivered to the pellet in less than a billionth of a second produced up to 100,000 thermonuclear neutrons. This is 10,000 times less than the billion neutrons produced with glass laser systems at Lawrence Livermore Lab late last year, but these Los Alamos experiments do demonstrate efficient coupling of carbon dioxide lasers.

An eight-beam carbon dioxide laser system will begin operation at Los Alamos in 1978. With the recent Carter Administration cuts in the fusion research budget, the High Energy Laser System at Los Alamos — an upgrade of the eight-beam system which will reach breakeven — has been set back several years beyond its originally scheduled start-up date of 1981, if it is authorized at all. With an expansion of the existing program demonstration commercial prototype laser fusion power reactors could be brought on line by the early 1980s.