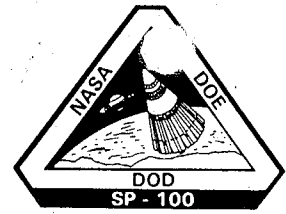


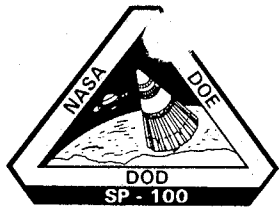
## **SAFETY COMPLETE**

- PSAR FOR REACTOR GROUND TEST**
- INHERENT SAFETY FEATURES: NEGATIVE TEMP COEFF'T**
- HIGHLY RELIABLE SHUTDOWN**
- INDEPENDENT CORE COOLING**
- REENTRY SHIELD: INTACT REENTRY**
- INDEPENDENT DESIGN SAFETY REVIEWS**
- SAFETY DESIGN INPUT DURING DEVELOPMENT**



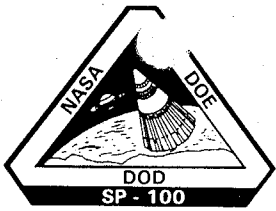
# **REACTOR COMPLETE**

- COLD CRITICAL TESTS**
- HYDRAULIC TESTS**
- UN FUEL PIN IRRADIATION TESTS: 10 YR LIFE**
- REESTABLISHED AND ADVANCED Nb ALLOY FAB  
(INCLUDING NB 1 ZR 0.1C/ PWC 11)**
- NIOBIUM ALLOY CLADDING WITH RHENIUM LINER**
- INTERNALS AND VESSEL NOZZLE FAB**



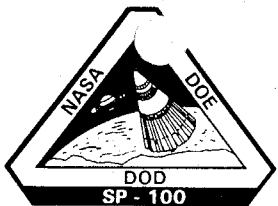
# SHIELD COMPLETE

- LITHIUM HYDRIDE FABRICATION
- LIH GAMMA IRRADIATION TO FULL TEN YEAR LIFE
- LIH IRRADIATED THERMAL AND STRUC DATABASE
- Be, B4C, U 238, & LIH IN STL STEEL STRUCTURE
- GAMMA IRRADIATION OF LIH VALIDATED



## **REACTOR I & C COMPLETE**

- COILS**
- BEARINGS**
- COATINGS**
- SPRING MOTOR**
- MULTIPLEXERS**
- THERMOCOUPLE**
- SOLID LUBRICANTS**
- PRESSURE MONITOR**
- MOTOR, CLUTCH & BRAKE**
- JOHNSON NOISE THERMOMETER**
- LINEAR VOLTAGE DIFFERENTIAL TRANSDUCER**



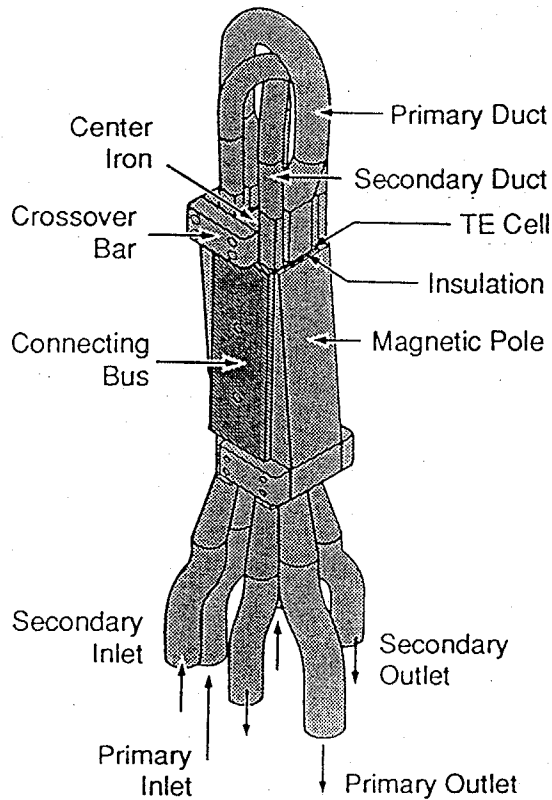
# HEAT TRANSPORT COMPLETE

- Nb1Zr PIPING UP TO 1400 K
- PUMP MAGNETIC DESIGN
- ELECTROMAGNETIC INTEGRATION DESIGN
- FABRICATED FULL-SIZE PUMP  
(22 TAP CELLS & 22 SIMULATED CELLS)
- FABRICATED 3 SETS OF PUMP DUCTS
- GSA AIR & WATER TEST
- SCREEN DESIGN VERIFIED WITH AIR/WATER

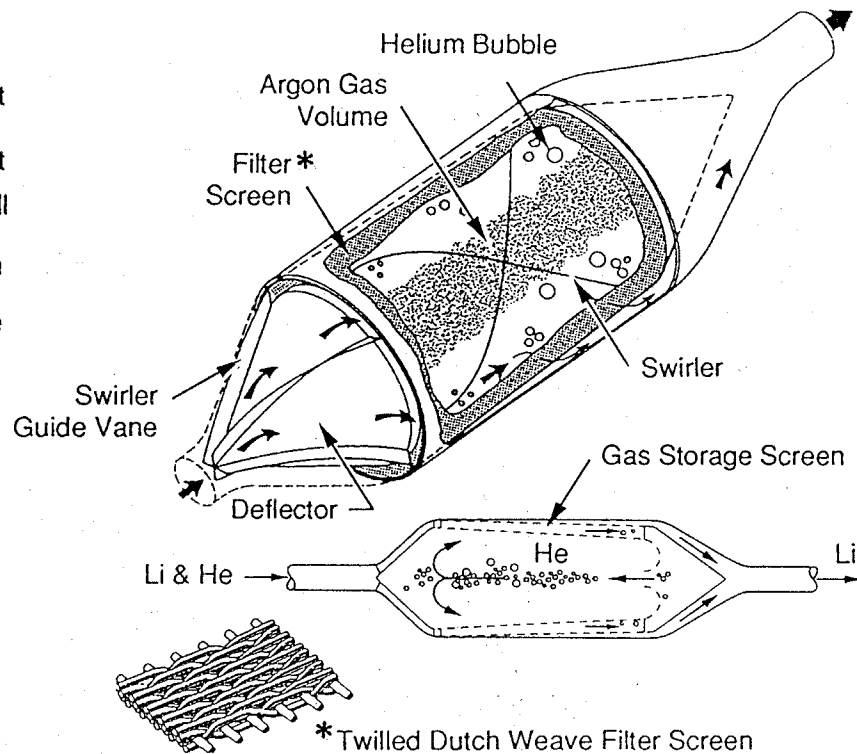


# TEM PUMP AND GSA

TEM Pump



Gas Separator/Accumulator



\* Twilled Dutch Weave Filter Screen

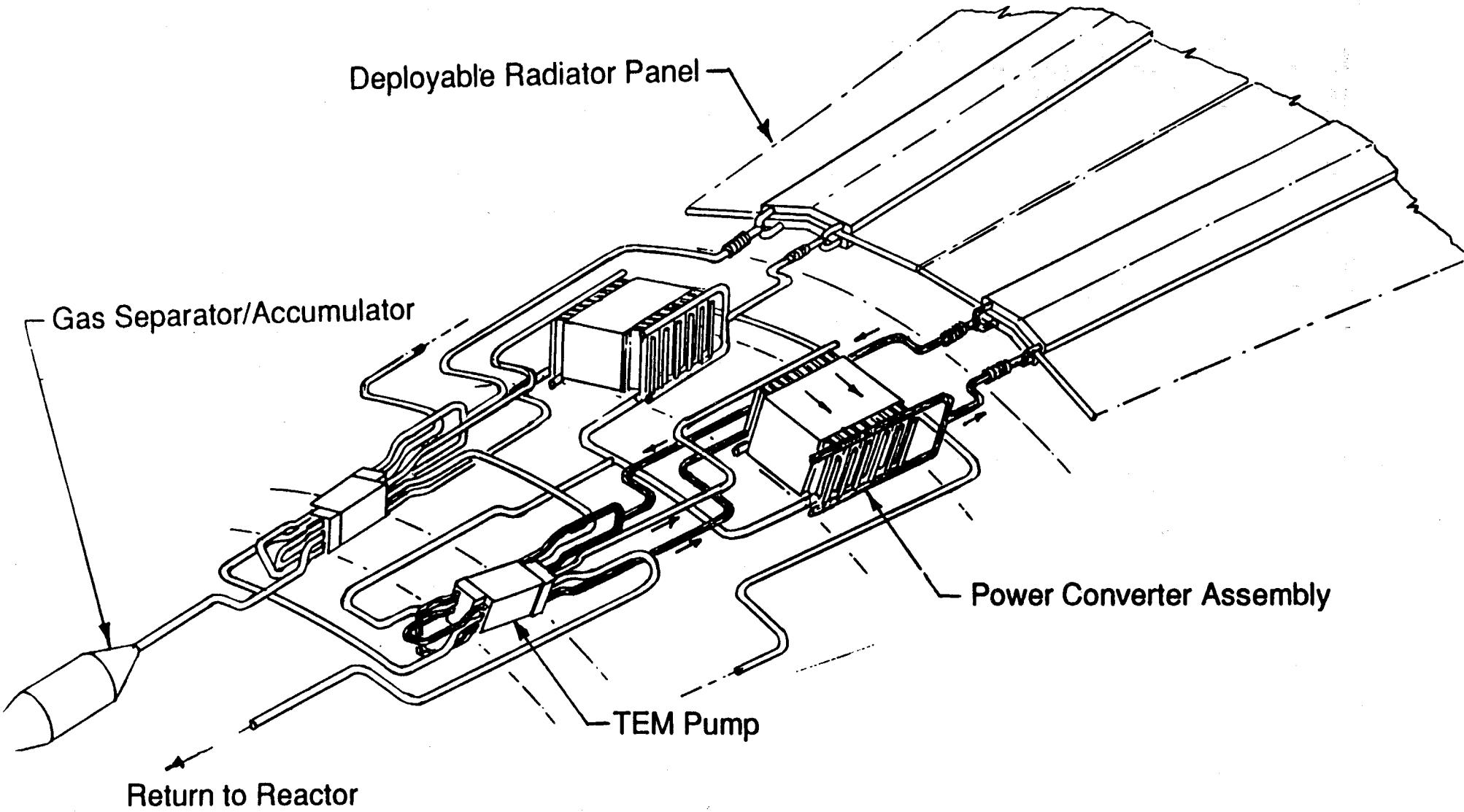
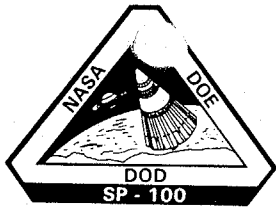


Figure 18. Heat Transport with Linked/Integrated Pumps



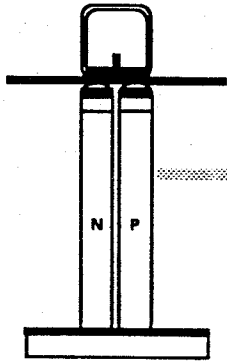
## **CONVERTER COMPLETE**

- PCA DESIGN FOR 20 KWE AND 100 KWE DESIGN**
- TCA 4X6 DESIGN AND FABRICATED**
- TCA COLD AND HOT HEAT EXCHANGERS DEVELOPED**
- TE CELLS - SIX CELLS PERFORMANCE TESTED**
- HIGH VOLTAGE INSULATOR**
- COMPLIANT PADS**
- LOW VOLTAGE INSULATOR**
- POROUS TUNGSTEN & NIOBIUM GRAPHITE ELECTRODES**



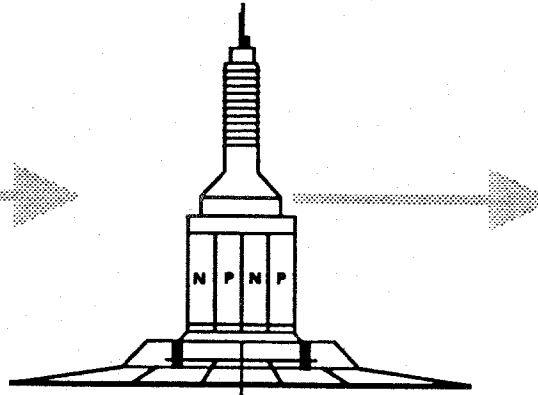


# SP-100 Thermoelectric Technology Evolution



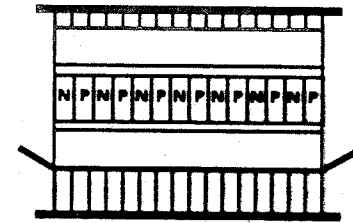
**LES 8/9, Voyager & Galileo Unicouple**

SiGe  
Single TE Couple  
Radiative Coupling  
Ths – 1000°C  
Tcs – 300°C  
0.5 Watt



**MOD-RTG Multicouple**

SiGe + GaP  
Multiple TE Couples  
Radiative Coupling  
Ths – 1000°C  
Tcs – 300°C  
3.5 Watts



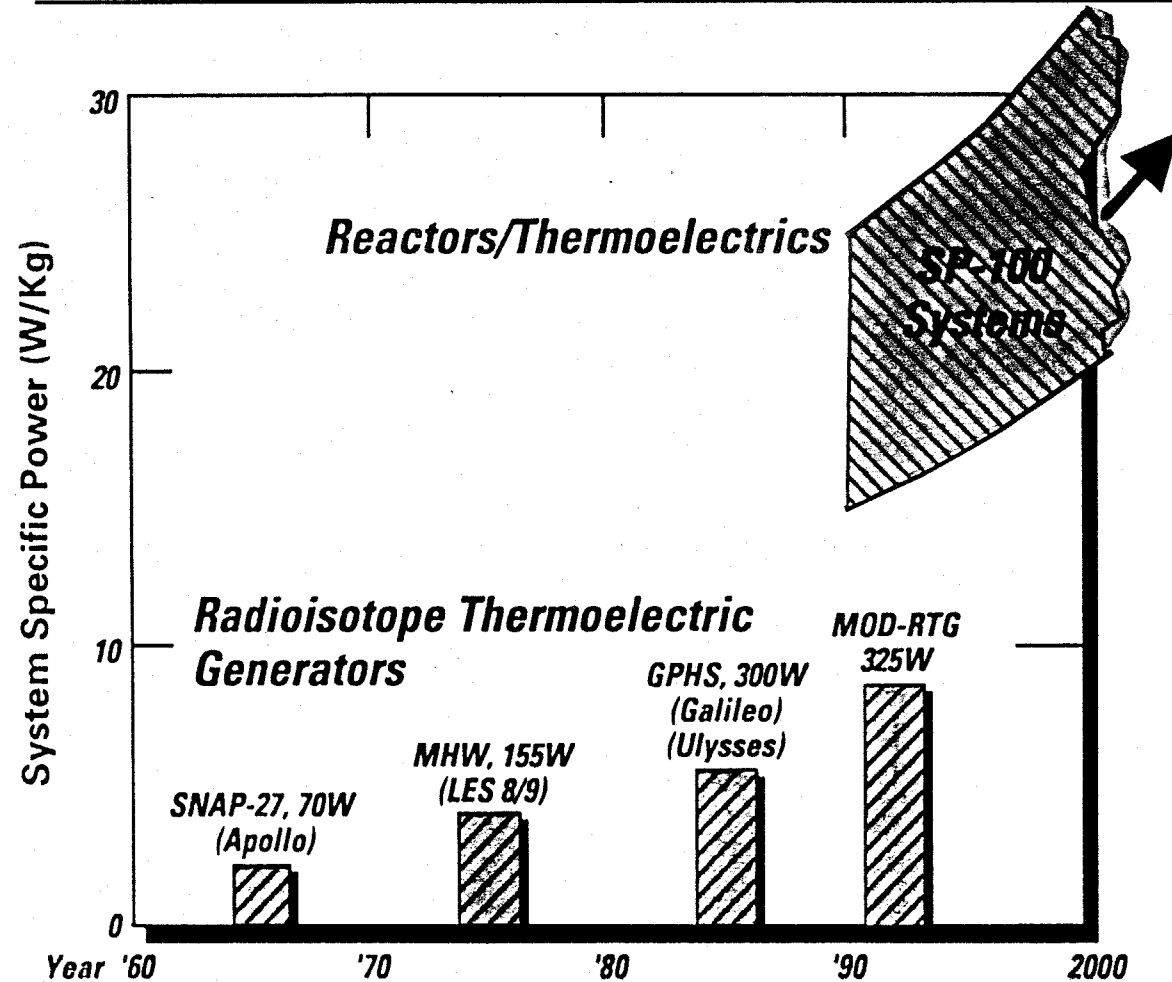
**SP-100 TE Cell**

SiGe + GaP  
Multiple TE Couples  
Conductive Coupling  
Ths – 1032°C  
Tcs – 590°C  
13 Watts

**Power Conversion Evolves from Space Proven Technology**



# Thermoelectric System Characteristics

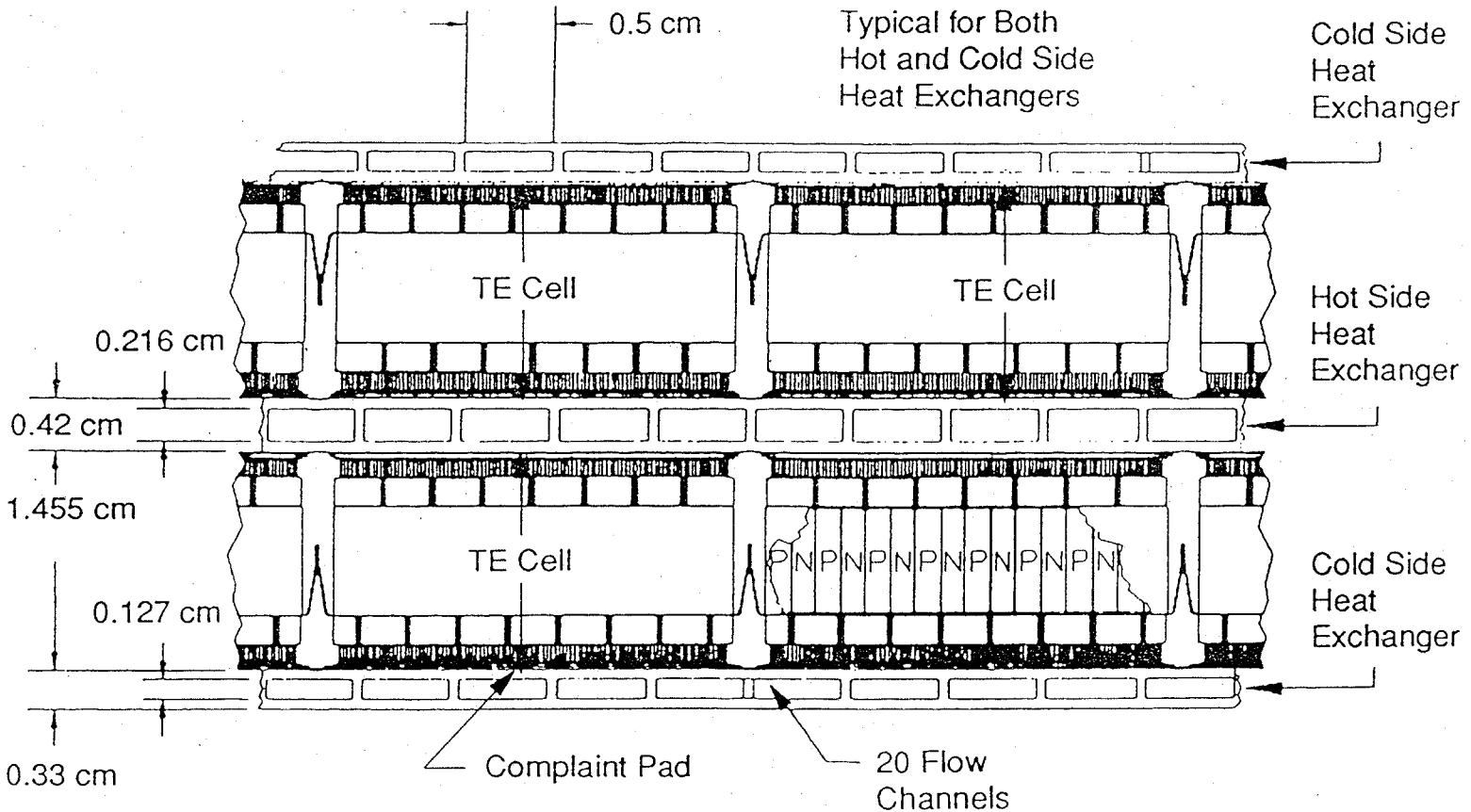


- No Exposure to High Radiation
- No Moving Parts
- No Fuel Interaction
- No Fission Product Venting
- No Complex Cesium Vapor Control
- No Single Point Failure

**Continuing Performance Improvement**



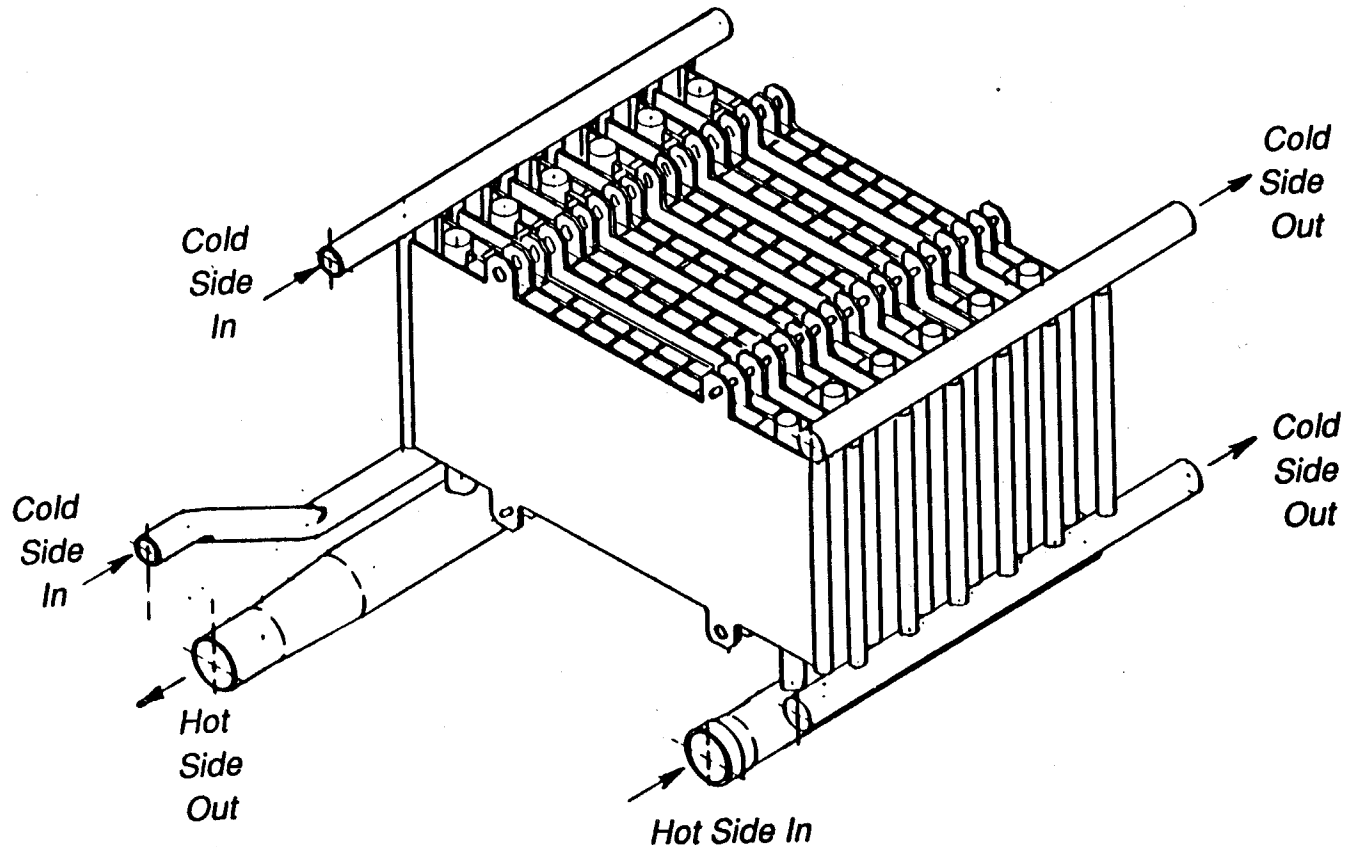
# THERMOELECTRIC CONVERTER ASSEMBLY CROSS SECTION





# Power Conversion Subsystem Power Converter Assembly

## Stack-Up of Thermoelectric Converter Assemblies



- **6 Thermoelectric Converter Assemblies with Headers and Manifolds**

**POWER  
CONVERTER  
ASSEMBLY  
(720 TE  
CELLS)**

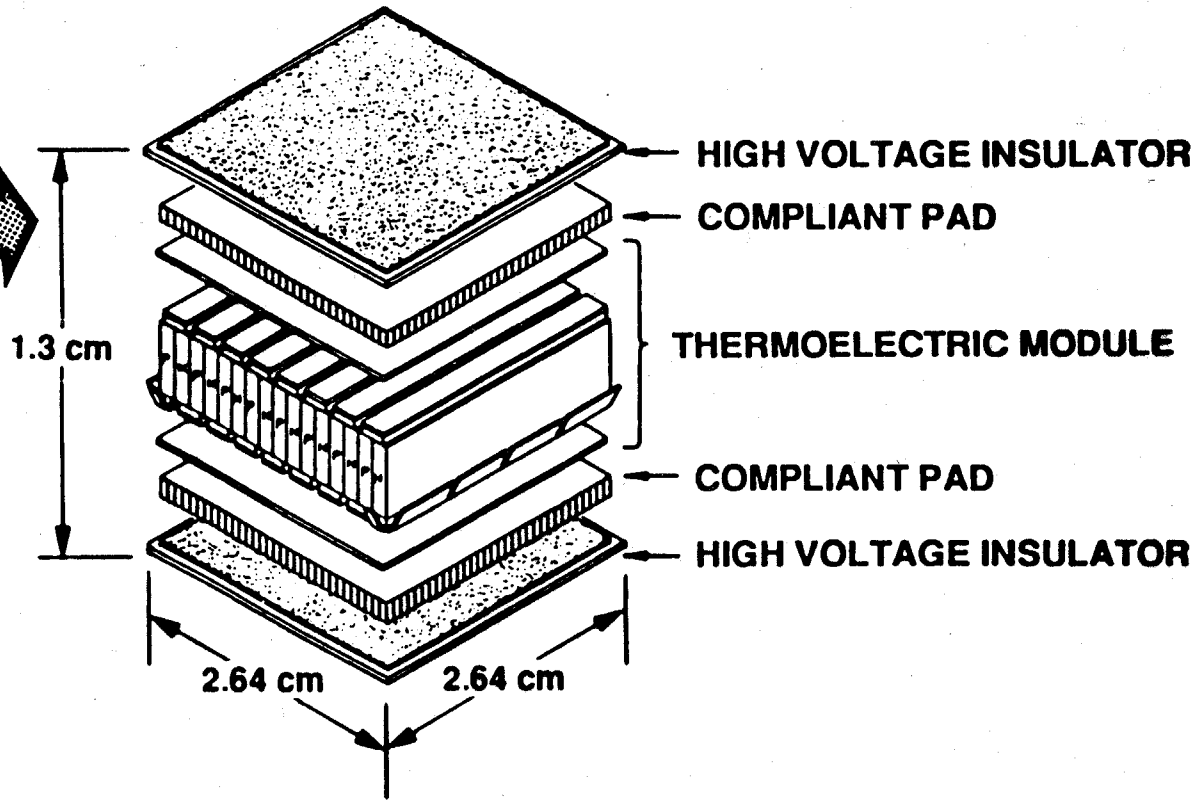
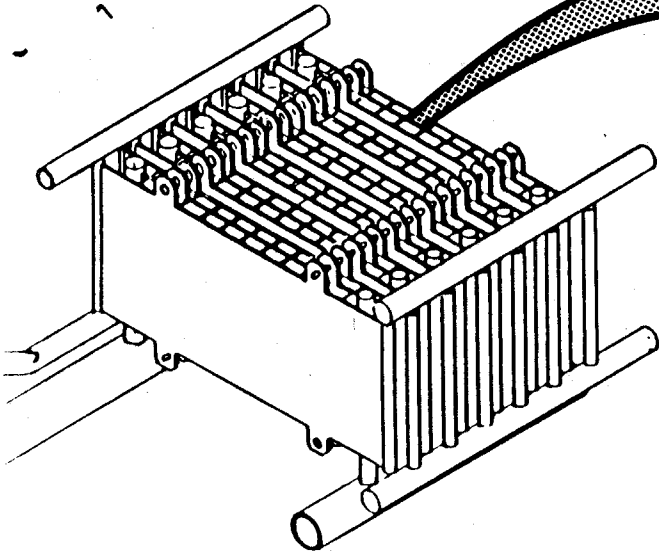
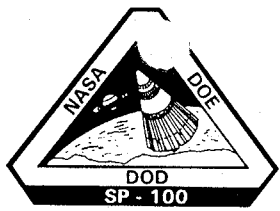


Figure 22. SP-100 Thermoelectric Cell



## **RADIATOR COMPLETE**

- "K" TITANIUM HEAT PIPE PERFORMANCE AND LIFETIME
- DUCT BLEED HOLE THAW TESTED AND VALIDATED

## **PCC&D COMPLETE**

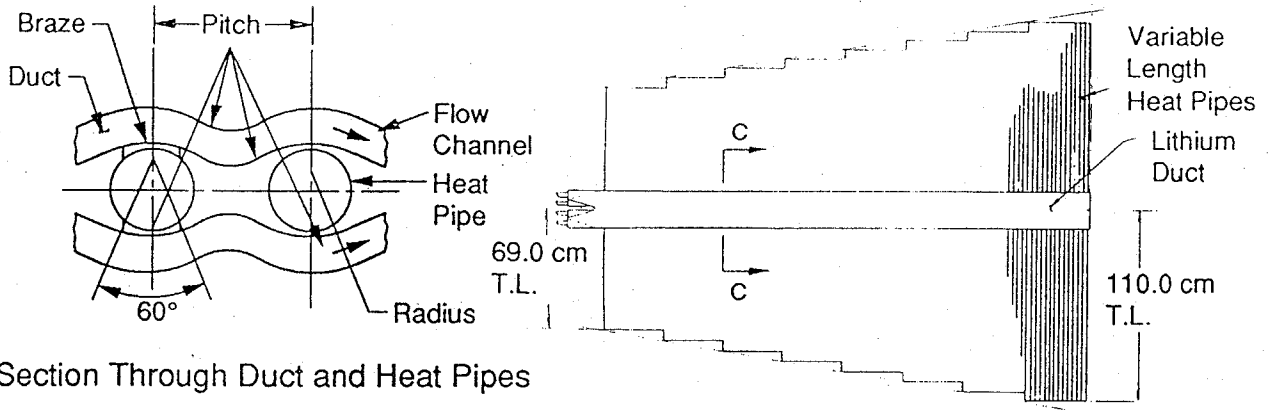
- EXISTING TECH / CONDITIONING & CONTROL SHIELDED

## **MECHANICAL/STRUCTURE COMPLETE**

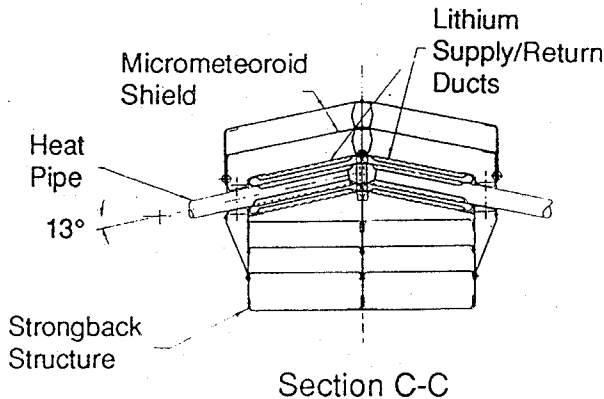
- 20 KWE SYSTEM FIXED RADIATOR
- EXISTING STRUCTURAL MATERIALS
- CONVERTER, PUMP SUPPORT EXISTING TECHNOLOGY



# 20-kWe SRPS RADIATOR



Section Through Duct and Heat Pipes



Section C-C

20 kWe HR S/S Parameter	Value
Total heat rejection (kWt)	526.0
Physical area (m <sup>2</sup> )	29.5
Mass (kg)	360.0
Average lithium temperature (K)	815.8
Average condenser surface temperature (K)	784.9
Heat pipe inside diameter (cm)	2.54
Evaporator length (cm)	9.27