CERN facilities for Superconducting RF

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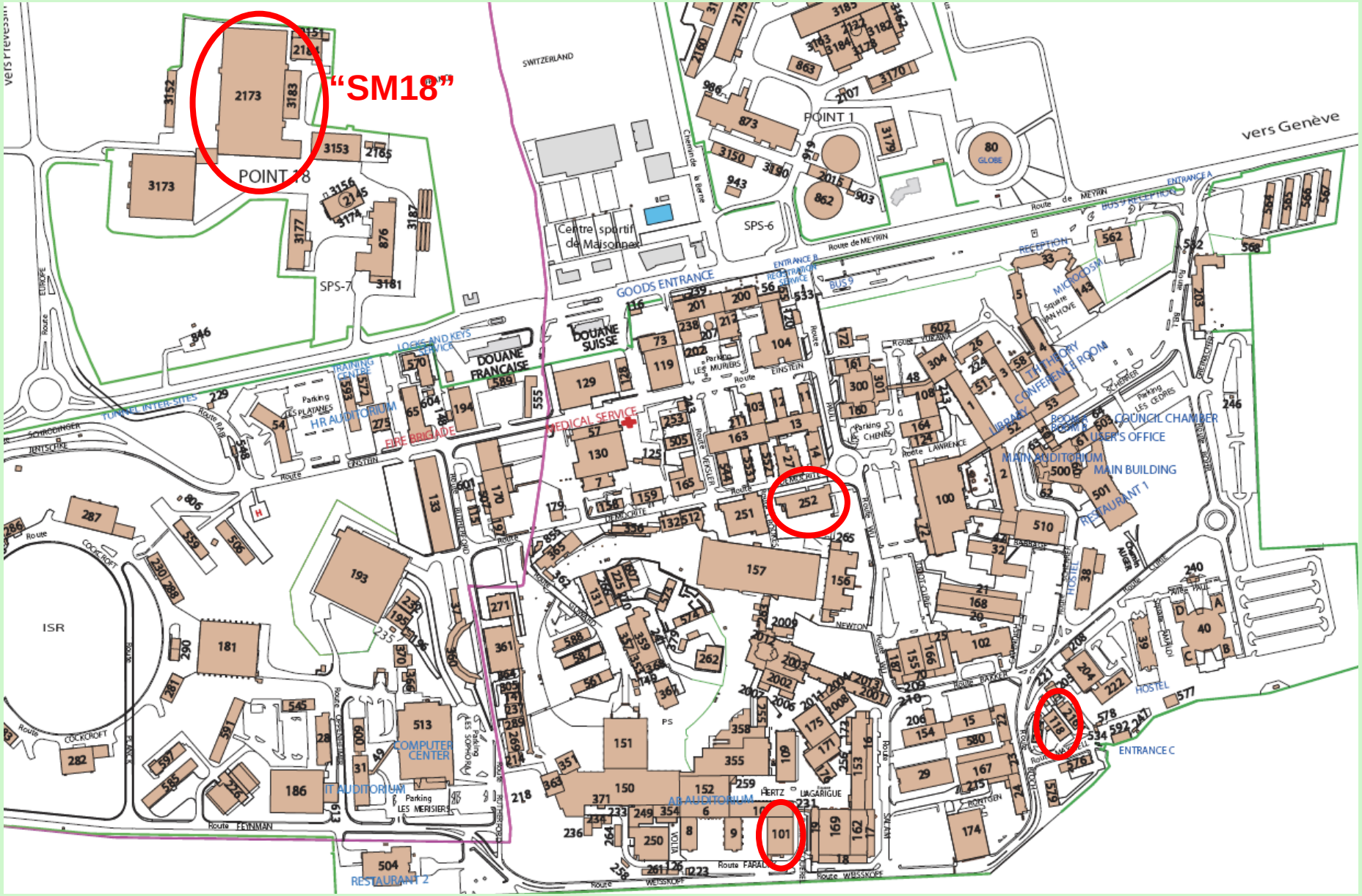
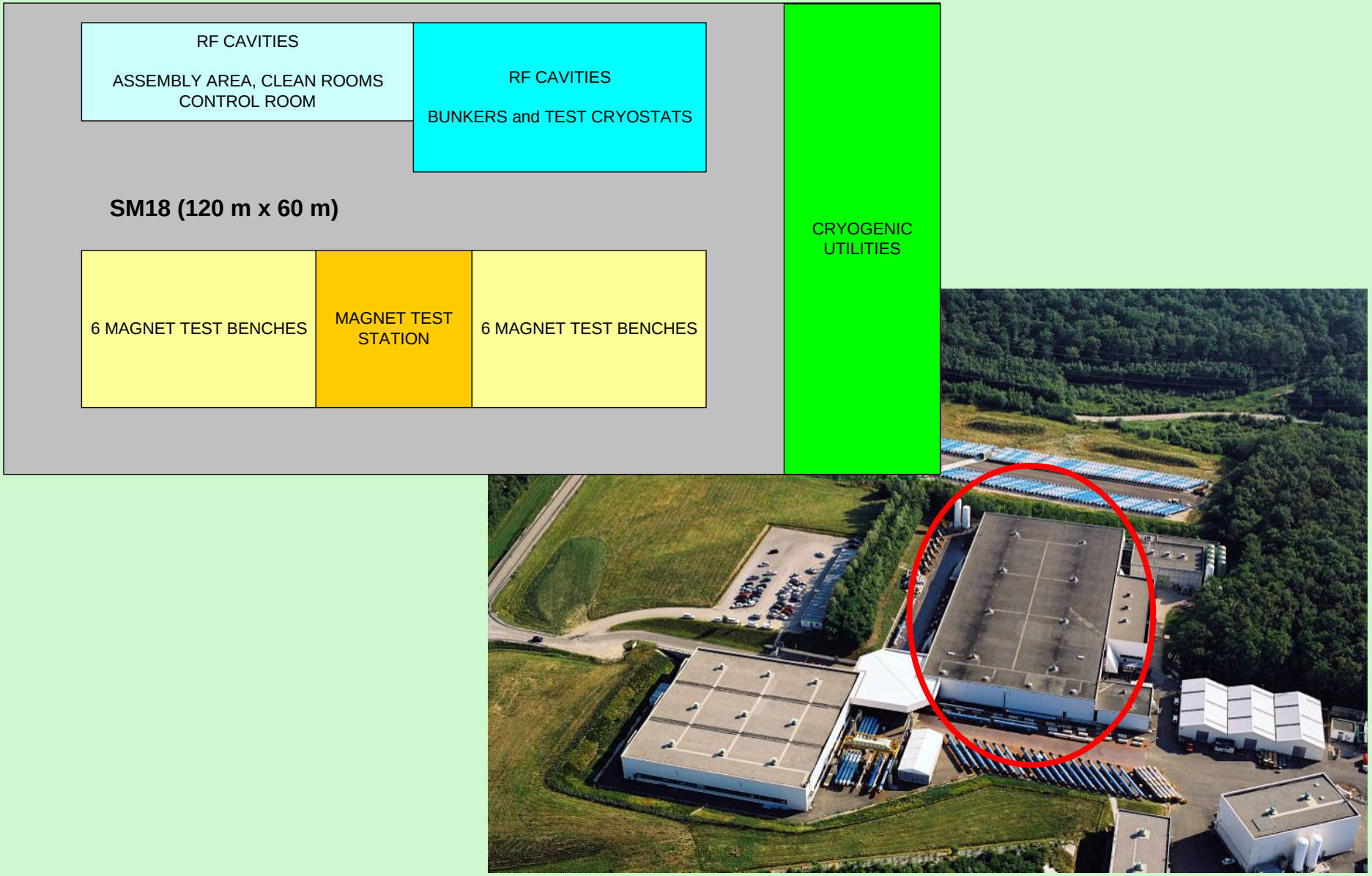
CERN “geography”



SM18 building



Clean Rooms & Surface Preparation Facilities

Water rinsing stations	
Location	***Characteristics***
Bldg 118	*100 bar, 18 MOhm.cm, closed circuit under N_2 for cavity rinsing*
Bldg 118	*100 bar, 18 MOhm.cm, glove box in N_2 atmosphere, connected to class 100 clean room*
Bldg 252	*6 bar, 18 MOhm.cm, open rinsing in front of laminar flow class 1000, see below*
Clean rooms	
Location	***Characteristics***
Bldg 118	*Class 100 5x5 m + entry zone class 1000 3x3 m (dismantling under consideration)*
Bldg 252	*Class 100 8x5 m + entry zone class 1000 4x5 m*
SM18	*Class 10 15x4 m + entry zone class 1000 15x4 m*
Bldg 101	*Class 100 3x5 m + entry zone class 1000 3x2 m*
"Grey" assembly areas	
Location	***Characteristics***
Bldg 252	*Class 10000 4x4 m equipped with LPWR (see above)*
SM18	*Class 10000 6x6 m and "front court" 4x15 m (ambient air)*
Surface preparation (polishing and coatings)	
Location	***Characteristics***
Bldg 118	*Chemical polishing for copper (up to LEP-LHC cavity size)*
Bldg 118	*Electropolishing (vertical) for 1.3÷1.5 GHz copper cavities*
Bldg 252	*Nb coating facilities for LHC cavities*
Bldg 101	*Nb coating facilities for 1.3÷1.5 GHz cavities (2x)*

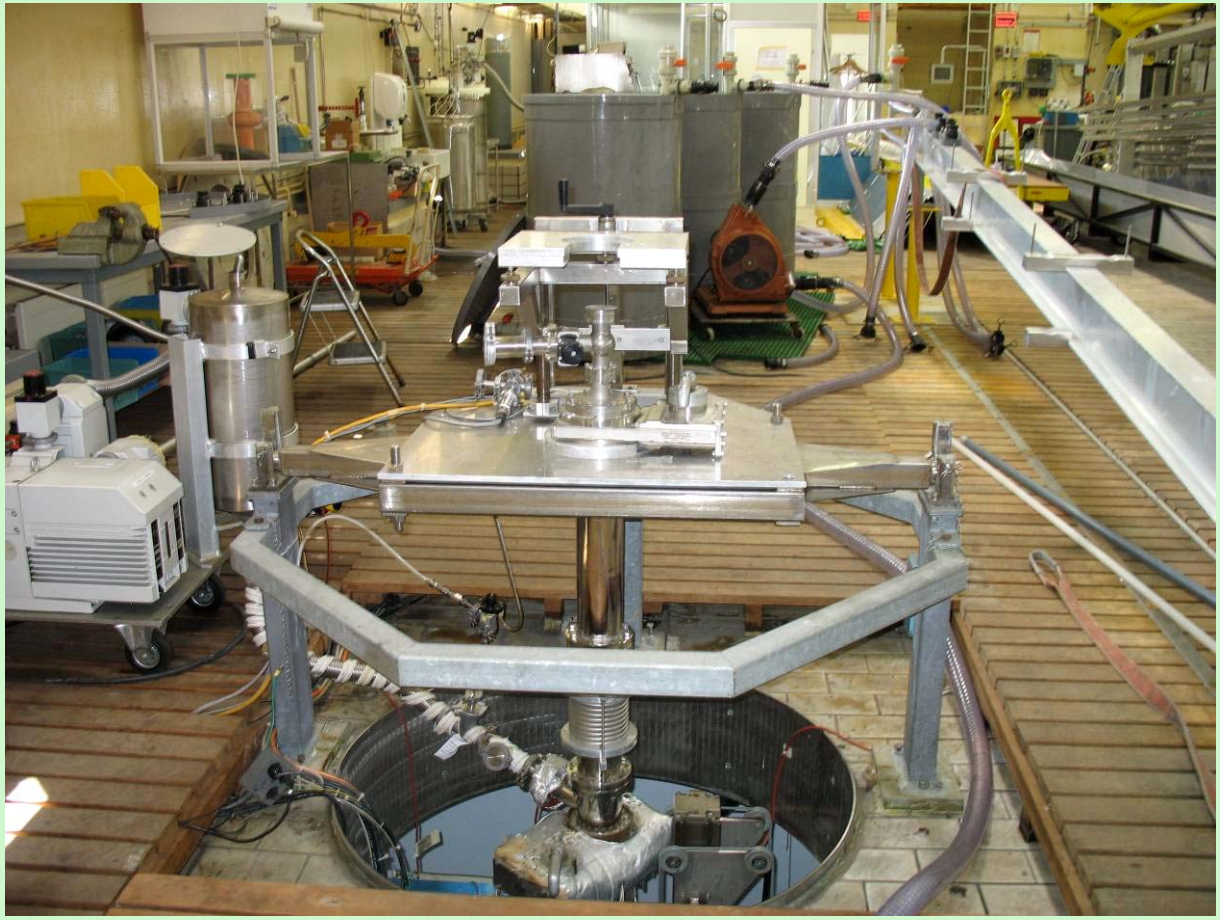
Cryogenics and RF Test Facilities

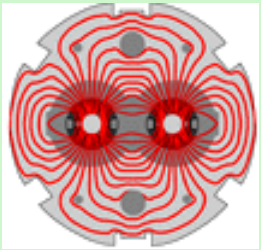
Cryogenics (after 2007)	
Location	***Characteristics***
SM18	*Helium refrigerator 6 kW @ 4.5 K, liquefaction capacity of 32 g/s, shared utility*
SM18	*Two gaseous helium pumping units of 18 g/s at 3 kPa, one unit available*
Bldg 165	*10 W @ 1.7 K*

Cryostats	
Location	***Characteristics***
SM18	*Two large ”bunkers” about 15 m long (up to strings of 4 LEP cavities)*
SM18	*Two vertical cryostats 4.2 m deep, 1.1 m diameter*
SM18	*One vertical cryostats 2.5 m deep, 1.1 m diameter*
Bldg 165 & SM18	*Two vertical cryostats for 1.3÷1.5 GHz single-cell cavities*

RF equipment	
Location	***Characteristics***
SM18	*1 MW 352 MHz Klystron, 300 kW 400 MHz klystron + ancillary equipment for RF testing (3 units)*
SM18	*Two 300 W solid-state amplifiers + ancillary equipment for RF testing (4 units)*
Bldg 165	*One 100 W solid-state amplifier + ancillary equipment for RF testing at 1.3÷1.5 GHz*

High pressure water rinsing station – bldg 118



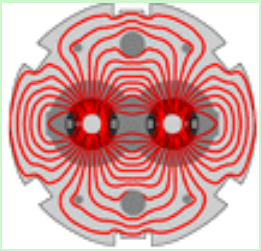


Ultra-pure high pressure water rinsing station under clean nitrogen gas in bldg. 118. The rinsing device enters the cavity from the bottom, where is always kept under a controlled nitrogen atmosphere. Drying is usually performed by pumping. The cavity is sealed after drying without ever entering in contact with the ordinary atmosphere. The station is fed from a high-pressure pump (100 bar, 18 MOhm.cm) with a throughput of about 1 m^3/hour.

Hiigh pressure water rinsing + glove box + clean room – bldg 118

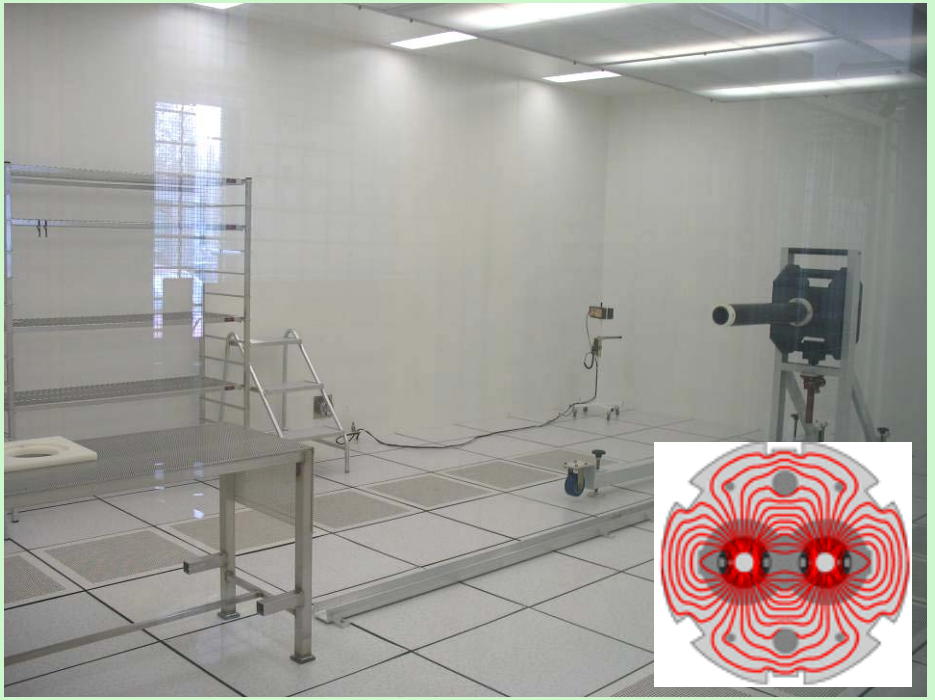
Glove box in bldg 118 allowing HPWR on pieces other than cavities (RF components etc.) under filtered nitrogen atmosphere, followed by online drying by pumping. It is connected to a clean room (5x5 m in class 100, with a personnel entry zone 3x3 m in class 1000) where the pieces can be assembled to other components. The clean air is blown from the ceiling down to the floor. There are presently plans to dismantle this clean room if no future use is foreseen.

Low pressure water rinsing + class 10000 working zone – bldg 252



"Grey" assembly zone (4x4 m, class 10000) with an horizontal laminar air flow, equipped with a low pressure (6 bar) high purity water rinsing station and alcohol drying equipment used for the final rinsing of LEP/LHC cavities before coating and for couplers.

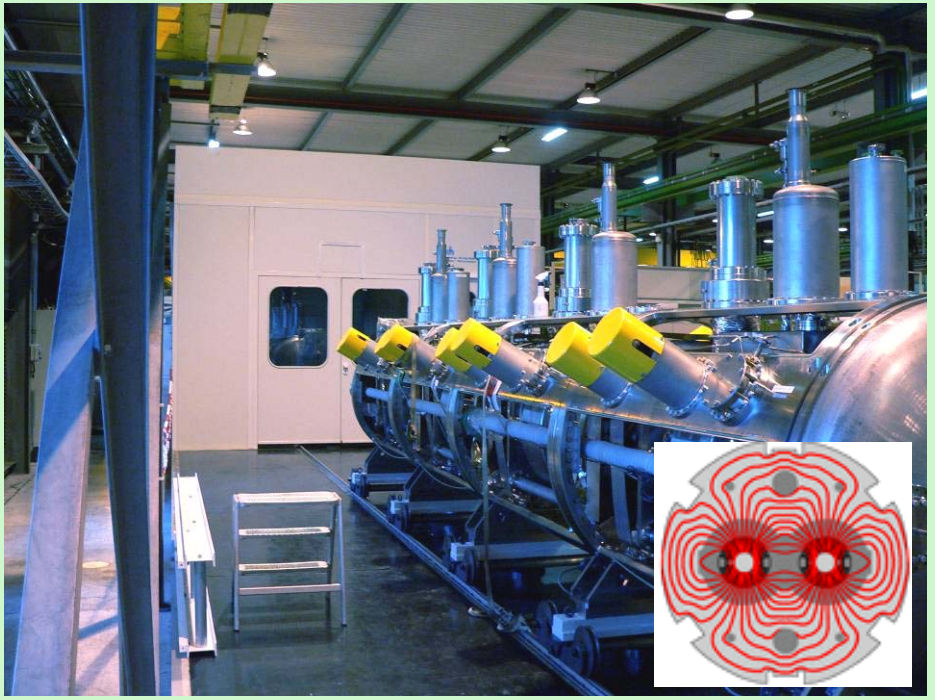
Class 100 clean room – bldg 252



External and internal view of the clean room in bldg. 252, close to the preceding “grey” zone, having a size of 8x5 m in class 100 with a personnel entry zone of 4x5m in class 1000. The clean air is blown from the ceiling down to the floor.

All the clean-rooms are professionally maintained (maintenance and cleaning contracts with external company) and the dust contents is constantly monitored.

Class 10 clean room – SM18



The clean room is divided in two parts of equal size, each 15 m long and 4 m wide, separated by a large double door. The dust-filtered air is blown from the ceiling towards the floor. The entry part is in class 1000, and the working part is in class 1÷10, exceptional for an installation of this size. An object enters the front part, letting the dust settle, and is only then transferred into the main working part. Right of the main doors, the personnel entry door to a small space for the operators to change into special garments, with another exit door into the class 1000 zone. The 'front court' allows modules to be mechanically assembled (critical volumes remaining closed, only opened inside) and set onto rails; these lead along the whole clean-room for easy transport.

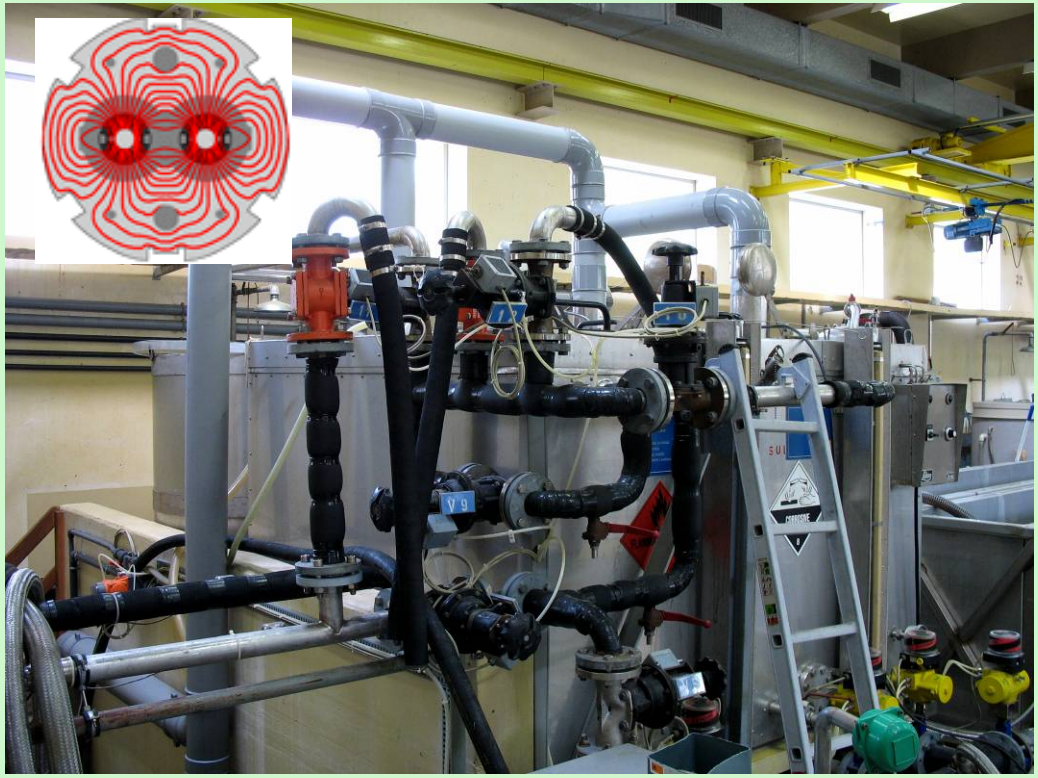
Class 10000 assembly zone – SM18

“Grey” mounting area in class 10000 with curtains and vertical laminar air flow. In the LEP period the HOM couplers were finally rinsed here – the water installation is dismantled now – before being assembled onto the cavities.

Class 100 clean room in bldg 101

Clean room in bldg 101, having a class 100 working zone of 3x5 m and a class 1000 entry zone of 3x2 m. This clean room is solely dedicated to the assembly of 1.5 GHz cavities prior to Nb sputtering

Chemical surface preparation – bldg 118

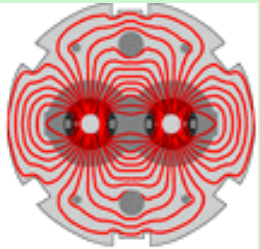


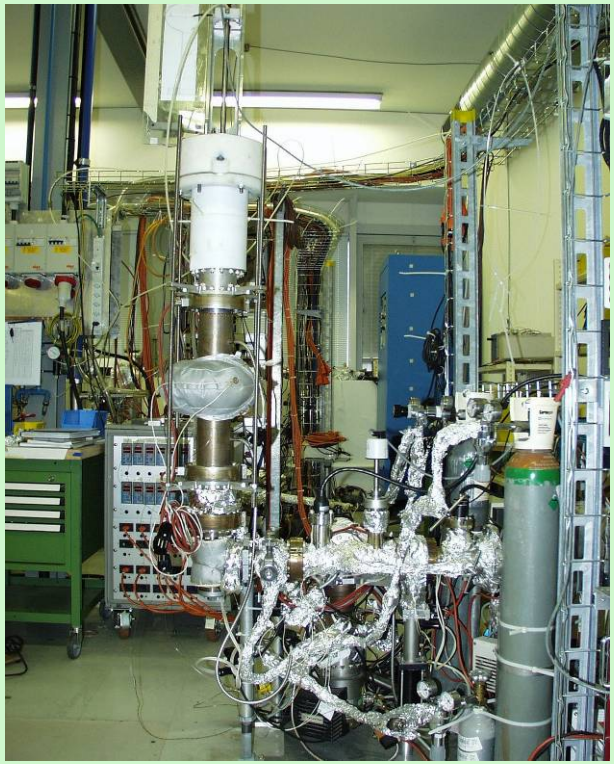
Copper chemistry facility (bldg 118), used for automated chemical polishing of cavities (cavities up to 200 MHz have been treated here), low pressure water rinsing and alcohol drying.

Copper vertical electropolishing facility (bldg 118), used for polishing of 1.5 GHz cavities, followed by HPWR. The workings of this facility are constantly monitored and the operating parameters regularly checked by numerical simulation of the EP process.

Electropolishing of copper and chemical polishing of niobium are part of the general service provided by the Surface Preparation workshop.

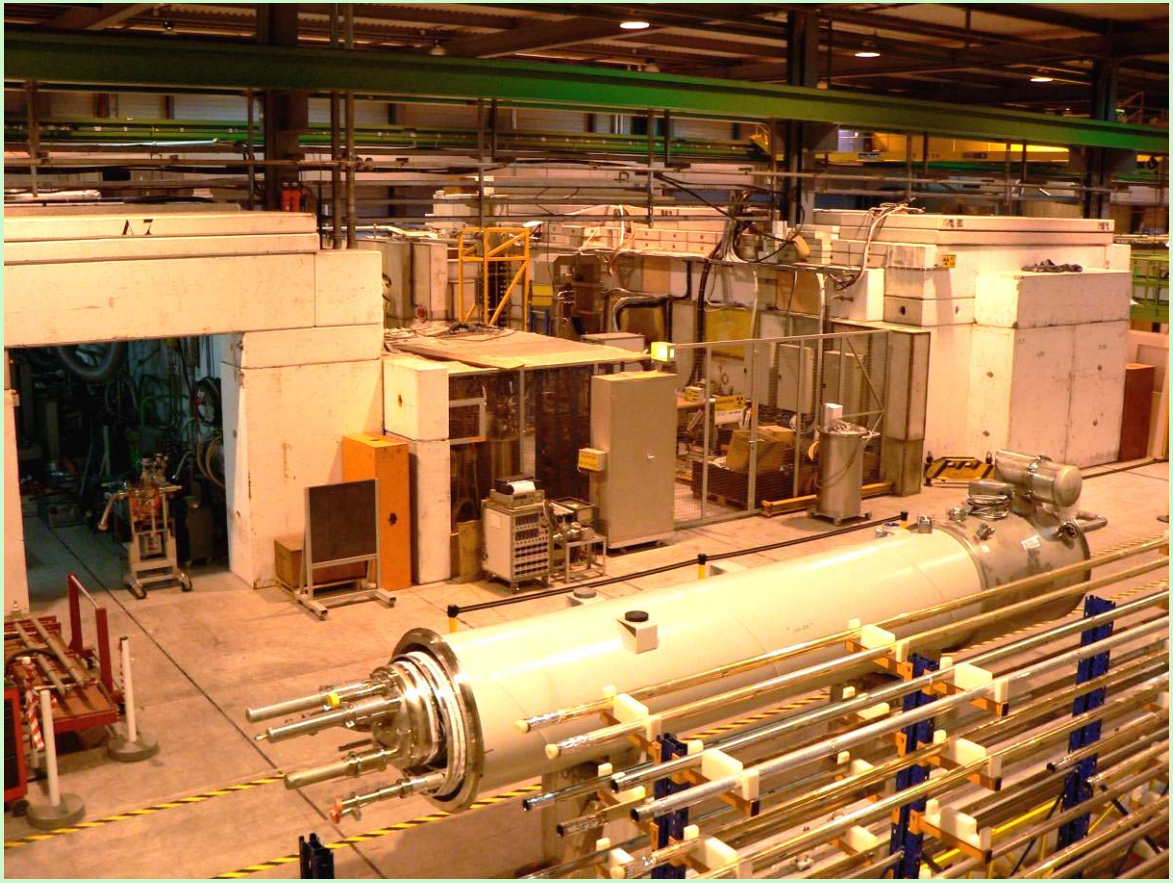
Niobium sputter coating facilities – bldg 252 and 101

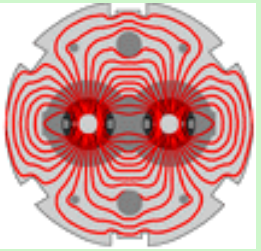




Sputtering facility for Nb coating of Cu cavities (a 200 MHz cavity from the Cornell/CERN project being coated is pictured)
Sputtering facility for Nb coating of 1.5 GHz Cu cavities. Another facility exists which allows the deposition of double layers, and which has also been used extensively for the copper coating of RF couplers extension tubes (these are made of stainless steel and connect the cold cavity to the warm part of the coupler).

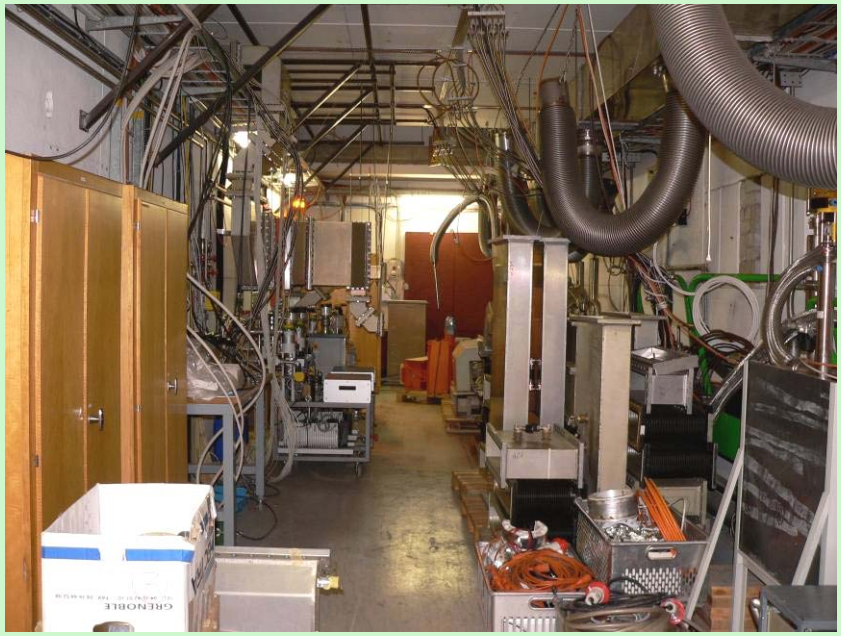
RF bunkers – SM18

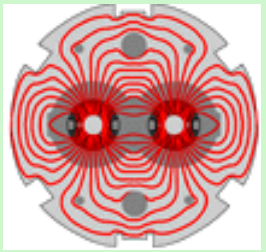




View on the RF measurement and conditioning bunkers. Left an open bunker, in the middle the klystron area (which housed another bunker during the LEP period), right a bunker in operation with closed concrete door (conditioning of LHC couplers on the module). In the front an LHC (quadrupole) magnet under preparation for testing.

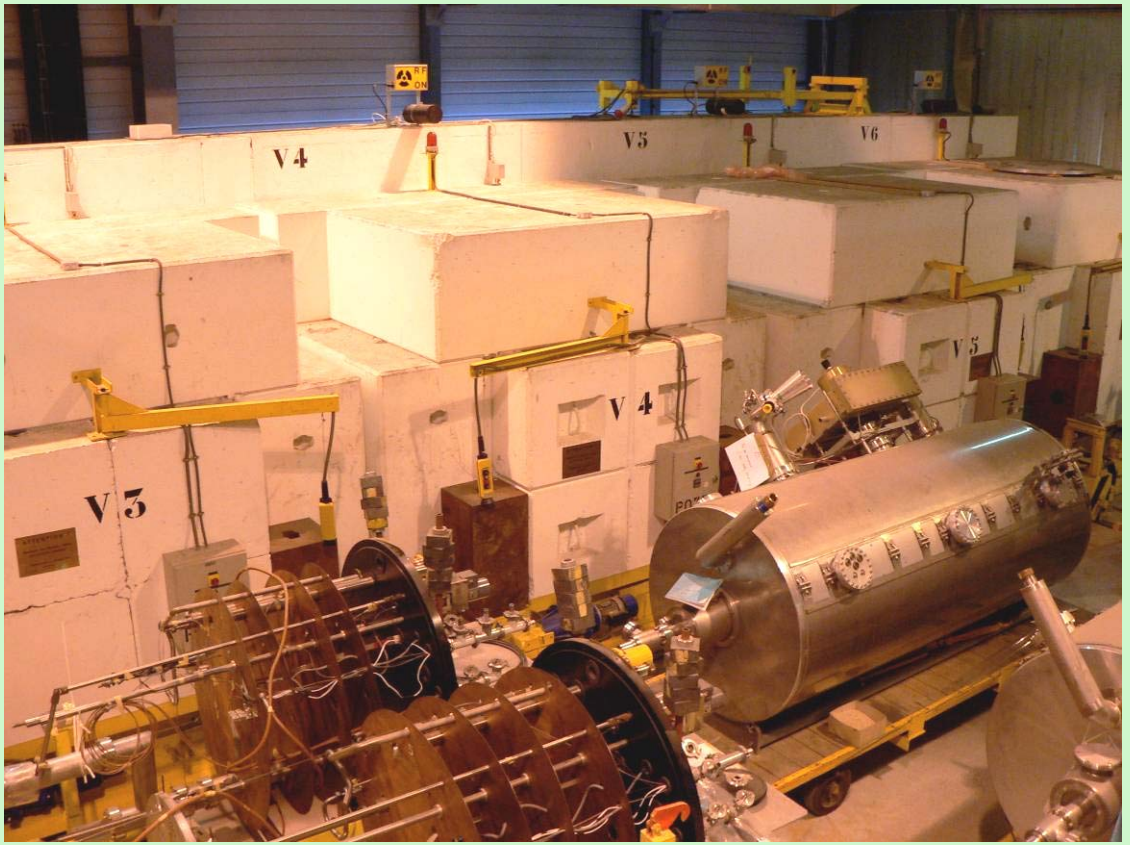
Close view in RF bunkers – SM18

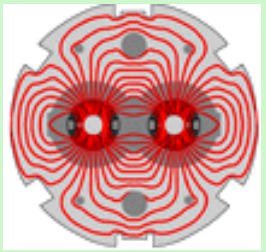




Left, view into the open bunker. At the top is the emergency He blow-out line with four corrugated hoses (‘elephant trunks’) to connect to the cavities rupture disk outlets.
At right, a 400 MHz, 300 kW klystron in operation. Out of view, but nearby, are a LEP type power converter (up to 100 kV, 40 A), an HV cage containing remote HV switch, fast LHC type protection system, 352 MHz and 400 MHz modulators. There is also a LEP 352 MHz 1 MW klystron. Both klystrons have their circulator and full power loads. The water-cooling system allows up to 700-800 kW.

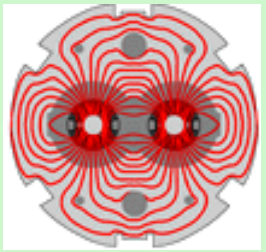
Vertical test cryostats – SM18





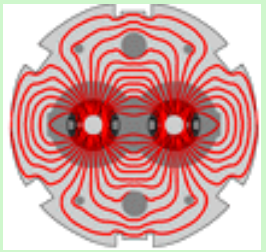
Visible are only the concrete ‘hats’ for radiation protection. These can be rolled away on rails, uncovering below a test cryostat sunk into the ground; two with sufficient depth to contain a LEP 352 MHz cavity of 2.4 m length and the (heat) radiation shields above it, and one of lesser depth used for single cell cavity tests. The 300 W solid-state RF power amplifiers with their circulator and load are housed behind the concrete wall (for low power cavity/module tests)

RF control room – SM18



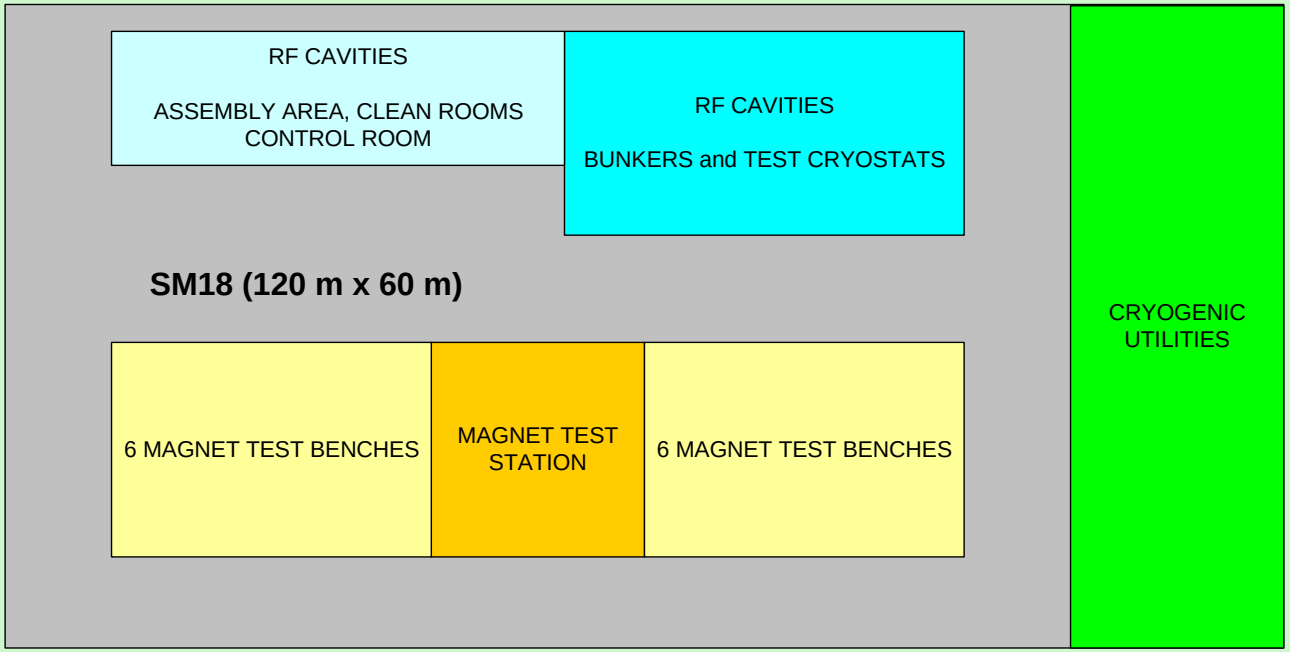
View of the control room of the SM18 RF installations. In the LEP period it housed up to 4 individual and 3 quadruple (3 modules with 4 cavities each) RF measurement benches with additional vacuum and cryogenic control and the interface to the cryogenic plant. The controls for a 60 kW 352 MHz tetrode installation were also included. Parts of it have been dismantled and klystron controls for 352 and 400 MHz have been added as well as LHC specific test hardware (e.g. tuner control, RF vector feedback).

Cryogenics – SM18



Gaseous helium pumping unit 18 g/s at 3 kPa, available after 2007

Cryogenics and cryostats – SM18 – after 2007



- RF needs for repairs for the LHC lifetime: one bunker + klystron gallery, one vertical cryostat, control room
- Needed for LHC operation and LHC magnet testing: ~ 6 test benches + test station + dedicated cryogenic infrastructure.
- After 2007, about 1000 m2 presently occupied could be let free