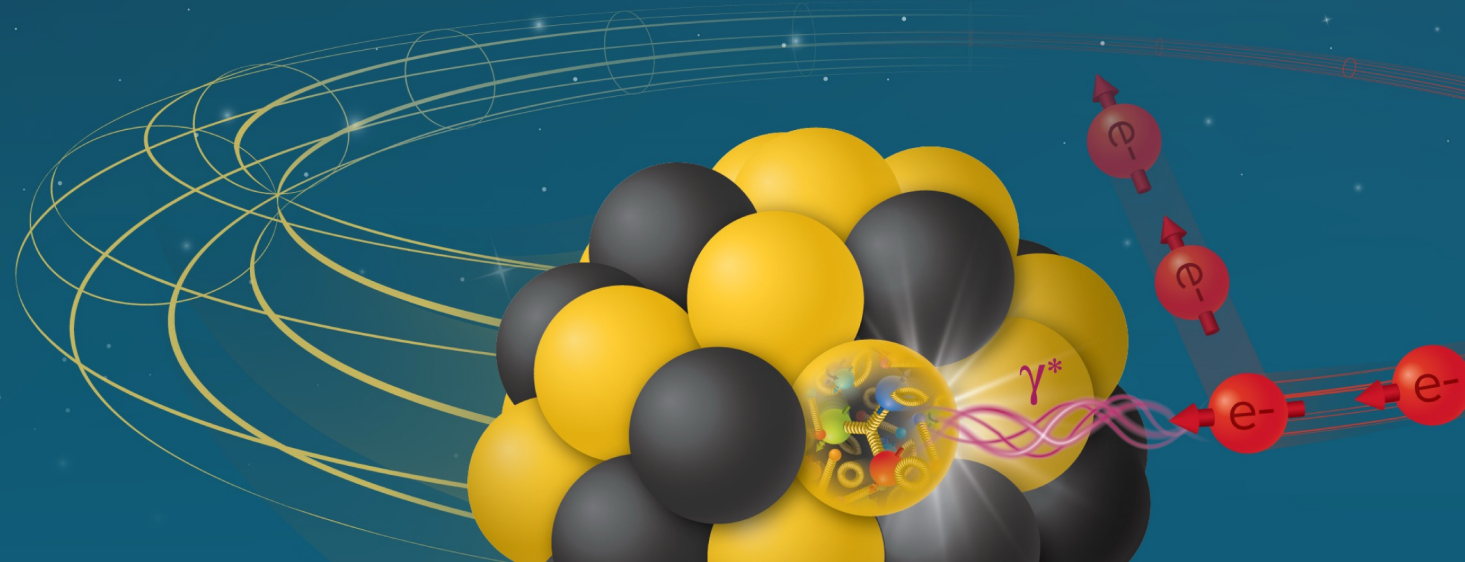


Cooling Requirements

E.C. Aschenauer (BNL),
for the ME-Engineering group and Girish Gowda

ePIC TIC Meeting
July 6th, 2026

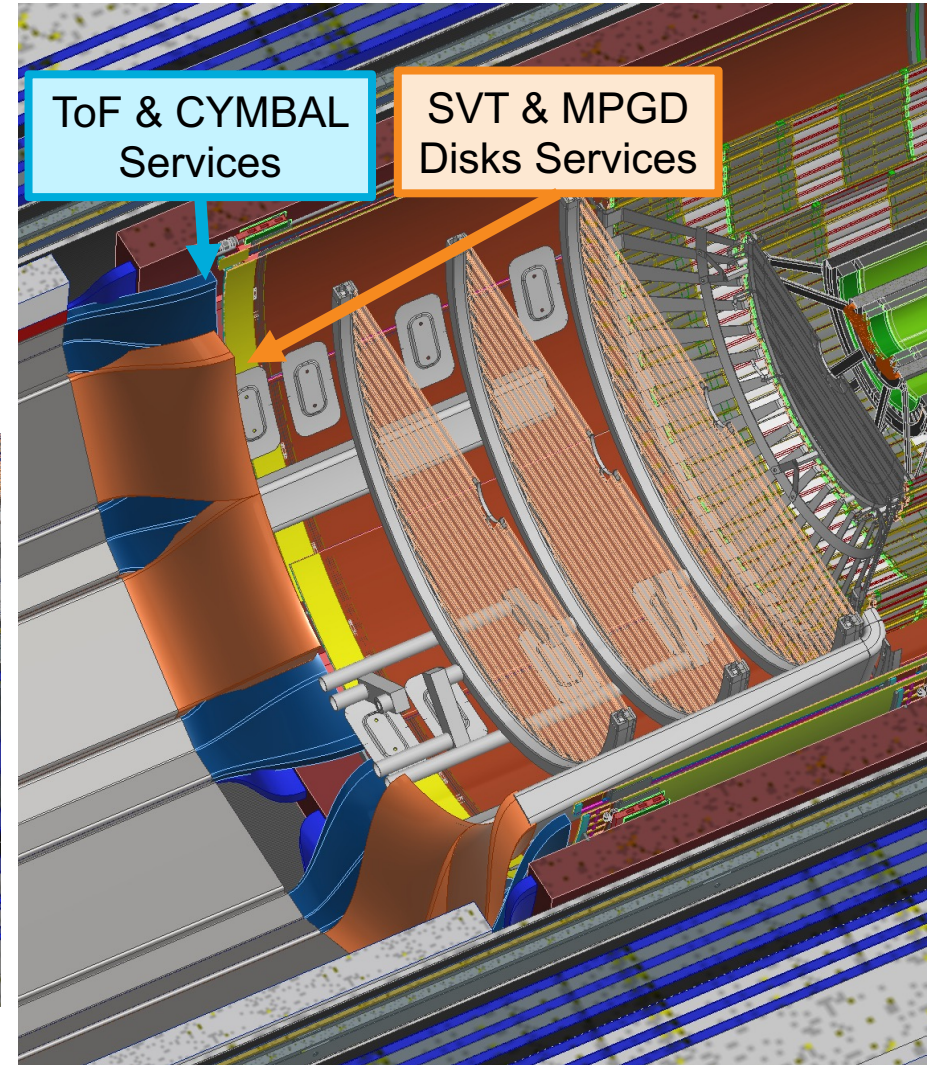
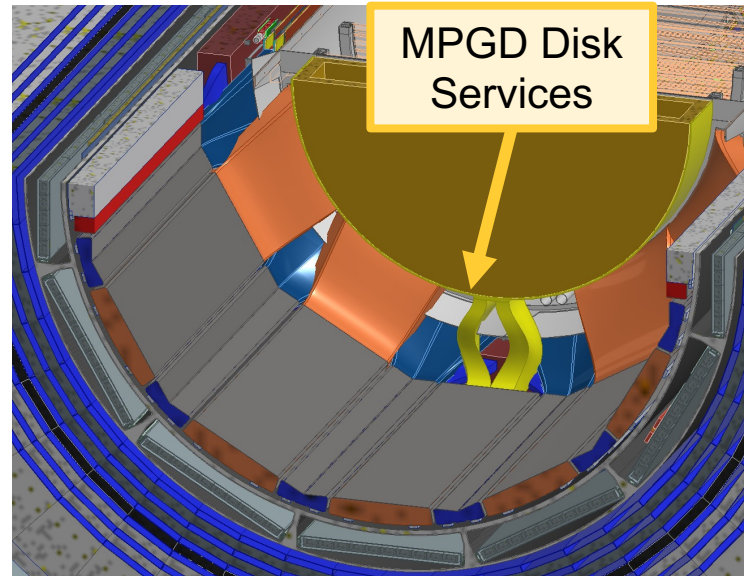
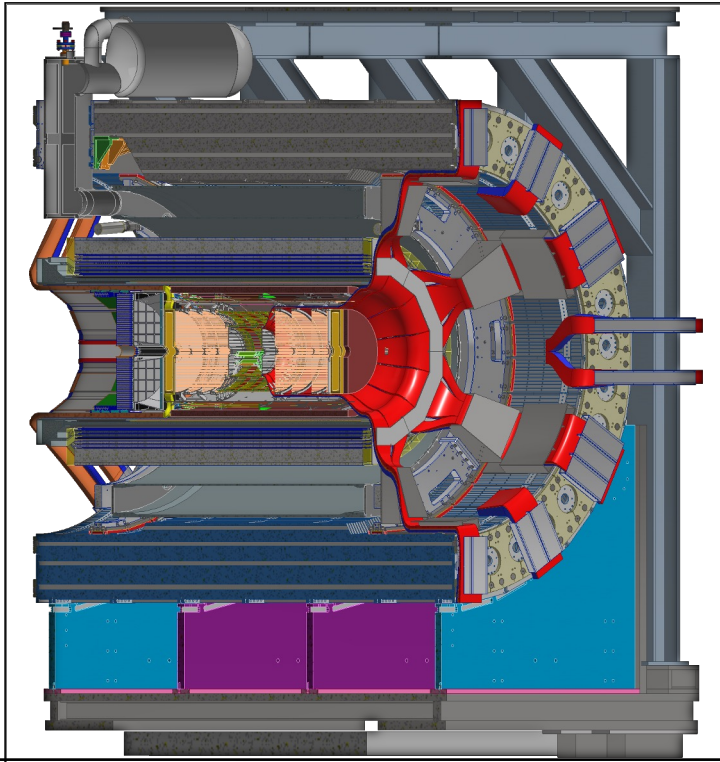
Electron-Ion Collider



Why Do We need to Care

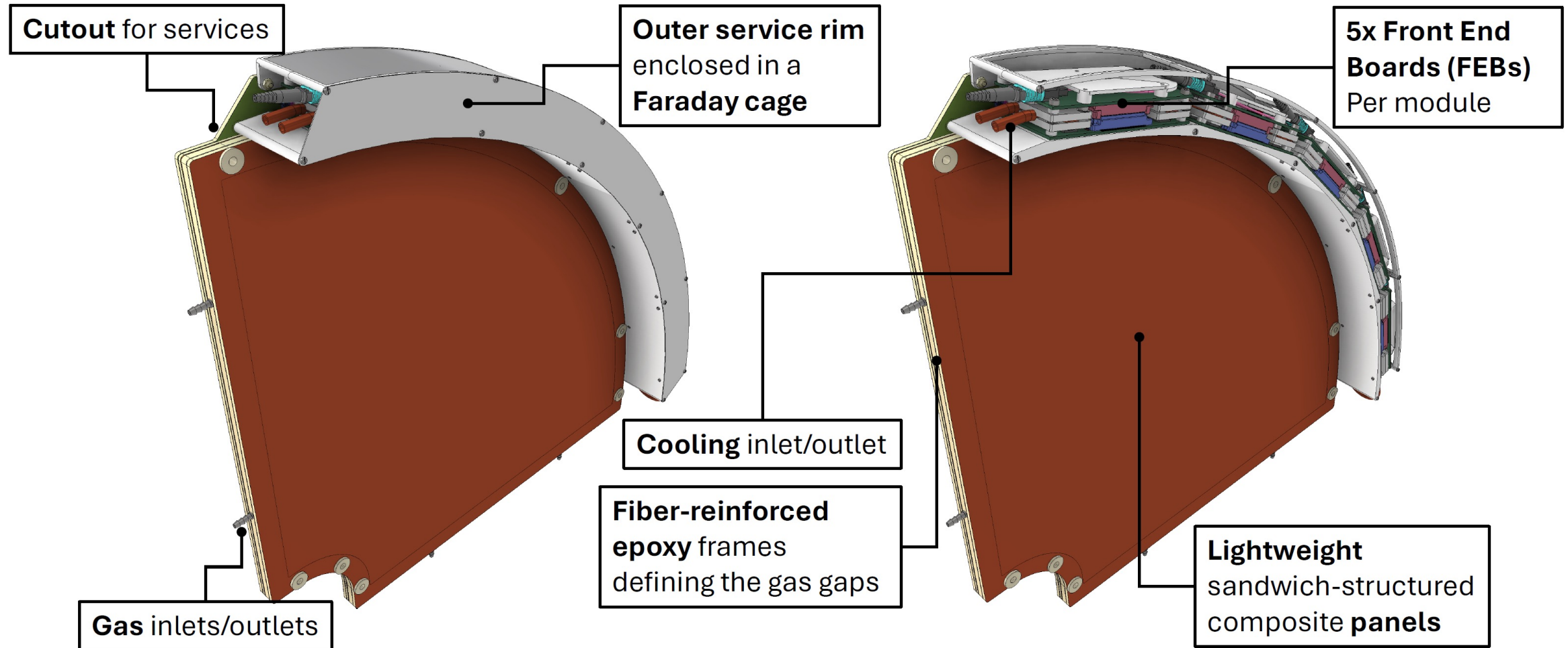
To keep our service space under control, it is crucial to have a very good understanding about our cooling needs
Still not defined as well as one needs.

Direction	Service Type	Sub Total	Total
Forward	Power	3946	6270
	Signal	1624	
	Cooling	700	
Backward	Power	1547	7547
	Signal	5458	
	Cooling	542	
Total		13817	

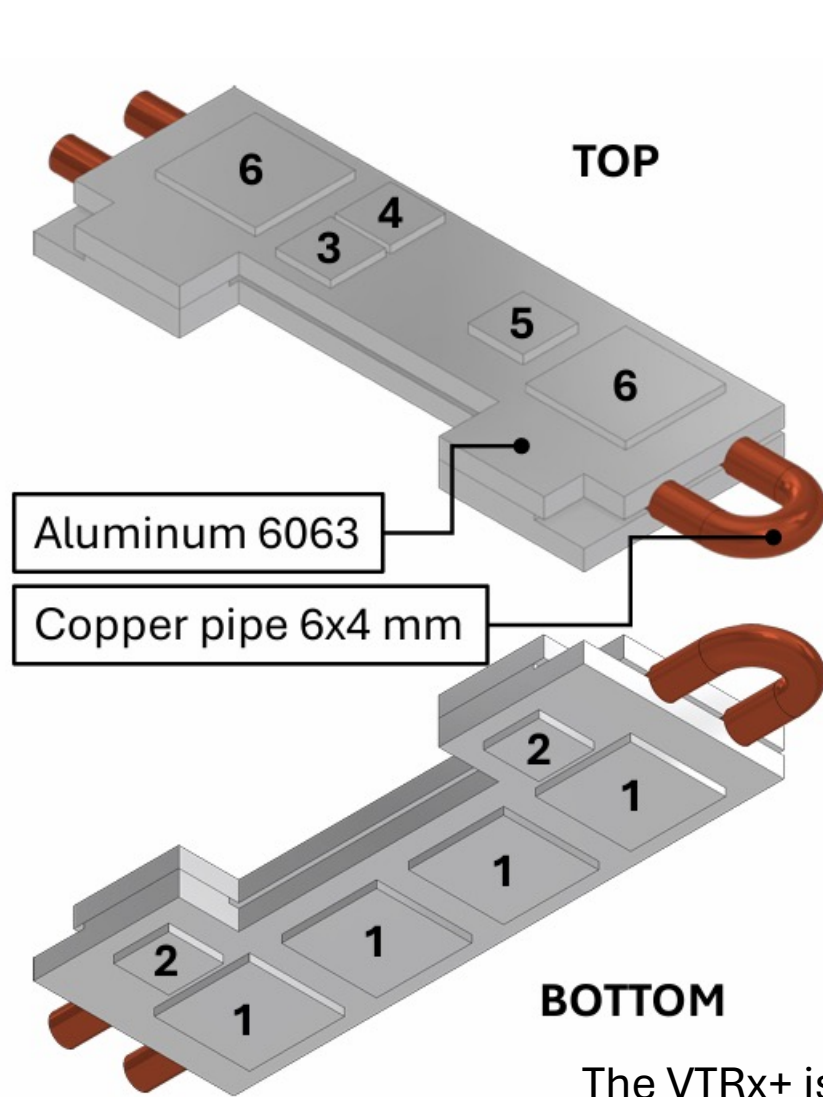


An Example What is needed

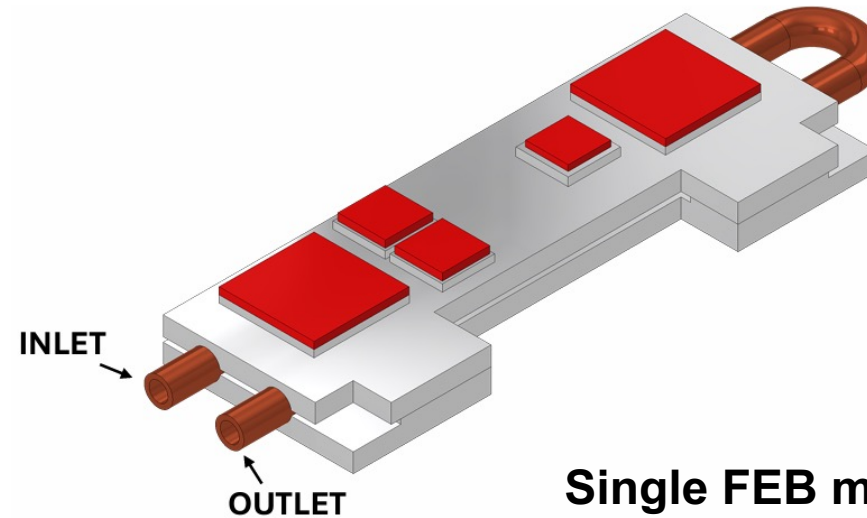
MPGD Endcap Disks: Module Design



MPDG – Disk - Components



The VTRx+ is not actively cooled
It should output around 175 mW



Single FEB model

Number	Component	Thermal Load (per individual component)
1	SALSA	1800 mW
2	LDO SALSA	900 mW
3	LDO lpGBT	200 mW
4	LDO VTRx+	875 mW
5	lpGBT	600 mW
6	DC/DC Converter	2500 mW
	TOTAL	15675 mW

MPGD Endcap Disks Detector – Heat Load

Components Heat load data

Component	Power	Power	Volume	Volume	Volumetric Heat Flux
	mW	W	mm^3	m^3	W/m^3
DC/DC	2500	2.5	600	0.0000006	4166666.67
DC/DC	2500	2.5	600	0.0000006	4166666.67
SALSA	1800	1.8	433.5	4.335E-07	4152249
SALSA	1800	1.8	433.5	4.335E-07	4152249
SALSA	1800	1.8	433.5	4.335E-07	4152249
SALSA	1800	1.8	433.5	4.335E-07	4152249
LDO SALSA	900	0.9	150	0.00000015	6000000
LDO SALSA	900	0.9	150	0.00000015	6000000
LDO IpGBT	200	0.2	150	0.00000015	1333333
LDO VTRX	875	0.875	150	0.00000015	5833333
IpGBT	600	0.6	100.44	1.0044E-07	5973716
	15675	15.675			

Note:

many subsystems till today did not include all components, for example, the DC-DC converters have been forgotten

ePIC Detector – MPGD Endcap Disks

Cooling Scope of Work :

Cooling media	Water	
Inlet Temperature	22	C
Ambient Temperature	23	C
Tube diameter	4	mm
Tube material	Copper	
Operating Temperature of SALSA	25	C
Maximum Temperature of SALSA	35	C
Temperature rise	2	C
Temperature stability	± 3	C
Flow rate of single module	0.5	lpm
Pressure drop of single module	0.03	bar
Heat dissipation to ambient from single module	0.98	W
Total Heat dissipation to ambient	16	W
Cooling loops	Parallel	
Insulation requirement	No	
Neighboring detectors	SVT, pfRICH, TOF	

Detailed Power Estimates :

Component	Power mW	Power W
DC/DC	2500	2.5
DC/DC	2500	2.5
SALSA	1800	1.8
SALSA	1800	1.8
SALSA	1800	1.8
SALSA	1800	1.8
LDO SALSA	900	0.9
LDO SALSA	900	0.9
LDO IpGBT	200	0.2
LDO VTRX	875	0.875
IpGBT	600	0.6
FEB Heat Load	15,675	15.675
FEB Heat Load in a single module	78,375	78.375
Total Detector Heat Load	1280	1280
Number of FEBs in a module	5	
Total Number of Modules in detector	16	

MPGD Endcap Disks Detector – Goals & Parameters

Target Parameters (Performance Goals)	Value, values or range
Operating Temperature Range (SALSA)	25 - 35 °C
Temperature Stability (SALSA)	± 3 °C peak to peak

Simulation Parameters	Value, values or range
Ambient Temperature	23°C → 40°C
Water inlet temperature	22°C, 19°C (if needed)
Water flow rate	0.5 liters / min

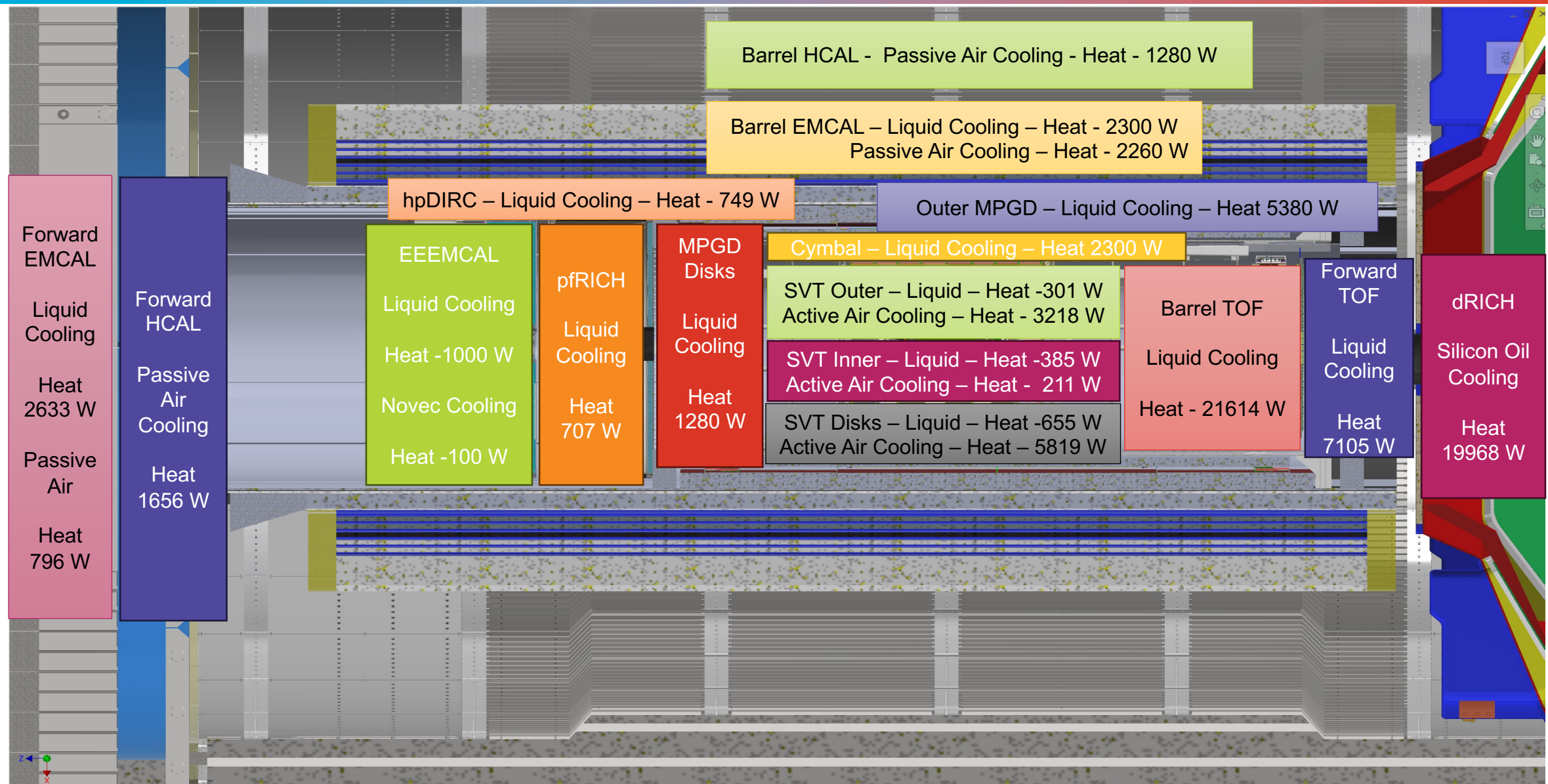
Ambient Temperature might be affected by SVT air cooling and by hot air being trapped within the faraday cage (in the absence of forced circulation)

To be safe the cooling solution should work in a wide range of environmental temperatures

The correlation between detectors is why we need the full information from everybody

What is needed

Layout – ePIC Detector Cooling



ePIC Detector – Cooling – Scope of Work

- Updated CAD Model in Vault for global thermal model simulation
- CAD Model Quality check with no interfering components for global thermal model simulation
- Heat dissipation value to ambient from liquid cooling of electronics of the detectors
- Confirm operating range - Minimum and Maximum Temperature of each detector
- Confirm inlet temperature and ambient temperature of each detector considered
- Confirm temperature stability of each detector
- Confirm Tube diameter (ID & OD) and Tube Material of each detector
- Cooling loops arrangement are in Serial or Parallel
- Flow Rate and Pressure drop values of Thermal simulation of each detector
- Confirm Power estimates with breakup of each detector
- Confirm neighboring detectors impacted by heat dissipation
- Confirm insulation requirement

Summary

If you get an email by Girish and/or the engineering team, **please respond and update**
[Detector Parameters and Services per Subsystem.xlsx](#)

Detector	Cooling	Cooling Data
SVT Outer	Water	Need updates for some information
SVT Inner	Water	Need updates for some information
SVT Disks	Water	Need updates for some information
EEEMCAL	Water	All information available
MPGD Endcap Disks	Water	All information available
Outer MPGD	Water	All information available
Cymbal	Water	Need updates for some information
Barrel TOF	Water	Need updates for most information
Forward TOF	Water	Need updates for most information
hpDIRC	Water	No information – only HRPPD data
pfRICH	Water	No information – only HRPPD data
Forward EMCAL	Water	All information available
Barrel EMCAL	Water	Need updates for some information
Platform Electronics & Racks	Water	Need updates for some information

Detector	Cooling	Cooling Data
SVT Outer	Active Air	All information available
SVT Inner	Active Air	All information available
SVT Disks	Active Air	All information available
Barrel EMCAL	Passive Air	Need updates for some information
Forward EMCAL	Passive Air	All information available
Barrel HCAL	Passive Air	Need updates for some information
Forward HCAL	Passive Air	No information – only PCB insert sensor data
EEEMCAL	Novec	All information available
dRICH	Silicon Oil	Need updates for most information

QUESTIONS