42nd AIAA/ASME/SAE/ASEE Joint Propulsion Conference & Exhibit
9 - 12 July 2006, Sacramento, California

AIAA 2006-4557

NERVA Derived Engine and Operations Concept

Todd Grimm* and Rolf Hamke†
Aerojet; Rancho Cordova, CA 95670

NASA's modern vision for the manned exploration of Mars will require nuclear propulsion. Ongoing mission trade studies indicate that a combination of chemical propulsion, nuclear electric propulsion (NEP), and nuclear thermal propulsion (NTP) will most effectively meet those requirements. During the Apollo era of the 1960's, NASA and the Atomic Energy Commission jointly conducted the NERVA program (Nuclear Engine for Rocket Vehicle Application). Aerojet was the prime contractor and, together with Westinghouse, developed a flight-like nuclear thermal rocket engine. The development concluded in 1971 with the successful completion of flight-like engine system tests conducted at the Nevada Test Site, ETS. One of the key development successes of the NERVA program was the demonstration of a high performance, low Net Positive Suction Pressure (NPSP) liquid hydrogen turbopump. An important aspect of the NERVA program was the validation of key system and component design tools, including the engine system analysis code, called the Common Digital Model (CDM), which was capable of both transient and steady-state analysis of NTP systems. This paper describes the capabilities of the analysis code, its applicability to other engine systems and the results of recent upgrades of the model to a modern computer format. It also describes the benefits of modernizing this validated code and applying it to support efforts stemming from NASA's rekindled interest in NTP systems. The NERVA Common Digital Model is America's *only* transient nuclear thermal engine simulation tool that has been anchored to actual hot-fire test data.

I. Introduction

The NERVA program of the 1960's and early 197 tor Westinghouse with developing an operational nuclear ght type nuclear reactor series called Nuclear Rocket Ex fire tested a close-coupled, flight like engine at the Ne and August 1969 but NERVA was canceled just two years . 1, could be built. The program was canceled because, among other reasons, the need for a high thrust, high efficiency space engine had faded since the program's inception. NASA had begun to shift away from exploratory missions like Apollo and, with the exception of a handful of small interplanetary probes, focused on scientific and commercial launches to low Earth orbits which didn't require NTP. This paper is organized in two parts; the first is a history of the NERVA test program and all of the associated hardware, the second is a discussion of the Common Digital Model, a transient engine simulation tool developed during the program and anchored to the results of the NERVA test program.

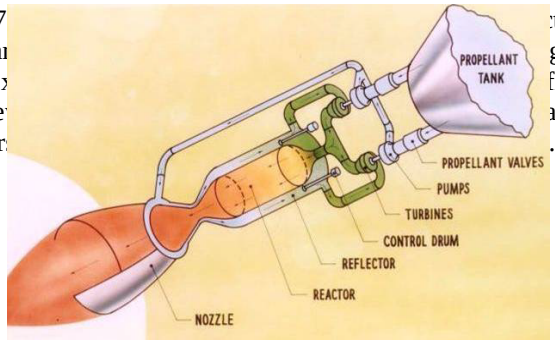

Figure 1. NERVA Flight Engine Configuration[1]

* Associate Engineer, Systems Engineering, P.O. Box 13222 Sacramento, CA 95813. Prof. Member
† Technical Principal, Liquid Propulsion, P.O. Box 13222 Sacramento, CA 95813. Past Member