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100 - 500 kWe NEP Systems

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100 - 500 kWe NEP Systems

- Use 2.4 MWt SP-100 reactor / dynamic power conversion
- Enhancing to 100 kWe thermoelectric SP-100
- Serve as interim step between 100 kWe and multimegawatt NEP
- New NEP mission/performance regime

System/Technology Assumptions

- SP-100 Reactor
  - fast spectrum, lithium-cooled, pin type
  - 2.4 MWt
  - 1375 K out
  - 7 yr life
- Dynamic Power Conversion
  - 1100 K Brayton
  - 1300 K Brayton
  - 1300 K Rankine
  - 1 to 4 100-125 kWe "modular" power conversion loops
  - 2000 V to load
- Heat Rejection
  - 10 kg/kWe (SP-100 program)
- Krypton Ion Thrusters
  - 50-100 cm
  - 3000-7000 sec Isp
  - 50-150 kWe/thruster
  - 6 kg/kWe

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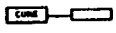
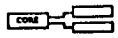
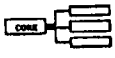
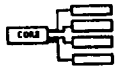
Electrical Output Power of Modular Dynamic Power Conversion Systems

Conversion Loops	Low Temperature Brayton Cycle 100 kWe Loops	High Tempetature Brayton Cycle 125 kWe Loops	Rankine Cycle 125 kWe Loops
	100	125	125
	200	250	250
	300	375	375
	400	500	500

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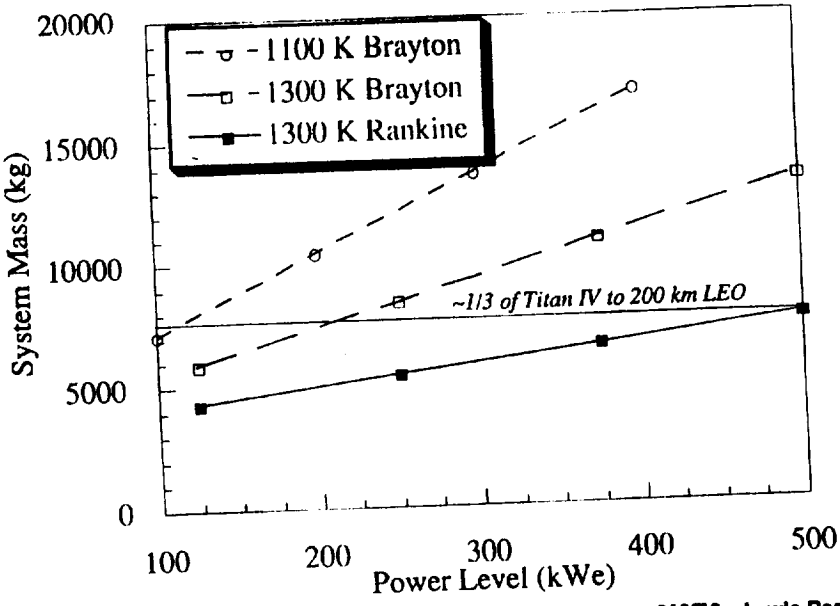
Rankine and Brayton Power System Mass

(2.4 MWt SP-100 reactor, 1 to 4 power conversion loops)



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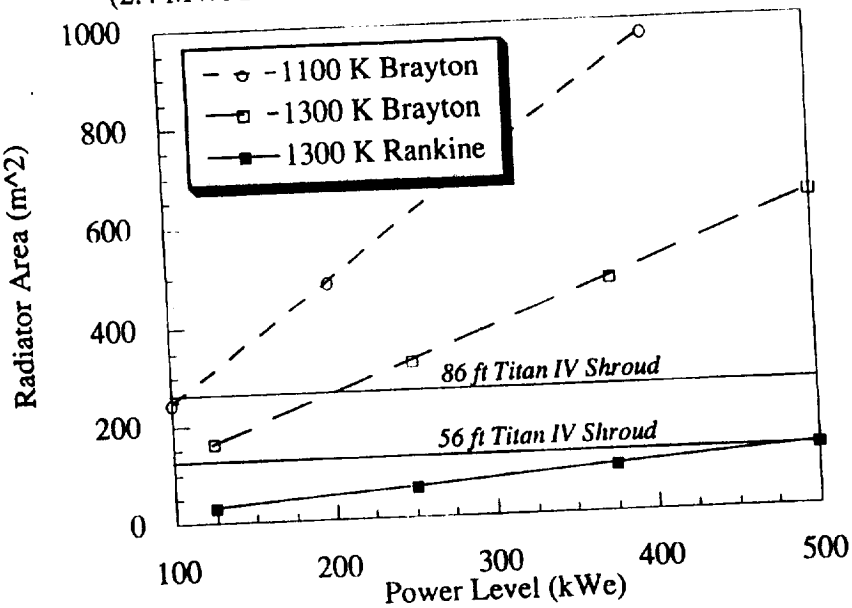
Rankine and Brayton Radiator Area

(2.4 MWt SP-100 reactor, 1 to 4 power conversion loops)



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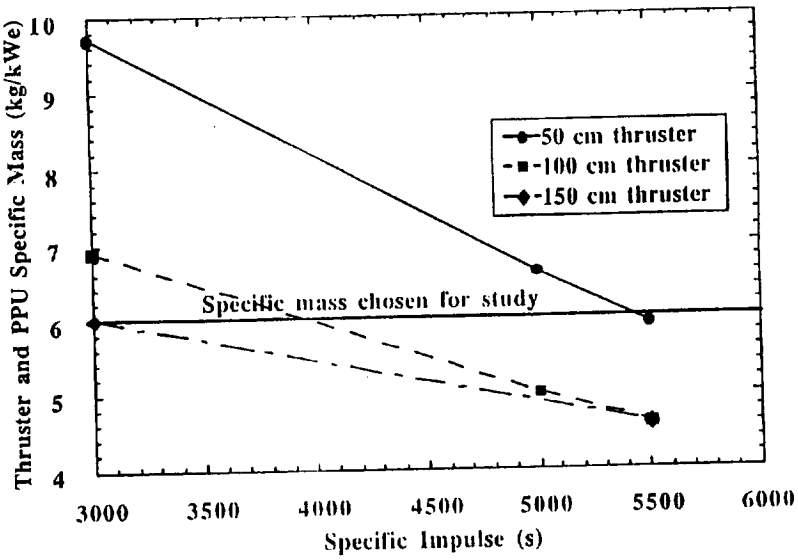
KRYPTON ION THRUSTER MASS SCALING (500 KWe)



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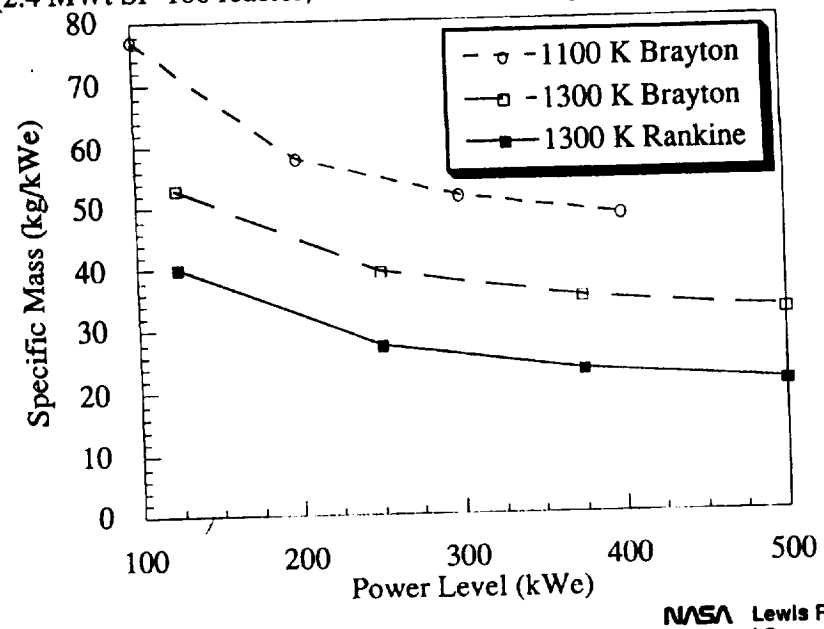
NEP System Specific Mass for Rankine and Brayton Power Conversion

(2.4 MWt SP-100 reactor, Ion thrusters, 1 to 4 power conversion loops)



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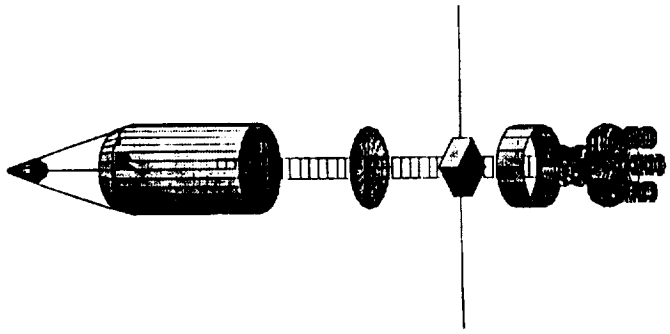
NEP: Systems Modeling

500 kWe SP-100/K-Rankine/Ion NEP Vehicle



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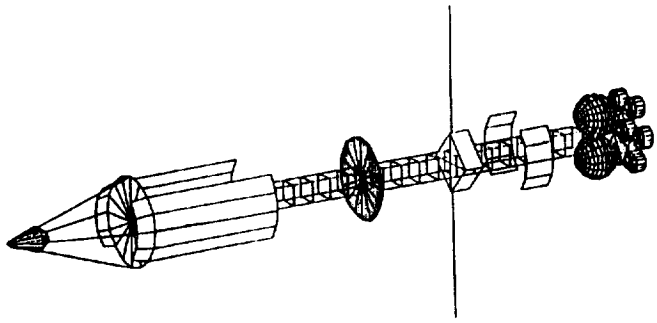
250 kWe SP-100/K-Rankine/Ion NEP Vehicle



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NEP MISSIONS

- **Lunar Cargo**
  - **Scenario:**
    - Depart LEO (400 km)
    - Spiral to Moon, Capture at Moon
    - Spiral down to Low Lunar Orbit (LLO)
    - Return Empty
  - Payload:
    - 40 MT to lunar surface
    - 39.5 MT lunar lander
  - Trip Time:
    - Round trip time < 1 year
    - **Trip Time = Reactor, thruster operating time**
  - Reference Cargo Vehicle:
    - Cryogenic LOX/LH2
    - Isp: 468 seconds
    - IMLEO: 267 MT
    - Trip Time: 3 days

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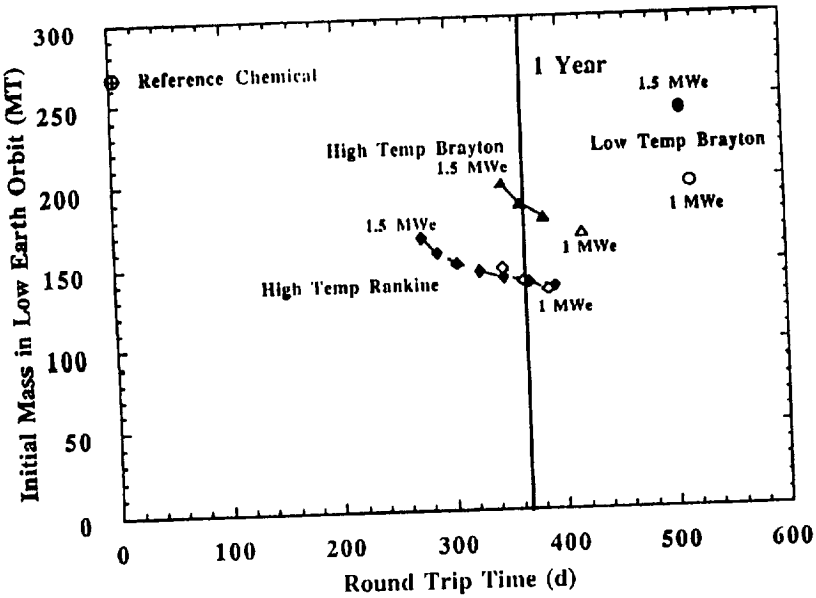
EARLY TRACK NEP LUNAR CARGO MISSION PERFORMANCE



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RESULTS

- 1350 K Rankine, Brayton provide system beneficial to SEI objectives
- Lunar Cargo:
  - 1350 K power systems at 1- 1.5 MWe allow 90 - 130 MT savings over chemical vehicle (up to 50% reduction)
  - Round trip times: 250 days - 1 Year
- Mars Cargo:
  - 1350 K power systems at 1- 1.5 MWe allow mass performance comparable to advanced NTP systems
  - Trip Time: 500 days - 2 Years

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CONCLUSIONS

- Early Track NEP provides the option for "faster, cheaper" implementation of advanced propulsion for SEI
- Other areas of application:
  - Space Science - significant augmentation to exploration of outer planets and beyond
  - Precursors - Early Track NEP to Mars for robust mapping, sample return, subsurface probing
- Technology Developments Required:
  - Dynamic Power Conversion
  - Scaled Krypton Ion Thrusters
    - MPD Thrusters may also be an option
  - System integration

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