Project Pluto

The "Tory-IIC" prototype

On January 1, 1957, the U.S. Air Force and the Atomic Energy Commission selected the Lawrence Livermore National Laboratory's (LLNL) predecessor, the Lawrence Radiation Laboratory, to study the feasibility of applying heat from nuclear reactors to ramjet engines.

This research became known as "**Project Pluto**" and was moved from Livermore, California to new facilities constructed for $1.2 million on eight square miles (21 km²) of Jackass Flats at the Nevada Test Site (NTS), known as Site 401.

The complex consisted of six miles (10 km) of roads, critical assembly building, control building, assembly and shop buildings, and utilities. Also required for the construction was 25 miles (40 km) of oil well casing which was necessary to store the million pounds (450 t) of pressurized air used to simulate ramjet flight conditions for Pluto.

The work was directed by Dr. Ted Merkle, leader of the laboratory's R-Division.

The principle behind the ramjet was relatively simple: motion of the vehicle pushed air in at high pressure through the front of the vehicle (ram effect), a nuclear reactor heated the air, and then the hot air expanded at high speed out through a nozzle at the back, providing thrust.

The notion of using a nuclear reactor to heat the air was fundamentally new. Unlike commercial reactors, which are surrounded by concrete, the Pluto reactor had to be small and compact enough to fly, but durable enough to survive a 7,000 mile (11,000 km) trip to a potential target.

The success of this project would depend upon a series of technological advances in metallurgy and materials science. Pneumatic motors necessary to control the reactor in flight had to operate while red-hot and in the presence of intense radioactivity. The need to maintain supersonic speed at low altitude and in all kinds of weather meant the reactor, code named "Tory", had to survive temperatures of 2,500 degrees Fahrenheit (1,600 degrees Celsius), and conditions that would melt the metals used in most jet and rocket engines. Ceramic fuel elements would have to be used; the contract to manufacture the 500,000 pencil-sized elements was given to the Coors Porcelain Company, which would become better-known later for their brewery division. The tolerances were so tight that Tory's base plates had an auto-ignition point only 150 degrees above the reactor's peak operating temperature. Engineers calculated that the aerodynamic pressures upon the missile might be five times those the hypersonic X-15 had to endure.

The proposed use for nuclear-powered ramjets would be to power an unmanned cruise missile, called SLAM, for Supersonic Low Altitude Missile. In order to reach ramjet speed, it would be launched from the ground by a cluster of conventional rocket boosters. Once it reached cruising altitude and was far away from populated areas the nuclear reactor would be turned on. Since nuclear power gave it almost unlimited range, the missile could cruise in circles over the ocean until ordered "down to the deck" for its supersonic dash to targets in the Soviet Union. Once powered up, the unshielded half-gigawatt nuclear reactor would emit highly lethal radiation in a large radius; such a vehicle could not possibly be human-piloted or reused. Indeed, some questioned whether a cruise missile derived from Project Pluto would need a warhead at all; the radiation from its engine, coupled with the shock wave that would be produced by flying at Mach 3 at treetop level, would have left a wide path of destruction wherever it went. The SLAM as proposed would carry a payload of many nuclear weapons to be dropped on multiple targets, making the cruise missile into an unmanned bomber. Contrary to some reports, the exhaust of the engine would not itself be highly radioactive.

The nuclear engine could in principle operate for months, so a Pluto cruise missile could be left airborne for a prolonged time before being directed to press home its attack.

On May 14, 1961, the world's first nuclear ramjet engine, "Tory-IIA," mounted on a railroad car, roared to life for just a few seconds. Three years later, "Tory-IIC" was run for five minutes at full power, producing 513 megawatts and the equivalent of over 35,000 pounds force (156 kN) thrust. But despite these and other successful tests the Pentagon, sponsor of the "Pluto project," had second thoughts; Intercontinental ballistic missile technology had proved to be more easily developed than previously thought, reducing the need for such highly capable cruise missiles. On July 1, 1964, seven years and six months after it was born, "Project Pluto" was cancelled.