lant—enough to keep the average family car running for over 40 years.

Chemical rockets require these large amounts of fuel and oxidizer to produce the thrust necessary to lift and accelerate the rocket vehicle. In a nuclear rocket, however, the energy of combustion is replaced by the energy of nuclear fission. A nuclear reactor is used to heat a single propellant, hydrogen. Hydrogen is chosen because it is the most efficient propellant known.

Rocket-engine designers attempt to produce engines that will achieve the highest possible fuel efficiency. We measure this efficiency in terms of specific impulse, which is defined as pounds of thrust per pound of propellant flow per second through the rocket's exhaust nozzle. Thus the higher the specific impulse, the lower the weight of propellant required. Specific impulse values twice those of the best chemically powered rockets are possible with nuclear rockets using the reactor concepts currently being developed, and certain advanced nuclear concepts promise even greater efficiency.

In the AEC's cooperative program with NASA, we are working toward the development of a single nuclear rocket engine that will satisfy a variety of upper-stage and spacecraft applications. That standard system will be a 1500-megawatt NERVA engine which will produce 75,000 pounds of thrust. NERVA, by the way, stands for Nuclear Engine for Rocket Vehicle Application. At this point I should make it clear that upper-stage nuclear rockets are planned to take over after the vehicle has been launched from earth by chemically powered rockets.

NERVA engines are shown in the schematic drawing in Figure 1 as part of a basic NERVA propulsion module that can be applied singly or in clusters. Note the three different mission configurations and the NERVA engine by itself in Figure 2. Compare the small size of the engine with the vehicle it pushes. NERVA would be about 30 feet long, the reactor in its center about 4 feet in outside diameter.

The NERVA engine could extend the capabilities of the Saturn V Apollo earth launch vehicle for landing payloads on the moon and for sending unmanned payloads about the solar system. Applied singly or in clusters of modules to spacecraft assembled in earth orbit, the NERVA engine could also be used for manned missions to the planets.