N93-26914

SPACE NUCLEAR
THERMAL PROPULSION (SNTP) PROGRAM

PRESENTATION TO

NUCLEAR PROPULSION TECHNICAL
INTERCHANGE MEETING

BY

LT COL GARY A. BLEEKER
PROGRAM MANAGER
PHILLIPS LABORATORY

20 OCTOBER 1992

SPACE NUCLEAR THERMAL PROPULSION PROGRAM

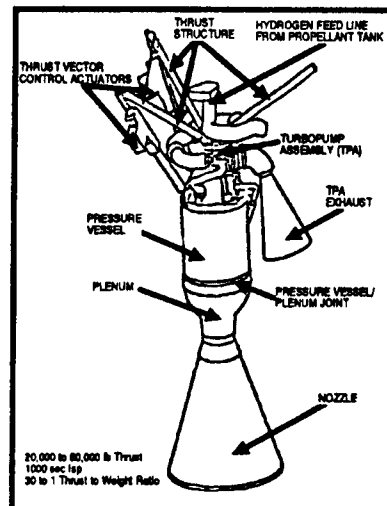**NUCLEAR ROCKET PROGRAM**

● **TECHNOLOGY CHALLENGE**

-DEVELOP ADVANCED NUCLEAR ROCKET
ENGINE WITH 2X THE ISP OF BEST LIQUID
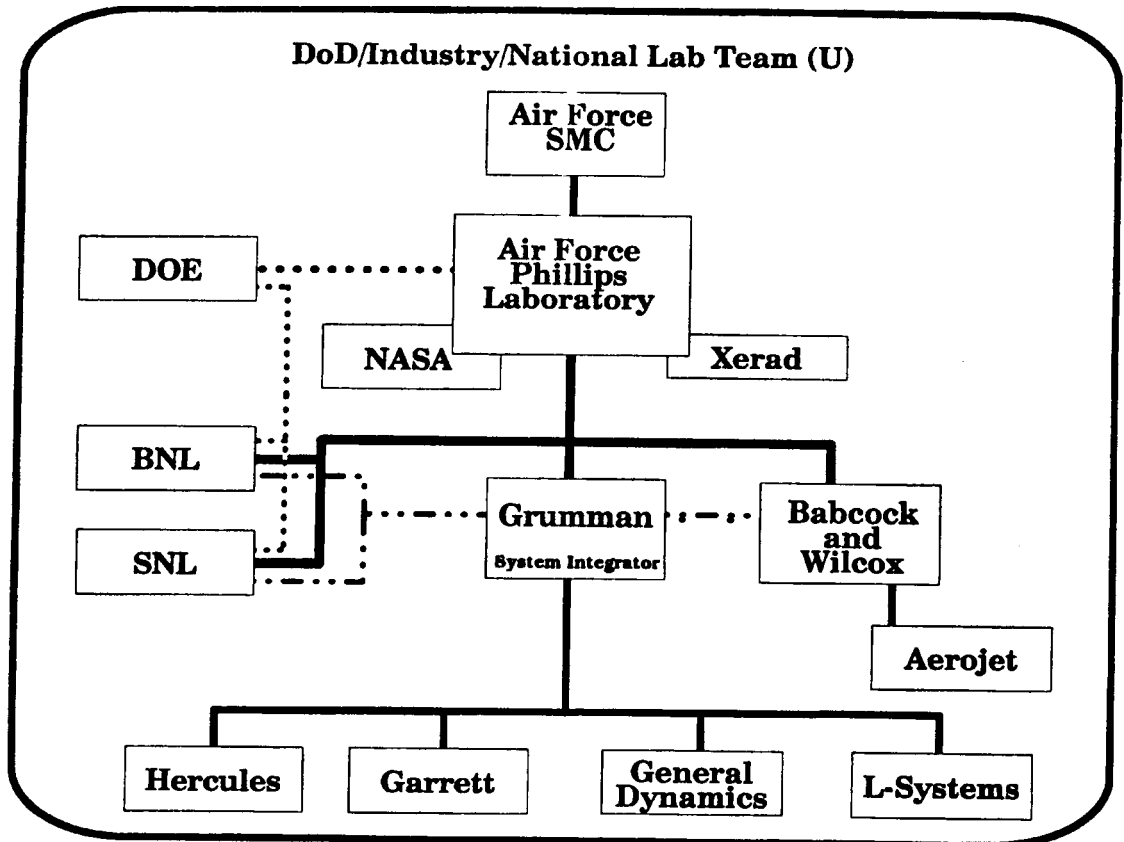ENGINES AND THRUST TO WEIGHT
COMPARABLE TO H2/O2

-PROGRAM PRIORITIES ARE SAFETY,
RELIABILITY, OPERABILITY,
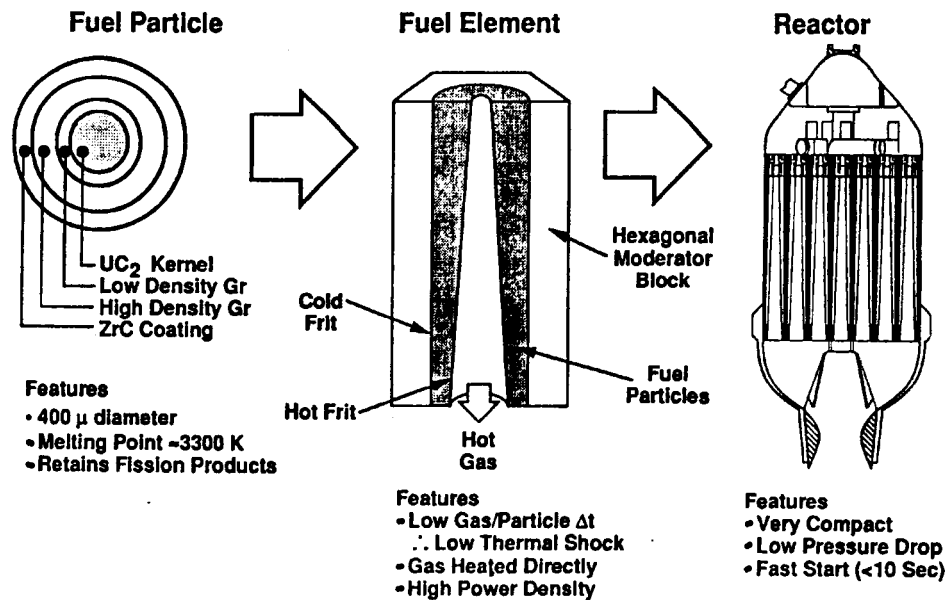PERFORMANCE, AND AFFORDABILITY

● **PAYOFF**

-WIDE VARIETY OF POTENTIAL
APPLICATION FOR UPPERSTAGES, OTV's
AND PLANETARY MISSIONS
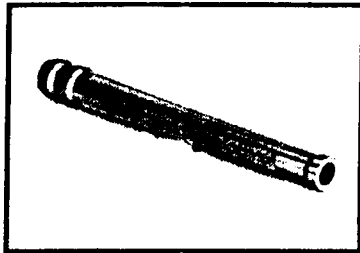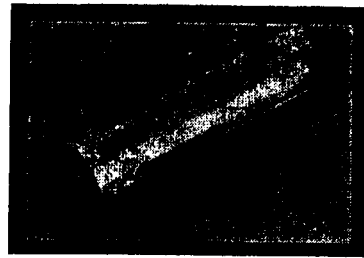
-60-80% COST SAVINGS PER LAUNCH

DoD/Industry/National Lab Team (U)

- Air Force SMC
- DOE
- Air Force Phillips Laboratory
- NASA
- Xerad
- BNL
- SNL
- Grumman (System Integrator)
- Babcock and Wilcox
- Aerojet
- Hercules
- Garrett
- General Dynamics
- L-Systems

Enabling Technology - The Particle Bed Reactor

Fuel Particle

- UC$_2$ Kernel
- Low Density Gr
- High Density Gr
- ZrC Coating

Features
- 400 µ diameter
- Melting Point ~3300 K
- Retains Fission Products

Fuel Element

Cold Frit
Hot Frit
Hot Gas

Features
- Low Gas/Particle Δt
  ∴ Low Thermal Shock
- Gas Heated Directly
- High Power Density

Reactor

Hexagonal Moderator Block
Fuel Particles

Features
- Very Compact
- Low Pressure Drop
- Fast Start (<10 Sec)
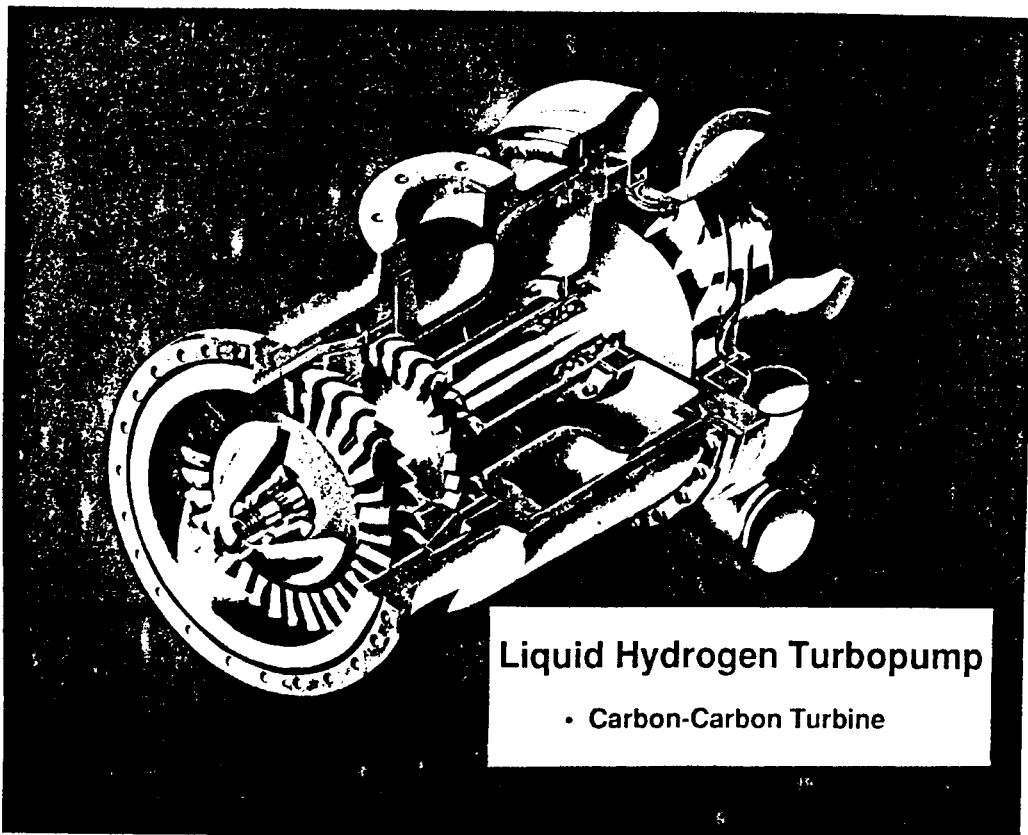
ELEMENT COMPONENT HARDWARE
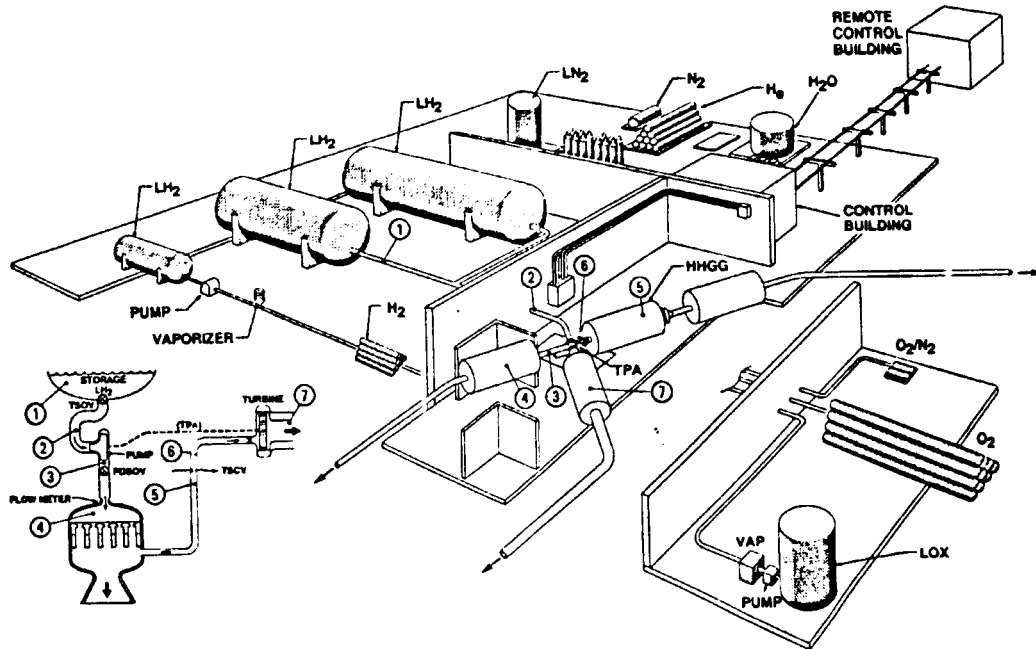

HOT FILTER

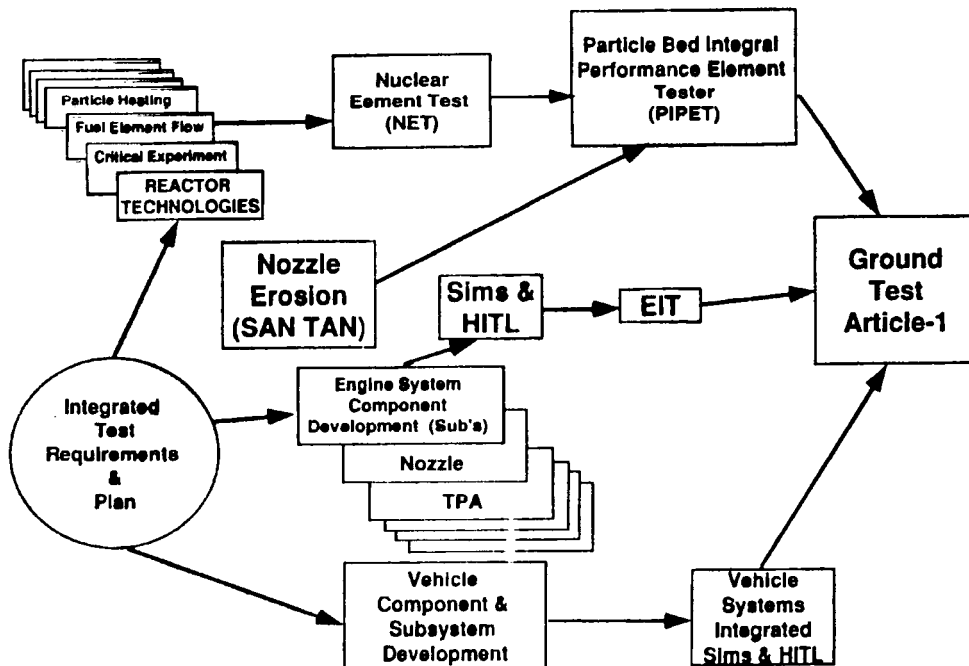COLD FILTER

HIGH TEMPERATURE FUEL

Liquid Hydrogen Turbopump

- Carbon-Carbon Turbine

SNTP Hydrogen Test Facility Layout
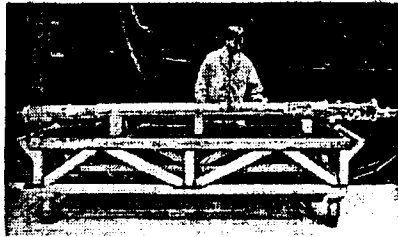

INTEGRATED TEST PLAN
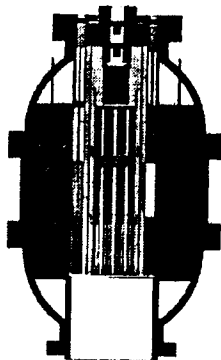
NUCLEAR ELEMENT TESTING

NET TEST CAPSULE

STATUS:

NET-0	COMPLETED (Non-Nuclear Checkout)
NET-1	Mar 93
NET-2	Sep 93
NET-3	FY94

ANNULAR CORE RESEARCH REACTOR

GROUND NUCLEAR TEST SITE

TEST REACTOR

GROUND NUCLEAR TEST FACILITY LAYOUT

STATUS:

REACTOR PDR		Feb 92		
REACTOR FACILITY DESIGN	TITLE II	Feb92		
COOLANT SUPPLY SYSTEM	TITLE I	Oct 91	TITLE II	4Qtr FY93
EFFLUENT TREATMENT SYSTEM	TITLE I	2Qtr FY93	TITLE 1	FY94

Ground Test Approach

7 Element Tester

Core Tester

Engine Tester

Primary — Confinement Barrier

Significant Cost Reduction By Combining Sub Scale and Full Scale Facilities
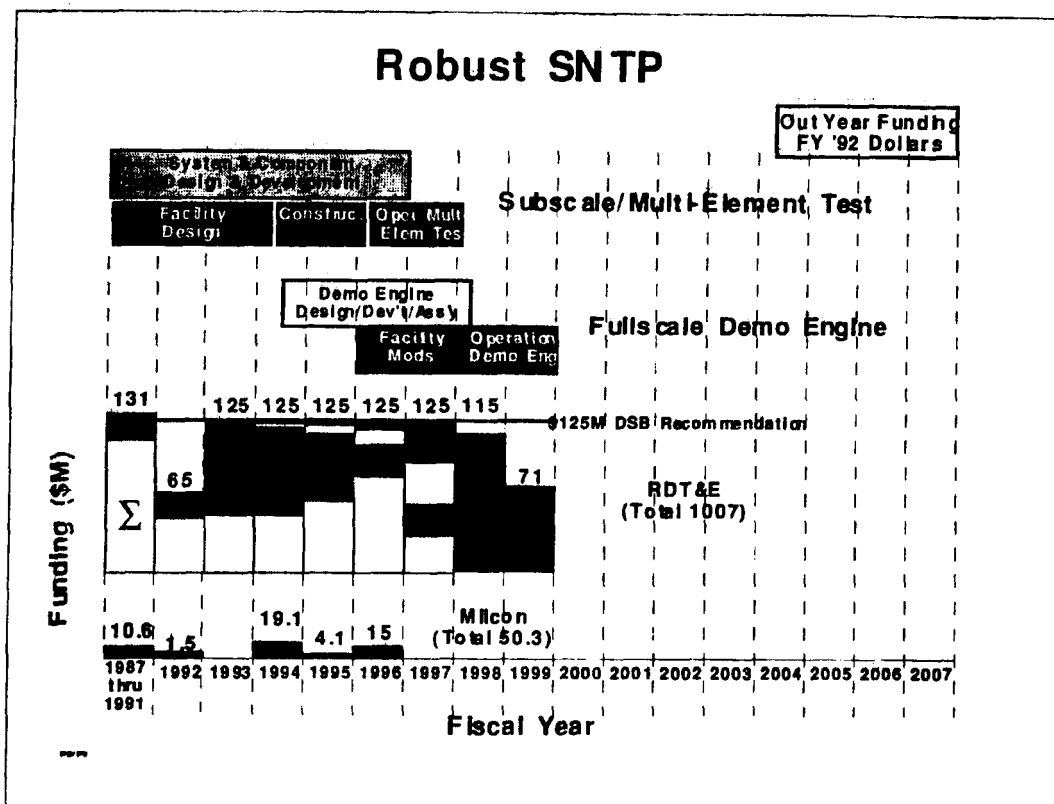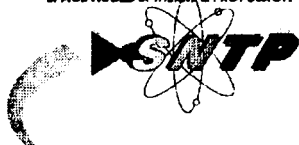
Exhaust to ETS
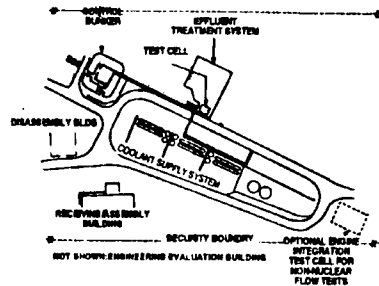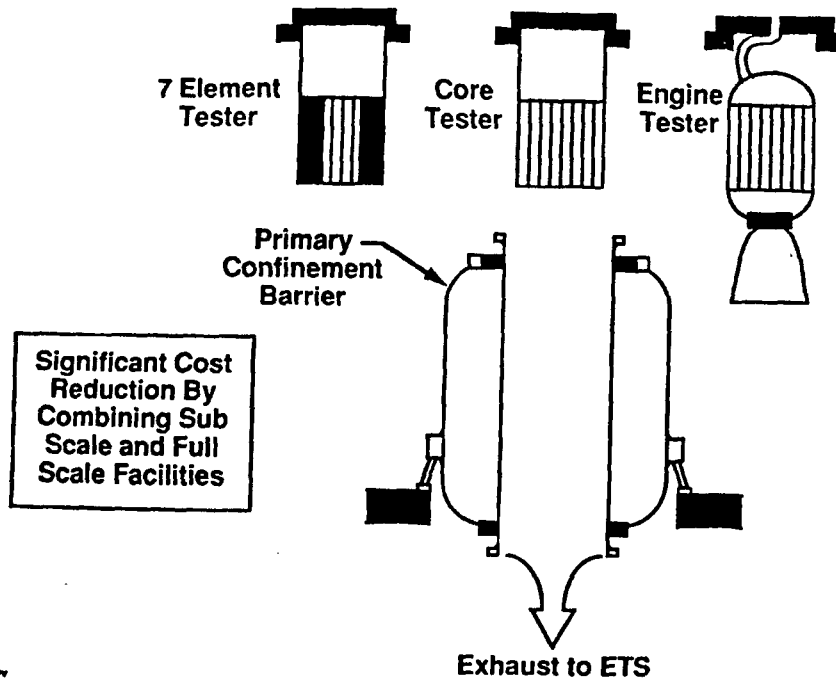
SAFETY, ENVIRONMENTAL, HEALTH

● **TOP PRIORITY FROM INCEPTION**

- **PROGRAM SAFE.Y POLICY ESTABLISHED AND BEING FOLLOWED**

- **PSAR COMPLETE AND UNDER REVIEW**

- **MEETING ALL FEDERAL/STATE REGULATORY REQUIREMENTS**

- **SUBSTANTIAL INTERNAL AND EXTERNAL REVIEW (DSB, DOE, NAS)**

- **FOLLOWING ALARA (AS LOW AS REASONABLY ACHIEVABLE) APPROACH**

Robust SNTP

System & Component
Design & Development

| Facility Design | Construc. | Oper Mult Elem Tes |

Subscale/Multi-Element Test

Demo Engine
Design/Dev't/Ass'y

| Facility Mods | Operation Demo Eng |

Full scale Demo Engine

131 | 125 | 125 | 125 | 125 | 125 | 115

◆125M DSB Recommendation

Σ   65   71

RDT&E
(Total 1007)

10.6   1.5   19.1   4.1   15   Milcon
(Total 50.3)

1987 thru 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007

Fiscal Year

Funding ($M)

SPACE NUCLEAR THERMAL PROPULSION

SNTP

SUMMARY

o **NUCLEAR WILL BE THE PROPULSION SYSTEM OF THE 21st CENTURY**

   - **ESSENTIAL TO MAINTAIN U.S. COMPETITIVENESS AND SUPREMACY IN SPACE**

o **SNTP CONFORMS TO NATIONAL POLICY**

   - **HIGH PAYOFF R&D: MANY APPLICATIONS/MISSIONS**

   - **LEVERAGE DOD, DOE, AND NASA TECHNOLOGY BASE**

o **BASED ON CURRENT PROGRESS, PROGRAM HAS A HIGH PROBABILITY OF SUCCESS**

o **ALL APPLICABLE NUCLEAR SAFETY AND ENVIRONMENTAL OBJECTIVES WILL BE MET**