APPENDIX B

PROMETHEUS-H BASELINE PARAMETER LIST

PARAMETER CATEGORY	PAGE NO
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PROMETHEUS-H BASELINE PARAMETER LIST

GENERAL PLANT PARAMETERS	VALUE
Net Electric Power (MWe)	999
Gross Electric Power (MWe)	1189
Recirculation Power (MWe)	190
Driver Power (MWe)	137
Auxiliary Power (MWe)	28
Cavity Pumping Power (MWe)	25
Total Thermal Cycle Power (MWt)	2780
Net Thermal Power (MWt)	2759
Blanket (MWt)	1597
First Wall (MWt)	1162
Usable Driver Waste Heat	NA
Usable Pumping Waste Heat	21
Thermal Conversion Efficiency (%)	42.7
Recirculating Power Fraction (%)	16
Net System Efficiency (%)	36
Net Thermal Power (MWt) ((1.14x1818)+725-38)	2759
Fusion Power (MW)	2543
Surface Heating Power	725
Neutron Power	1818
Energy Multiplication Ratio	1.14
Power Loss to Shield	-38

REACTOR CAVITY	VALUE
Cavity Radius (m)	4.5
Cavity Cylinder Height (m)	4.5
Total Cavity Height (m)	13.5
FW Surface Area (m^2)	382
Volume (m^3)	668
Total Target Yield (MJ)	719
X-ray (MJ)	46
Debris (MJ)	159
Neutron (MJ)	514
Power	
Surface Heating (MW)	725
Neutrons (MW)	1818
Neutron Source Strength (n/sec)	8.82×10^{20}
FW/Blanket/Shield Characteristic	
TBR	1.2
Power Multiplication	1.14
Nuclear Power (MW) (1818x1.14)	2073

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REACTOR CAVITY (Cont)		VALUE
Nuclear Power Distribution	%	MW
First Wall (+Surface Heatg)	21.1	1162
Blanket/Reflector/Plenum	77.1	1598
Vacuum Vessel	0.4	8.3
Shield (concrete)	1.4	29
First Wall System		
Structural Material		SiC
Coolant Channel Wall Thickness (mm)		5.0
Coolant Channel Diameter (cm)		5.0
Mean Fiber Pore Diameter (μm)		50.0
Porosity (%)		10.0
Permeability (m^2)		1.76×10^{-14}
Coolant Media		Liquid Lead
Surface Protection Media		Liq Lead Film
Surface Film Thickness (mm)		0.4-0.6
Inlet Temperature (°C)		375
Outlet Temperature (°C)		525
Delta-T(bulk) (°C)		150
Mass Flow Rate (kg/s)		54,422
Volume Flow Rate (kg/s)		5.21
Coolant Flow Area(cylindrical chamber)		1.1775 (m^2)
Average Velocity (m/s)		4.42
Reynolds Number		1.12×10^6
Frictional Factor		0.02
Coolant Path Length (m)		12.34
Frictional Pressure Drop (MPa)		0.5
Inlet Pressure (top)(MPa)		1.0
Outlet Pressure (bottom)(MPa)		1.5
Pumping Power (85% efficiency)(MW)		3.0
Maximum SiC Temperature (°C)		775
No. Liq Lead Steam Generators		6
No. Liq Lead Pumps		6
Blanket System		
Structural Material		SiC
SiC Min Temperature (°C)		400
SiC Max Temperature (°C)		765
Coolant Media		Helium
Helium Inlet Temperature (°C)		400
Helium Outlet Temperature (°C)		650
Helium Velocity (m/s)		42
Helium Inlet Pressure (MPa)		1.5
Pressure Drop (kPa)		19
Neutron Multiplier		FW Liq Lead Coolant
Breeder Material		Li_2O
Li_20 Min Temperature (°C)		422

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REACTOR CAVITY (Cont)	VALUE
Blanket System (Cont)	
Li_2O Max Temperature (°C)	765
Li_2O Theoretical Density Fraction	0.8
Li_2O Density (kg/m^3)	2.01×10^3
Beeder Volume (m^3)	75
Avg Annual Li Burnup (%)	0.6
Peak-to-Average Burnup (%)	3
Tritium Inventory (g)	100
Tritium Generation Rate (g/day)	362
BET Surface Area (m^2/kg)	50
Grain Radius (µm)	10
Grain Diffusion Coefficient:	
Pre-exponential Factor (m^2/s)	6.81×10^{-7}
Activation energy (kJ/mol)	84.8
Purge Composition	He + 0.2%H2
Amount of Protium in Purge (%)	0.2
Helium Purge Pressure (MPa)	0.2
No. Helium Steam Generators	6
No. Helium Reheaters	6
No. Helium Recirculators	6
Vacuum System	
Cavity Pressure @0 °C (mtorr,Pb)	100
Background Gas Density (cm^{-3})	3.5×10^{15}
No. Vacuum Pumping Ports	4
No. Vacuum Pumps/Port	3
Vacuum Pump Type	Roots Blower
Vacuum Pumping Port Diameter (m)	1
Vacuum Vessel Material	Ferretic Steel
Cavity Exhaust (total)	110.6 mg/s .... 48,056 l/s

	mg/s	l/s
Hydrogen (total-all forms)	104.6	47,308
Helium	6.0	748

DRIVER SYSTEM	VALUE
Driver Type	Single Heavy Ion Beam LINAC
Target Illumination Scheme	Indirect Drive, Two Sided
Number of Beams..(12 main + 2 prepulse)	18
Repetition Rate (pps)	3.54
Driver Output Energy (MJ).....(7.0 delivered to target)	7.8
Ion Accelerated	Lead
Charge State	+2
Final Energy (GeV)	4.0
Driver Power (MWe)	137

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PARAMETER SUMMARY SINGLE-BEAM, MASCHKE SCALING
(alpha = 0.2, beta = -0.15, gamma = 0.8

		Injection	Ramped to Fixed Transition	Final Transport	Main Beam Buncher	Main Beam Final Focus	Prepulse Beam Buncher	Prepulse Beam Final Focus
Beam Voltage	MV	3	49.73	2000	2000	2000	2000	2000
Beam Radius	cm	9.39	9.39	9.39	9.94	15.02	10.50	14.94
Lattice Period	m	0.5	1.33	4.85	4.67	3.55	4.50	3.56
Pulse Length	ns	15495.0	1639.0	85.3	70.5	17.8	176.4	54.4
Bunch Length	m	36.54	15.74	5.13	4.24	1.07	10.61	3.27
Beamlet Current	A	14	132	2532	3065	12125	3674	11915
Packing Fraction	%	69.0	39.3	18.8	21.5	56.2	24.4	55.5
Magnet Length	m	0.344	0.523	0.911	1.00	1.99	1.10	1.98
Magnet Bore Rad	cm	15.51	15.51	15.51	16.43	24.81	17.34	24.68
Magnet a/L Ratio		0.273	0.179	0.103	0.099	0.075	0.096	0.076
Core Inner Radius	cm	43.0	43.0	43.0	155.44	0	68.0	0
Core Thickness	cm	36.9	150.2	7.8	6.46	0	16.2	0
Depressed Tune	Deg	8	5.25	3.02	2.59	0.86	2.24	0.87

		Ramped Gradient	Fixed Gradient	Storage Rings	Main Beam Buncher	Main Beam Final Transport	Prepulse Beam Buncher	Prepulse Beam Final Transport
Number Beams		1	1	14	6	6	1	1
Section Lengths	m	222.5	1953.9	157.3	84.5	180.0	195.6	180.0
Tunnel Widths	m	9.8	9.7	8.1	8.1	8.1	8.1	8.1
Core Volume	m^3	906.0	1628.6	0	60.4	0	193.0	0
Pulser Energy	MJ	0.13	1.9	0	0.49	0	0.59	0
Number Quadrupoles		300	578	34	18	39	41	37
Quad Lengths	cm	40.1	77.0	91.1	94.0	133.4	96.6	141.1
Number Dipoles		0	0	32	0	19	0	20
Dipole Lengths	cm	0	0	239.6	0	229.8	0	215.5
Magnet Powers	MW	0.9	1.734	0.198	0.054	0.348	0.123	0.342
Driver Efficiency	%	70.6	85.0	34.4	20.6			
Z_{ion}		2	A_{ion}	207	E_{ion}	4		
B_{pole}		1.97	N_{beams}	18	$Emit_n$	9.8		
α_s		0.20	β_s	-0.15	γ_s	0.80		
β_F		0.20	f_{Bunch}	2.1%	τ_{TGT}	7.28		
Len_{STND}		30	f_{Bunpp}	4.9%	τ_{PRE}	30		

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TARGET		VALUES
Target Type		Hohlraum
Target Illumination Scheme		Indirect Drive, Two Sided
Driver Output Energy (MJ)		7.8
Final Beam Transport Efficiency.(%)		90
Target Gain		103
Target Yield (MJ)		719
Neutron Energy (MJ)	514	
Debris Energy (MJ)	159	
X-ray Energy (MJ)	46	
Fusion Power (MW)		2543
Neutron Power (MW)	1818	
Surface Heating Power (MW)	725	
Repetition Rate (pps)		3.54
Fuel Burnup Fraction		32%
Tritium Throughput (g/day)		1248

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