Why Use Nuclear Energy?

James Dewar's history of the nuclear rocket focusses on nuclear thermal rockets, the most capable technology for space propulsion. The heat produced by the fission reaction is used to heat a propellant (generally, hydrogen), which is propelled at great speed out the back of the rocket engine, pushing the vehicle forward by producing a reactive, propulsive force.

The key to the increased efficiency and performance of nuclear engines over those burning chemical fuels, is the energy density of the reaction. Nuclear fission can create temperatures significantly higher than chemical burning, in a much smaller volume. The speed at which the rocket propellant is expelled, which is a function of temperature, is a crucial parameter in measuring the performance of any engine. The hotter it runs, the faster the propellant, the more efficient the engine.

Engine efficiency is measured as specific impulse, which is at most 450 seconds for chemical engines, up to about 850 for technology demonstrated by the Nuclear Engine for Rocket Vehicle Application (NERVA), and in the thousands of seconds for more advanced, gas-core nuclear reactor systems. Because it needs to carry both liquid hydrogen and liquid oxygen, only 6-8% of the Space Shuttle's gross weight is useful payload. For an advanced nuclear-driven system, the payload fraction could be more than double that.

What could you do with this vastly increased capability? One concept to make use of a nuclear engine's cargo capacity was put forward in the 1960s by space visionary Krafft Ehricke, which he called Helios. A chemical stage would boost a 15,000 MW nuclear engine to 100,000 feet, where the nuclear engine would be fired. Ehricke calculated that Helios could place a quarter of a million pounds in Earth orbit, or land 80,000 pounds on the Moon.

The high performance gained from nuclear propulsion could also be optimized to shorten trip times, trading off payload capability for speed. People could go to Mars in weeks, not months. Pluto could be reached by an unmanned spacecraft in less than 2,000 days, rather than a decade.

What would be the impact of using nuclear propulsion? Dewar states: "Instead of tiptoeing through the Solar System, these advanced propulsion ideas would allow humans to blast through gravitational fields and conquer the vast distances, to arrive in months or weeks, and then return."

—Marsha Freeman

pulsion Office to carry out the nuclear rocket project.

At the end of the Eisenhower Administration, there was some reluctance to embrace nuclear technology, with concerns voiced about safety, radiation, and "what other nations will say." Dewar likens this fear to that on the part of the "oil admirals" that Adm. Hyman Rickover faced when he started developing the nuclear Navy, "who feared sending men deep beneath the waves next to a radioactive reactor. It was probably the same as what the oil and coal officers faced a century earlier from the wind admirals, who feared putting men in the dark hold of a ship next to exploding boilers and steam lines, to be scalded to death."

Kennedy's New Ocean of Space

To pave the way for what they hoped would be a change in policy in the White House under an incoming Kennedy Administration, the Congressional promoters of the space nuclear program inserted a plan calling for the development of the nuclear rocket, as part of an accelerated space program, into the Democratic Party's Platform for the November 1960 Presidential election.

During this time, as Los Alamos was conducting tests on small-scale, high-density reactors that could fly in space, the manager of the Atomic Energy Commission/NASA Space Nuclear Propulsion Office, Harry Finger, called for bids from industry to develop the Nuclear Engine for Rocket Vehicle Application (NERVA). Not surprisingly, opposition from the Bureau of the Budget (BOB) was swift, and persisted throughout the duration of the program. Although Congressional enthusiasts may have exaggerated how quickly nuclear rockets could be propelling spacecraft, the BOB dishonestly objected that the AEC "grossly underestimated" Rover's cost.

In October 1960, an article published under Presidential candidate John F. Kennedy's name, urged a manned lunar landing, a space station, a space shuttle, and a nuclear rocket. But when the Kennedy Administration came to Washington, the President's science advisor opposed the Rover project, as did the budget director. To try to garner support for its hostile position, the BOB put out an estimate that a manned lunar landing would cost $45 billion—purposely a gross exaggeration, more than double what NASA estimated, and what Apollo ultimately cost.

The fight between the Congressional, scientific, and NASA promoters of space nuclear technology, and the anti-technology lobby and the budget balancers, finally came down to the issue of test flying a reactor; this would be an expensive phase of the project, and Congressional supporters knew that anything less would indicate that the program was just for research and development. Opponents were willing to continue a low-level R&D program, but had no intention