OUTLINE, COSTS FOR 1 HORN

- Material costs
- Similar projects
- Estimation
- Others

MATERIALS

- Aluminium Alloy : 1.65 euros/kg (metalprices.com)
- Aluminium 6061T6 alloy sheet 1.91$\times$127$\times$368 cm, weight: 241 kg, price/kg:3.53 euros, total price: 850 euros.
- Al 6061T6 rod diam 30 cm $\times$ 182 cm : $\simeq$ 2700 $ (metalsdepot.com)

COOLING

- jets : 30 nozzles $\times$ 7 euros $\sim$ 210 euros
- orientable joints: 30 $\times$32 $\sim$ 950 euros
- atomiseur nozzle : 30 $\times$7.7 $\sim$ 230 euros
- pipes 6/horn:
- large pipe 1/horn:
- tubing: $6 \times 6 = 36$
- aluminium frame
- heat exchanger
- electrical pump
- flow meter, electronics, temperature sensors, pressure sensors
- tubings
- connectors
- water tank

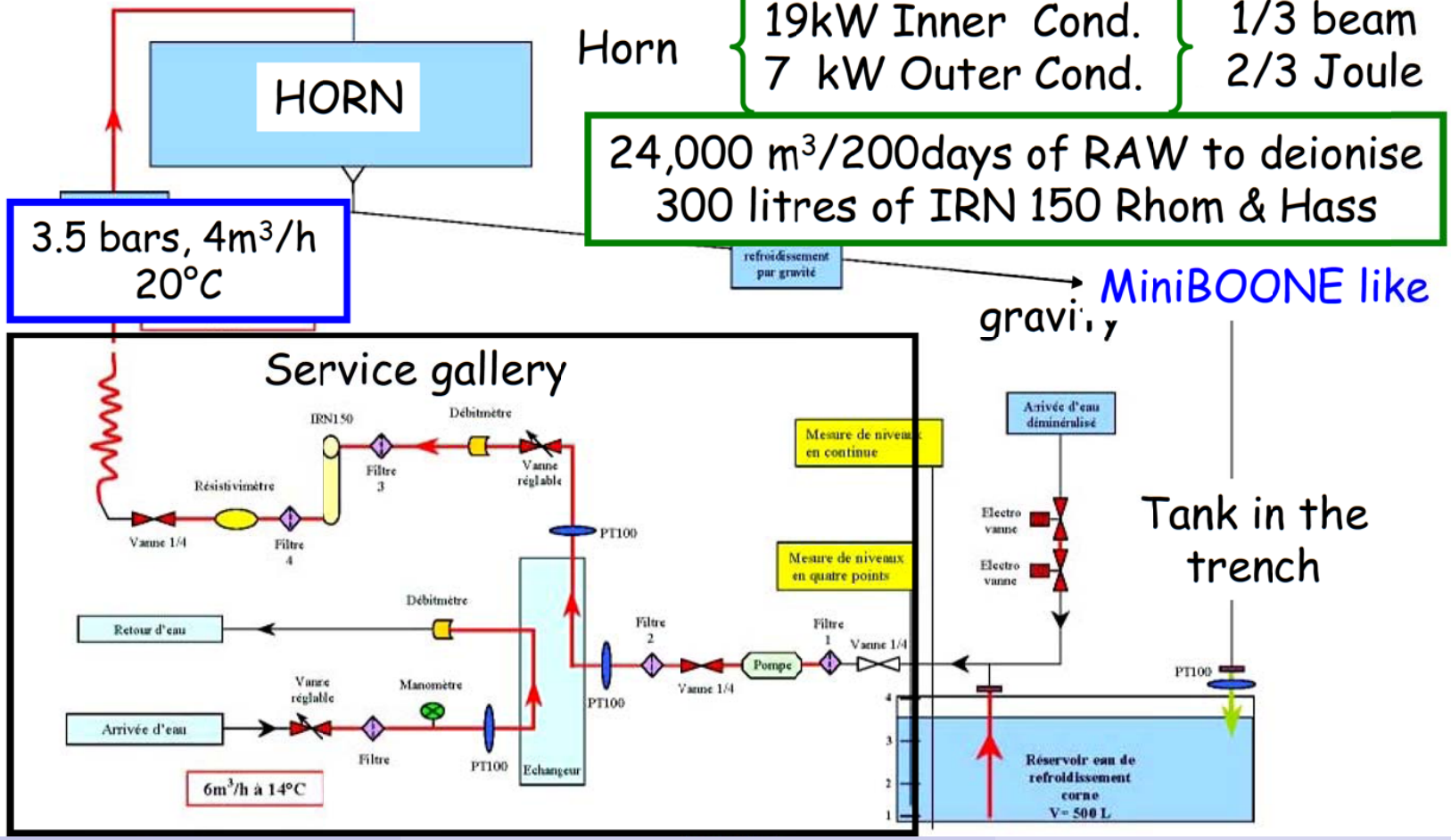
ELEMENTS

- materials : Aluminium 6061T6
- horn
- frame
- tubing
- nozzle
- insulating disk glass
- insulating ceramic
- nuts and bolts

WORK

- R&D studies: stress, safety factor, horn lifetime estimation, dynamics studies, cooling system, irradiation.
- machining inner conductor
- machining outer conductor
- machining end plates
- surface finish
- holes drilling
- assembling; welding
- prototype testing: Geometry, temperature, Magnetic field distribution, cooling; vibrations.

Cooling System: principle

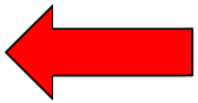


Some costing

kCHF/k€

item	CERN original estimate (MoU in 2000)	LAL & CERN estimate (20 July 2004)
2 Horns + 1 Reflector	600 / **390**	920 / **600**
2 Cooling systems	100 / **65**	181 / **118**
3 Support Systems		
(originally motorized)	220 / **143**	62 / **40**
2 sets of striplines	170 / **111**	268 / **174**
		(incl. fast coupling)
		(incl. 20 kEuro tests)
Total	**1090 / 709**	1431 / **932**

May still increase...



+30%

It may turn out that it would have been wrong by a factor 2...

DECAY TUNNEL

- steel cylinder tube of 2 m radius, 25m length and 1.6 cm thickness.
- Fluka $\rightarrow$ $P = 360$ kW of total power deposition.
- power density: $q = \frac{360E3}{\pi\left(2.016^2 - 2^2\right)\times 25} = 71.3\ kW/m^3$
- uniform cooling and assume $T_{wall} = 30\,^{\circ}\mathrm{C}$:
  $h = \frac{P}{2\pi \times RL\Delta T} = \frac{360E3}{2\pi \times 2 \times 25 \times 10}$
- $h \geq 115 \frac{W}{m^2 K}$
- the steel wall need active cooling, either water or gas.