



**High
Luminosity
LHC**

WP4 RF equipment volume needs

06 November 2015

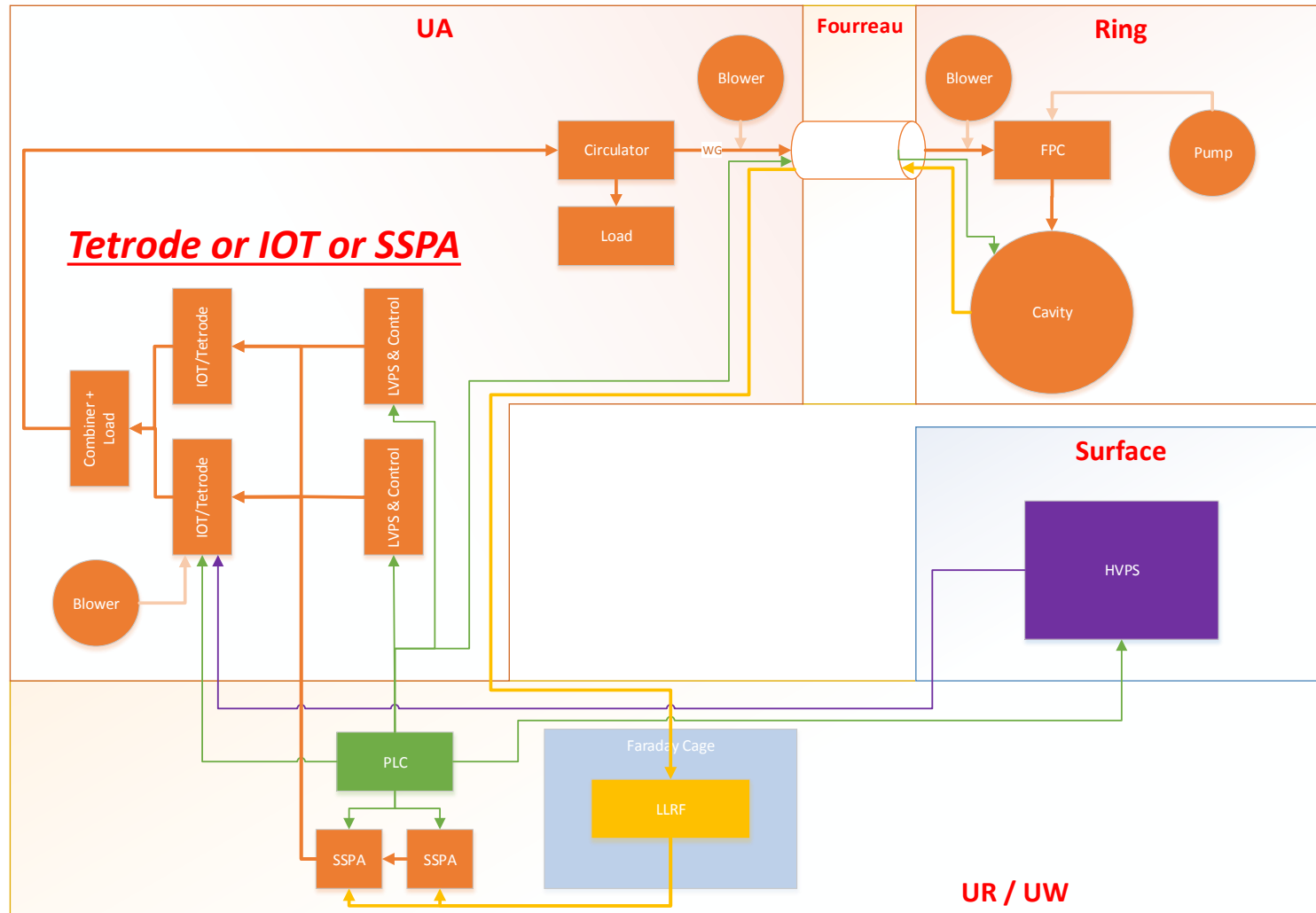
Eric Montesinos



The HiLumi LHC Design Study is included in the High Luminosity LHC project and is partly funded by the European Commission within the Framework Programme 7 Capacities Specific Programme, Grant Agreement 284404.



RF System Bloc Diagram per IP side



RF power density

- Whatever the power system in this range of frequency and this range of power the power density of an amplifier is approximately 1.4 kW/m³

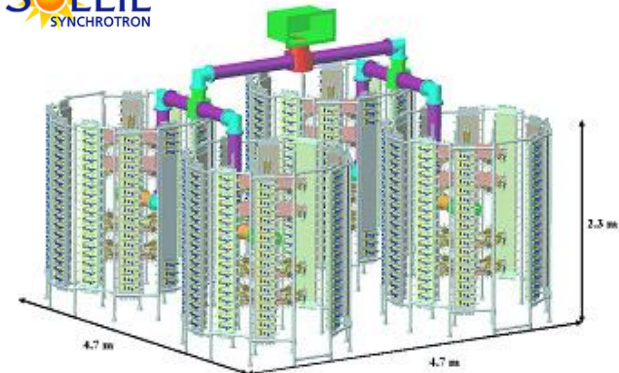
(not including combiners, circulators, RF loads, cable trays, water piping, ...)

- Per LHC IP side, we need 8 x 100 kW (maximum), i.e. 800 kW / (1.0 kW/m³) = total 800 m³
- Ideal requested UA gallery for amplifiers and services is about 1000 m³
- Allocated UA volume for amplifiers and services is R3 x 25 = **550 m³ (Cannot be reduced)**

Previously wrongly calculated 850 m³



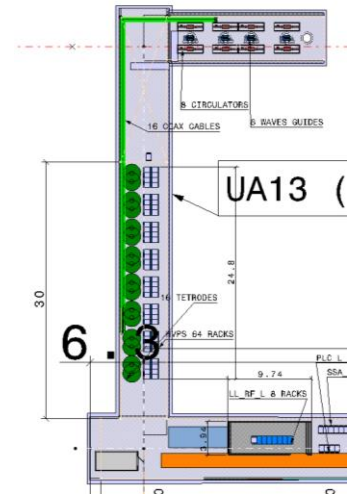
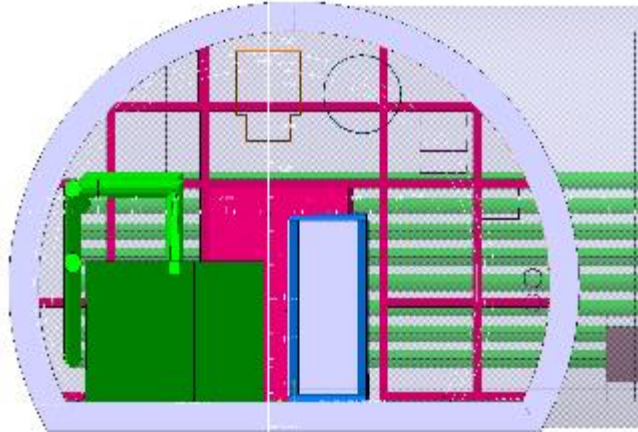
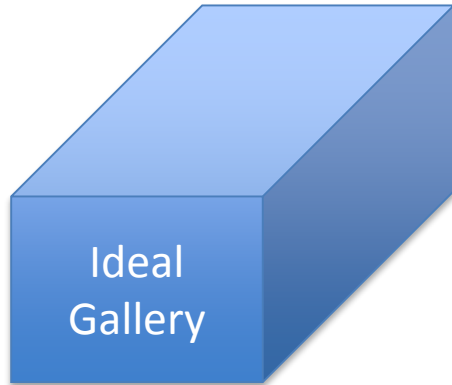
Soleil 4 x 45 kW unit
Tower density = 0.8 kW/m³



CERN SPS 4 x 500 kW unit
One transmitter density = 1.1 kW/m³



RF power density



Ideal volume for 8 x 100 kW		
Technology	100 kW Amplifiers + lines kW/m ³	Total m ³
SSPA	0.7	1150
IOT	0.8	1000
Tetrode	0.8	1000

- Current proposal
- R3 m x 25 m = **553 m³**
 - $[R^2(\pi[1-\alpha/360]+1/2 \sin \alpha)]$ avec ici $\alpha = 125$ degrés
- Already ***compressed by 50 %*** compared to any other power stations (with same frequency and same power level per unit) with a ***unfavourable shape*** (tubular gallery instead of parallelepiped gallery)
- ***Already too much squeezed !***
- Trying to squeeze it even more would prevent the possibility of (promising) SSPA

Services requirements per IP side

Equipment	Location	Qty	Electricity	Water	Air	Handling		
HVPS	Surface (or UA ?)	1 (or 8)	2 MVA in case of IOTs (800 kW) 1 MVA in case of Tetrodes (400 kW)	TE-EPC	TE-EPC	Yes		
SSPA	UR and UW	<div style="background-color: red; color: white; padding: 5px;"> No change with HVPS on surface As with HVPS in the gallery all HVPS losses would be in water </div>			5 kW	Yes		
PLC	UR and UW				6 kW	-		
LLRF	UR and UW				12 kW	-		
Faraday Cage	UR and UW				T° and humidity	Yes		
LVPS	UA	64	400 V – 16 KVA	-	16 kW	-		
Amplifiers	UA	8	<div style="background-color: red; color: white; padding: 5px;"> Initially 50 kW, Corrected to MINIMUM 80 kW </div>			800 kW	<u>80 kW</u>	Yes
Combiners	UA	8				-	-	Yes
Circulators	UA	8				-	-	Yes
Loads	UA	16				(800 kW)	-	Yes
WG	UA & ring	8	-	-	-	Yes		
Blowers	UA & Ring	24	400 V – 25 KVA	-	25 kW	-		
FPC	Ring	8	400 V – 8 KVA	8 kW	8 kW	-		
Cavities	Ring	8	tbd	tbd	tbd	Yes		

All data extracted from the Conceptual Specification