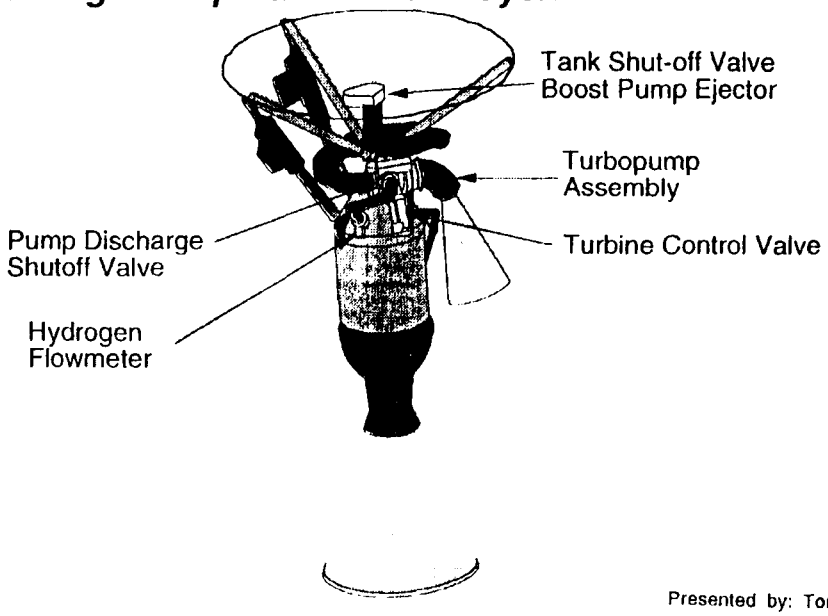
N93-26937

SNTP Propellant Management System

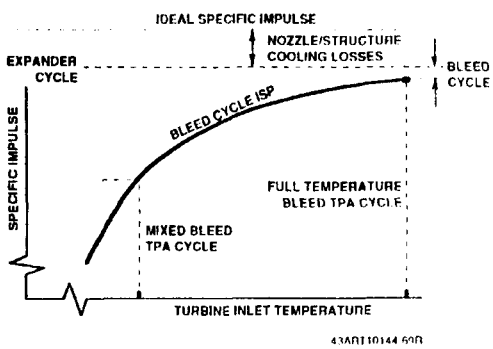
Current SNTP Engine System
Uses High Temperature Bleed Cycle



Presented by: Tom Tippetts
Allied Signal

SNTP Cycle Selection

Full-Temperature Bleed Cycle is Lowest Engine System Mass with Minimal Isp Penalty

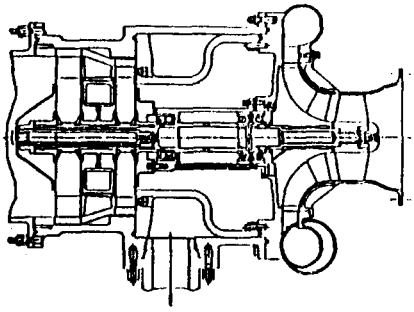


- **No design interaction with reactor**
- **Allows light-weight radiation-cooled nozzle**
- **Lowest system complexity, potentially highest system reliability**
- **High-temperature, low-Z material minimize cooling in radiation environments**

NTP System Components Have Unique Design Constraints

- High Ionizing Radiation Environment
- High Heat Load From Radiation Energy Absorption
- Restricts Use Of High-Z Materials
- Design Must Provide For Heat Removal

Bleed Cycle Presents Unique Design Requirements for Turbopump



- Moderate operating pressures (1350 psi)
  - Single-stage pump
  - Light pressure vessels
- High operating temperatures (2750 K)
  - Highly energetic working fluid
  - High-pressure ratio impulse turbine
  - High turbine temperatures
  - Large thermal gradients
- Environmental factors
  - Environmental heating – low -Z material
  - Limited elastomers selection
  - Hot-hydrogen embrittlement
- Use of bleed cycle and uncooled thrust nozzle results in substantial system weight savings.

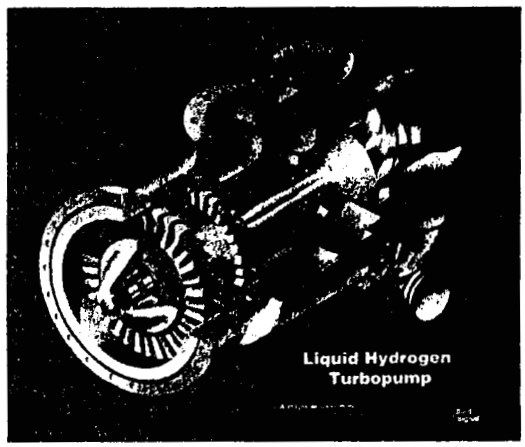
Bleed-Cycle Turbopump

Uses Carbon-Carbon Components for Operation on 2750 K Gas

Carbon-Carbon Hot Section Housing

Carbon-Carbon Turbines

Titanium Shafting



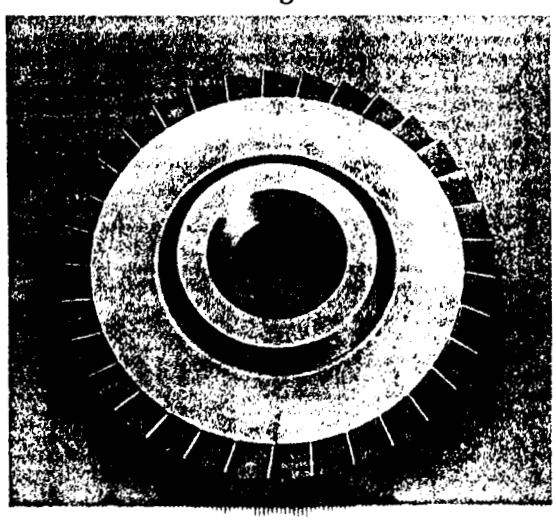
Carbon-Carbon Nozzle/Plenum

Aluminum Pump and Inducer

Ceramic Rolling Element Bearings or Foil Bearings

SNTP Carbon-Carbon Turbine Wheel

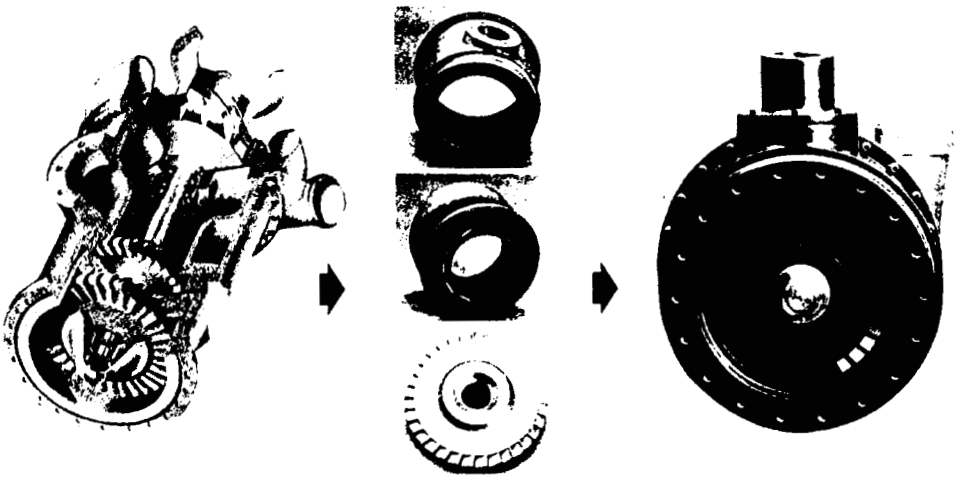
Design is Based on Technology Developed on the ELITE Program



- Helical 2-D polar weave architecture
- Impulse blades
- 55,600 rpm
- 2750 K inlet temperature
- 45-percent design stress margin
- 26-percent design speed margin

Turbine Development Program

High-Temperature, Carbon-Carbon Components Are Being Fabricated and Will be Tested at 2750 K

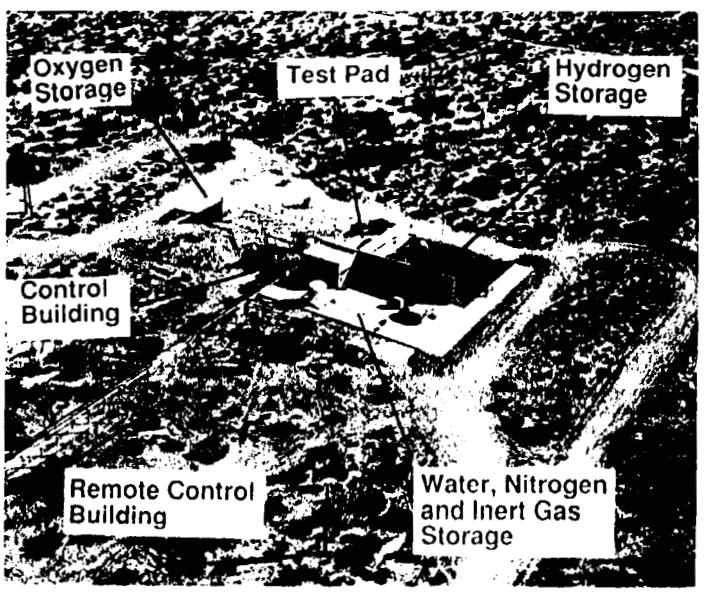


Turbopump Preliminary Design → High-Temperature Component Design and Fabrication → Hot-Turbine Spin Rig Test (HTSR)

Page 3 (T)2782

San Tan Hydrogen Test Facility

Facility Constructed for Development of SNTP Hydrogen-Related Components



- Turbopump, valves, internal reactor components
- Hot, two-phase, and cryogenic hydrogen capability
- Dedicated facility for non-nuclear NTP testing
- Company-funded construction