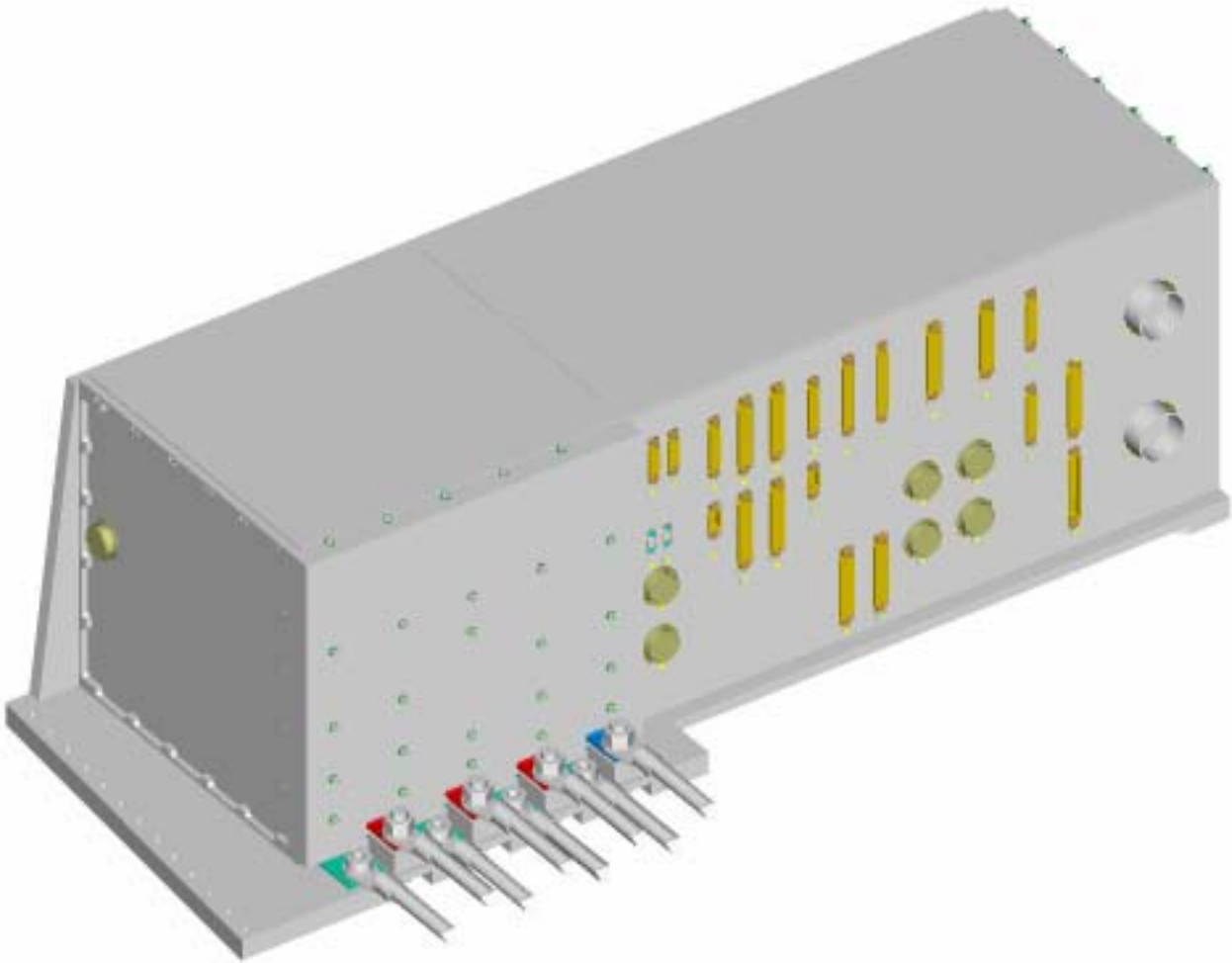
AMS-2 THERMAL CDR

CAB THERMAL ANALYSIS

prepared by J.Vallega

CAB THERMAL ANALYSIS



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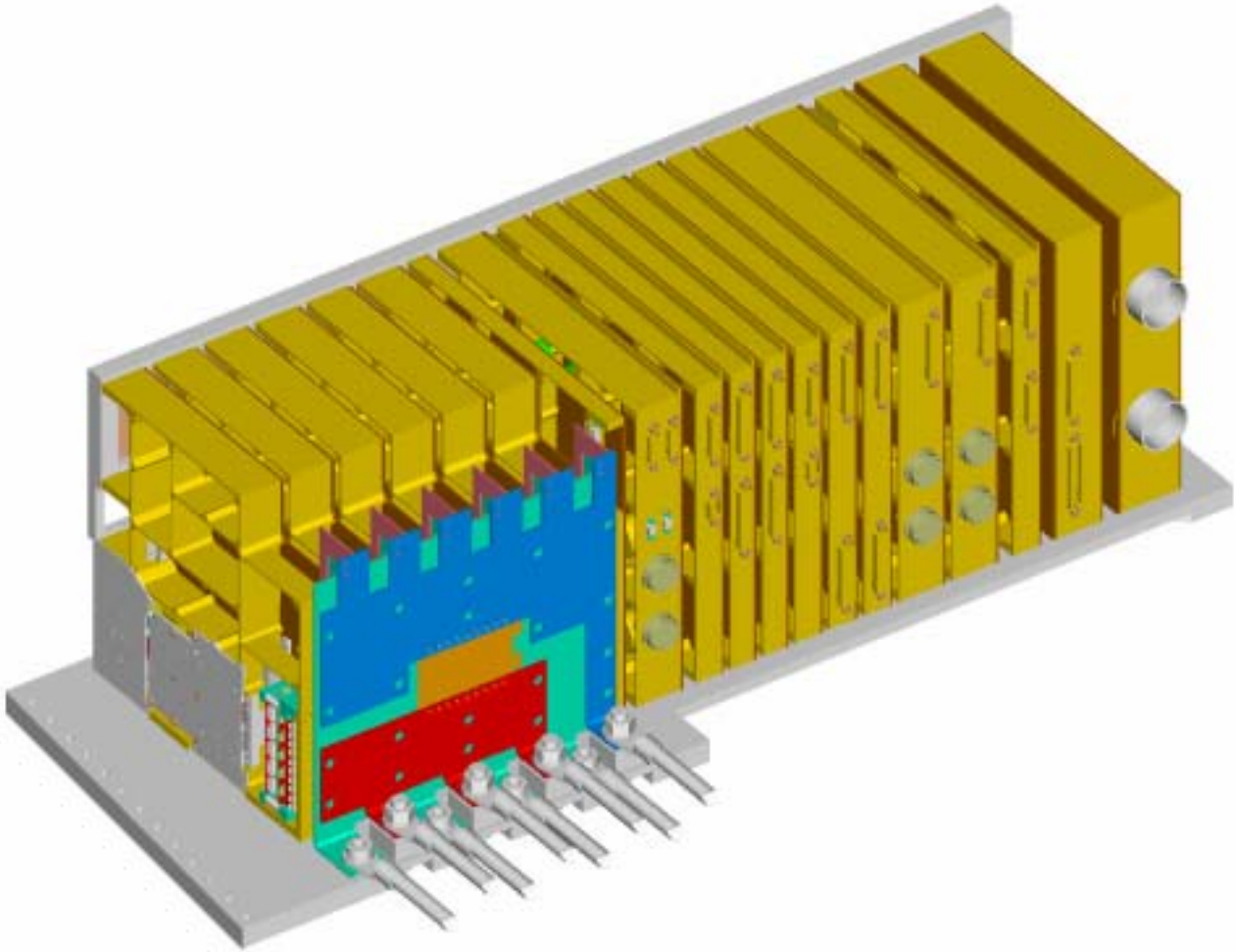

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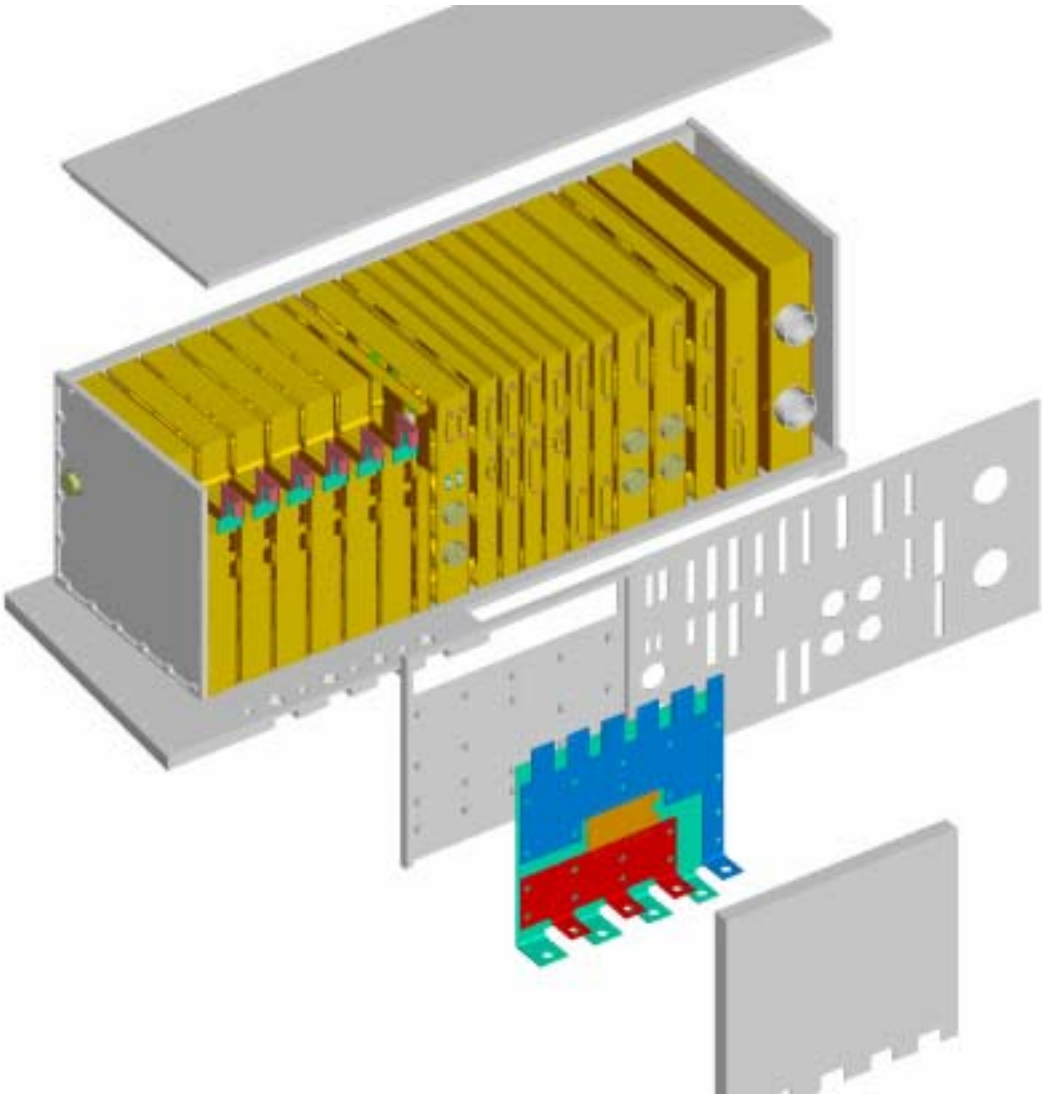
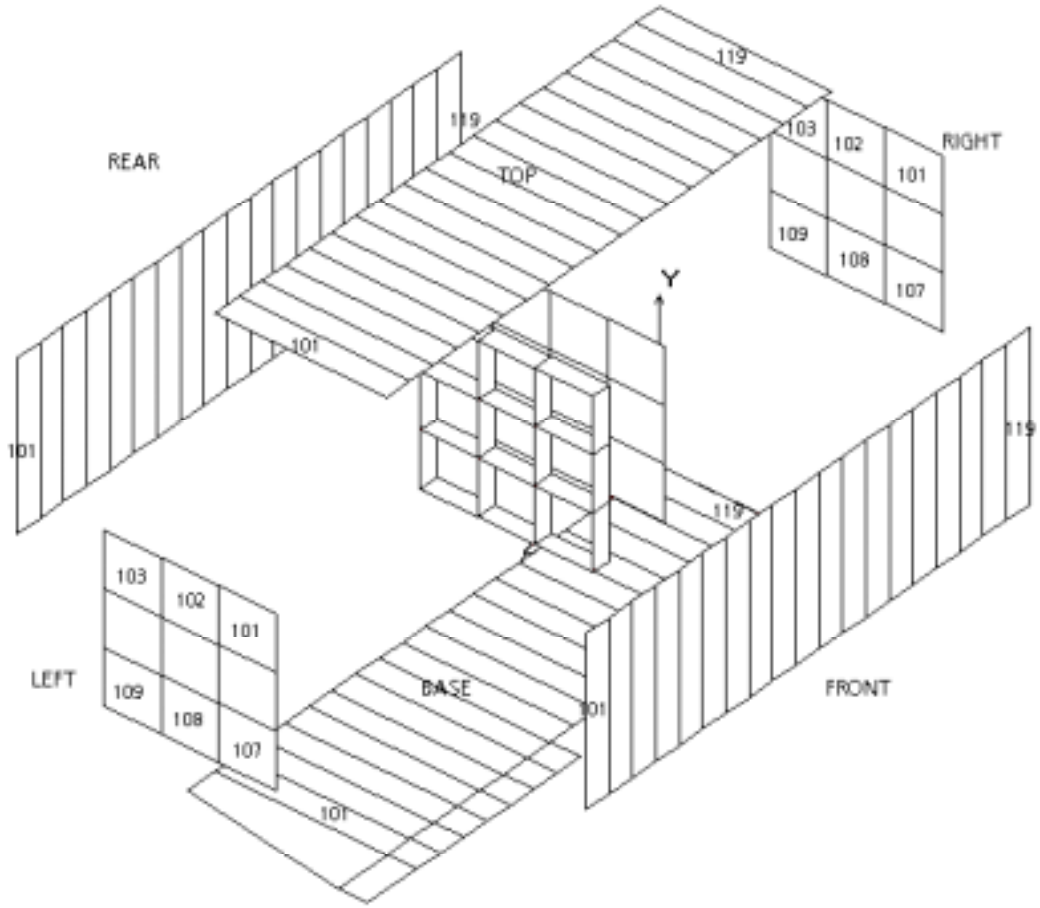


THERMAL MATHEMATICAL MODEL MESHING

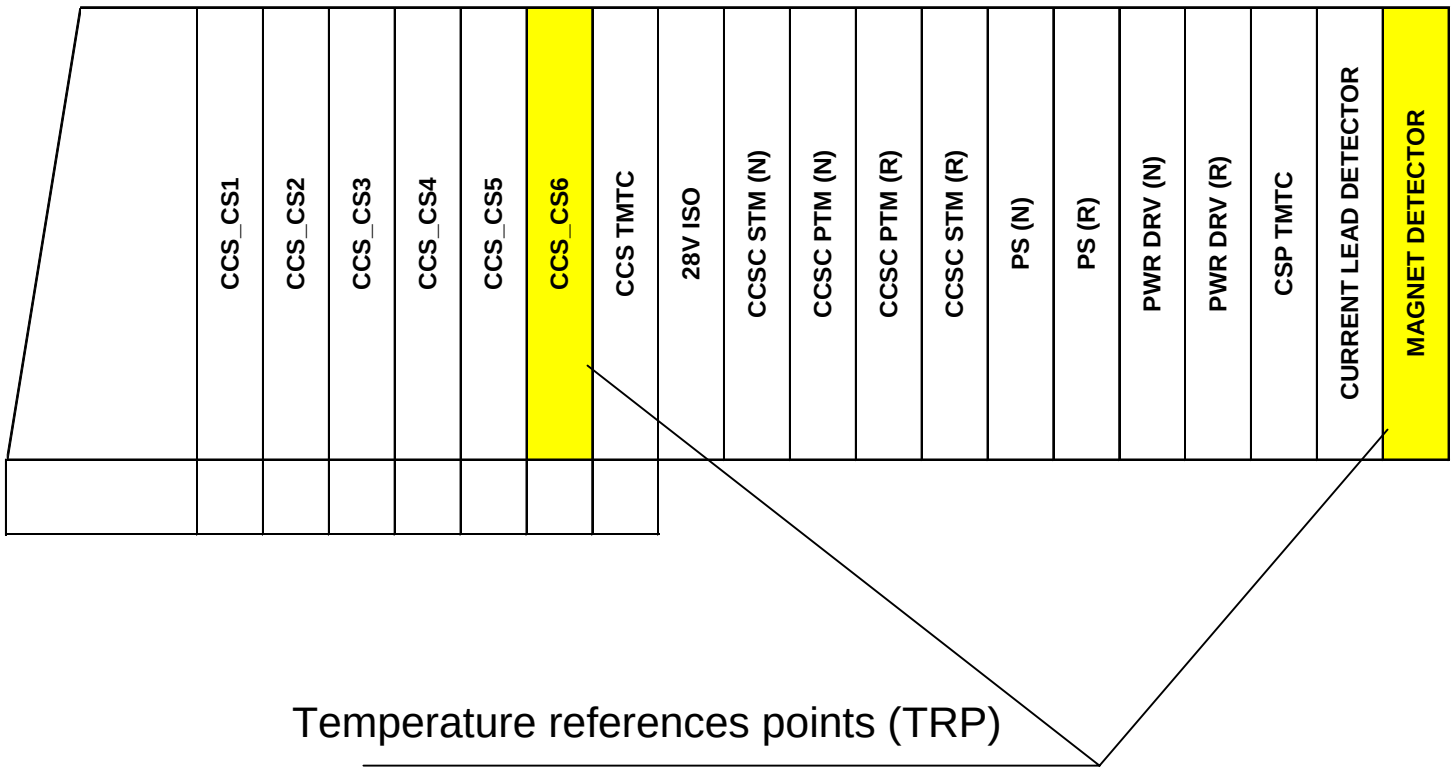


DESIGN TARGETS

1) KEEP THE BASE PLATE TEMPERATURE IN ALL OPERATING CONDITIONS BELOW 50ºC

2) KEEP ANY CAB POINT IN NON OPERATING CONDITIONS ABOVE -30ºC

CAB BASE PLATE DISCRETIZATION



BOUNDARY CONTIDIONS (1)

HEAT SINKS

USS UPPER TRUNION - CONDUCTIVE

OUTER SPACE (WAKE DIR) - RADIATIVE

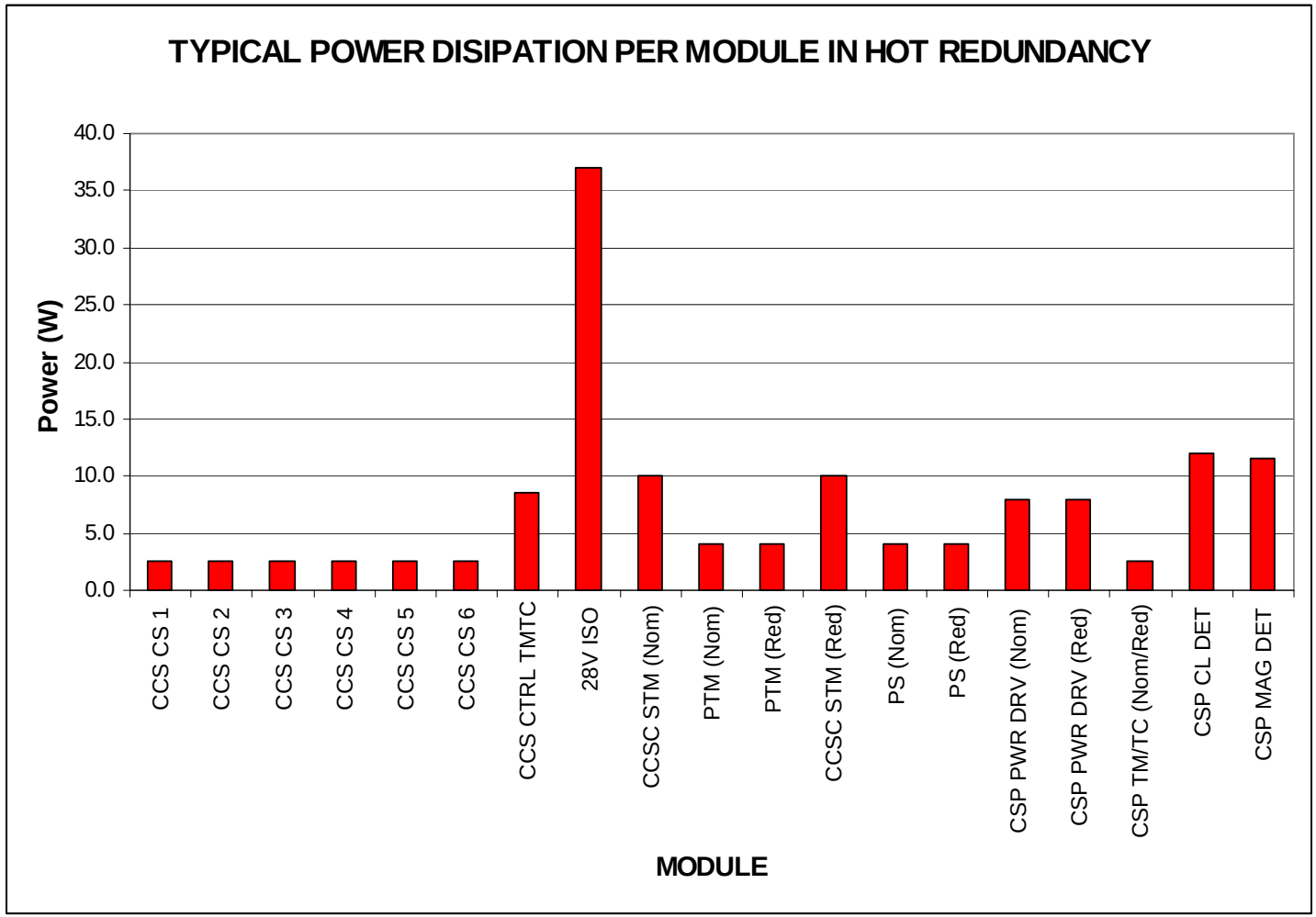
MAGNET - CONDUCTIVE

BOUNDARY CONDITIONS (2)

HEAT SINKS TEMPERATURES (ºC)

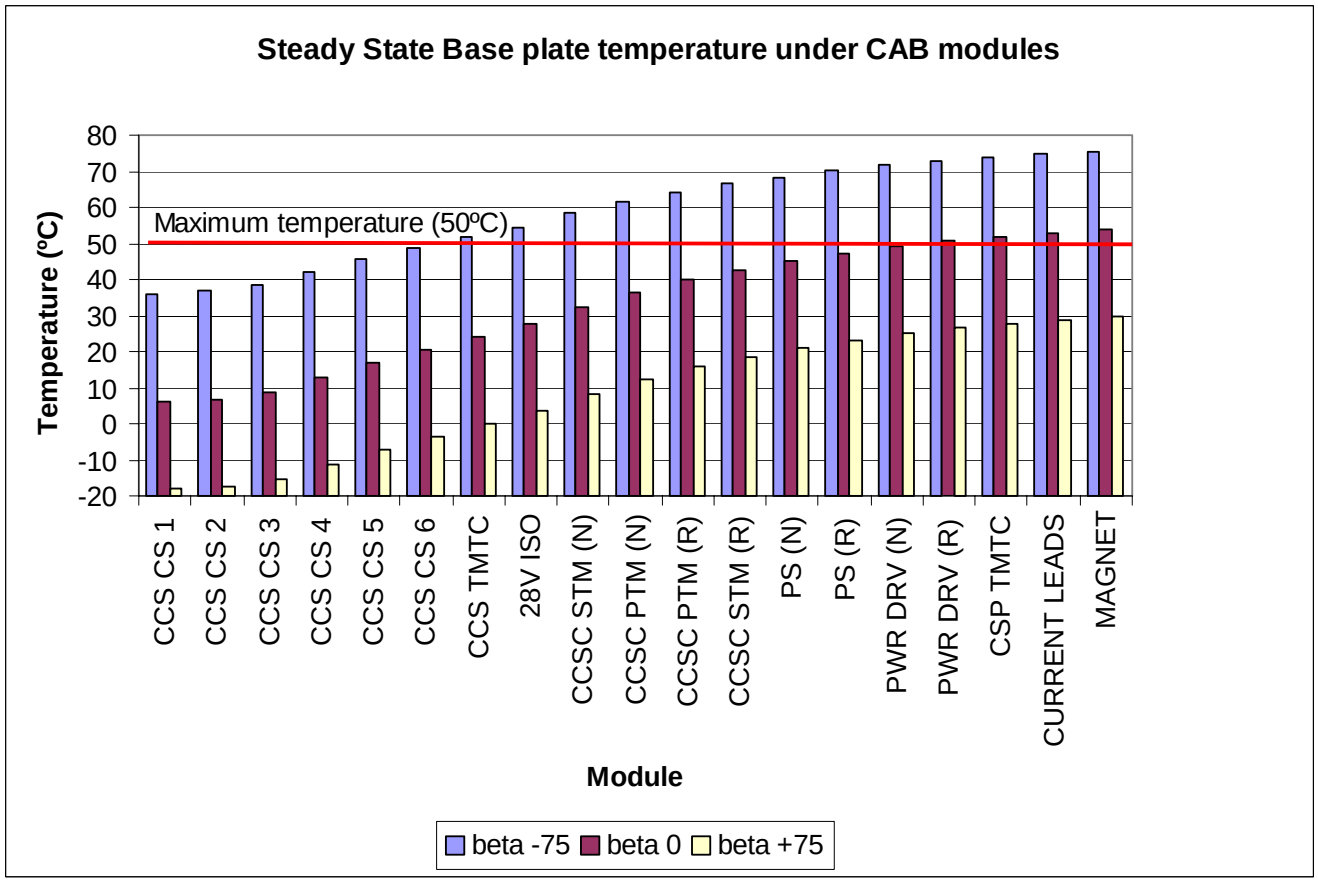
		TEMPERATURES (ºC)			
		UPPER TRUNION	WAKE	MAGNET WHEN NO CHARGING	MAGNET IN RAMP UP
ENVIRONMENT	HOT beta-75	34.7	-29.5	25	-143
	HOT beta 0	4.2	-50.6	-25	-143
	COLD beta +75	-19.9	-71.6	-33	-143

CAB THERMAL ANALYSIS



Sensitivity to environment

CAB baseplate temperature vs design target



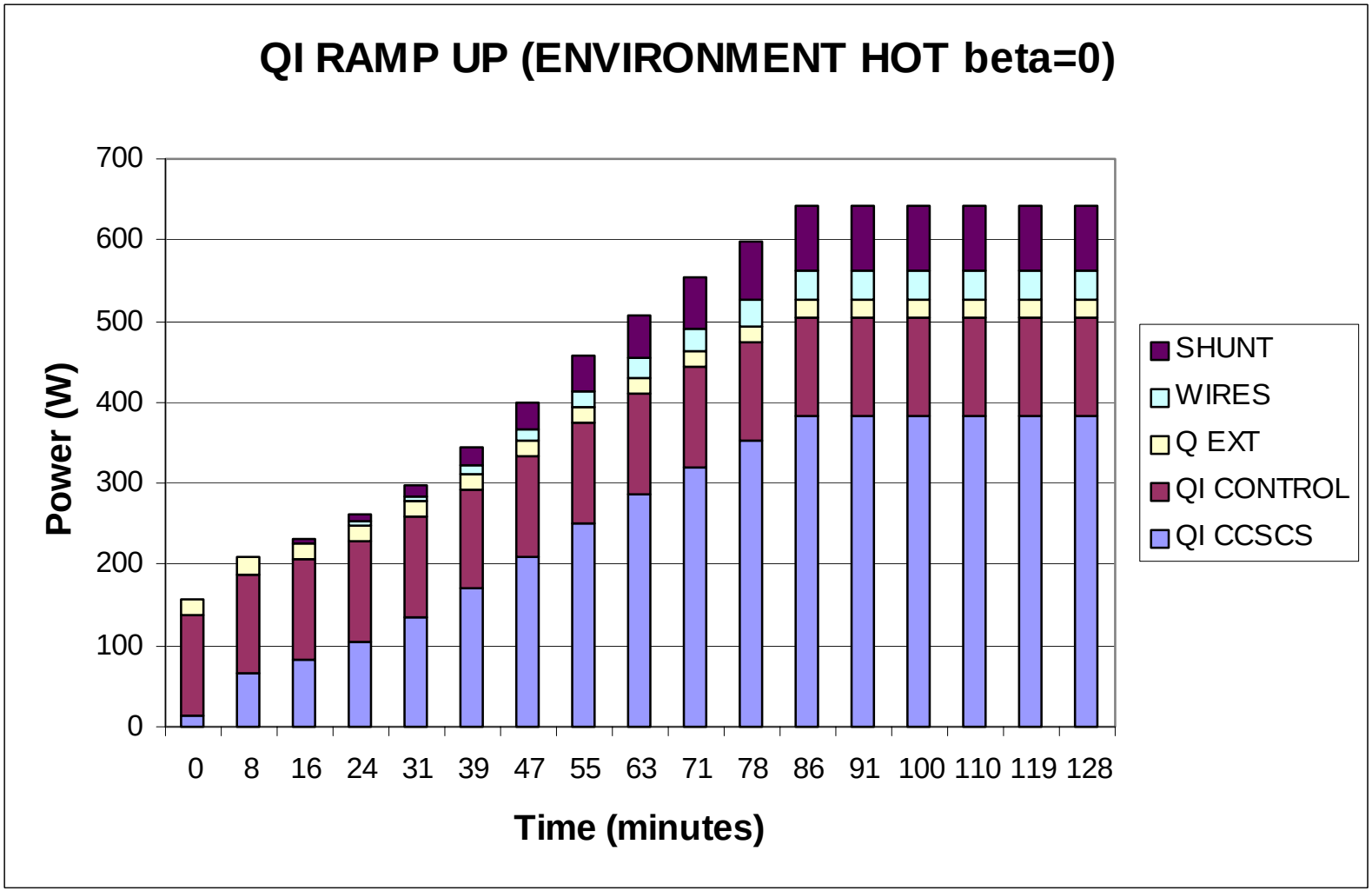
FEASIBILITY TABLE POWER vs ENVIRONMENT TEMPERATURE (STEADY STATE)

POWER CONDITION	TOTAL CAB POWER (W)	ENVIRONMENT		
		HOT beta-75	HOT beta 0	COLD beta +75
TYPICAL COLD REDUNDANCY	99.7	NO	YES	YES
MAXIMUM COLD REDUNDANCY	114	NO	YES	YES
TYPICAL HOT REDUNDANCY	120.7	NO	YES	YES
MAXIMUM HOT REDUNDANCY	138.5	NO	NO	YES

OUT OF TEMPERATURE RANGE (ABOVE 60ºC)
BETWEEN 50ºC AND 60ºC (VALID ONLY FOR MAGNET TRP)
IN TEMPERATURE RANGE (BELOW 50ºC)

CAB THERMAL ANALYSIS

RAMP UP DISSIPATION POWER



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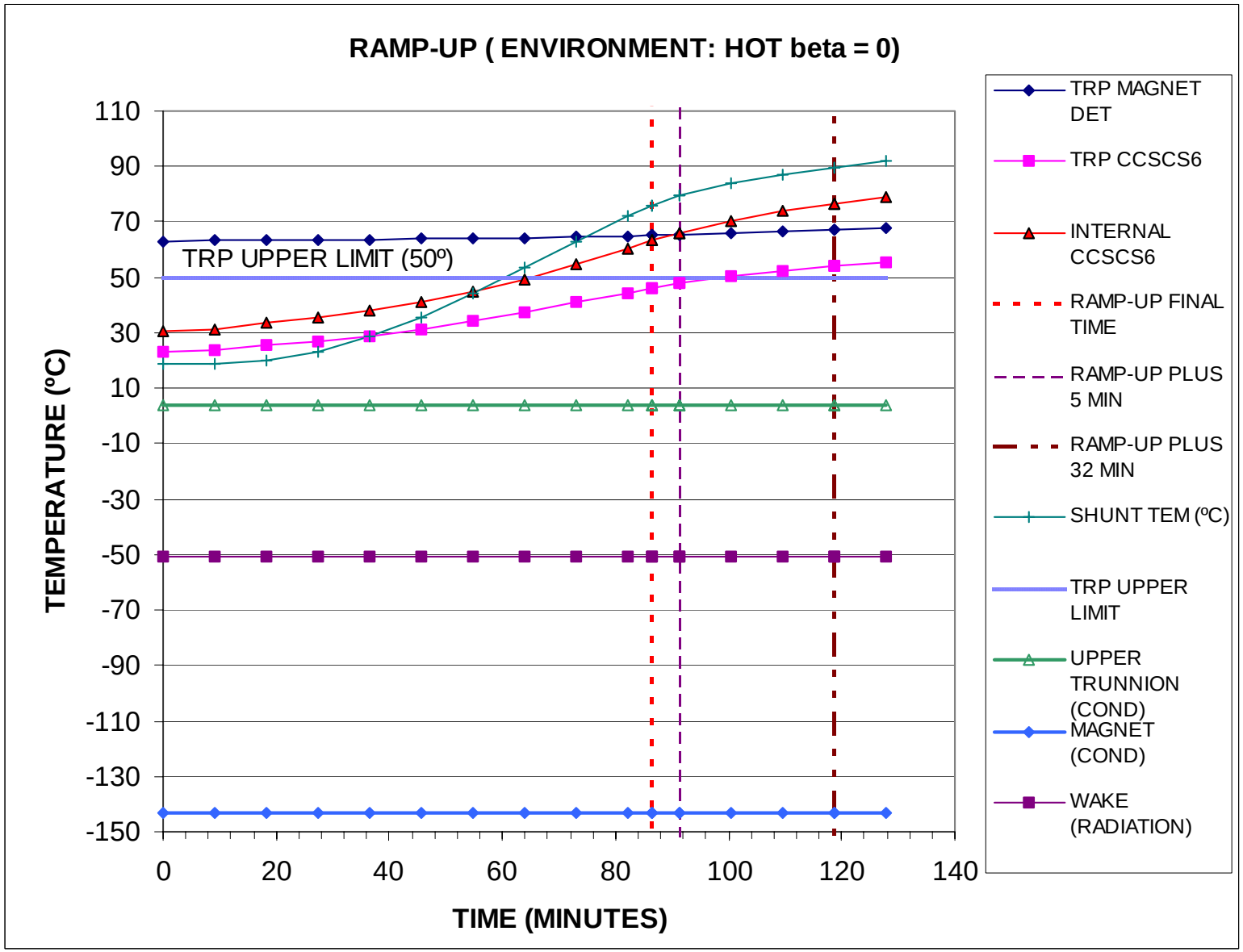

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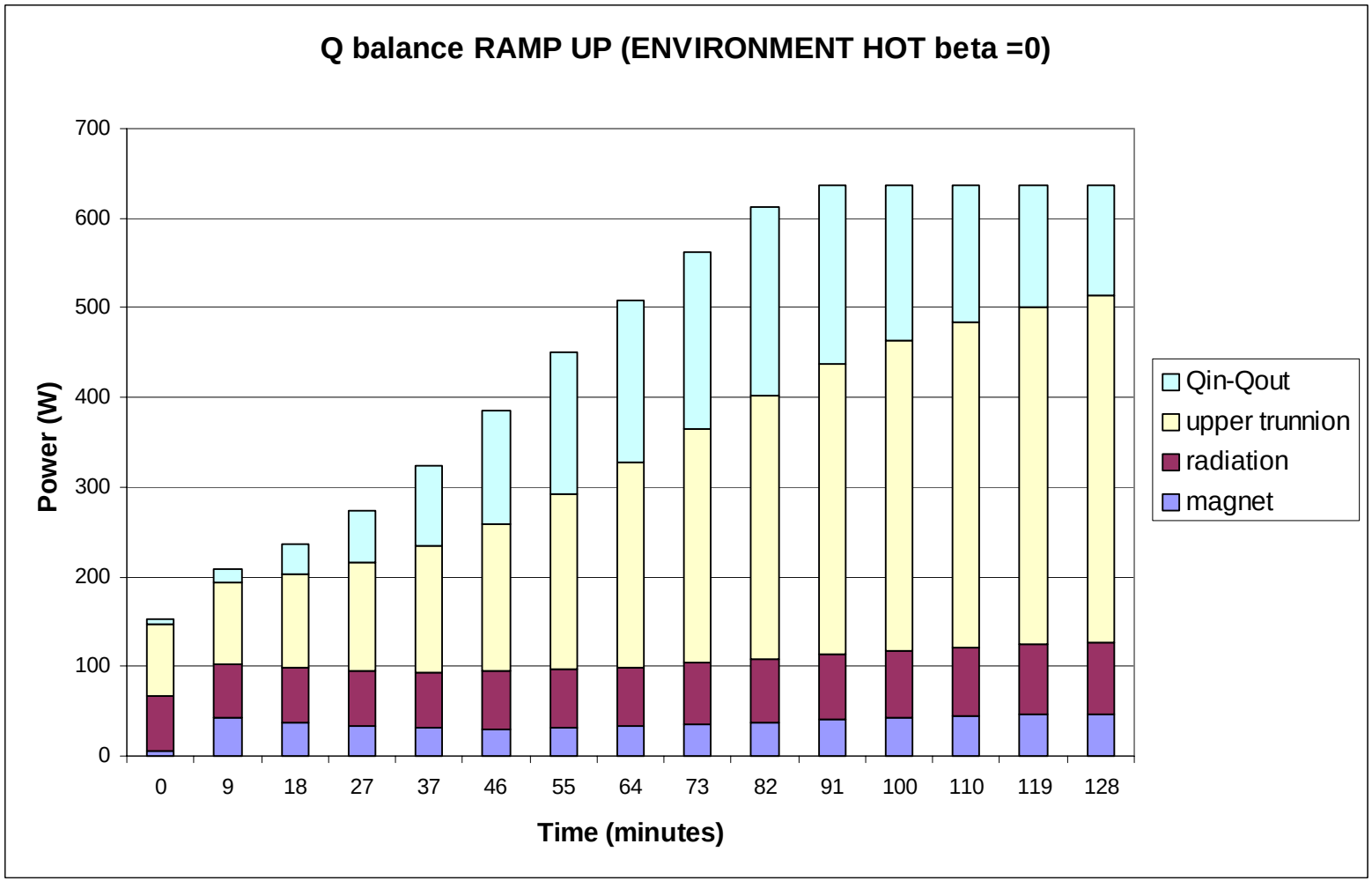

THERMAL BALANCE SUMMARY

CONDUCTIVE LINK

EFFICIENT FOR CCS OPERATION IN TRANSIENT

(RAMP UP AND RAMP DOWN OPERATIONS)

RADIATIVE LINK

EFFICIENT FOR CAB CONTROL IN STEADY STATE

CONDITIONS TO START A RAMP UP

- To start from a power - environment condition that have steady state temperatures in MAGNET DET TRP below 50ºC

- The 50ºC criteria assumes that the upper trunnion temperature do not change during ramp up, CCS is very sensitive to upper trunnion temperature.

Sensitivity analysis (1)

SENSITIVITY ANALYSIS CASE MAXIMUM POWER HOT REDUNDANCY	WITHOUT THERMAL FILLER	CURRENT BASELINE	WITH THERMAL FILLER & 40% RADIATIOR INCREMENT	WITH THERMAL FILLER & 80% RADIATIOR INCREMENT
RADIATOR SURFACE (m^2)	0.208	0.208	0.288	0.368
RADIATOR SURFACE INCREMENT (%)	0%	0%	40%	80%
CONTACT CONDUCTIVITY TO TRUNNION (W/°C m^2)	100	500	500	500
TEMPERATURES IN BASE PLATE TRP´s (°C)				
TRP CCSCS6	32	23	21	20
TRP MAGNET DETECTOR	68	63	56	50

Sensitivity analysis (2)

CAB with a increment of 80% in radiation surface

POWER CONDITION	TOTAL CAB POWER (W)	ENVIRONMENT		
		HOT beta-75	HOT beta 0	COLD beta +75
TYPICAL COLD REDUNDANCY	99.7	YES	YES	YES
MAXIMUM COLD REDUNDANCY	114	NO	YES	YES
TYPICAL HOT REDUNDANCY	120.7	NO	YES	YES
MAXIMUM HOT REDUNDANCY	138.5	NO	YES	YES

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