- **Overview of Baseline**

See System Physical Configuration

1.) Reactor provides thermal energy to Li working fluid at 1375 °K (initially frozen until orbit is achieved)

2.) Lithium is pumped by 3 thermoelectric pumps to thermoelectric conversion devices on 12 panels.

3.) Waste heat is removed by heat pipes filled with Li in Ti tubes surrounded by C-C for protection against meteorites. Rejection temperature = 800 °K

4.) Electrical power is delivered at 200 VDC and 34.8 VDC to load ≈25 m from the reactor.

5.) Core is made up of UN fuel sealed in Re lined Nb-Zr cladding operating with a fast neutron spectrum. It is 37 cm in diameter and 75 cm high.

6.) Core is rendered safe during launch by 3 control rods that are removed only after orbit is achieved.

7.) Operational control is accomplished by 12 sliding reflector Be elements

8.) Total reactor power is ≈ 2,300 kW_{th} that is converted into 100 kW_e.

9.) The shield is a 17° cone made of alternate layers of B_4C, W and LiH.

10.) Each TE assembly (12) has a total of 720 cells located on 6 "plate and frame" assemblies each of which produce 1.5 kW_e.

Table on Generic Flight System Performance/Design Characteristics

And

GFS Design System Requirements and Performance Parameters

11.) System mass goal is (1992) 4000 kg ;

See figure of mass distribution

12.) Beside a reference design, there is a backup and advanced design.

System Physical Configuration

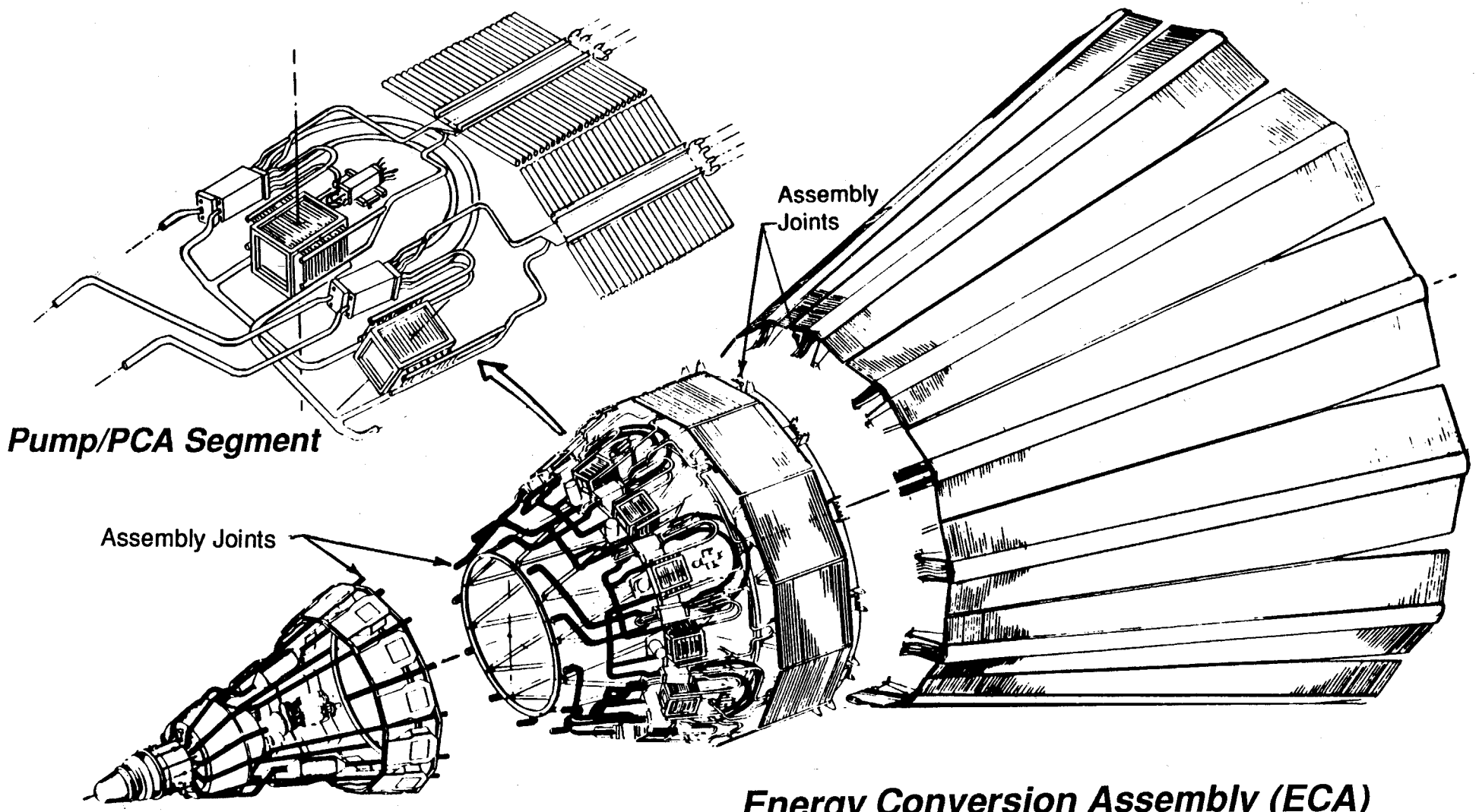


TABLE 2. Generic Flight System Performance/Design Characteristics.

Key System Performance Characteristics	
Rated Electrical Power Output (kWe)	100
BOM Reactor Outlet Temperature(K)	1350
EOM Reactor Outlet Temperature (K)	1375
Reactor Thermal Power Required (kWt)	2400
Average EOM Radiator Temperature (K)	791
Key System Design Characteristics	
Launch Vehicle	Titan IV/Centaur
Shield Half-cone Angle (deg)	17
Separation Distance (m)	22.5
Deployable Boom	Yes
Thermopile Area (m^2)	7.08
Radiator 1-Side Physical Area (m^2)	106
Power Distribution Voltage (Vdc)	200
Number of Thermoelectric Elements	
Power Conversion	8640 Cells
Auxiliary Cooling and Thaw (ACT)	180 Cells
Thaw Provisions	NaK Tracelines
Mass by Subsystem (kg)	
Reactor	700
Shield	960
Heat Transport (Includes thaw battery, if required)	520
Reactor Instrumentation and Control (I&C)	320
Power Conversion	450
Heat Rejection	1040
Power Conditioning, Control and Distribution (PCC&D)	390
Mechanical/Structural	220
Total	4600
System Power-to-Mass Ratio (W/kg)	21.7

TABLE 3. Generic Flight System Design Features.

Reactor Design Features	
Auxiliary Cooling Loop	Yes
Reentry Shield	Yes
Reactor Structural Material	PWC-11
Fuel	UN
Safety Rods	In-core
Control Elements	Peripheral Sliding
Shield Subsystem Design Features	
Neutron Shield Material	LiH/B_4C
Gamma Shield Material	U238
Primary Heat Transport Subsystem Design Features	
Number of Primary Loops	6
Pump Type	TEM
TEM Pump Thermoelectric Material	SiGe/GaP
Reactor I&C Subsystem Design Features	
Signal/Control Multiplexers	Yes
Power Conversion Subsystem Design Features	
Thermoelectric Material	SiGe/GaP (BOM Z = 0.86 E-3/K)
Thermoelectric Cell Type	Conductively Coupled
Heat Rejection Subsystem Design Features	
Number of Secondary Loops	12
Radiator Type	12 Deployable Panels C-C/Ti Heat Pipes
Secondary Piping/Radiator Duct Material	Titanium

GFS design major system requirements

Major Parameter	Value
System mass goal (kg)	4000
Stowed length goal (M)	6.0
System power level (kWe)	100
Housekeeping power (We)	300
Orbit life (yrs/yrs full power)	10/7
Orbit altitude (KM)	≥1100
Launch vehicle	Titan IV
Safety	No accidental criticality
Radiation dose to user plane (neutron)	10^{13} N/cm^2
Radiation dose to user plane (gamma)	5 x 10^5 RAD
Radiation dose to user plane (diameter)	4.5 M

GFS design performance parameters

Parameters	Value
Reactor power (MWT)	2.3
Peak react. outlet temp EOL (K)	1375
HT loop ΔT (K)	92
HT loop mass flow (KG/S)	5.9
Peak rad. inlet temp (K)	840
HR loop ΔT (K)	48
HR loop mass flow (KG/S)	10.4
Avg. rad surf. temp (K)	790
Rad black body area (M^2)	94
Rad physical area (M^2)	104
PC thermopile area (M^2)	5.5
T/E leg length (cm)	0.55
Gross power generated (kWe)	105.3

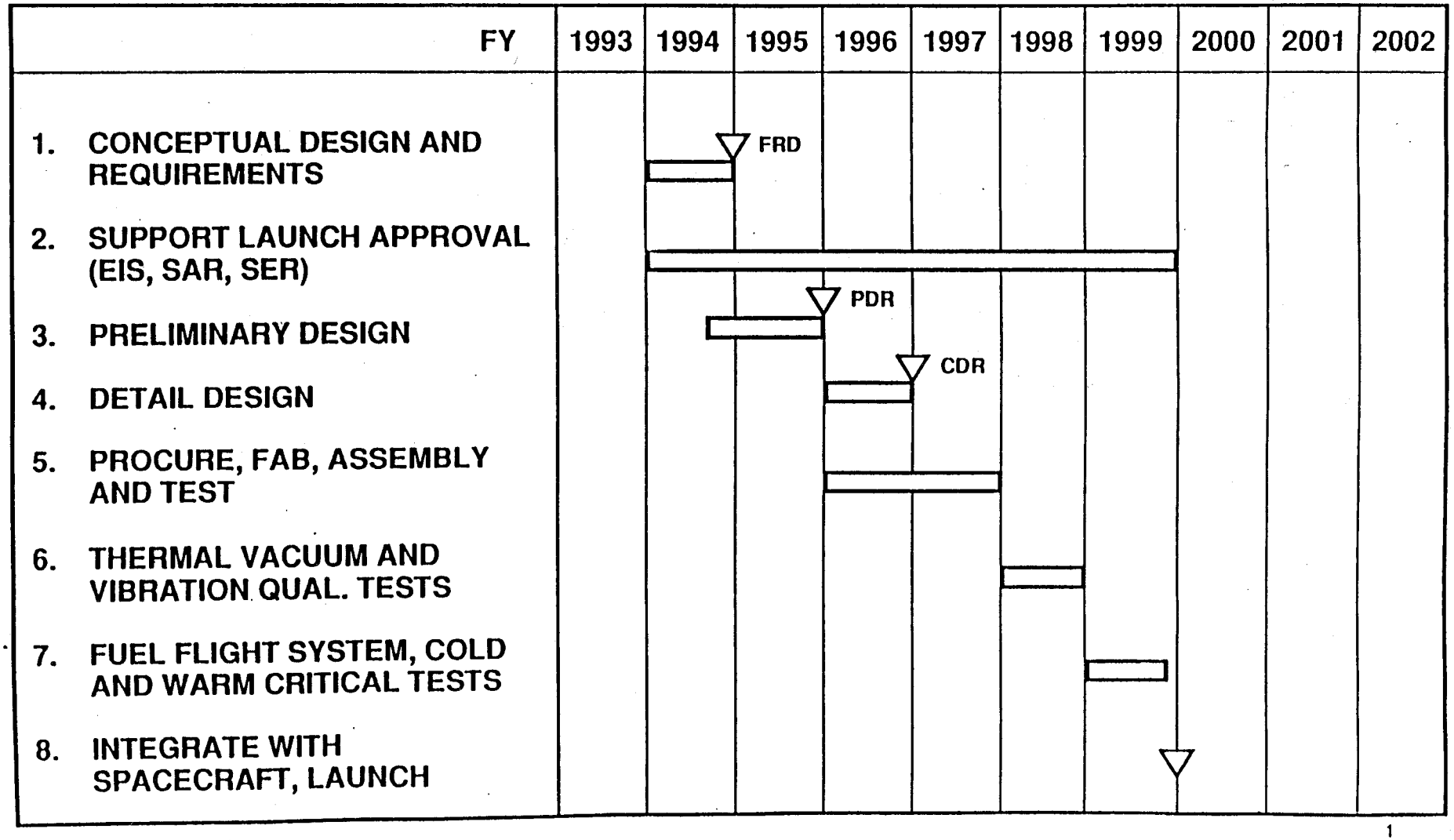
What Was Left on the Table?

- *Early Mission Schedule*
- *Space Propulsion*
- *Surface Power*

JPL

Los Alamos

EARLY MISSION SCHEDULE



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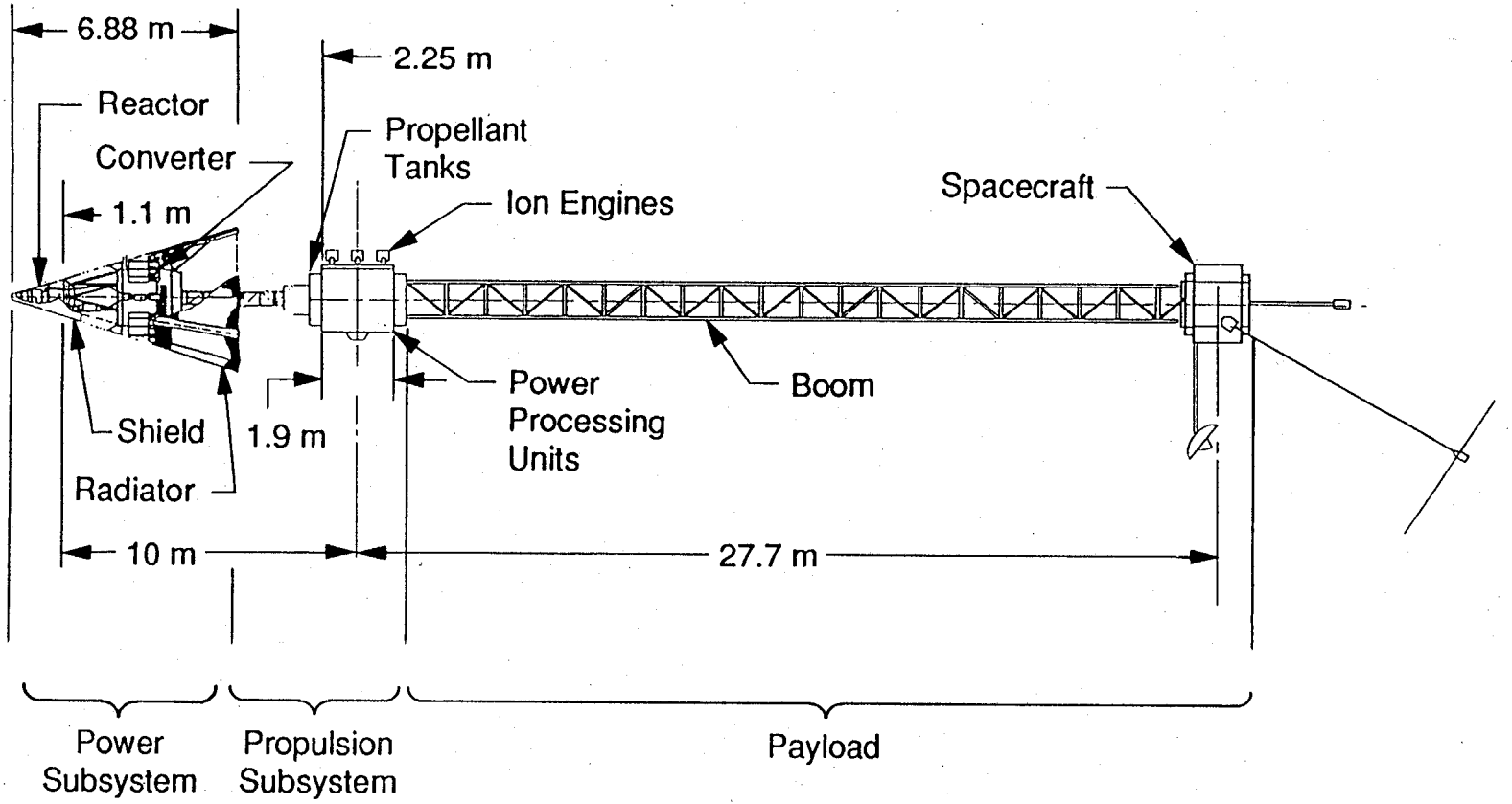
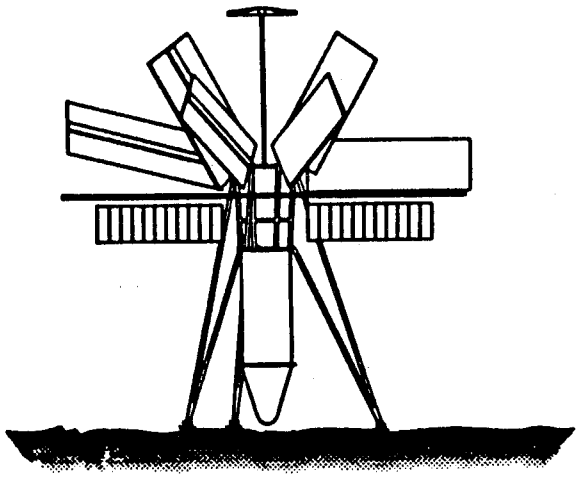
FRD = Functional Requirements Defined

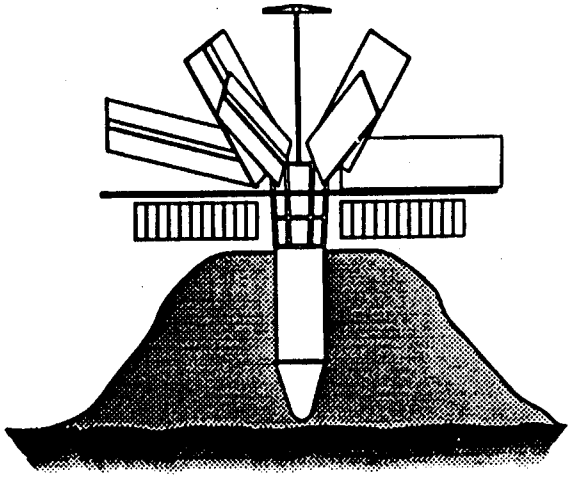
20-kWe NEP SIDE THRUST SPACECRAFT



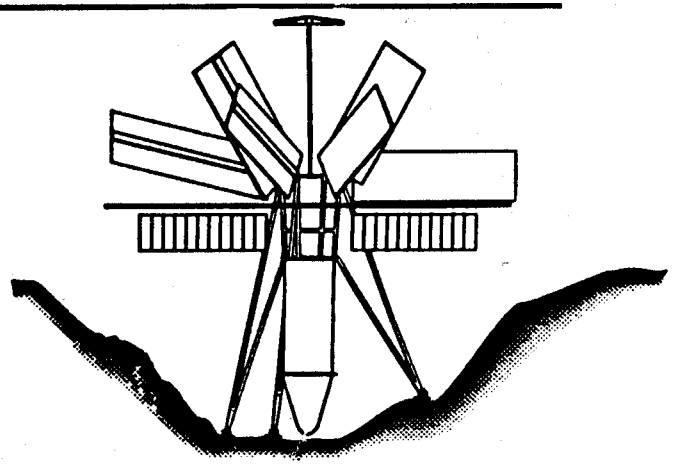
Potential Emplacement Concepts



CASE 1 – LEVEL SURFACE MOUNT



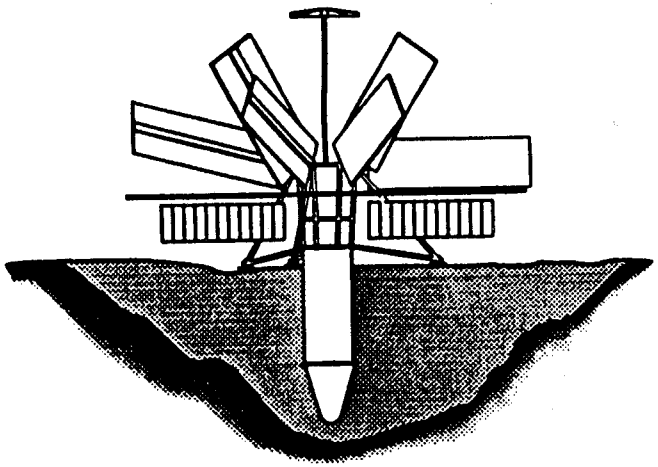
CASE 2 – LEVEL SURFACE MOUNT WITH BERM



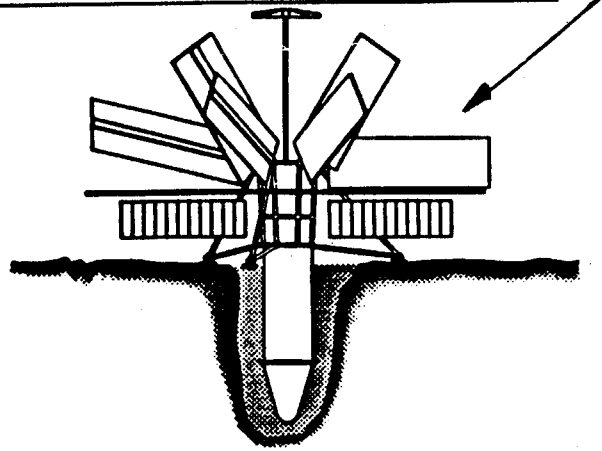
CASE 3 – NATURAL CRATER SURFACE MOUNT

Adaptable to the First Lunar Outpost requiring delivery on a one-way cargo mission and self-deployment

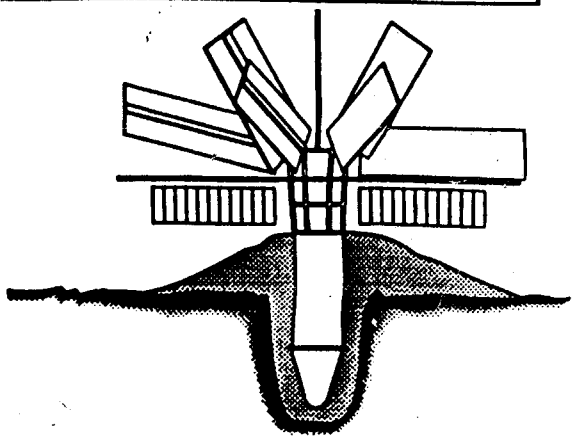
Selected for multi-hundred kW installation meeting NASA 90-Day Study requirements



CASE 4 – CAVITY (FILLED-IN CRATER)



CASE 5 – CAVITY (EXCAVATED)



CASE 6 – PARTIAL CAVITY WITH BERM