TSR @ Isolde

Status Report on the TSR building

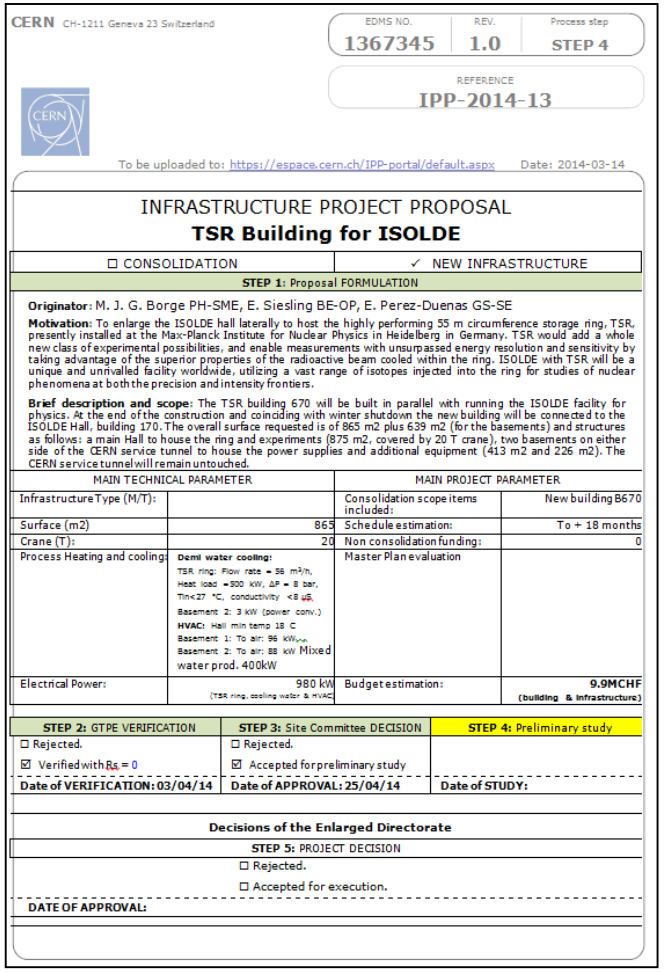
(and Infrastructure)

TSR @ Isolde workshop

CERN, 27/28 April 2015

Erwin Siesling

TSR Infrastructure Project Proposal (CERN)



CERN CH-1211 Geneva 23 Switzerland

EDMS NO.	REV.	Process step
1367345	1.0	STEP 4

REFERENCE
IPP-2014-13

To be uploaded to: https://espace.cern.ch/IPP-portal/default.aspx Date: 2014-03-14

INFRASTRUCTURE PROJECT PROPOSAL

TSR Building for ISOLDE

☐ CONSOLIDATION	✓ NEW INFRASTRUCTURE

STEP 1: Proposal FORMULATION

Originator: M. J. G. Borge PH-SME, E. Siesling BE-OP, E. Perez-Duenas GS-SE

Motivation: To enlarge the ISOLDE hall laterally to host the highly performing 55 m circumference storage ring, TSR, presently installed at the Max-Planck Institute for Nuclear Physics in Heidelberg in Germany. TSR would add a whole new class of experimental possibilities, and enable measurements with unsurpassed energy resolution and sensitivity by taking advantage of the superior properties of the radioactive beam cooled within the ring. ISOLDE with TSR will be a unique and unrivalled facility worldwide, utilizing a vast range of isotopes injected into the ring for studies of nuclear phenomena at both the precision and intensity frontiers.

Brief description and scope: The TSR building 670 will be built in parallel with running the ISOLDE facility for physics. At the end of the construction and coinciding with winter shutdown the new building will be connected to the ISOLDE Hall, building 170. The overall surface requested is of 865 m2 plus 639 m2 (for the basements) and structures as follows: a main Hall to house the ring and experiments (875 m2, covered by 20 T crane), two basements on either side of the CERN service tunnel to house the power supplies and additional equipment (413 m2 and 226 m2). The CERN service tunnel will remain untouched.

MAIN TECHNICAL PARAMETER		MAIN PROJECT PARAMETER	
Infrastructure Type (M/T):		Consolidation scope items included:	New building B670
Surface (m2)	865	Schedule estimation:	To + 18 months
Crane (T):	20	Non consolidation funding:	0
Process Heating and cooling:	**Demi water cooling:** TSR ring: Flow rate = 56 m³/h, Heat load =500 kW, ΔP = 8 bar, Tin<27 °C, conductivity <8 µS, Basement 2: 3 kW (power conv.) **HVAC:** Hall min temp 18 C Basement 1: To air: 96 kW Basement 2: To air: 88 kW Mixed water prod. 400kW	Master Plan evaluation	
Electrical Power:	980 kW (TSR ring, cooling water & HVAC)	Budget estimation:	**9.9MCHF** (building & infrastructure)

STEP 2: GTPE VERIFICATION	**STEP 3:** Site Committee DECISION	**STEP 4:** Preliminary study
☐ Rejected.	☐ Rejected.	
☑ Verified with Rs = 0	☑ Accepted for preliminary study	
Date of VERIFICATION: 03/04/14	**Date of APPROVAL: 25/04/14**	**Date of STUDY:**

Decisions of the Enlarged Directorate

STEP 5: PROJECT DECISION

☐ Rejected.

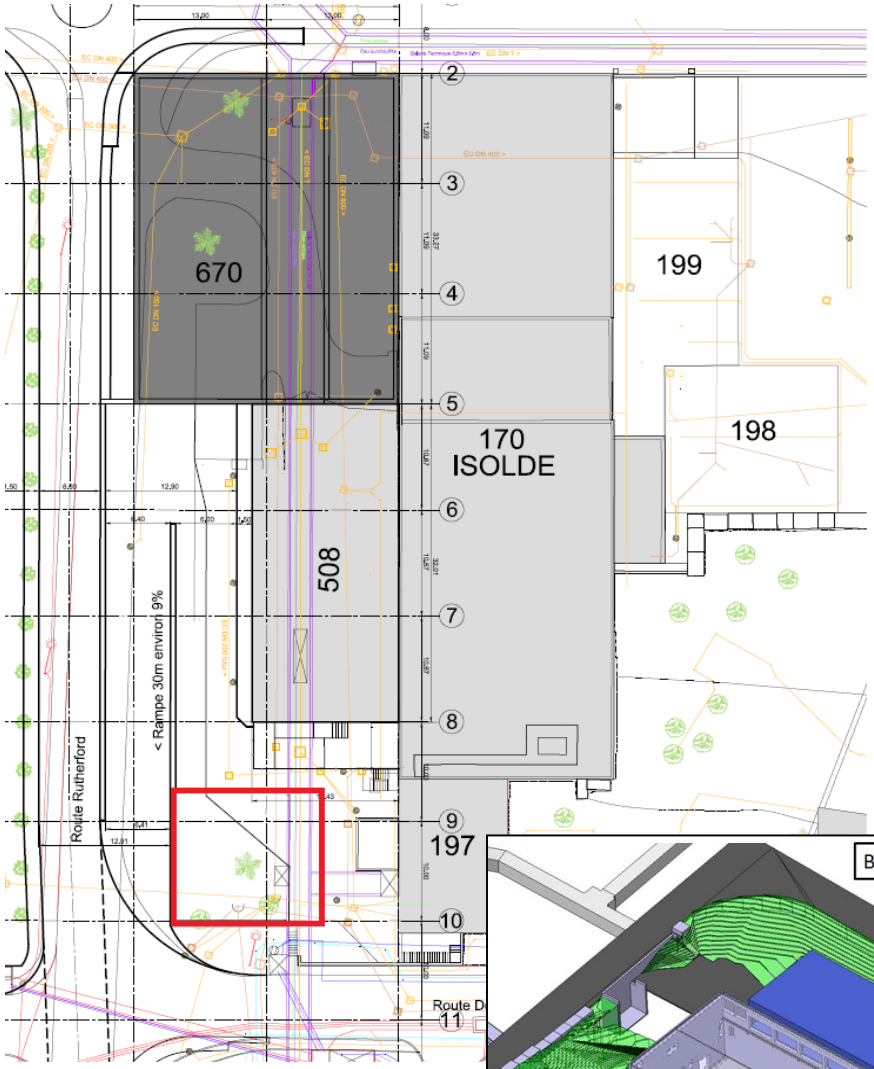
☐ Accepted for execution.

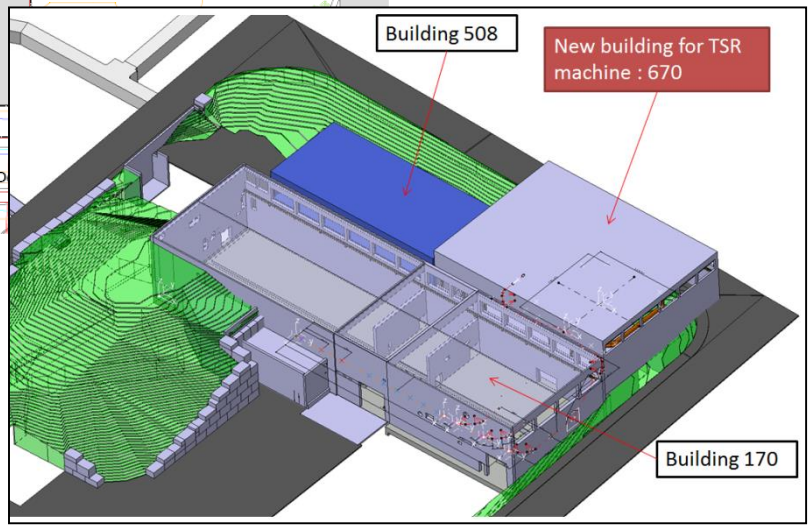
DATE OF APPROVAL:

The TSR IPP is to be submitted this month and describes the feasibility and costs for the construction of the building and the necessary infrastructure. For this several studies were carried out by specialists of the different CERN groups. A summary of the technical and cost related results of these studies will be shown in this talk.

The building and infrastructure requirements are based on the TSR Integration Study Report and TSR Technical Design Report.
Integration drawings are based on the civil engineering drawings for the TSR building *(CE 1.0670.0002).*

Integration building and outdoor equipment



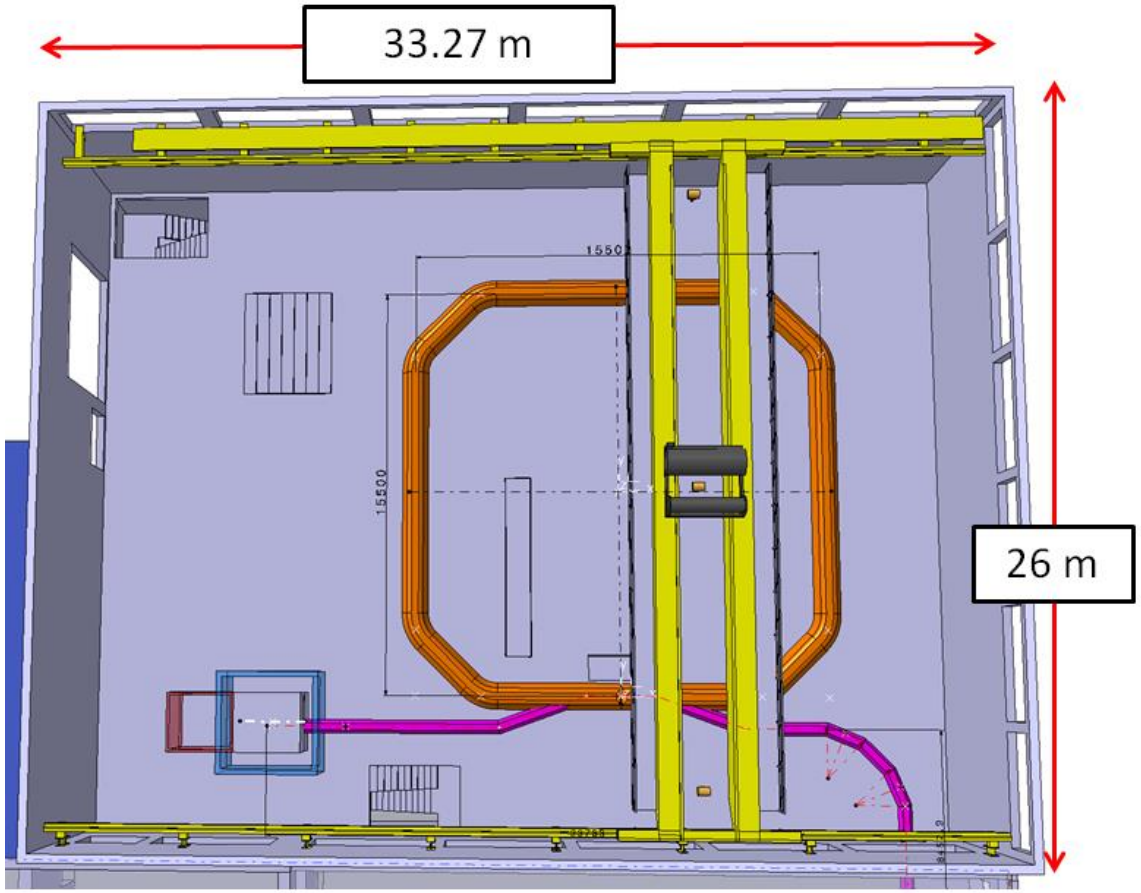


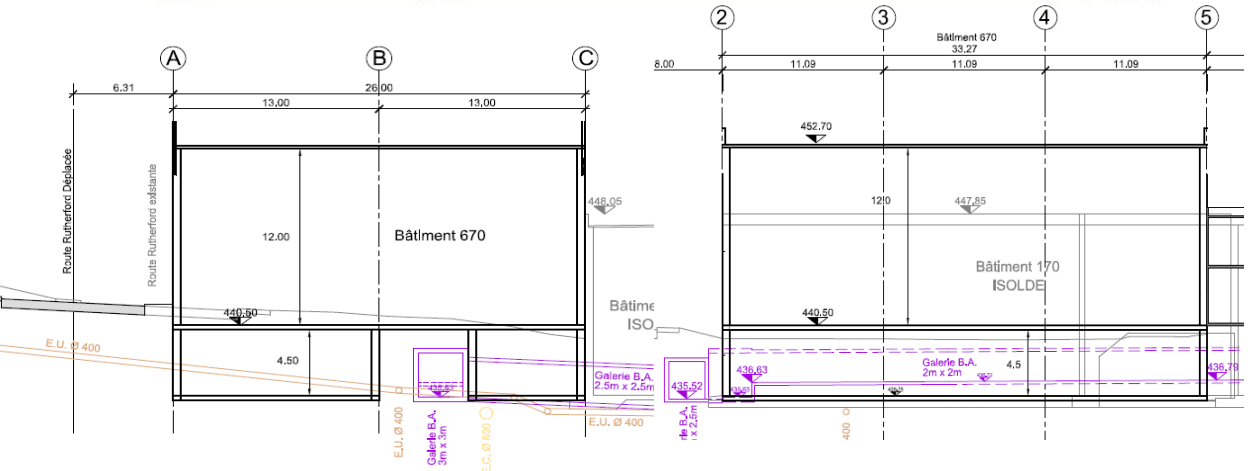
TSR building 670:
The building will be on top of the existing CERN service gallery which is not to be touched nor modified. The two basements will be located on each side of the service gallery.
Minor adaptation of the Rutherford and Einstein road will be necessary and have been taken in account in the new road planning.
Access to the TSR and user building 508 will require a new ramp down from the Democrite road.

Cooling station (red square):
To host the primary, demineralized and mixed water cooling systems
Location: as close as possible to the TSR hall, in order to optimize connections lengths and costs
Dimensions: at least 12m x 8m, 4-5m high.
Connection closed prefabricated trenches (caniveau) shall be made available by civil engineering: connection from cooling station bldg.197 to new TSR cooling station, connection from new TSR cooling station to TSR hall

Cooling towers:
Outdoor area: 12m x 8m
Location: on the roof of the cooling station, or as close as possible from the cooling station, in order to optimize connections lengths and costs

Chillers:
Outdoor area: 5m x 8m
concrete slab at ground level or grating metal structure on a roof (bldg.197 to be checked)
Location: as close as possible from the cooling station, in order to optimize connections lengths and costs





Surface and weight

Main TSR hall: **865m2** (was 875m2) **(26x33.27)** of which 20x20m (400m2) reserved for the ring (final position of the ring within the building to be defined). Covered by a 20T overhead crane.

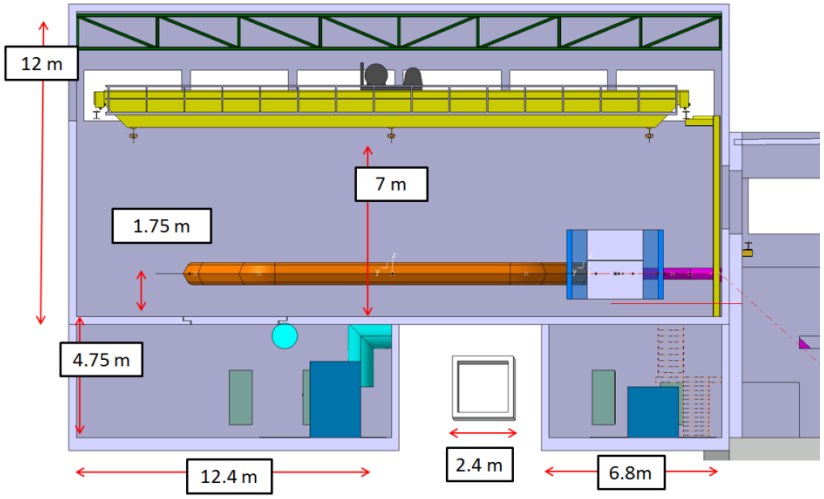
Loads:
Weight at each TSR corner:
Dipole: iron 12t + coil 0.8t
Quadrupole: iron 1.9t + coil 0.36t
Sextupole: 0.65t
Concrete bases 3.2t (estimate)
Each corner:
2x12.8t + 5x2.26t + 3x0.65t + 2x3.2t= **45.25 ton**

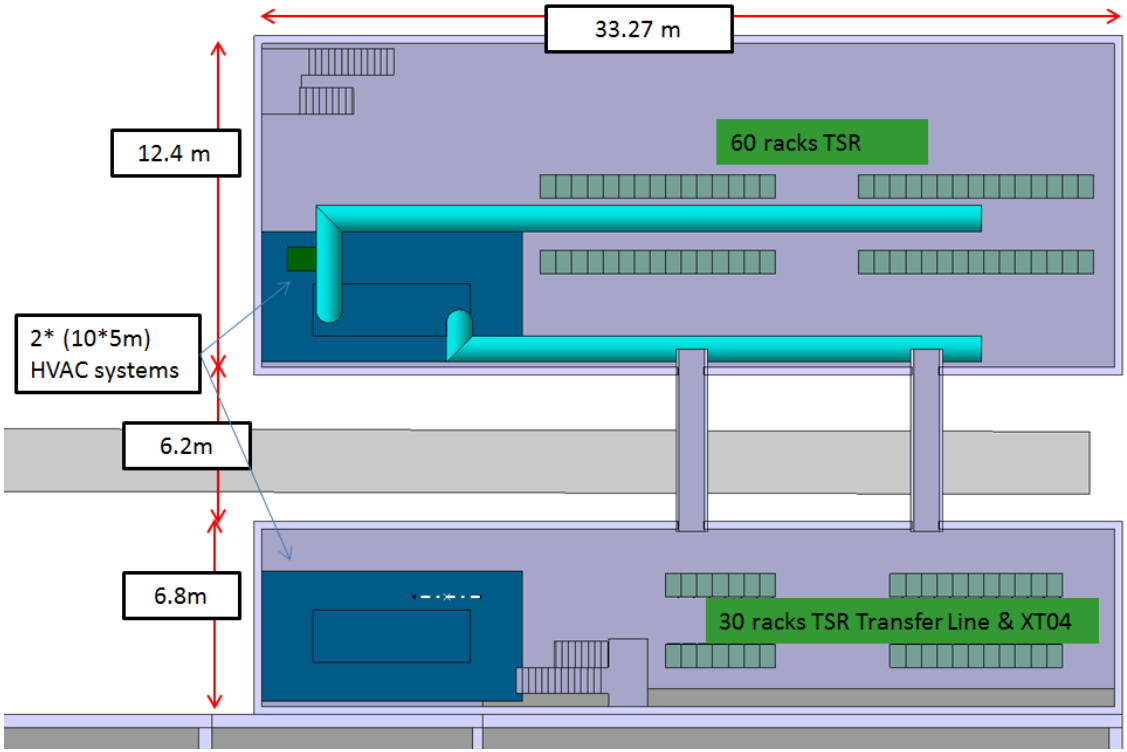
Electron cooler:
total **15 ton**

Total TSR machine floor weight:
4x45.25ton=181 ton
1 Electron cooler

Total: 196 ton (was 191 ton)

Surface and levels





Levels:
Level of the center of beam at 1.75m above TSR floor

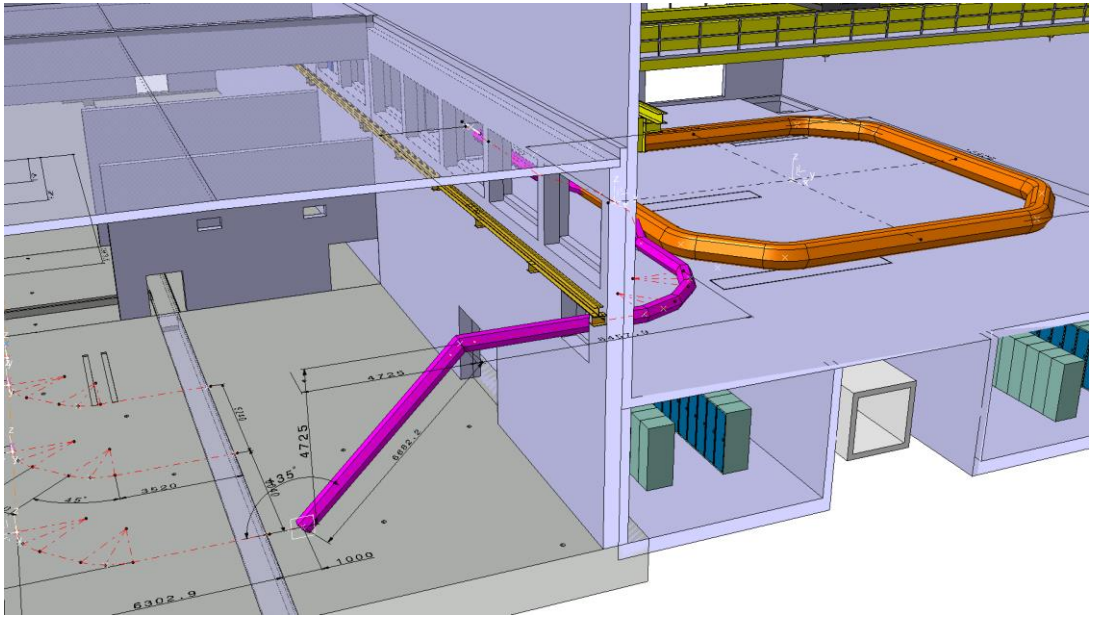
Building height 12m with 7m between floor and crane hook (from 10m to 12m due to heavy crane construction. Requirement of 7m under the hook kept)

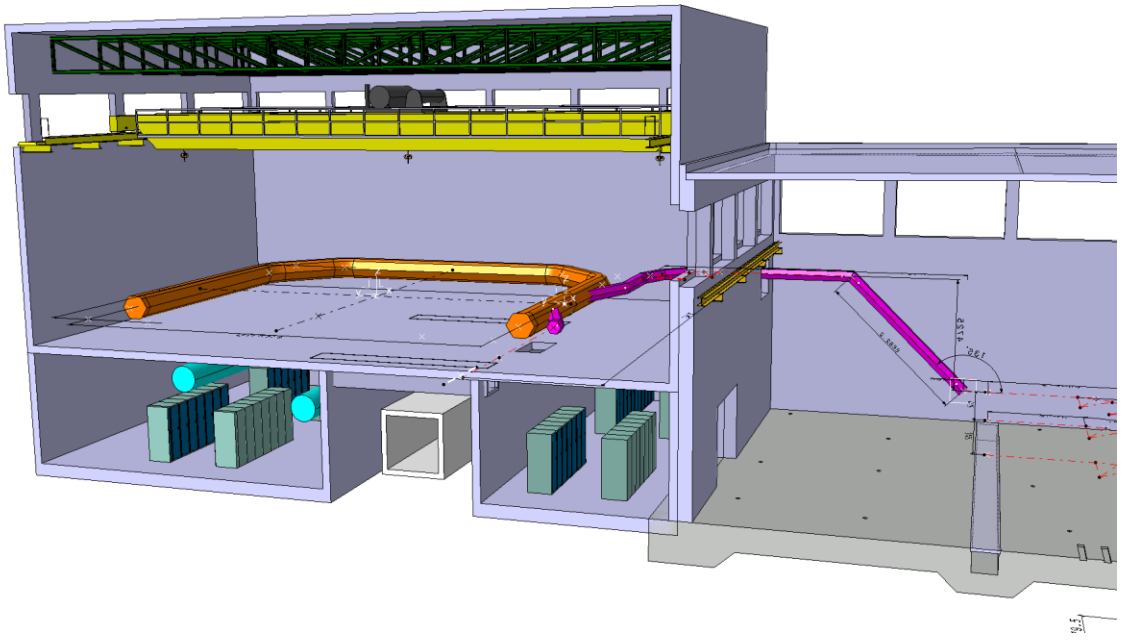
TSR floor 4.75m above HIE Linac floor. Will require tilted beamline coming up from the hall.
Basement floor at same level as HIE Linac floor

Total available basement surface:

1) 12.4x33.27=413m2, height 4.5m
   (was 420m2 height 3.5m)
2) 6.8x33.27=226m2, height 4.5m
   (was 217m2 height 3.5m)
   (Remark: Basement floor brought to same level as HIE Linac floor for access reasons and high ceiling for HVAC ducts installation)

Total 639m2 (was 637m2)





Building layout

Building:
- Foundation as stable as reasonably achievable
- Basement constructed around the CERN service tunnel without contact to leave the service tunnel untouched.
- Matrix of cable feedthroughs to basements in the TSR floor
- One pit to the Jura side basement: min 2x3m
- Access door + tourniquet
- Emergency exits
- Access stairs down to basements
- Large door to the outside: min 5x6 m
- Door from 2nd basement to 170: 3x3.5 m
- Minimum thermally insulated construction, temp. in winter 18C +/-2K for the hall, and 26C+/-2K in summer.
- Opening towards B 170 for connecting beamlines

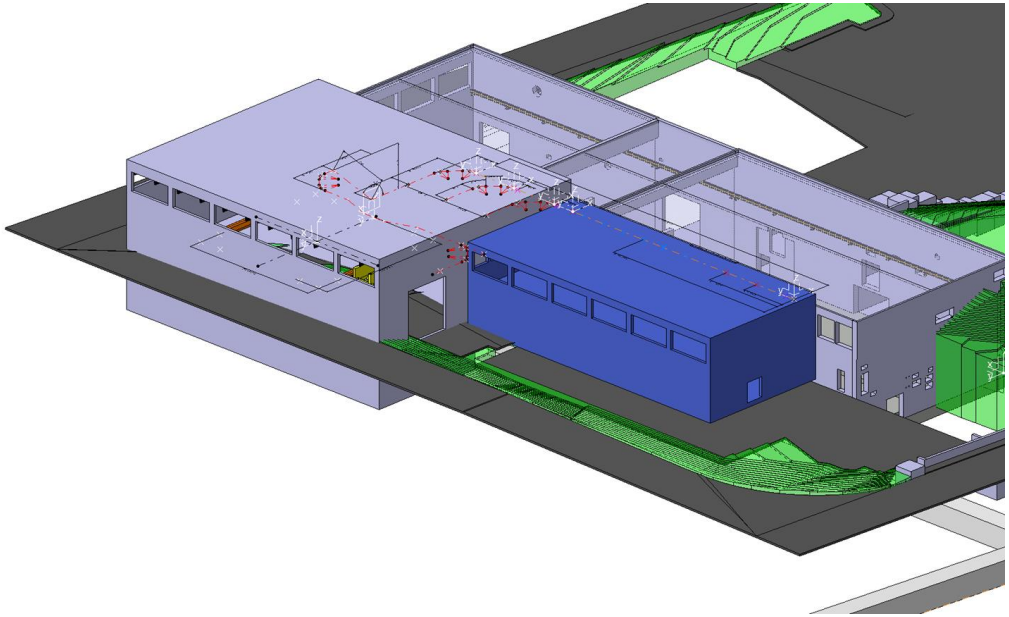
Basements:
- To house power-supplies and additional racks (total 29m length floor space for the TSR equipment and 7m for the e-target equipment + 10 standard 19'' racks. The present E-Cooler HV cage (16m2) will be replaced by a single electronics rack with HV insulation inside.
- To house ventilation units
- To house the transfer line and XT04 line power supplies

BUILDING HVAC REQUIREMENTS (HEATING VENTILATION AND AIRCONDITIONING)

The temperature of the TSR experimental hall will be controlled in winter season at 18C +/-2K, and in summer season at 26C+/-2K in order to provide appropriate working conditions and avoid and risk of condensation on the equipment.
Basements 1 and 2 will be air cooled in order to compensate the equipment heat loads, supplying racks and power converters with air at 22C+/-2K , while a reduced heating power will maintain the ambient temperatures at 18C +/-2K in case of users' equipment shutdown in winter season.
The HVAC system will be made of 3 air handling units (1 for the hall, 2 for the basements) with flow rates from 25'000 to 35'000 m3/h, and of a mixed water cooling and distribution system of about 400 kW comprising three 200kW chillers.
Air renewal will be implemented according to applicable rules, i.e. 500m3/h for the hall, and 250m3/h for each basement.
A smoke extraction system will also be installed for the three areas.

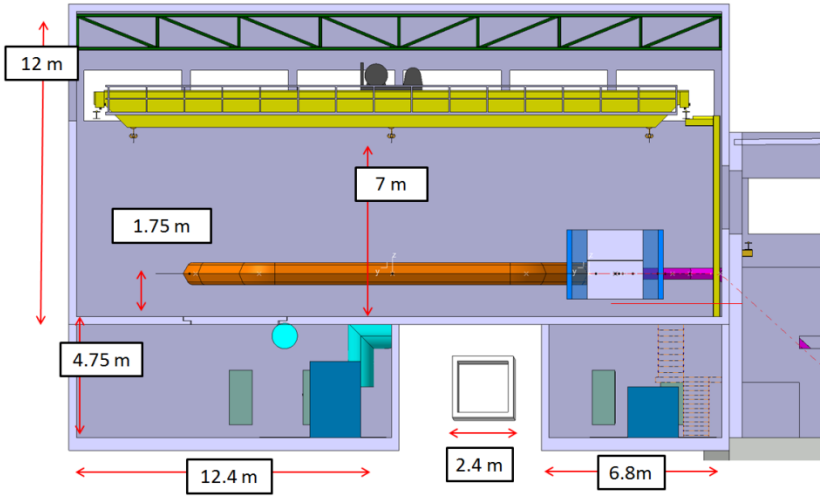
PROCESSES POWER REQUIREMENTS

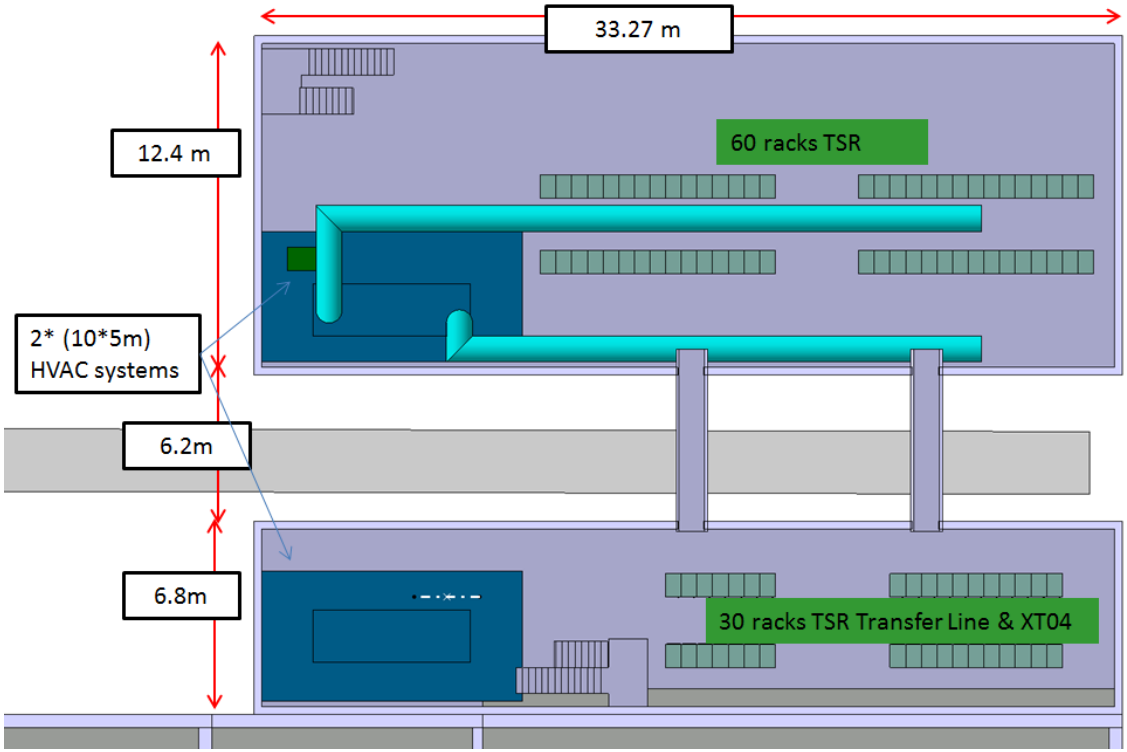
The present ISOLDE transformer can deliver 2 MW of which <1 MW is used for ISOLDE. This will be even less in the future with the new HIE-ISOLDE transformer in place taking over a number of the REX LINAC power convertors. Therefore, the 500 kW for the TSR ring could be taken from the existing transformer, in addition to the 160 kW for a water cooling station (CV) and 320 kW for ventilation.
The requirements for the Electrical power, Cooling water and HVAC are:
TSR ring: 500 kW
Water cooling station: 160 kW
HVAC system: 320 kW



In terms of water cooling, demineralized water requirements are 500kW, 56 m3/h at T<30°C. This will make necessary to create a new cooling station to provide water at temperature 27°C-37°C (the existing one in building 197 cannot be extended). It will be made of a primary water cooling system equipped with two 600kW cooling towers, and of a secondary demineralized water cooling station.
A study will be made in order to optimize the cooling systems taking into account the existing and future cooling towers, chillers, and stations, in that area.

HVAC and Cooling space requirements





HVAC of basement 1:
Dimensions: at least 10m x 5m, height = 3.5m above false floor
False floor >= 0.8m
Charge on the floor 300kg/m2
Location: Preferably on the Bellegarde side of TSR to optimize connections lengths and costs
Access door: 3m x 3m

HVAC of basement 2:
Dimensions: at least 10m x 5m, height = 3.5m above false floor.
False floor >= 0.8m
Charge on the floor 300kg/m2
Location: Preferably on the Bellegarde side of TSR to optimize connections lengths and costs
Access door: 3m x 3m

HVAC of TSR hall:
Dimensions: at least 10m x 5m.
Location: Preferably on the Bellegarde side of TSR to optimize connections lengths and costs, installed at height on a metal structure.

Overall project schedule

CIVIL ENGINEERING SCHEDULE

Study (2 mnts), Market survey (6 wks), preparations specs (2 mnts), call for tender (1 month), preparations contractor (2 mnts) – with some actions overlapping about 8 mnts.
Aim to reach the Finance Committee in December 2015 -> contract signature January 2016 and start construction February 2016.
For the building one should count 9 months due to the complexity of the basements / service tunnel.

TECHNICAL INFRASTRUCTURE SCHEDULE

The typical CV schedule for such a project is:

12 months for design and tendering
12 months for installation works and commissioning

Writing of the specifications for the different systems, the integration and the tendering process will be handled by the different CERN groups. The actual fabrication and installation of the systems however will be in the hands of the selected contractors.

Civil engineering & Infrastructure costs

Work unit	kCHF	FTE (man months)
Building	4500	4
Ventilation system	1000 +/-30%	12
Water cooling station	1000 +/-30%	12
Electrical transformer	-	
Cabling and electrical infrastructure	650 +/-30%	6
Compressed air	8	0.5
Fire detection system	120	0.5
Crane	350	1
Tourniquet controlled access	31	
Porch door	25	
Total	**7684**	**36**

Integration study 2013

Work unit	kCHF	FTE (man months)
CE WORKS		4
-Building 670 - TSR + asphalt surfacing	5500	
-CE works water cooling station+ducts	350	
Ventilation system	1500	12
Water cooling station	1300	12
Electrical transformer	-	
Cabling and electrical infrastructure	650 +/- 30%	6
Compressed air	15	0.5
Fire detection system	120	0.5
Crane	350	1
Tourniquet controlled access	31	
Porch door	25	
Total	**9841**	**36**

Cost increase:
CE works: building 2m higher (due to crane 7m under hook), basements 1m deeper (air ducts + equal with Linac floor)
Cooling & Ventilation syst: high heat dissipation in basements due to air cooled power supplies implies chillers and 3 HVAC systems

Acknowledgement

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