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NASA LEWIS RESEARCH CENTER

Systems Overview

Nuclear Propulsion Technical Interchange Meeting

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NUCLEAR PROPULSION OFFICE

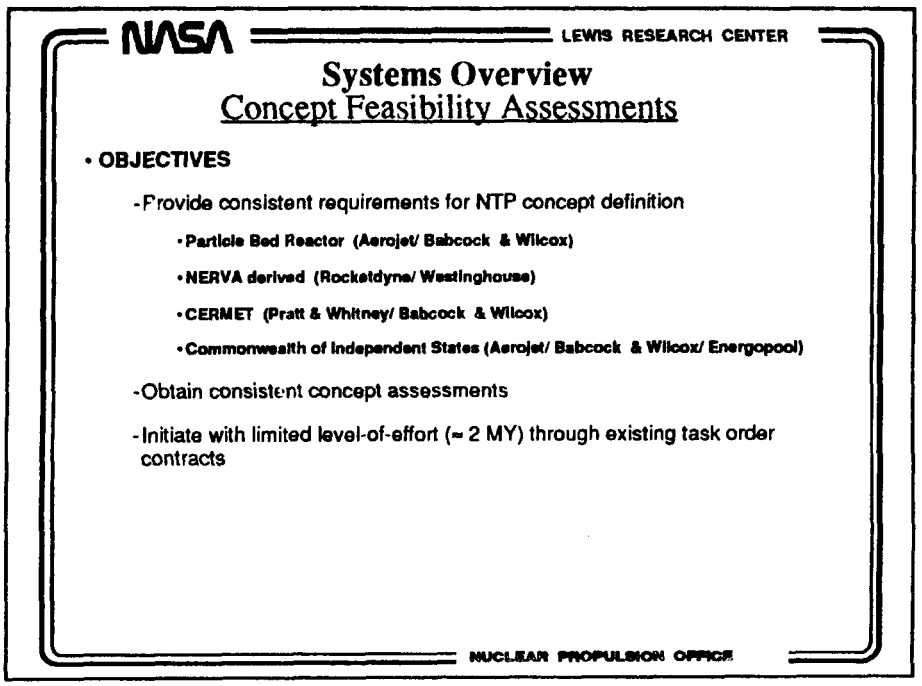
Systems Overview
Requirements and Public Acceptance

The following charts provide a brief synopsis of the contracted efforts for FY92 in assessing Nuclear Thermal Propulsion requirements, concepts, and associated issues.

Requirements and Public Acceptance

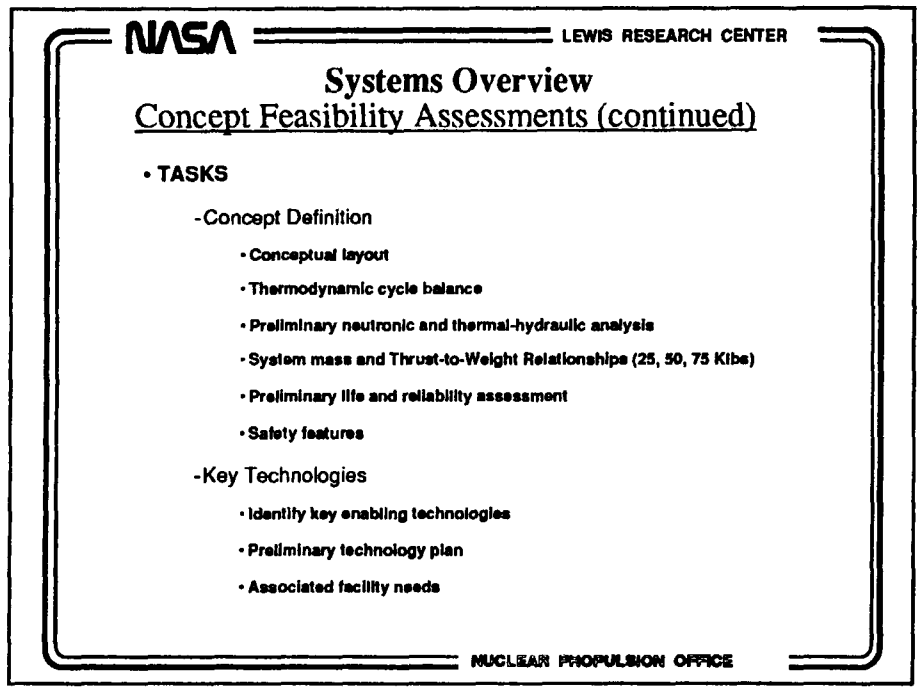
Objective
This effort is to provide NASA LeRC with assistance in space nuclear propulsion system requirements management and public acceptance planning. Requirements management will include requirement definition, requirement change management and control, and requirement document maintenance. Specific objectives are to: 1) provide assistance in defining clear, concise, verifiable nuclear propulsion system requirements, 2) provide full traceability of requirements with reference, analysis, design, and historical data with the ability to assess the impact of requirement changes, 3) produce documentation of the nuclear propulsion system requirements and specifications that can easily accommodate changes, 4) provide assistance in public acceptance planning, and 5) include the resultant system requirements for a publicly acceptable SEI nuclear propulsion system.

Analytical Engineering Corporation
Analytical Engineering Corporation (AEC) was awarded a five year contract in FY92 to meet the objectives defined above. AEC's approach will utilize detailed functional analysis to ensure that system functional requirements are accurately interpreted and flow down to system specifications. An initial requirements document has been developed and continuous improvements are on-going.



Systems Overview
Concept Feasibility Assessments

The objective of these studies was to determine the feasibility of a nuclear thermal propulsion system based on a particular fuel element form for the nuclear reactor. The studies evaluated "state-of-the-art" concept feasibility, thrust level range implications, test facility requirements, manned mission impacts, and key component technologies required. Shown in the chart are the study teams and their associated fuel element that was the basis for their concept analysis.



Systems Overview
Concept Feasibility Assessments (continued)

Concept Definition

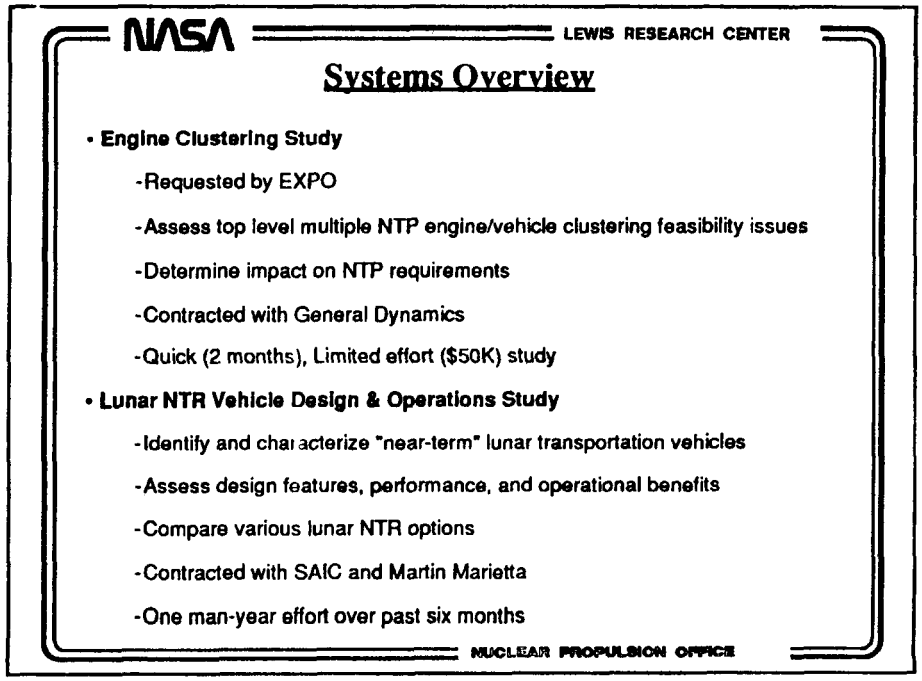
The Contractors were requested to define a nuclear thermal propulsion concept based on their particular reactor concept in sufficient detail to permit reasonable judgements on feasibility, weight, performance, safety features, operations, and key technology requirements. An overall assessment of the NTP engine would include the reactor assembly, nozzle, propellant feed system, thrust vector control, instrumentation and control, and propellant pressurization. The concepts were defined to meet, as a minimum, the basic performance requirements defined below. The NTP engine concepts were assessed at one specific thrust level point with sensitivities determined for two others.

Baseline Design Requirements

PARAMETER	REQUIREMENT
Thrust	25K -75K
Thrust/Weight (w/ Internal Shield)*	≥4
Specific Impulse	≥850 seconds
Throttling	25% Thrust @ Rated Temperature
Reuse	Multiple (Mission Dependent ≥ 10 Restarts)
Single Burn Duration	60 minutes (Maximum)
Engine Life	>270 minutes at Rated Thrust (3X Required)
Reliability	Manned Systems
Propellant	Hydrogen

Key Technologies

The Contractors were to determine from the defined concept the key enabling technologies that need to be addressed before the system could be developed. Technologies that would have a significant impact on the overall system performance, safety, or reliability would also be identified. For each enhancing technologies, its system impact were to be identified along with the risks associated with its development.



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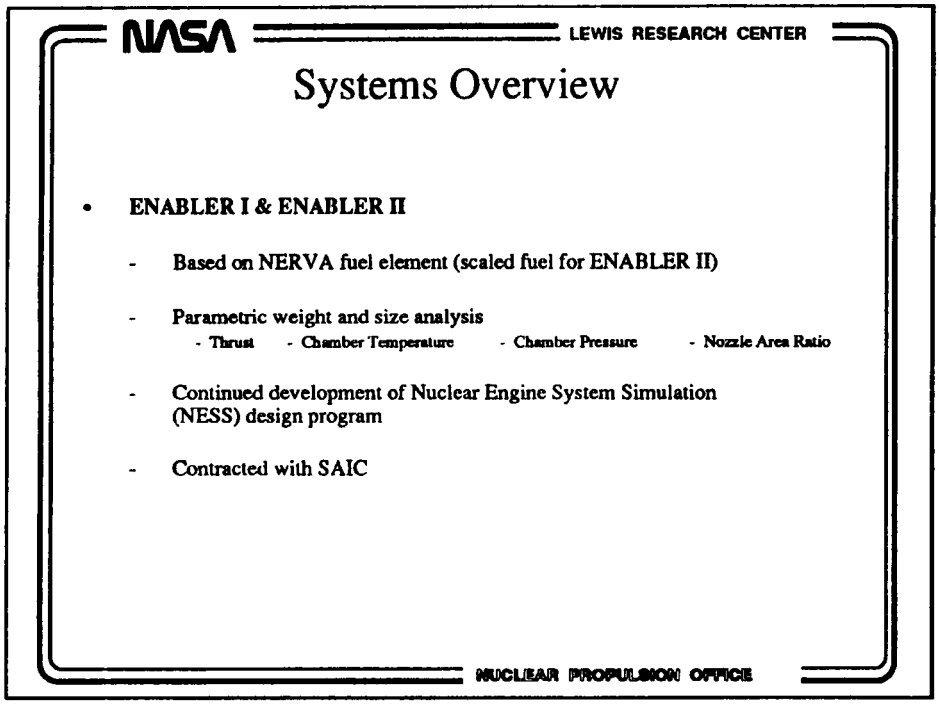
Engine Clustering Study

The objective of this study requested by NASA JSC's Exploration Project Office (EXPO) was to develop propulsion system designs that could be integrated with the provided reference vehicle. Four propulsion system options were developed using two and three engines with either boost pumps or run tanks for engine start up. The systems issues addressed consisted of TVC requirements, engine out possibilities, propulsion system failure modes and technology development requirements.

Lunar NTR Vehicle Design & Operations Study

The objective of this study was to identify and characterize the features of NTR propulsion stages for "near-term" lunar transfer vehicle missions. The study assessed NTR stage design features, performance, and operational benefits. Programmatic (schedule and cost) issues are also addressed. Comparison of various options for lunar transfer vehicles based on past studies on "all-propulsive" and "aerobraked" chemical were also addressed.



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Enabler I & II

The major objective of this task was to upgrade the Nuclear Engine System Simulation (NESS) analysis code to include the NERVA solid core engine (ENABLER I) and an advanced solid-core reactor module (ENABLER II) that utilizes scaled NERVA fuel elements. Additional objectives include the parametric characterization of the ENABLER I & II engine system concepts, and to examine on the "top-level" NTP engine design risk/reliability issues and their impact on the system.