Electricity Production

Note; • 12 assemblies of T/E convertors (see figure)

• Each panel is 10 cell rows wide and 32 cells/row = 320 cells/panel, or 640 cells/each of 12 assemblies

• In each panel, half of the cells (160) are in series

• Each cell produces 14.375 W_e at 0.63 V

• Total output per assembly
= 640 X 14.4 W_e
= 9,200 W_e

• Total Voltage = 160 cells x 0.63 V/cell
= 100.8 V

Exploded View of a Cell

See Figures

Note; The LaS_x has a large(14 x 10^{-6}/°K) expansion coefficient. Ni and Forsterite are chosen to match the expansion

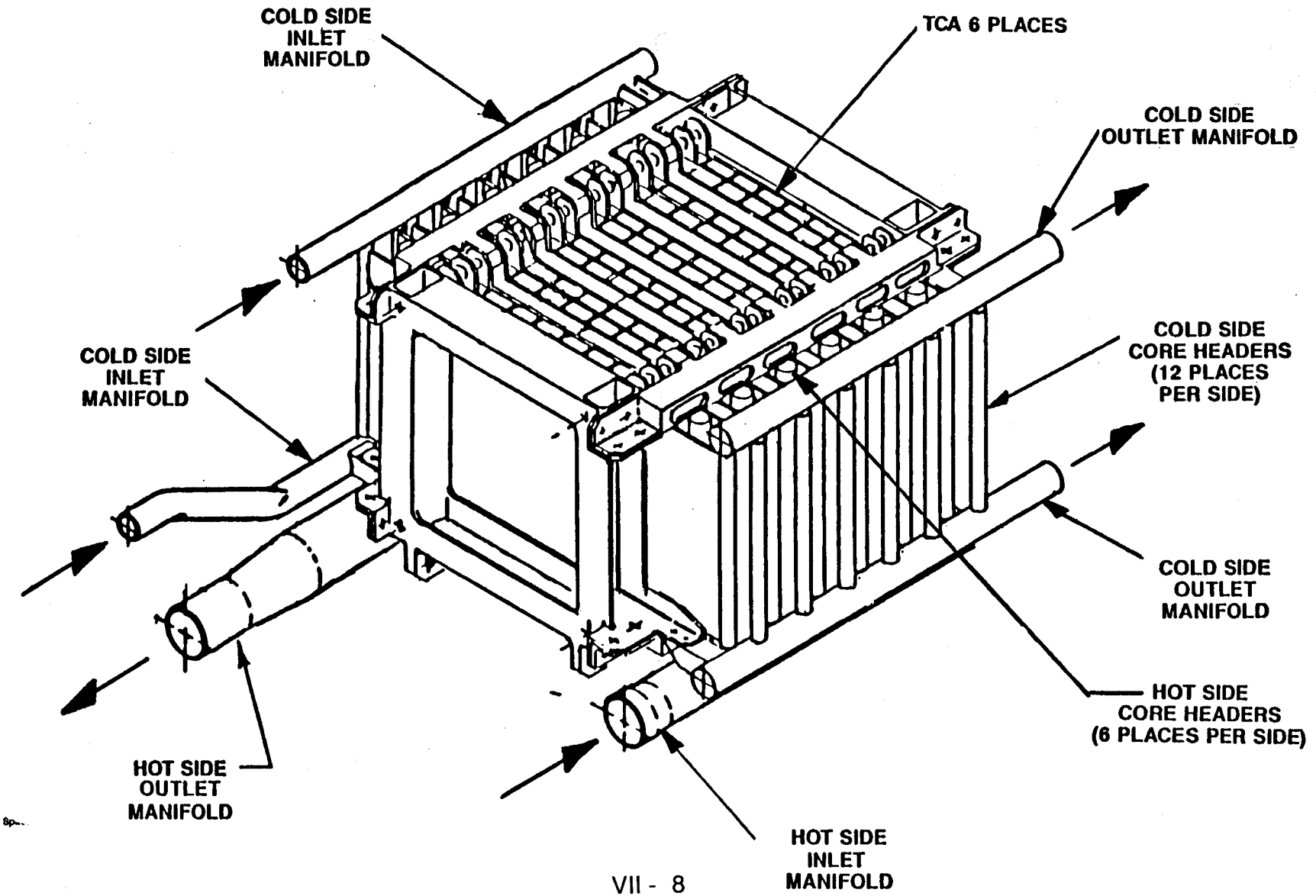
Note; Operation at 100 V or 200 V is possible by series or parallel connections

Note; Need more than 100 kW_e for load, auxiliary power is $\approx$ 5-10 kW_e.

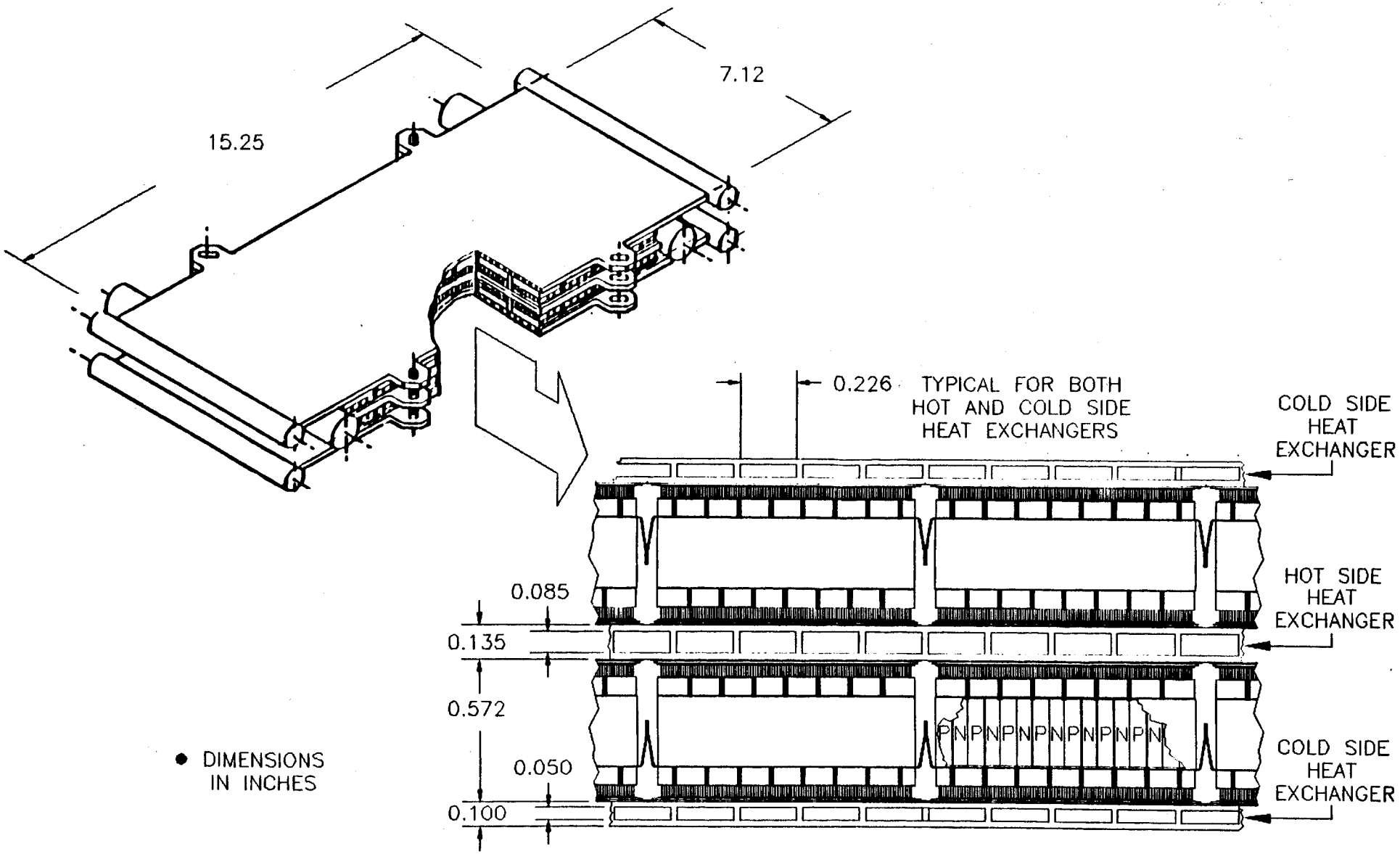
Reference Operating Performance

- ***Power = 110 kWe***
- ***Voltage, 100/200 V***
- ***Convertor efficiency= 6.6 %***
- ***Heat source temperature=1323 °K***
- ***Hot junction temperature = 1290 °K***
- ***Cold junction temperature=842 ° K***
- ***Heat sink interface temp=824°K***

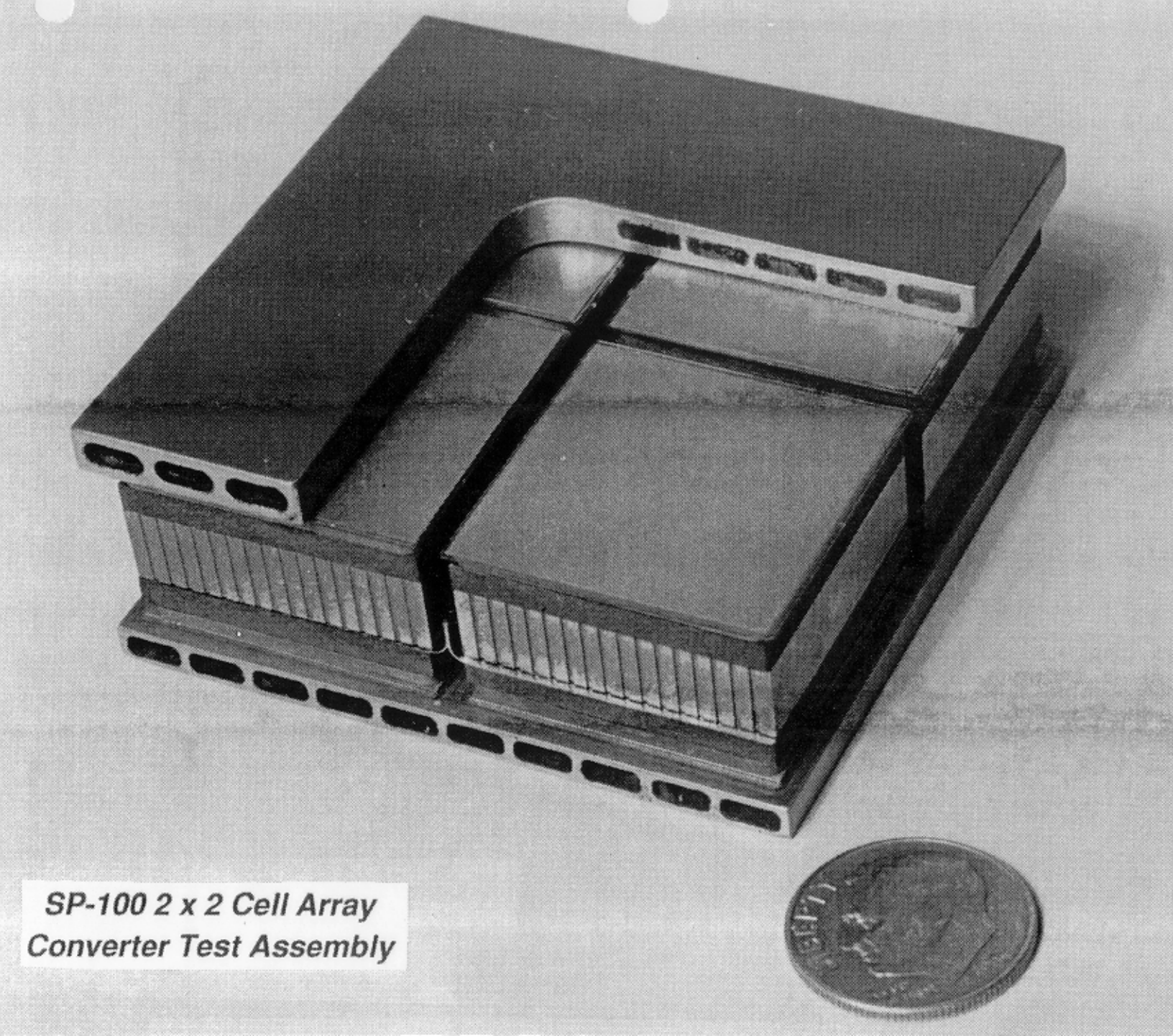
PACKAGING CONCEPT



Thermoelectric Converter Assembly (TCA)

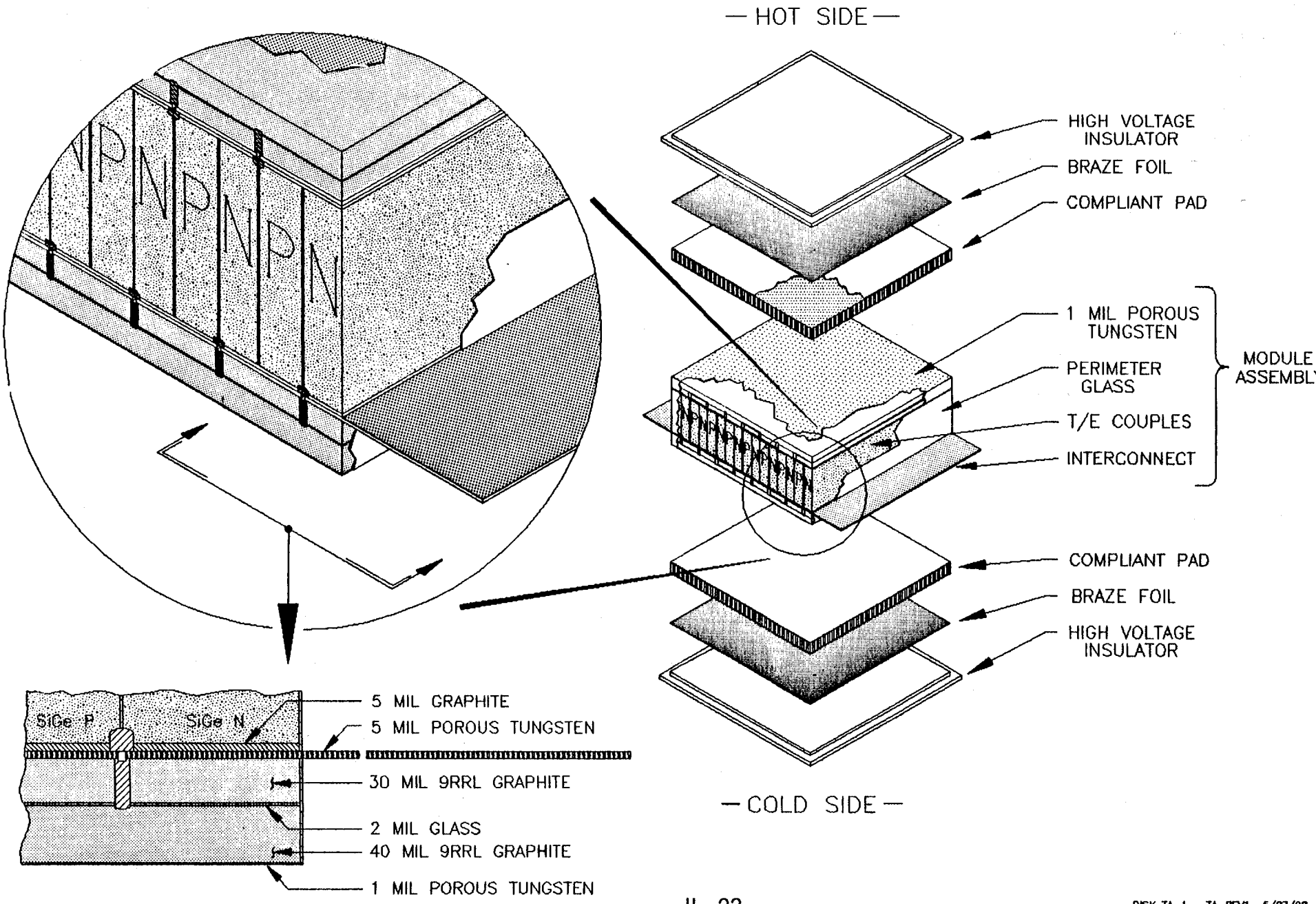


DISK TONY CONCUBA RWD/TAK 5/09/92



SP-100 2 x 2 Cell Array
Converter Test Assembly

SP-100 TA Cell Configuration



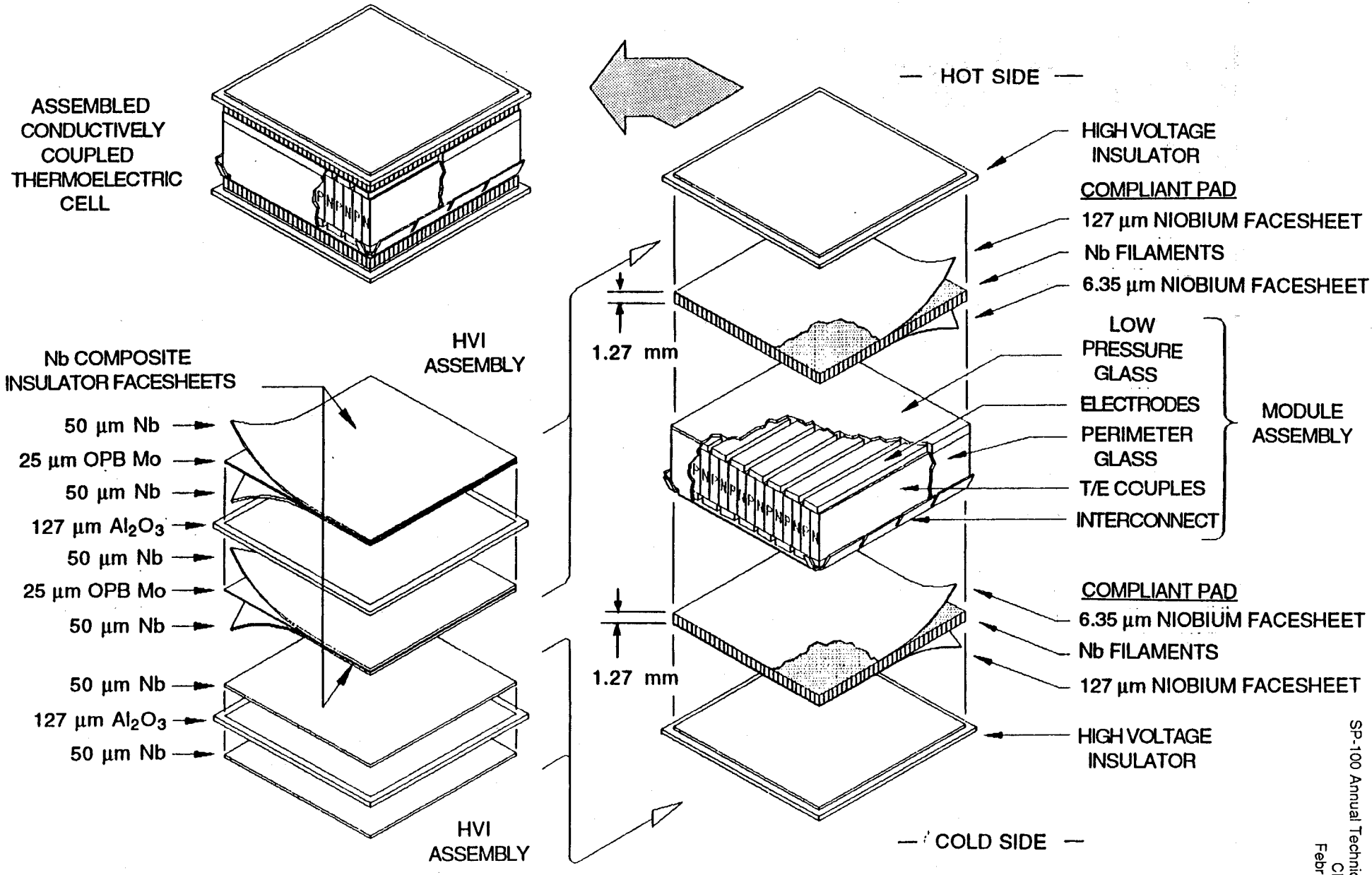
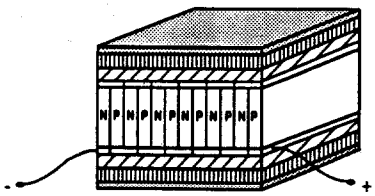
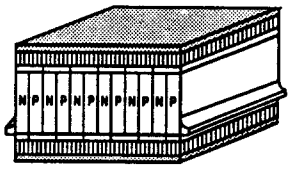
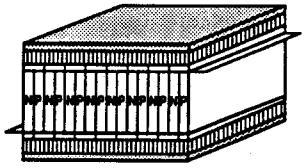


Figure 2.2-14. Thermoelectric Cell Construction Details







	PD-1	PD-2	TA-1
CELL OPERATING TEMPERATURES, °K:	1110/625	1350/875	1350/875
NO. OF COUPLES:	6	6	8
T/E MATERIAL:	SiGe	SiGe	SiGe
ELECTRODE:	SiMo	SiMo	GRAPHITE/TUNGSTEN
STRESS RELIEF:	GRAPHITE BUFFERS + COMPLIANT PAD (0.010 mm, ALL NIOBIUM)	DUAL FACESHEET COMPLIANT PAD (0.010 mm, FILAMENT)	DUAL FACESHEET COMPLIANT PAD (0.005 mm, FILAMENT)
HIGH-VOLTAGE INSULATOR:	SAPPHIRE (0.25 mm)	SAPPHIRE (0.25 mm)	SAPPHIRE (0.13 mm)
LOW-VOLTAGE INSULATOR:	0.18 mm GLASS	0.18 mm GLASS	0.05mm GLASS

Figure 26. TE Cell Evolution

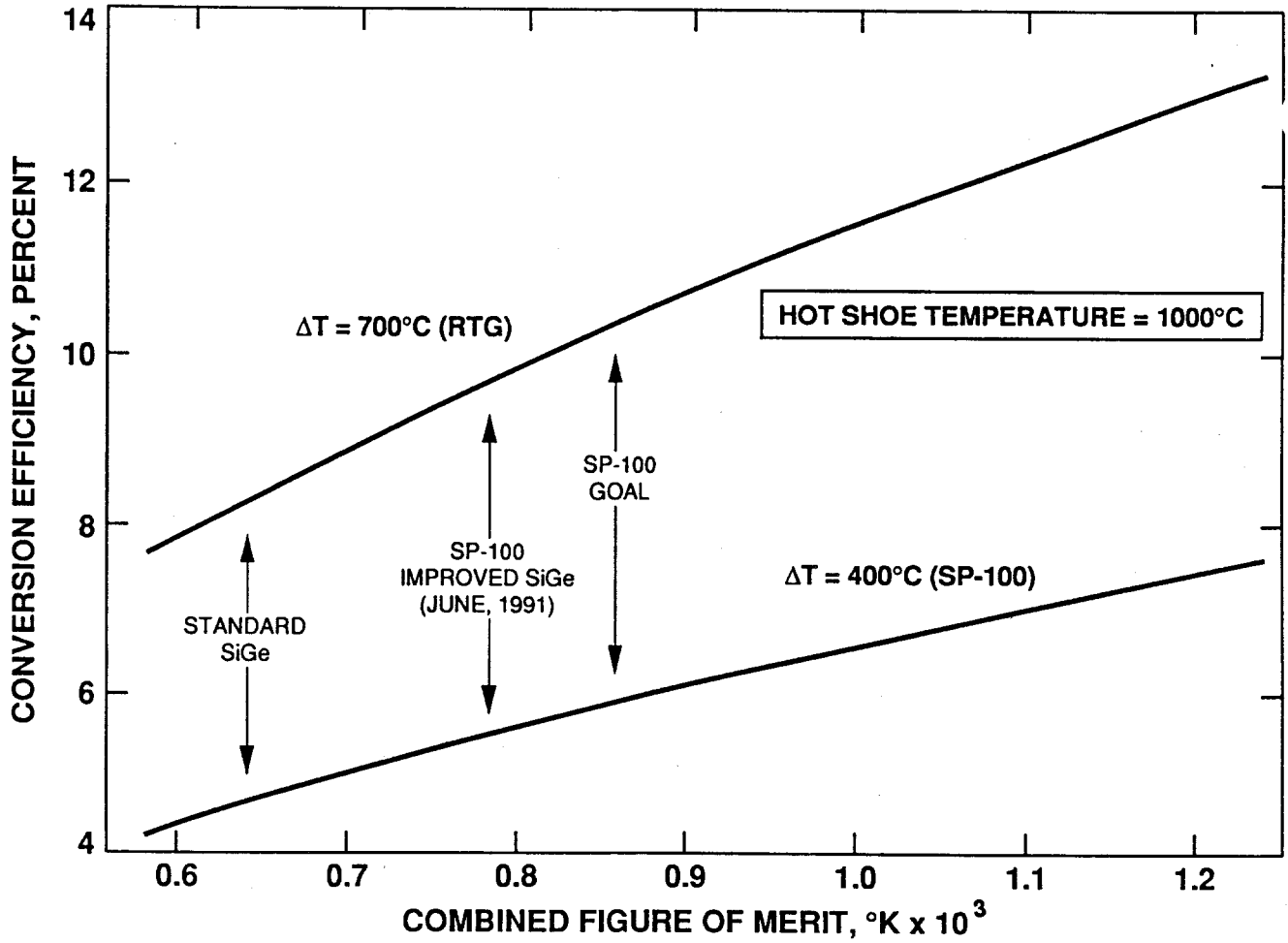
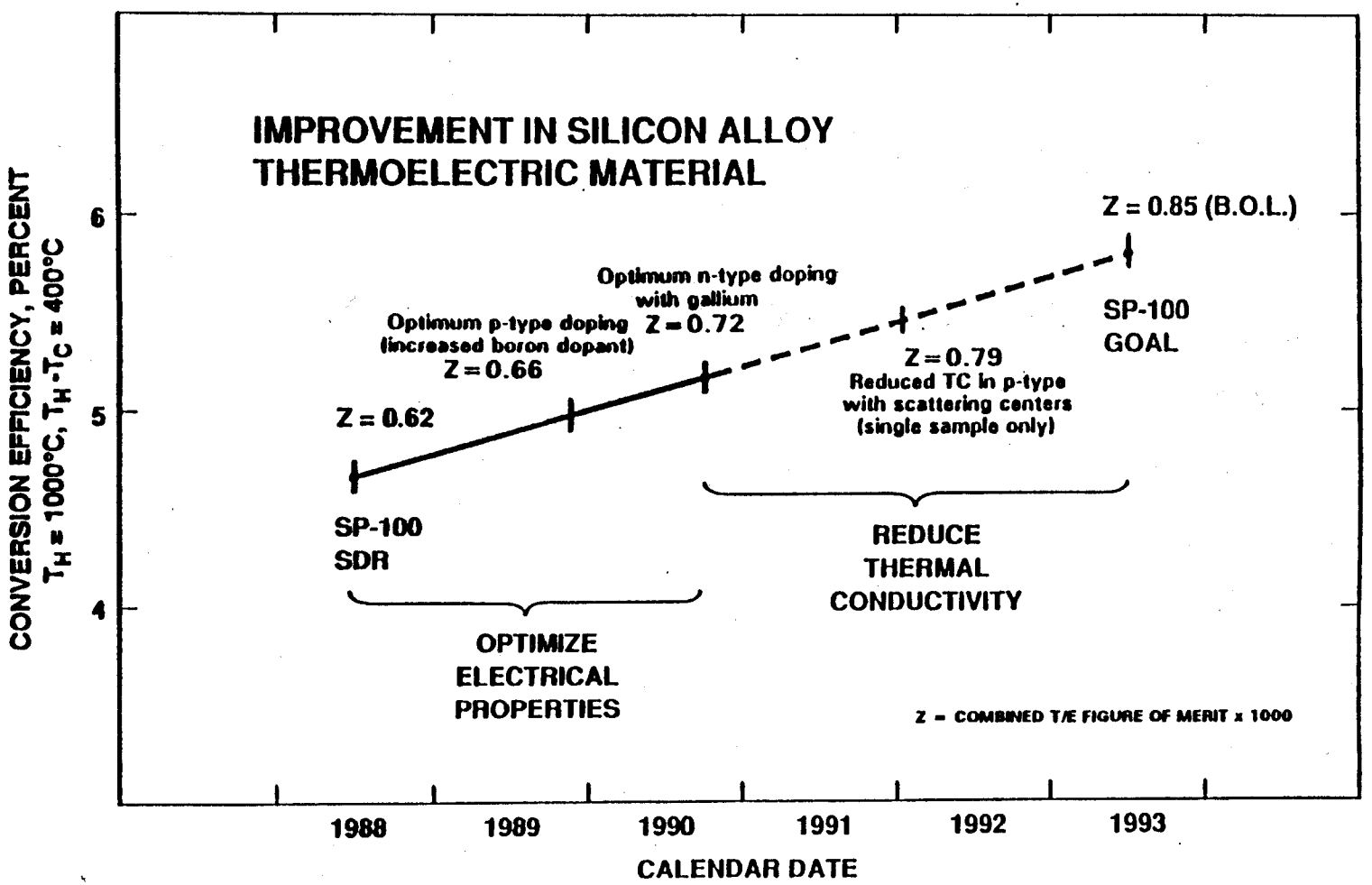


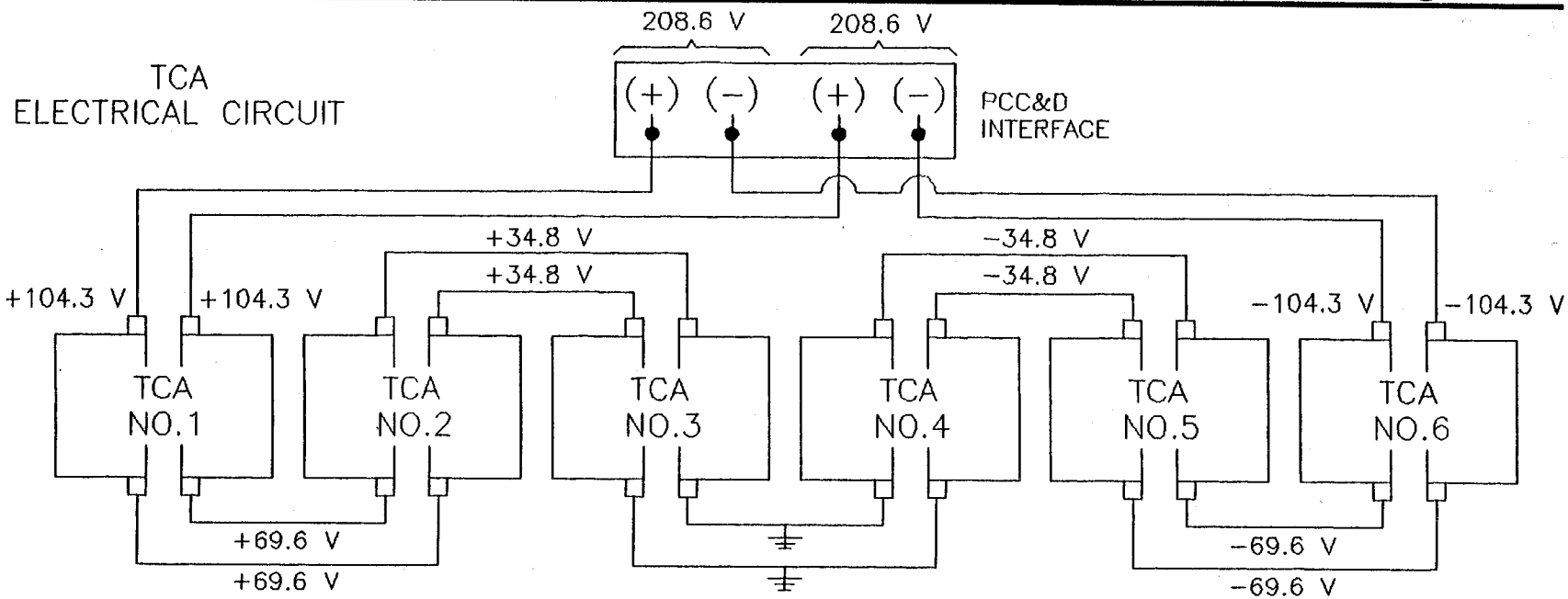
Figure 27. Status of SiGe Efficiency Improvement

Thermoelectric Materials Improvement

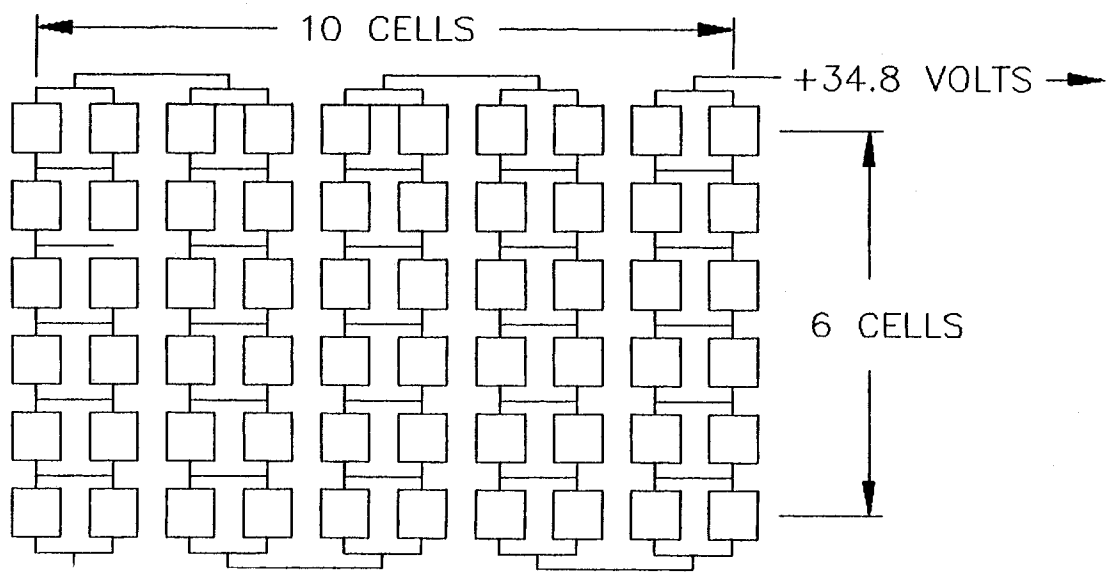


Thermoelectric Converter Assembly (TCA)
Power Conversion Subassembly (PCA) - Electrical Diagrams

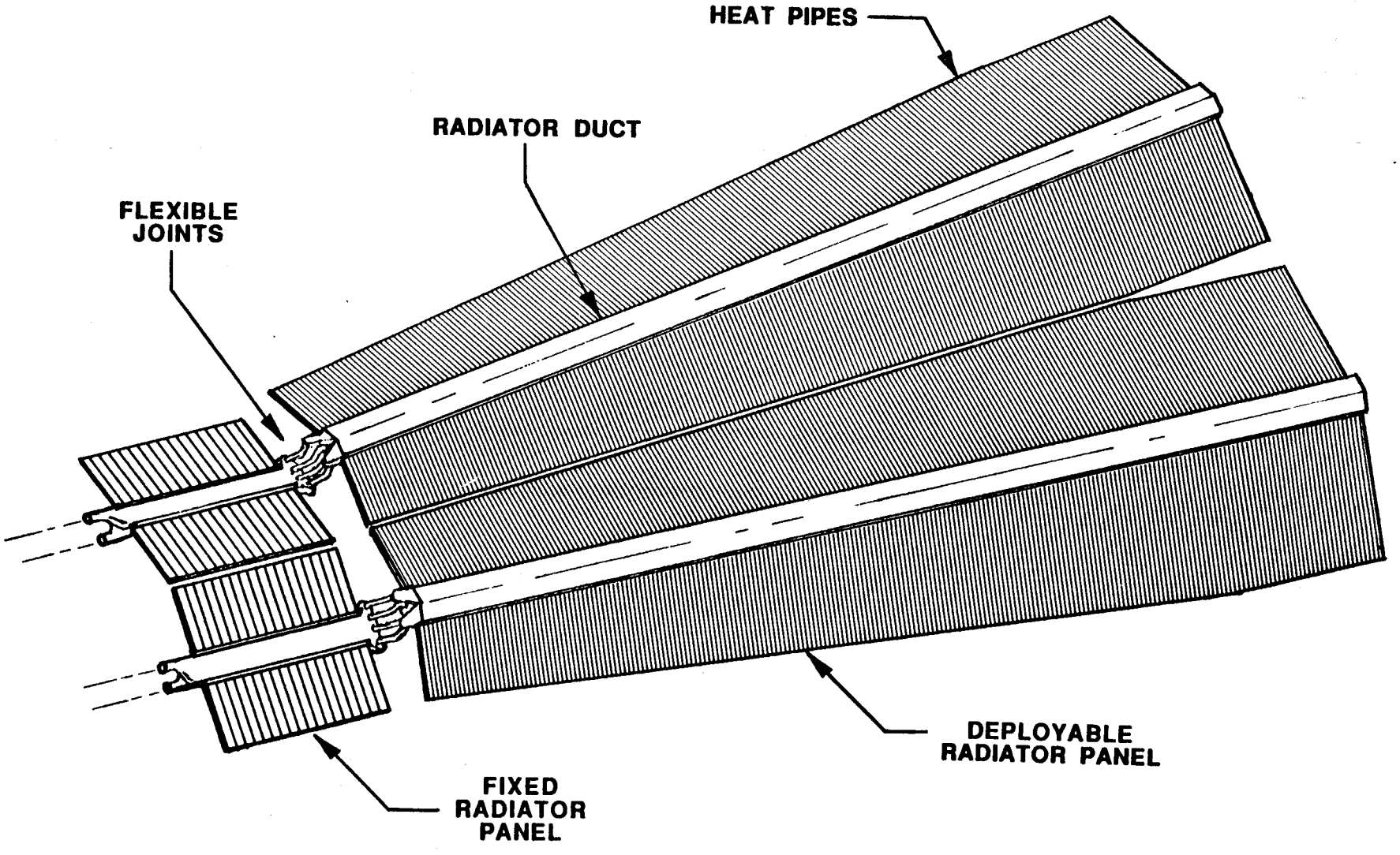
TCA
ELECTRICAL CIRCUIT



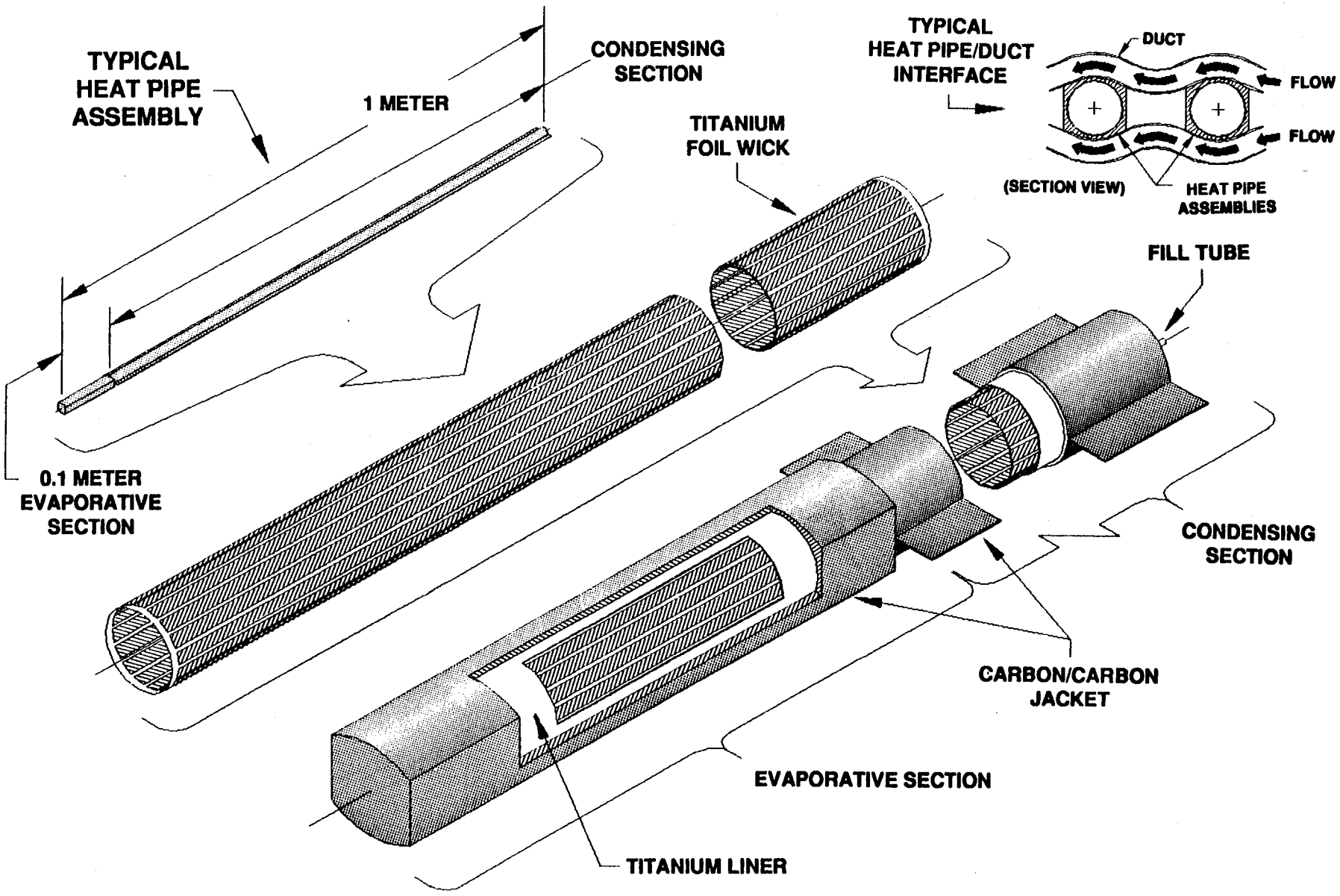
PCA
TE ARRAY
ELECTRICAL CIRCUIT



HRSS Radiator Panels



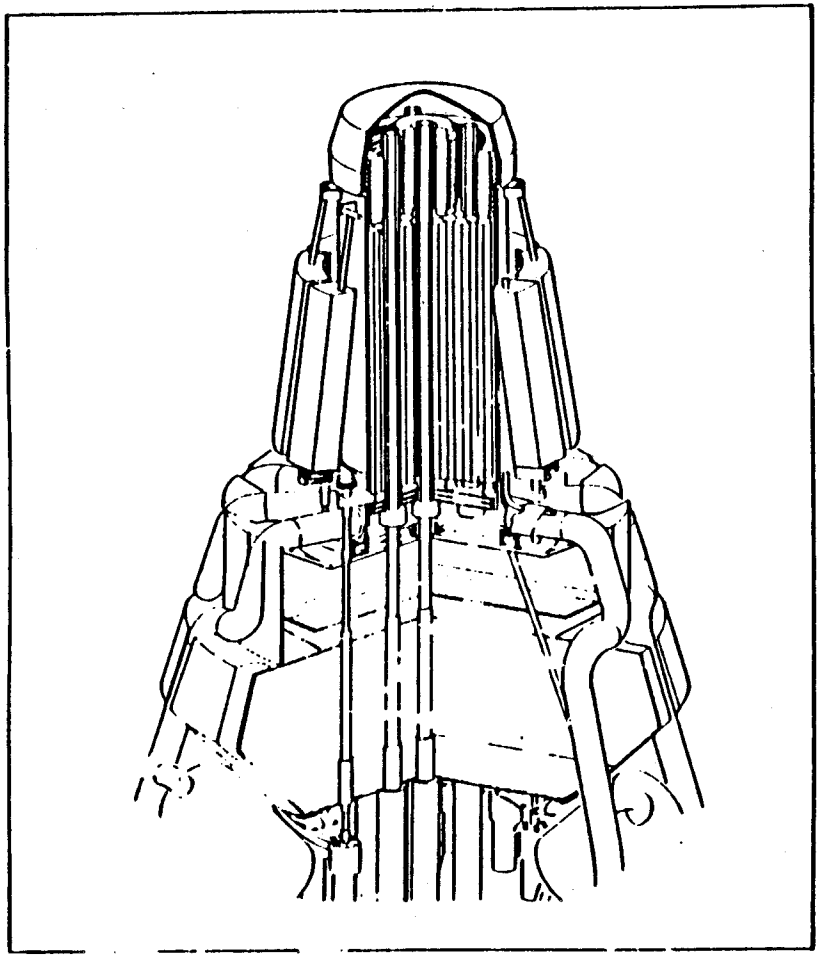
SP-100 Heat Rejection Radiator Heat Pipe



JPL/LOS ALAMOS

COMPARISON OF SP-100 WITH COMMERCIAL REACTORS

SP-100 REACTOR



COMPARISON WITH COMMERCIAL REACTOR

PARAMETER	SP-100	TYPICAL COMMERCIAL REACTOR
POWER OUTPUT (MW_t)	2.5	3500
POWER OUTPUT (KWe)	100	1,000,000
LIFE (YRS)	10	40
NO. OF FUEL PINS	978	64,000
CORE HEIGHT (FT)	1.3	12.5
CORE DIAMETER (FT)	1.1	15.0
FISSION PRODUCTS (C_i)*	12×10^6	17.5×10^9

*CUMULATIVE DURING POWER OPERATION

Lunar Surface Power System Mass Breakdown

Item	100 kWe LSPS Mass (kg)	
Power Assembly	4180	
Reactor	650	
Shield	890	
Primary Heat Transport	310	
Reactor I & C	190	
Power Conversion	440	
Heat Rejection	700	
Cavity Cooling	450	
Power Assembly Enclosure	150	
Structure	400	
LSPS Monitoring and Control	1040	
Operator Assembly	100	(Required for the first unit only)
Fiber Optics Cable	100	
MUX/DEMUX Assemblies	80	
MUX Cabling	40	
Shunt Dissipator	40	
Shunt Cabling	80	
Governor Assembly	600	
LSPS Power Management	1700	
Dc/dc Converter	900	
Power Switchgear	800	
Auxiliary Equipment	300	
Cavity Liner	50	
Cavity Drill	90	(Required for the first unit only)
Shield Blanket	160	
Total	7220	