Via Vicenza 113 - 36015 Schio (VI)
Italia

SC cavities production at Ettore Zanon s.p.a.

Ing. G. Corniani

Ettore Zanon s.p.a.

Short Summary

A. Ettore Zanon s.p.a. Company

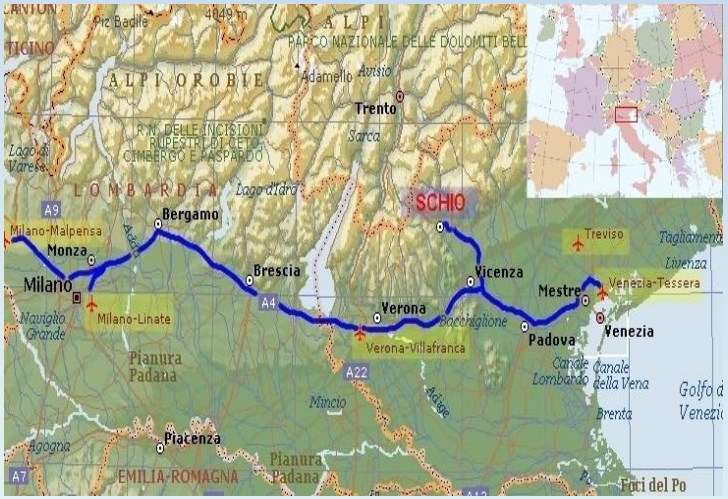
B. Overview of past production of SC cavities and cryomodules

C. Company participation to the R&D phase of the XFEL project and actual involvement (SC cavities serial production)

D. Cavities production lay-out and Infrastructures

E. Conclusion

SC cavities production (A)



The company was founded in 1919

It is located in the North-east of Italy

90 KM from Venezia

Number of personnel 210

Shop's workers 160

Machining , forming , welding and testing facilities

Standard production for chemical industry (reactors, heat exchangers)

Production of special components for research institutes and laboratories (UHV , cryogenics , Fusion , Superconductivity)

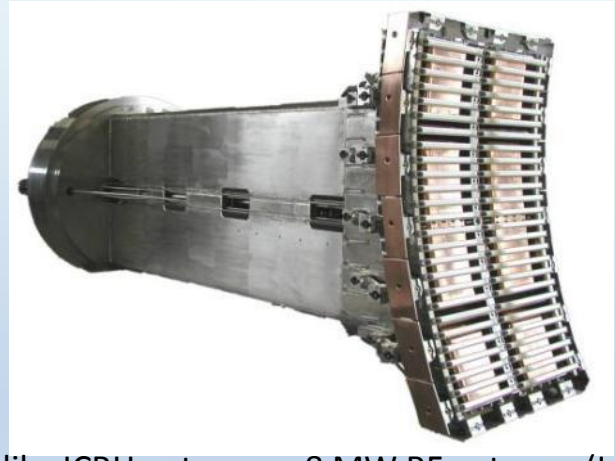
SC cavities production (A)

Standard productions

Oxychlorination reactor -Cladded material
Dimension Dia. 4,1 m X L. 20m , 165 Tons

Orbital welding of heat exchanger tubesheet
Material S.S. And Zirconium

Special components for research



ITER like ICRH antenna – 8 MW RF antenna (Inconel 625)
EFDA-JET

Aluminium thermal shield for the ATLAS detector at CERN

Overview of past production of SC cavities and cryomodules

Ettore Zanon s.p.a has been working and manufacturing special components for superconducting applications since more than 20 years.

Experience with niobium superconducting cavities started in the early 90's and has continued without interruption since nowadays.

In a similar way , by using the available in house production facilities and processes , the production and test of cryostats and cryomodules were successfully completed for many different scopes and projects.

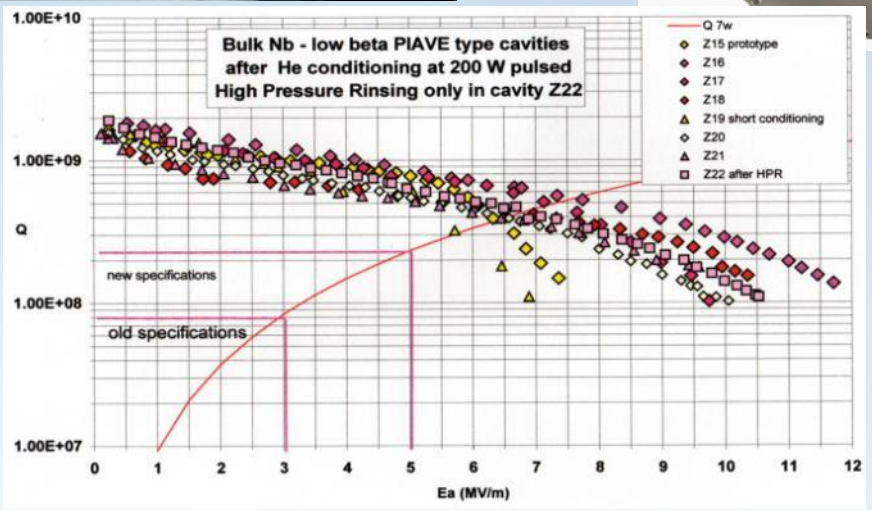
Here a quick non-complete overview of past productions

SC cavities production (B)

Quarter wave superconducting cavities for ALPI-PIAVE linacs
INFN Laboratori Nazionali Legnaro –Italy

Quarter wave superconducting cavities for ISAC-II project
TRIUMF laboratories at Vancouver-Canada

Production in different steps of 48 units



SC cavities production (B)

RFQ2 and RFQ1 quadrupole cavities for ALPI Linac

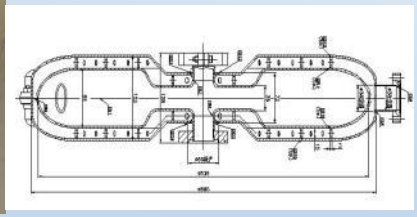
RFQ2 cavity , 80 MHz RF , full-niobium quadrupole superconducting cavity
overall dimensions ∅810mm x800mm. length

RFQ1 cavity , 80 MHz RF , full-niobium quadrupole superconducting cavity ,
overall dimensions ∅810mm x1410mm. length
Basically the union of two cavities SRFQ2

SC cavities production (B)

Re-entrant cavity (TRASCO program)

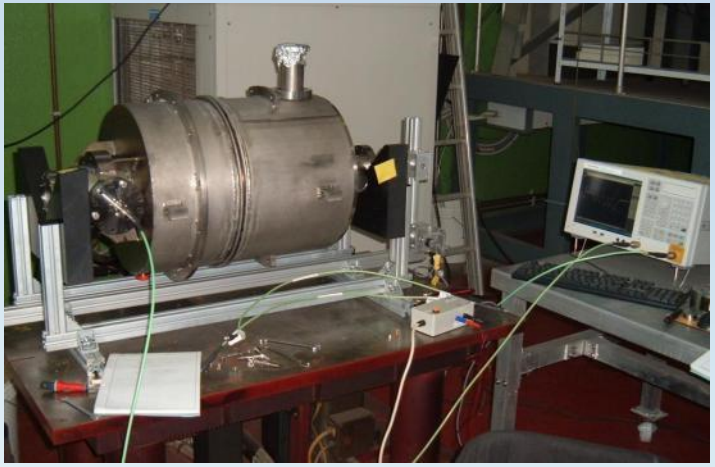
Double wall circular components made of RRR niobium sheets thickness 4mm.
inner shell diameter 536 mm ,outer shell diameter 560mm



5 cells superconducting cavity 700MHZ β=0,5 (TRASCO Program)

Titanium tank manufacture and cavity integration Tuning tooling design and manufacture , tuning operations (collaboration with INFN lab. LASA)

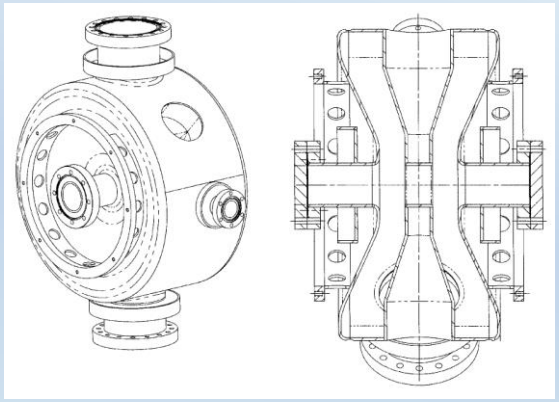
Similar design of the next ESS project

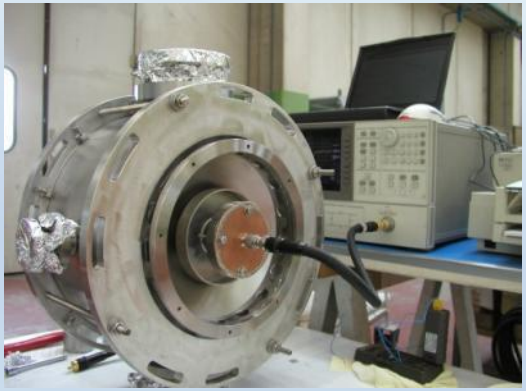


SC cavities production (B)

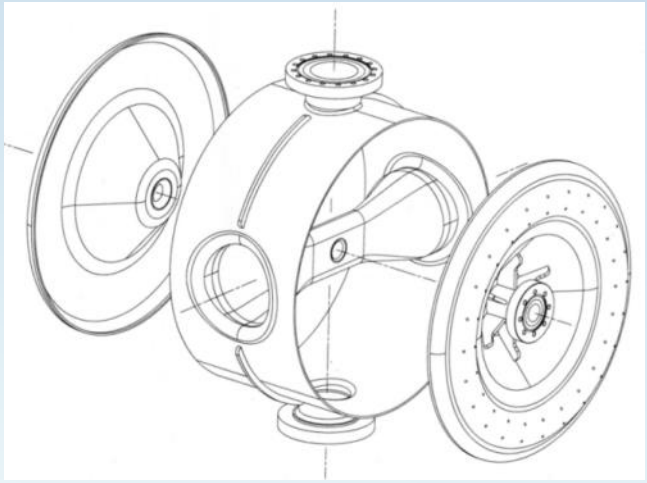
ß=0,175 2 GAP SPOKE RESONATORS

LANL Los Alamos National Laboratory Accelerator Driven Test Facility project





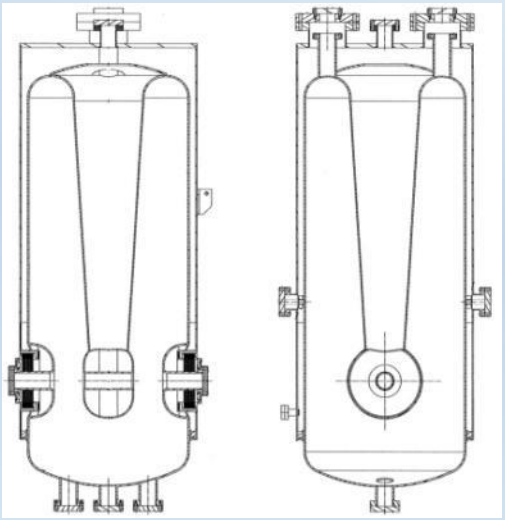
ß =0,22 , 325 MHz single Spoke Resonator -FERMILAB FNAL Proton Driver

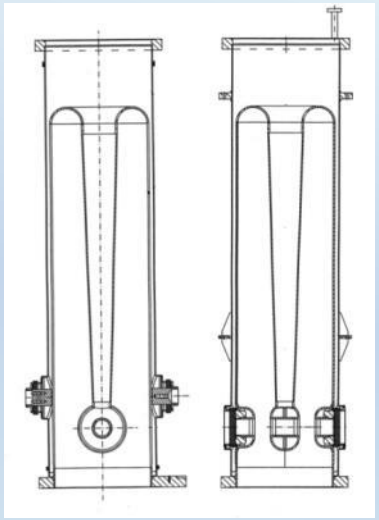


SC cavities production (B)

ß 0,12 and ß 0,07 , 88 MHz Quarter Wave Resonators

CEA , SPIRAL II Project – GANIL (several units with S.S. He tank)

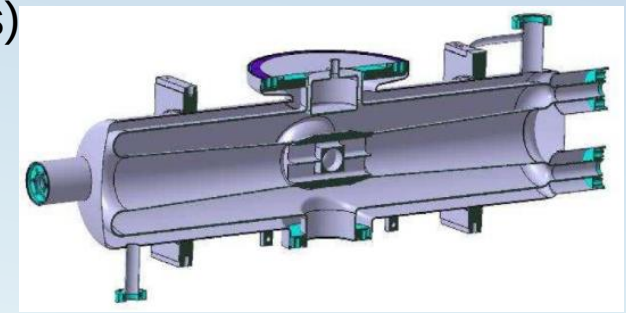




ß 0,094 175 MHz Half Wave Resonator (and titanium He tank)

CEA , IFMIF –International Fusion Material Irradiation Facility

(Prototype + 9 units in progress)



SC cavities production (B)

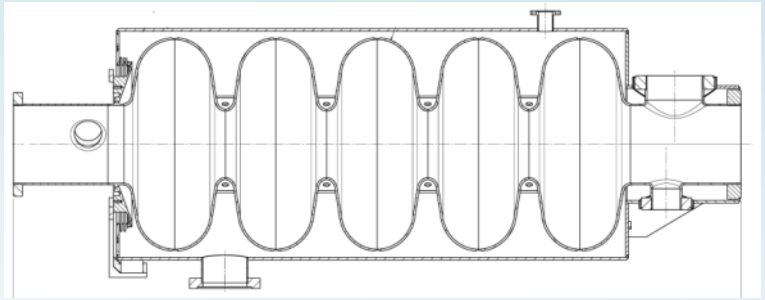
9 cells superconducting cavity 1,3GHz and 3.9 GHz for XFEL project (DESY)

Development and manufacture of 1,3GHz superconducting cavities (past delivery of 66 units - performances above 30MW/m) and infrastrucutre for serial production

Development and manufacture of the 3,9GHz superconducting cavities (3 units) and relevant toolings for BCP , RF and HPR operations

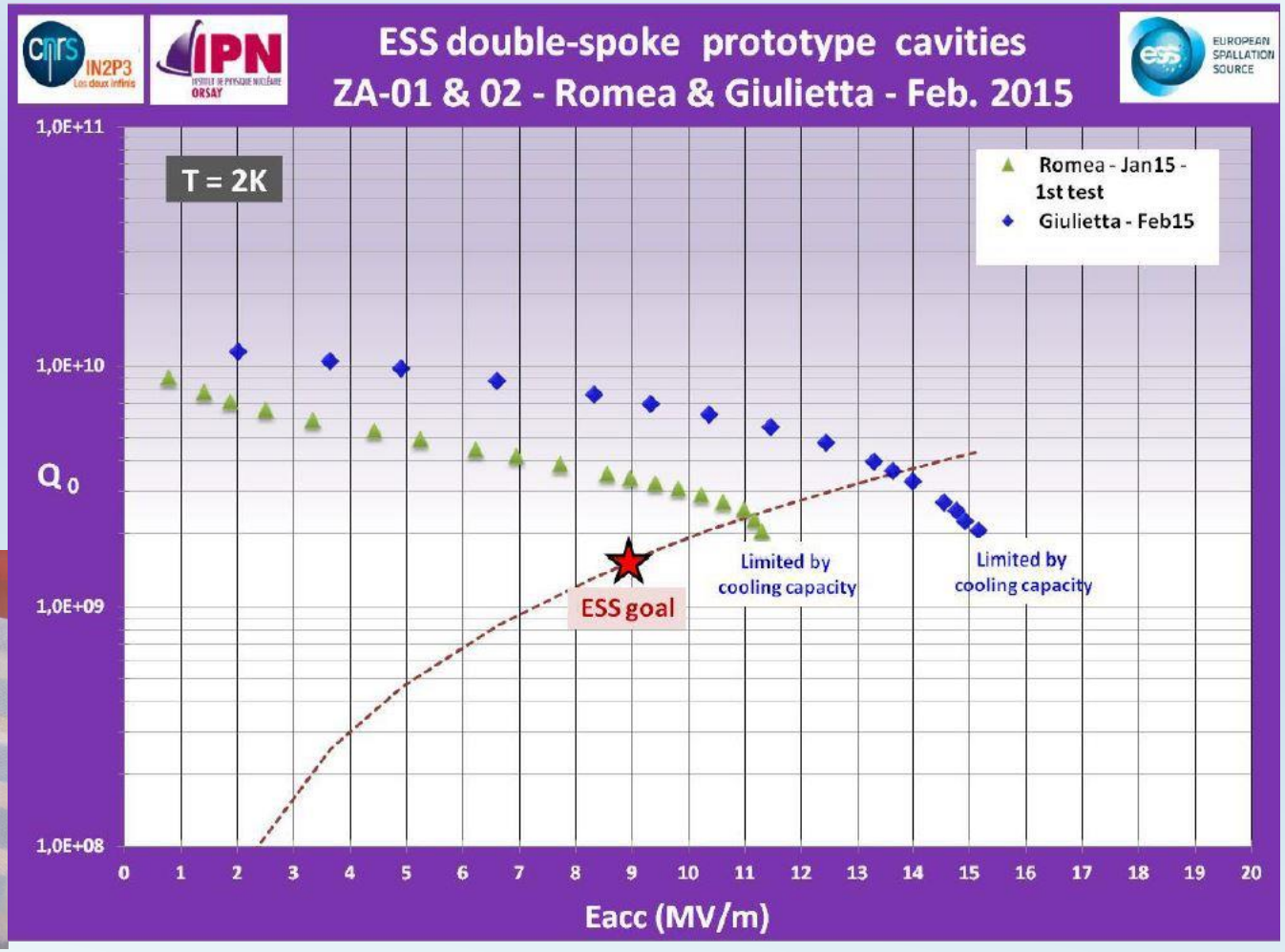
5 cells , 700 MHz SC elliptical cavities for EUCARD –ESS project

(CEA – two prototypes delivered)



SC cavities production (B)

Double Spoke cavities for ESS project
(IPN ORSAY– two prototype)



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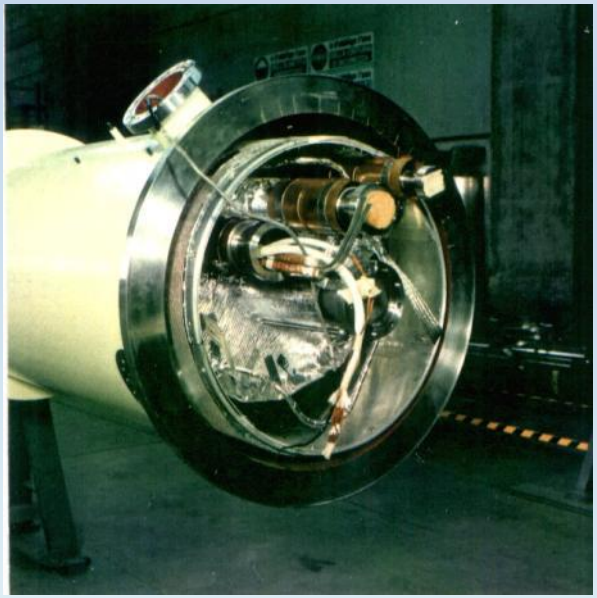
SC cavities production (B)

Production of cryostats and cryomodules for SC applications

HERA Project at DESY-Hamburg

Production and assembling of 242 cryostats for the

S.C. dipole magnets



SC cavities production (B)

LHC Project at CERN-Geneve

Pre-series manufacturing and assembling of 10m. and 15m. long cryostats for the S.C. dipole magnets

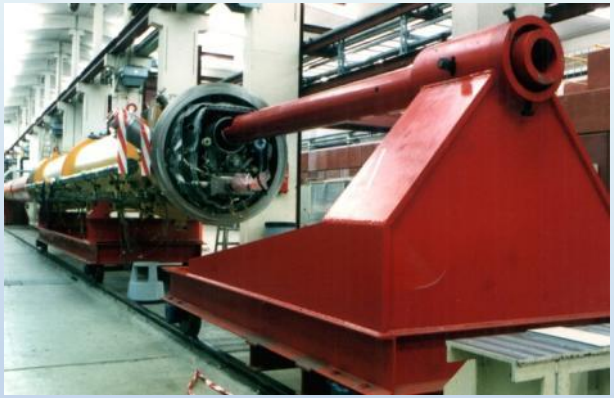
SC cavities production (B)

SPIRAL II Project – GANIL ,CEA

Series of cryomodule for SC cavities

SC cavities production (B)

TESLA Test Facility – XFEL Project at DESY



Past production of cryomodule for R&D phase

Actual production of cryomodule for XFEL

SC cavities production (C)

Company participation to the R&D phase of the XFEL project and actual involvement

(SC cavities serial production)

Development and manufacture of the cryomodules and assembling tooling (10 units supplied)

Development and manufacture of 1,3GHz superconducting cavities

(66 units supplied - performances above 30MW/m))

Development and manufacture of the 3,9GHz superconducting cavities

Manufacture of the Titanium helium tanks (111 units supplied)

Manufacture of the titanium blade tuner

(40 units , alternative design solution to the standard tuners)

SC cavities production (C)

Actual involvement to the XFEL project
August 2010 to 2011 , Award of DESY contracts for

A) Manufacture and final treatement of 420 units of the 9 cells , 1,3GHz SC cavities

Scope of work includes :

- Manufacture of the 1,3GHz cavities / Manufacture of their Titanium Helium tanks
- Integration of the cavities into their tank /Treatments and Surface cleaning treatments
- Components manufacture and certification according to PED (Presssure Equipment Directive)
- Delivery production rate 4 units/week
- Like above for 10+10 units of 3,9GHz SC caviites of the injector module

B) Manufacture and testing of 45 units of XFEL Cryomodules

Scope of work includes

- Vacuum vessel and cold-mass prefabrication and testing
- Delivery to the assembly site (CEA-France)

C) Manufacture and testing of 146 units of Titanium Helium tanks

Scope of work includes

- Tank prefabrication and He leak check
- Delivery to DESY

SC cavities production (C)

Staus of the XFEL project production at EZ (MAY 2015)

A) Cavity production 423 units welded - 378 units surface treatted and delivered
Performance of the delivered units up to 40 MV/m
Production end expected October 2015

B) 45 units of XFEL Cryomodules completed and delivered

C) 146 units of Titanium Helium tanks completed and delivered

D) 10 units of 3,9GHz cavity completed and delivered
Performance of the delivered units up to 25 MV/m

Cavities serial production lay-out and Infrastructures

• The cavity production has been organized with a dedicated lay-out into two dedicated buildingd separate from others Ettore Zanon s.p.a. production
(building lot I and building lot IV)

•Building lot I
prefabrication of cells , dumb-bell ,subassemblies , end groups
EB welding , chemistry

•Building lot IV (renewed building)
Final cavity welding , integration with Helium tank , surface treatments

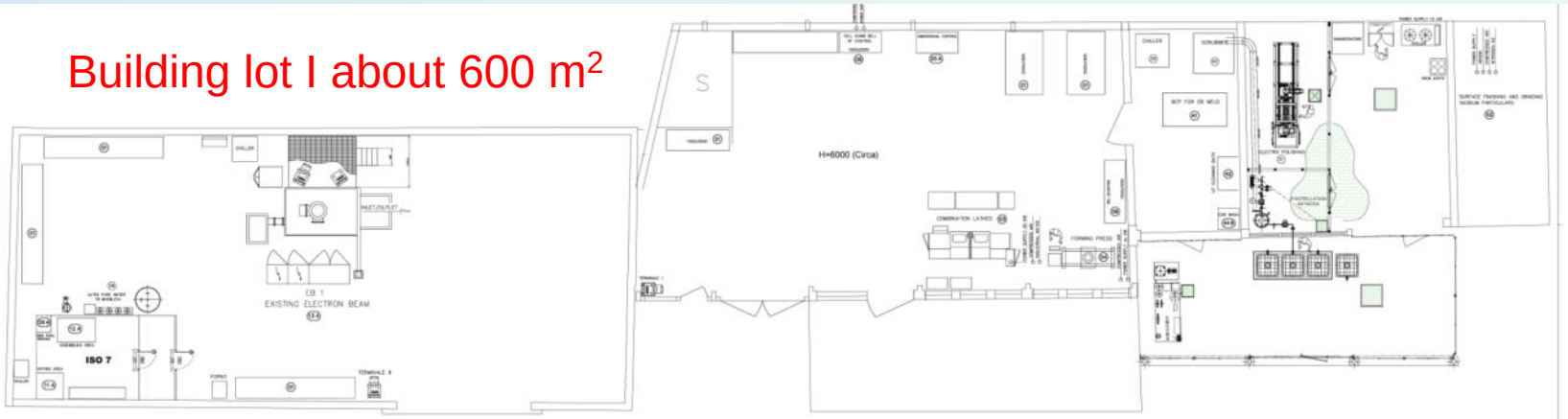
(Prefabrication of the titanium Helium tank in the “standard” shop)

Building Lot IV shall be assigned for future similar productions

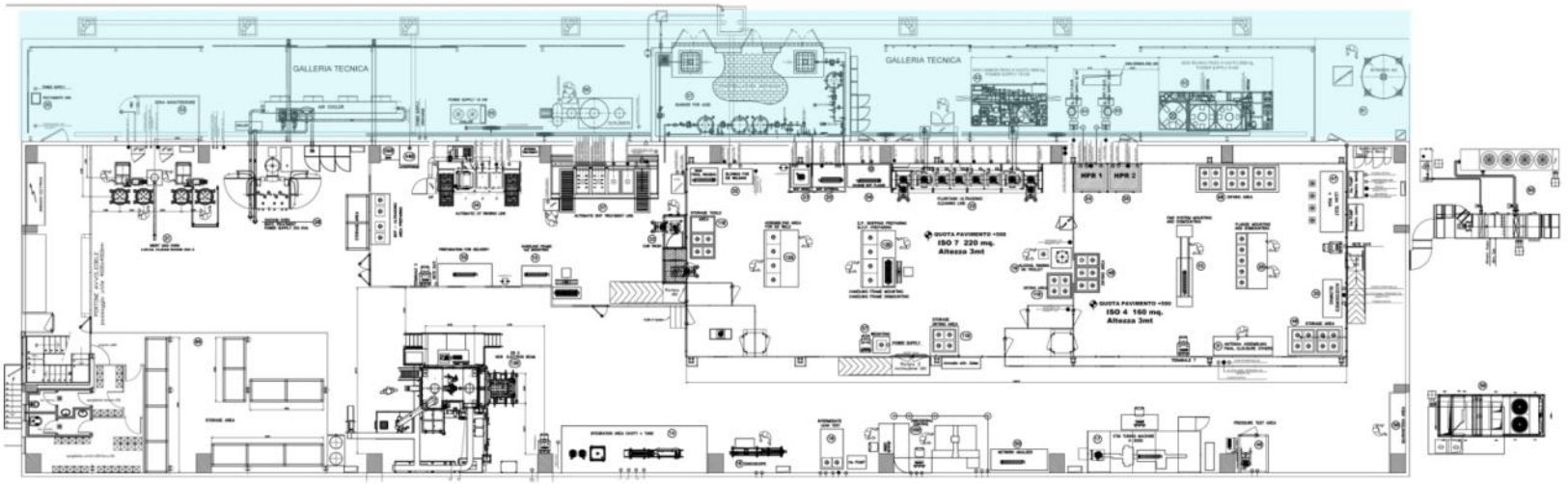
SC cavities production (D)

Cavity's production lay-out

Building lot I about 600 m^2

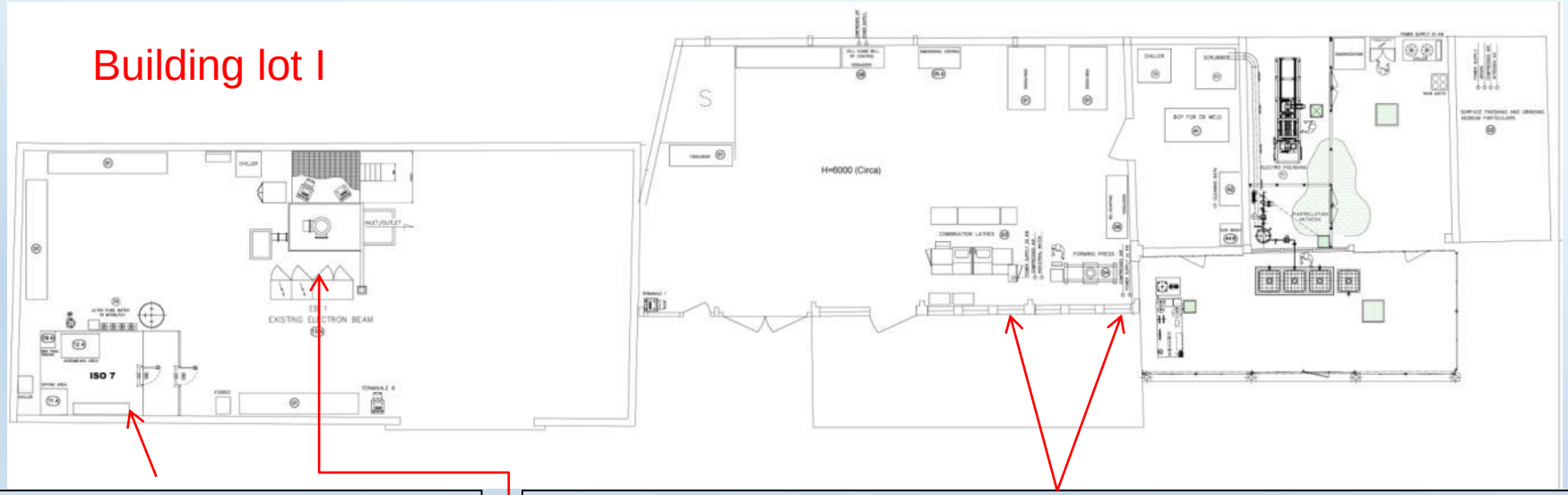


Building lot IV 1200 m^2 (plus 600 m^2 for services)



SC cavities production (D)

Building lot I



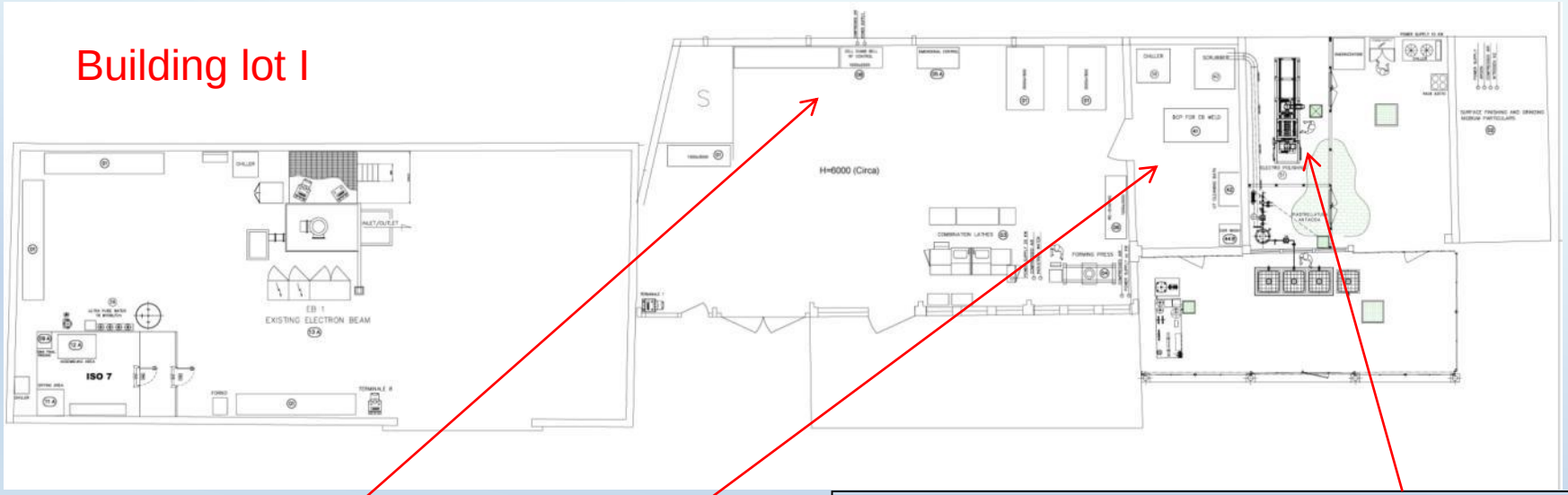
Clean room ISO7
UPW production unit
(18MΩcm)

Dedicated 200T forming press (cells , tube's pulling , reshaping) CNC turning machine (cell Dumb-bell machining, others)

Electron beam plant
150KV-30KW
with cryogenic pump

SC cavities production (D)

Building lot I



Material (Niobium) storage area and incoming controls
Dimensional controls

UT and BCP treatment of sub-components

Electropolishing with UPW plant(18MΩcm)

SC cavities production (D)

Building lot IV

The building has been completely “restored” for thie scope of XFEL production with installation of central conditioning system too (clean environment)

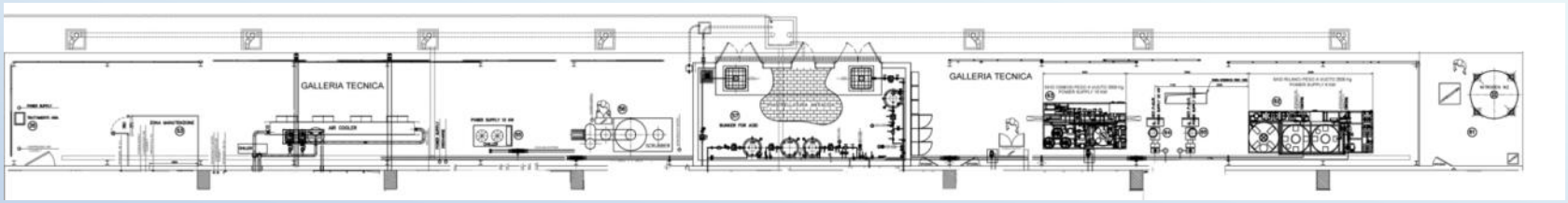
Into the building
Designed–optimized lay-out for the cavities serial production

Organization by manufacturing/testing station (MTS) located to suit the production flow

Outside of the building
“Service area” to concentrated all the equipments/services for the MTS

SC cavities production (D)

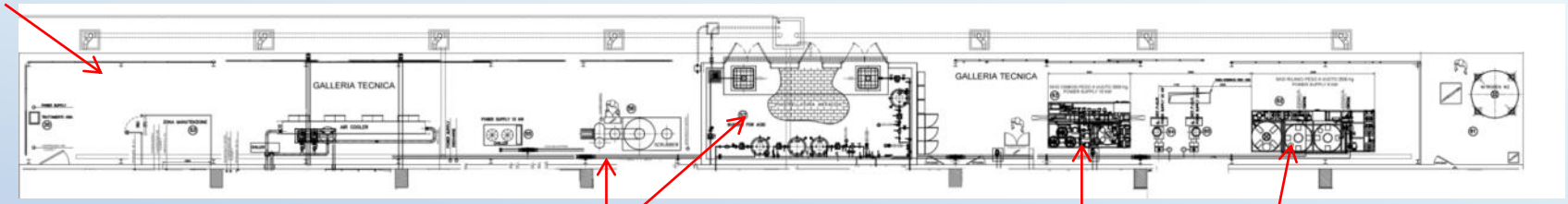
Building lot IV Service area



SC cavities production (D)

Maintenance area

Building lot IV Service area



Chemistry service area : storage of BCP acid tanks-cooling systems for BCP stations Scrubber for acid gasses vent	Ultra pure Water (UPW) production production up to $3m^3/h$ at 18 MΩcm $5m^3/h$ at >10 MΩcm

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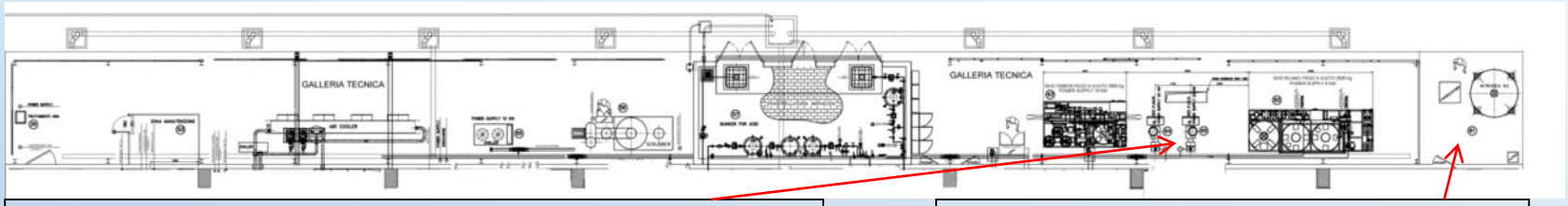
SC cavities production (D)

Building lot IV Service area

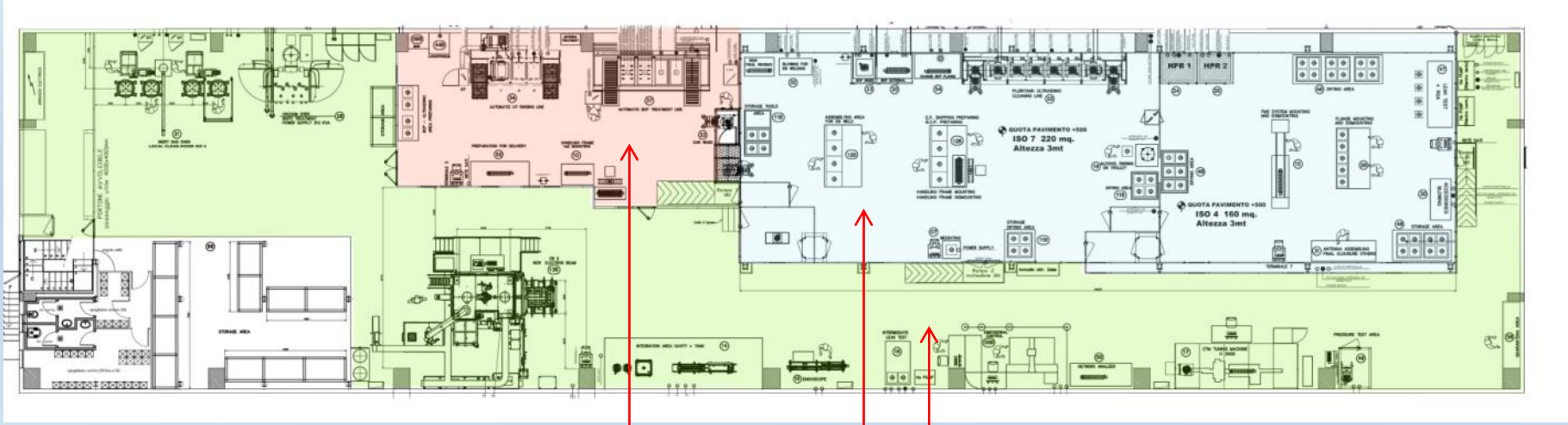


Pumps
(water 18 MΩcm ,>100 bar 1,5 m3/h)
for High Pressure Rinsing cabinets

Storage tank for LN2
Venting of EBW machine
and of leak check groups

SC cavities production (D)

Building lot IV



The buidling is organized in three main areas

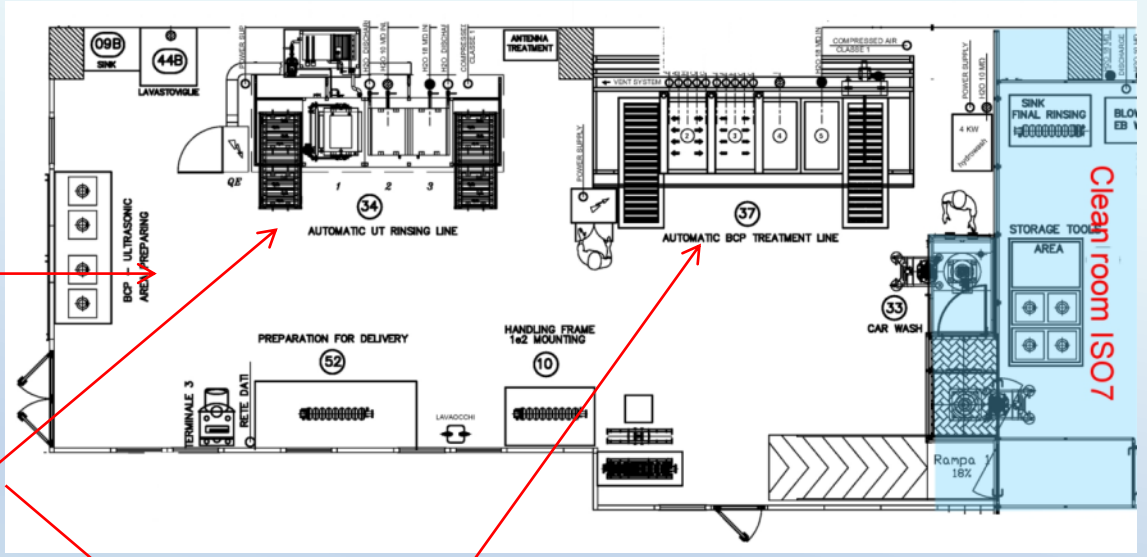
A) Chemical treatment area
B) Clean room ISO7/ISO4
C) Controls , Integration , 800° C -120° C treatments and testing area

Infrastructure status for XFEL (D)

Building lot IV
Chemical treatment area

Preparation and drying areas

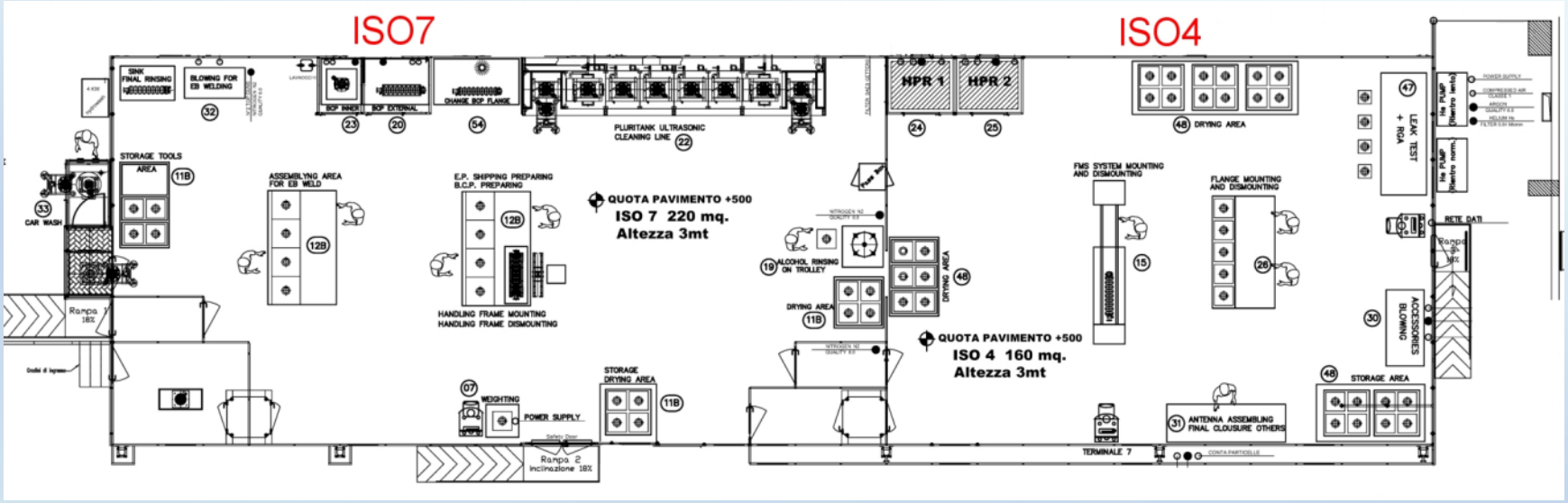
Automatic pluritank station for UT cleaning , rinsing water 10 MΩcm and 18 MΩcm



Automatic BCP treatment line
2 cooled acid baths for Niobium and Nb-55-Ti
1 bath first rinsing 1 bath final rinsing water 10 MΩcm and 18 MΩcm
protection tunnel ,fumes extraction to the scrubber

SC cavities production (D)

Building lot IV Clean room ISO7/ISO4



Dedicated to

clean assembling , final surface treatments , final assembling for the RFcold test

Total surface of about 450 m^2

ISO7 area 220m^2 ISO4 area 200m^2

Operators dressing rooms , air showers

All metallic floating floor

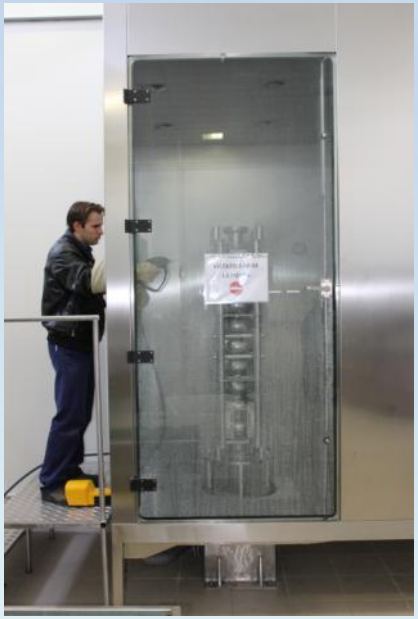
Customized treatment stations

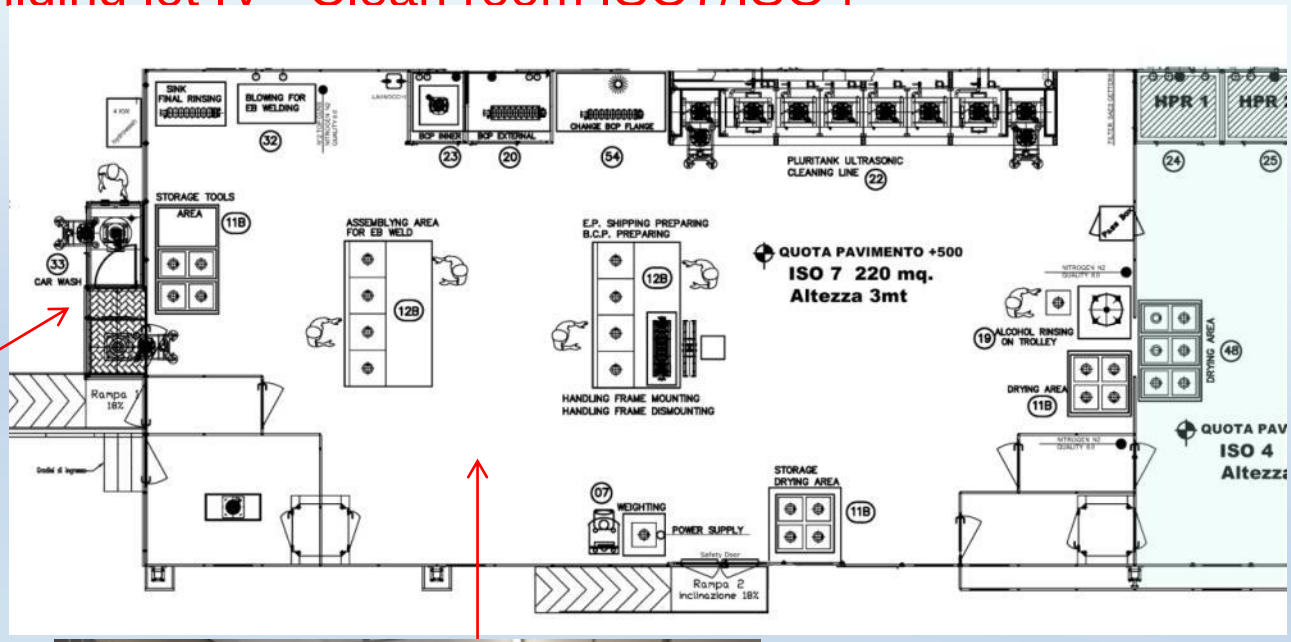
SC cavities production (D)

Building lot IV Clean room ISO7/ISO4

ISO 7

100 bar UPW cleaning cabinet for ISO7 entrance





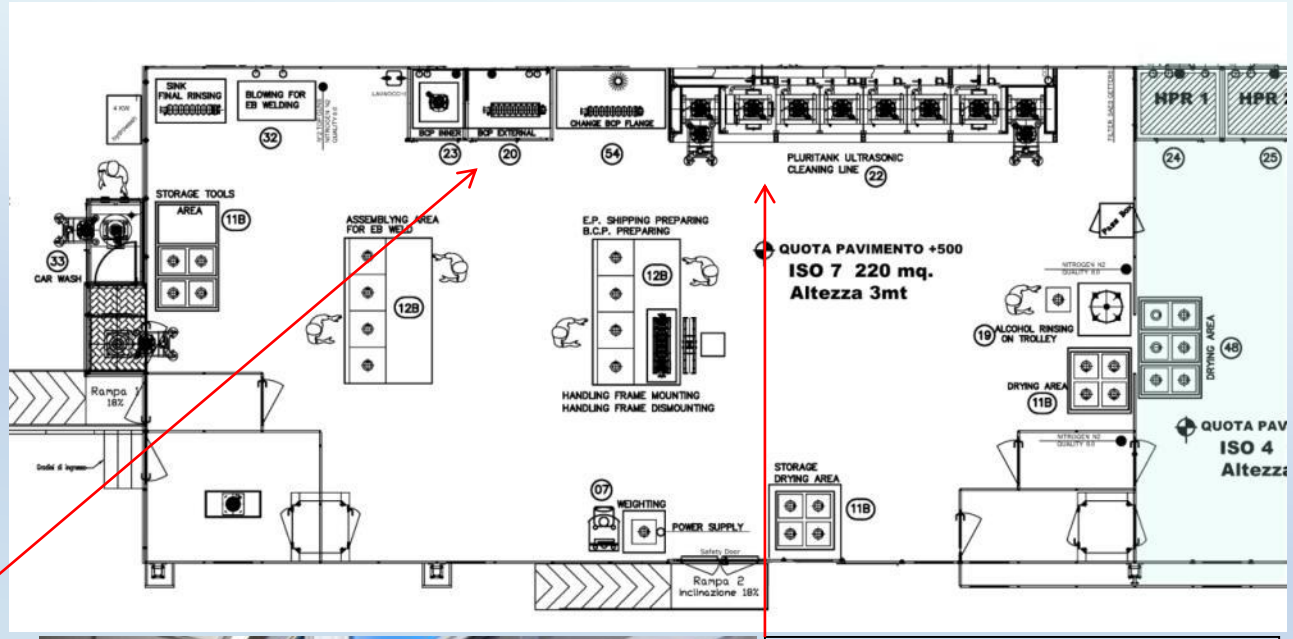
Pre-assembling stations for cavity EBW preparation

SC cavities production (D)

Building lot IV Clean room ISO7/ISO4

ISO 7

Cabinets for BCP close circuit
of the inner / outer cavity surfaces



Automatic pluritank station
for
UT cleaning and
rinsing baths
water 10 MΩcm
and 18 MΩcm

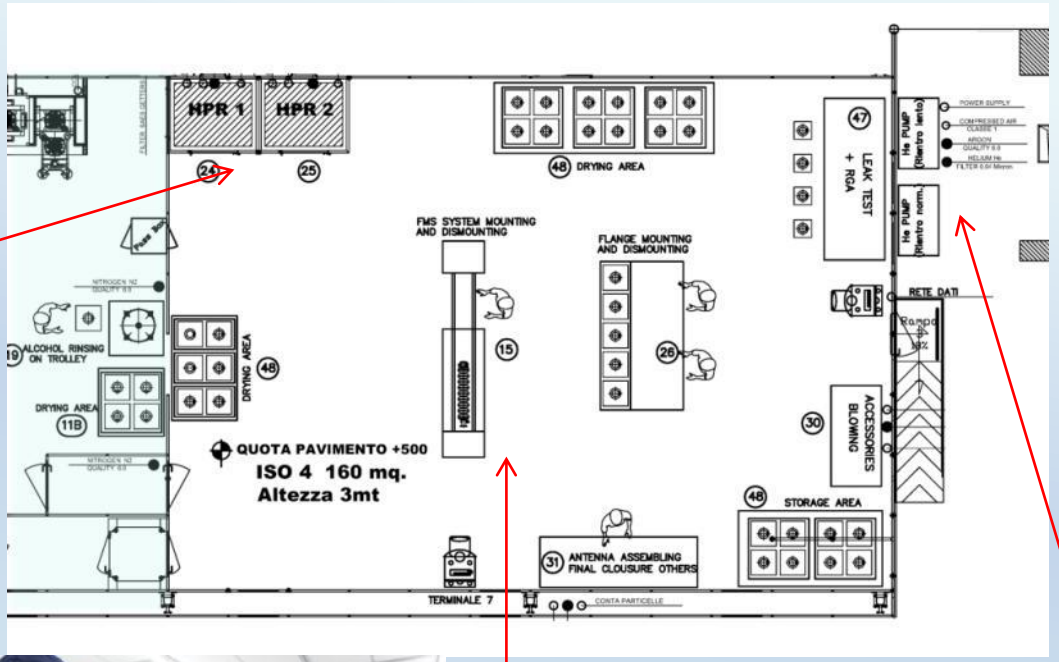
Alcol rinsing , Others

SC cavities production (D)

Building lot IV Clean room ISO7/ISO4

ISO 4

N° 2 cabinet for final HPR
UPW 18 MΩcm water
p>100bar , 1.5m^3/h
Cavity's rotation , vertical translation Nitrogen overlay



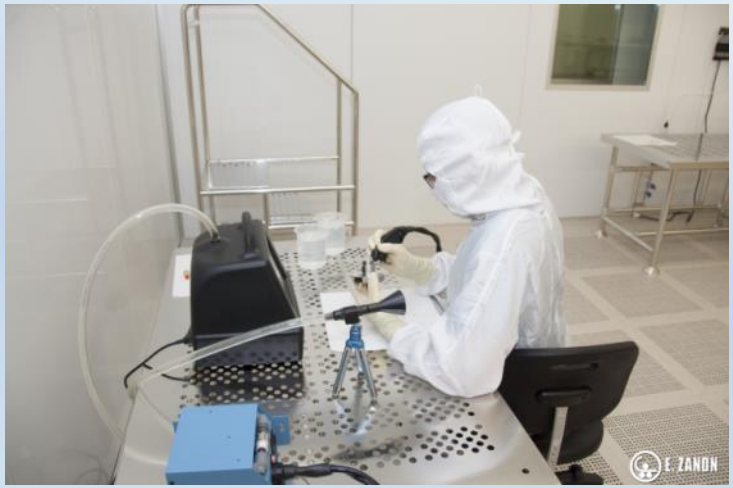
Station for final leak test special equiments for slow-controlled venting of the cavity ,…others

Assembling stations for FMS installation - RF antennas assembly

SC cavities production (D)

Building lot IV Clean room ISO7/ISO4

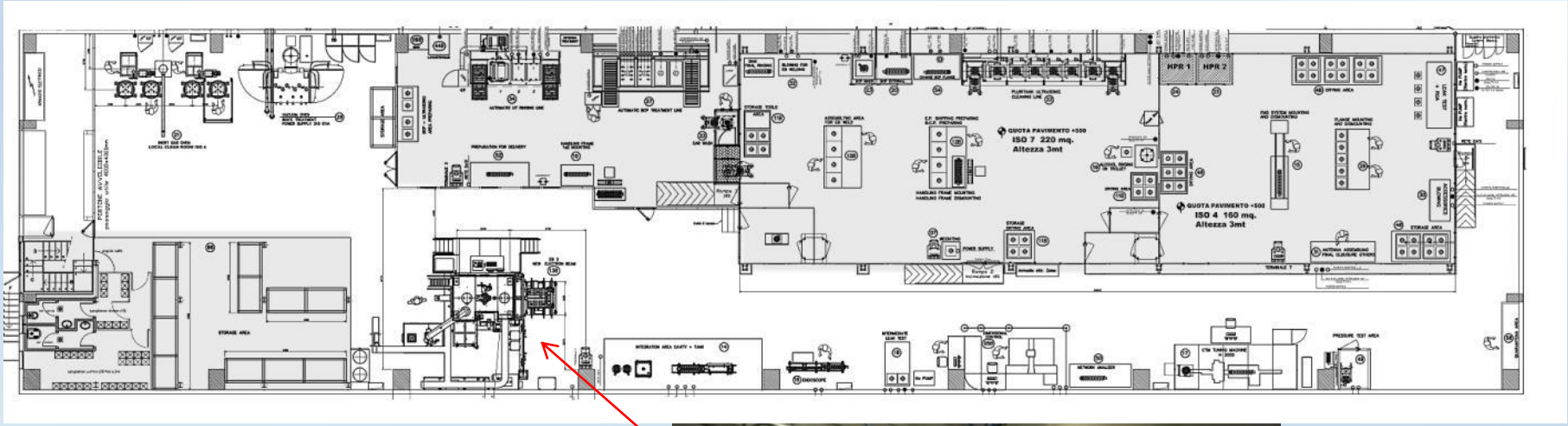
ISO 4



SC cavities production (D)

Building lot IV Control , Integration , 800° C -120° C treatments and testing area

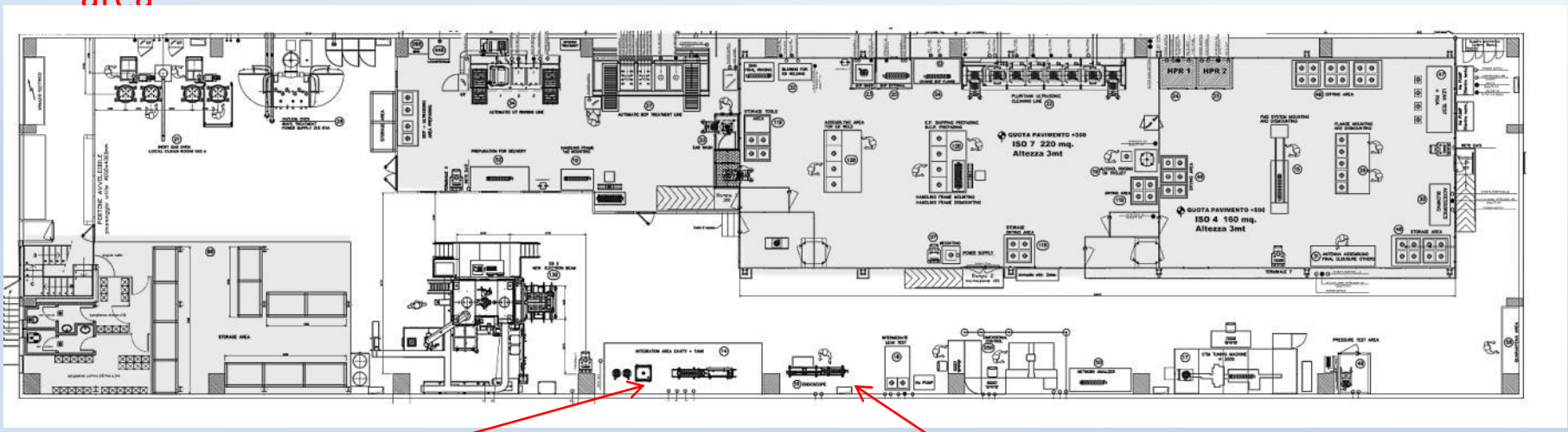
The area is organized to suit part of the production and control operations (good clean environment , not classified)



New EB welding plant : S.S. Chamber , size 3,4x2x2 m , oil free pumping group with cryogenic pump ($3x10^{-5}$ mbar 35 minutes) nitrogen venting , RGA

SC cavities production (D)

Building lot IV Control , Integration , 800° C -120° C treatments and testing area



Station with automatic TIG equipment for Cavity-tank final integration

Visual examination with photo recording of the cavity
inner welds and surfaces (boroscope)

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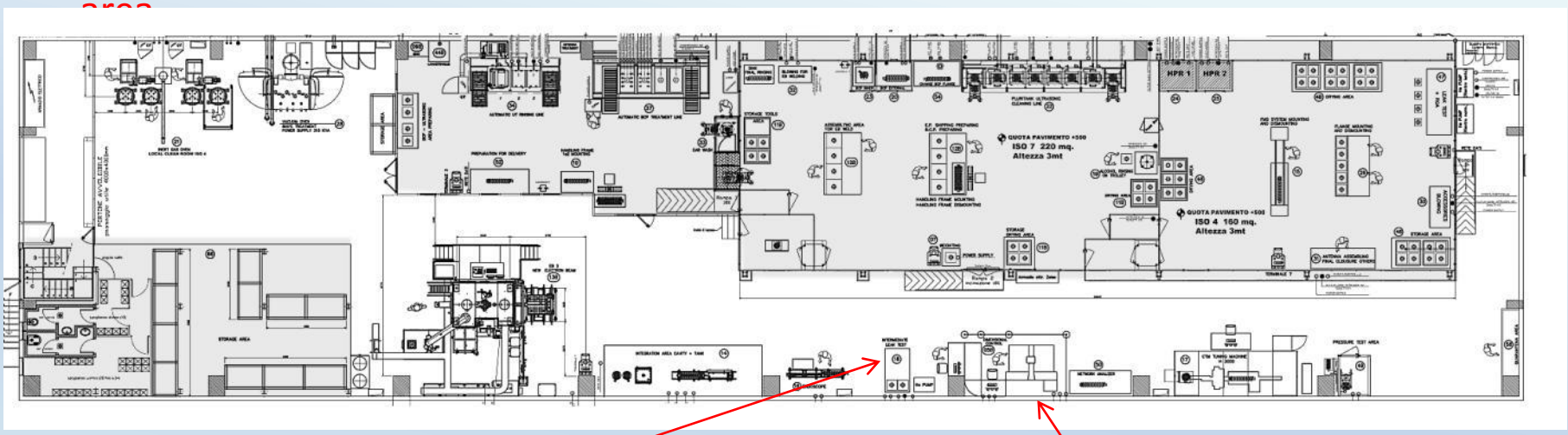
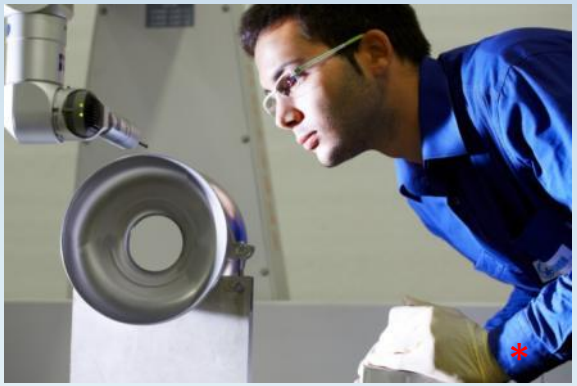
SC cavities production (D)

Building lot IV Control , Integration , 800° C -120° C treatments and testing



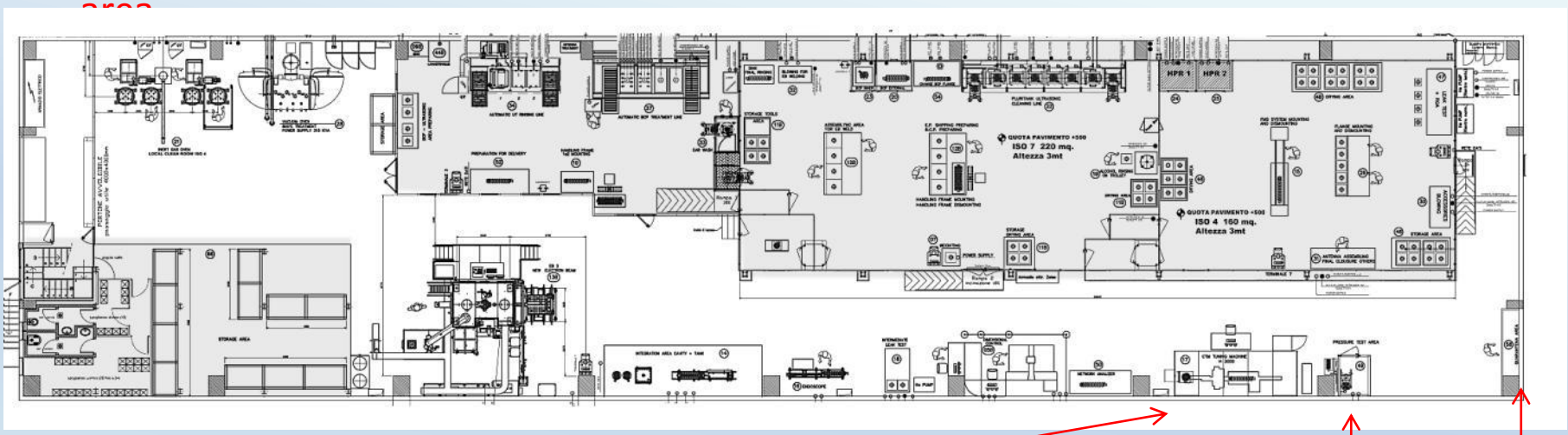
Intermediate leak test (oil free equipments)

CMM , semi-automatic ControlMeasuring Machine for dimensional survey



SC cavities production (D)

Building lot IV Control , Integration , 800° C -120° C treatments and testing



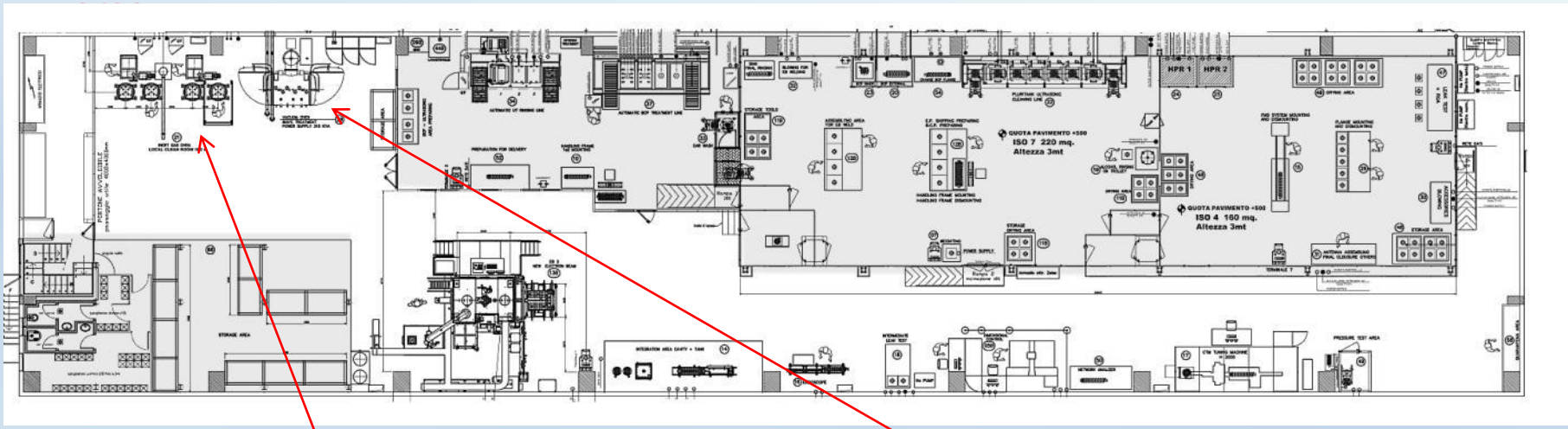
Dedicated Desy equipment for sub-component RF control and cavity final tuning

Shielded pressure test area (final PED certification)

Quarantine closed cabinet (non conform pieces)

SC cavities production (D)

Building lot IV Control , Integration , 800° C -120° C treatments and testing



Inert gas oven for final treatment
(120° C , 1x10^{-5} mbar , 52 Hours)

Vacuum oven for 800 ° C annealing
Molibdenum Hot-chamber 0,6x0,6x1,5m
(4 units per batch)
cryogenic pumps , RGA

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Nowaday (results and targets)

Ettore Zanon s.p.a. is going to complete successfully the XFEL cavity production. With the available infrastructures , the gained experience and trained team EZ wish to continue the presence in the field , offering the possibility to Research organizations , laboratory and industry to develop and manufacture critical components in a properly dedicated infrastructure

Our production team for SC cavities

END

Thanks for the attention