TOSHIBA

ATLAS
project

Integration and Test of the ATLAS Central Solenoid

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for the ATLAS CS team,

LAr Meeting, CERN, 26-27 January 2004

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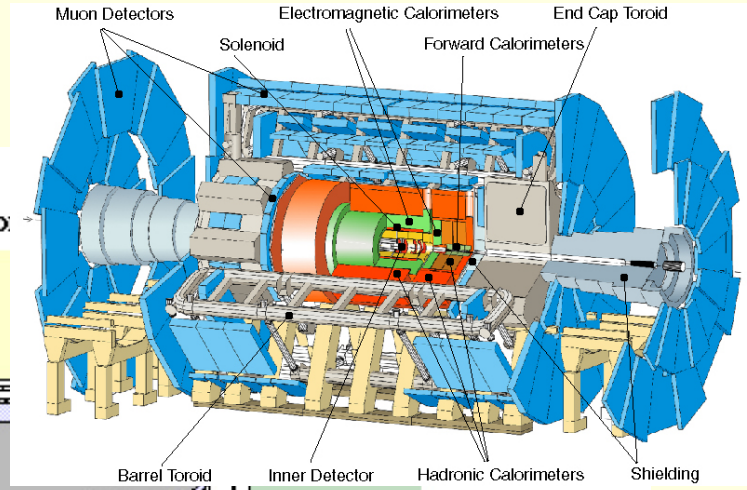
Introduction



Solenoid Layout

Thin superconducting central solenoid:

$B_c = 2T$ (I = 7600A)

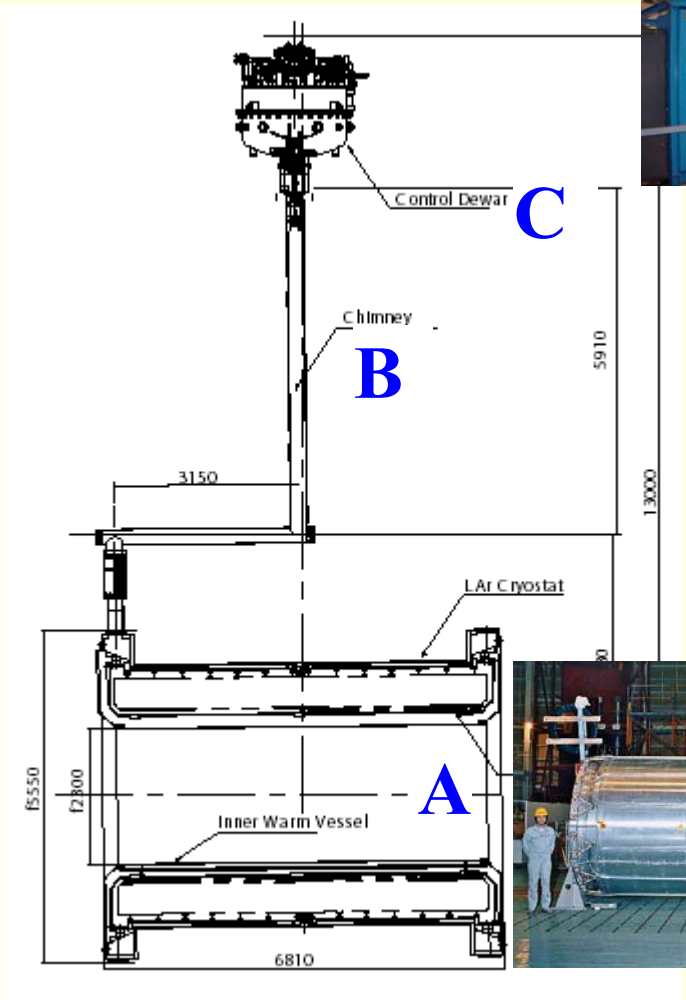
5.3m × ϕ2.3m × 45mm

wall thickness = 0.66 X_0

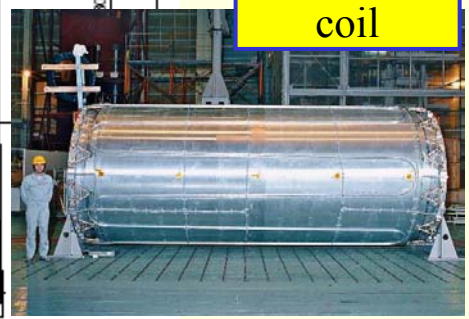
E/M = 7.1 kJ/kg

System consists of:

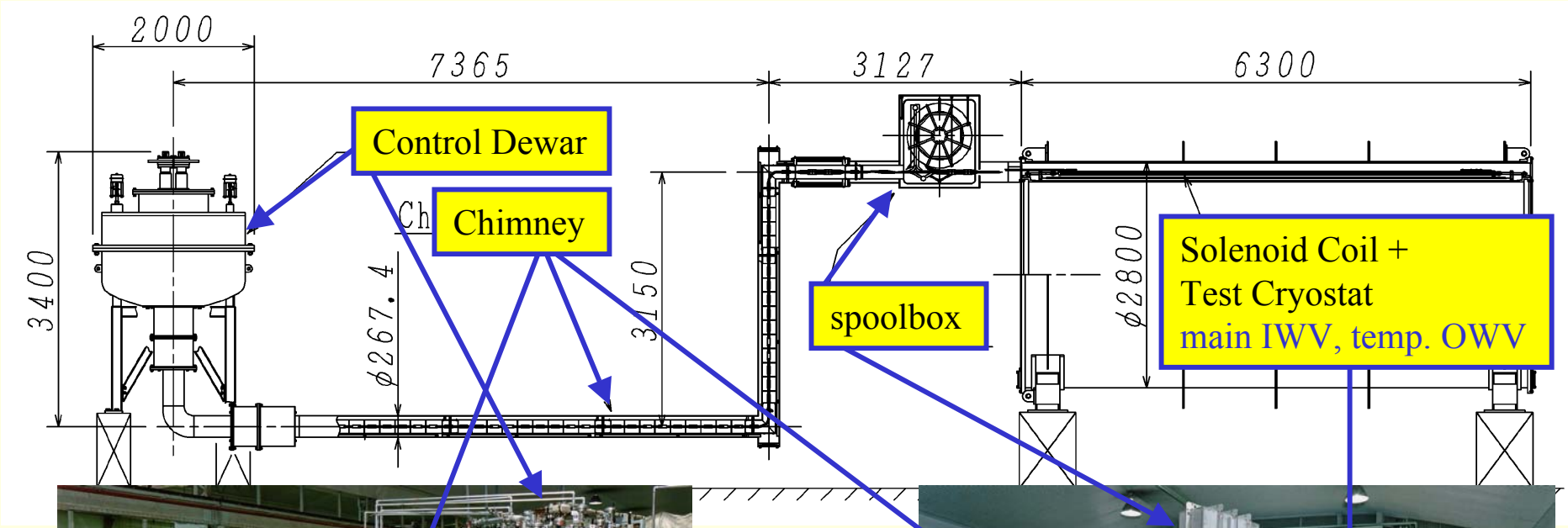
A. thin solenoid coil
B. chimney
C. control dewar + proximity cryogenics

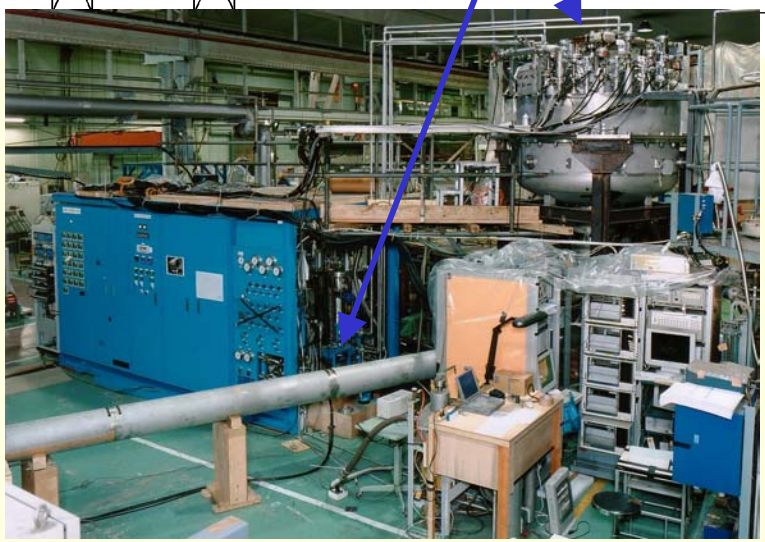



valve unit


coil

Factory Test in Japan





Progress Report

2001:

- delivery components

2002-2003:

- proximity cryogenics
- chimney
- power supply
- cryogenics control
- survey

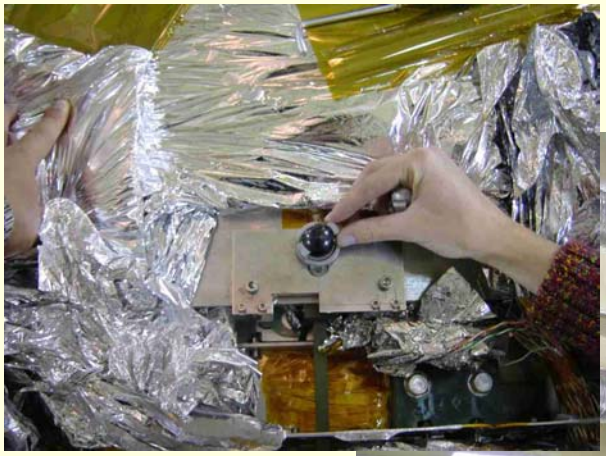
In progress:

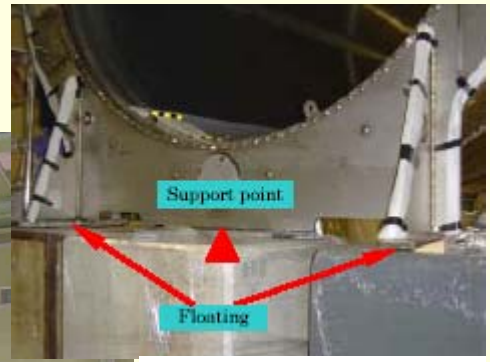
- magnet control system
- magnet safety system
- solenoid integration

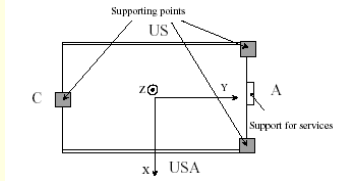
Chimney Test Results

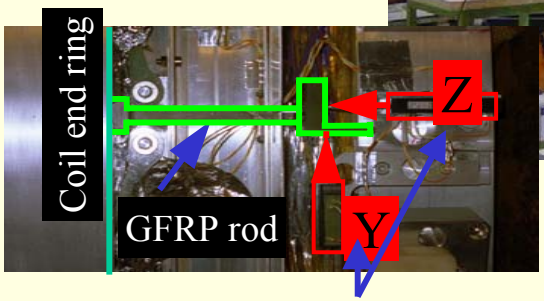
- excitation up to 9 kA
- verified safety of the design:
  - mass flow stop to SQD trip:
    28min. until quench
- proximity cryogenics and control
  - dynamic heat balance:
    heater up to 70W(cooling line) +3W(LHe level)
  - 150m capillary for (differential) pressure transducers

Survey October 2003

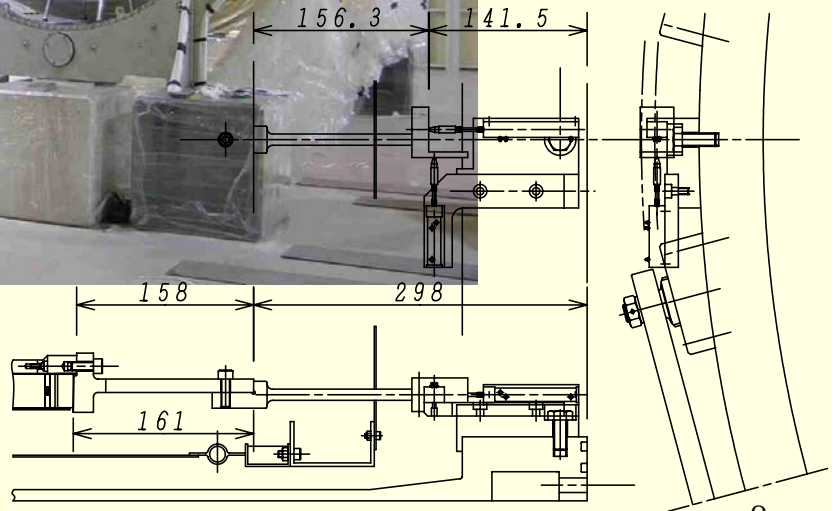








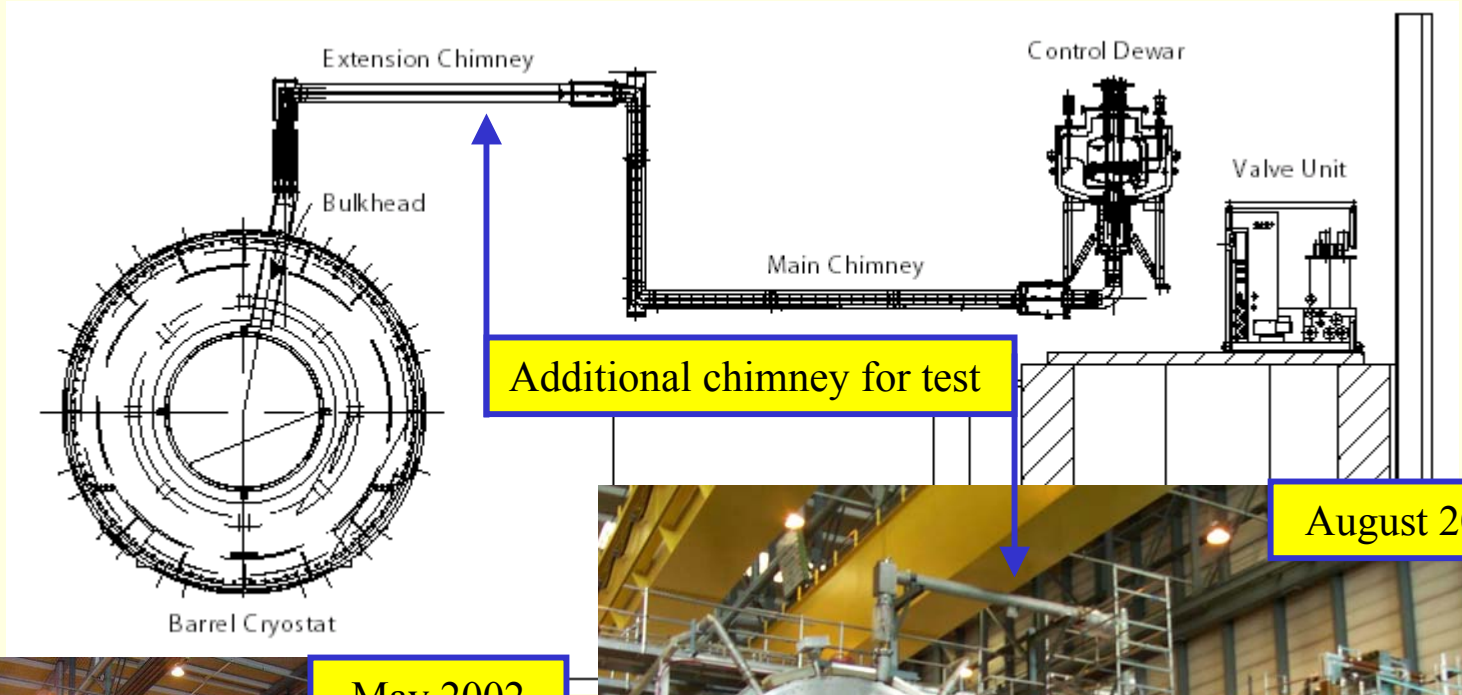
potentiometer



Survey Results

- coil with respect to IWV
  - vertical offset -1.6 to –2.6 mm
  - axial centre of the winding
    - warm: at -13.1mm
    - cold: at -0.1mm (4K, 2T)
  - error bars in order of 0.3 to 0.5 mm
- observed permanent axial shrinkage is
  - 1.6mm (potentiometer) - 1.8mm (optical survey)
- circularity solenoid end flanges
  - end A: +/- 2.7mm ; end C: +/-1.3mm

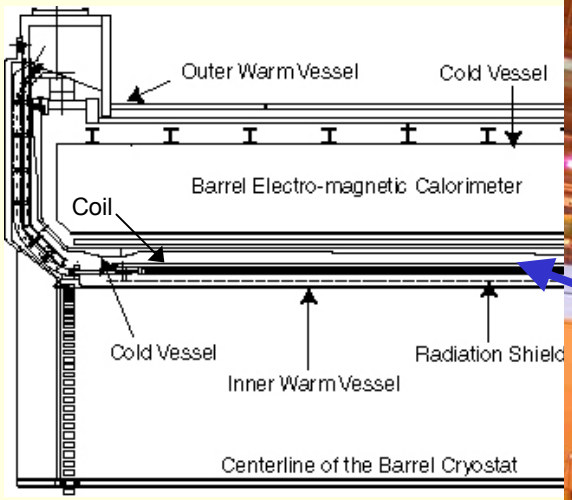
On-surface Integration

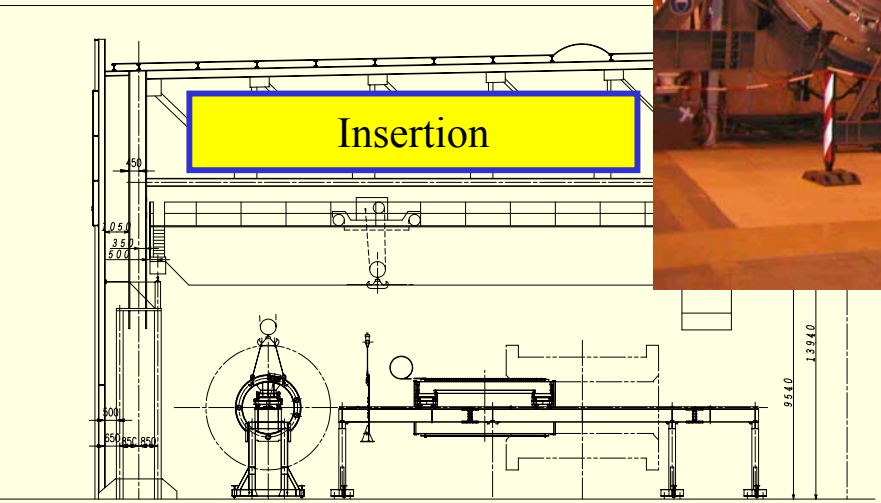


May 2002

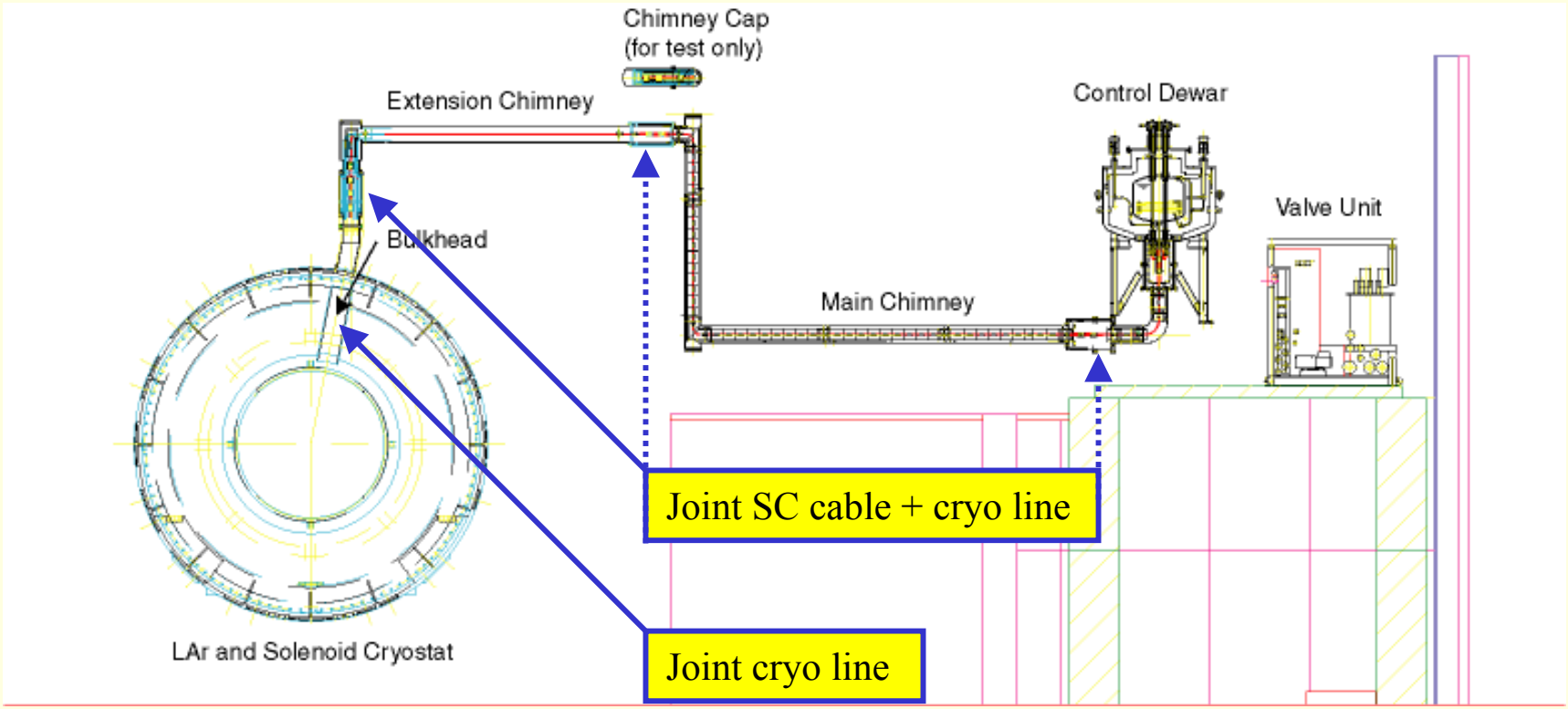
August 2003

Mechanical Integration



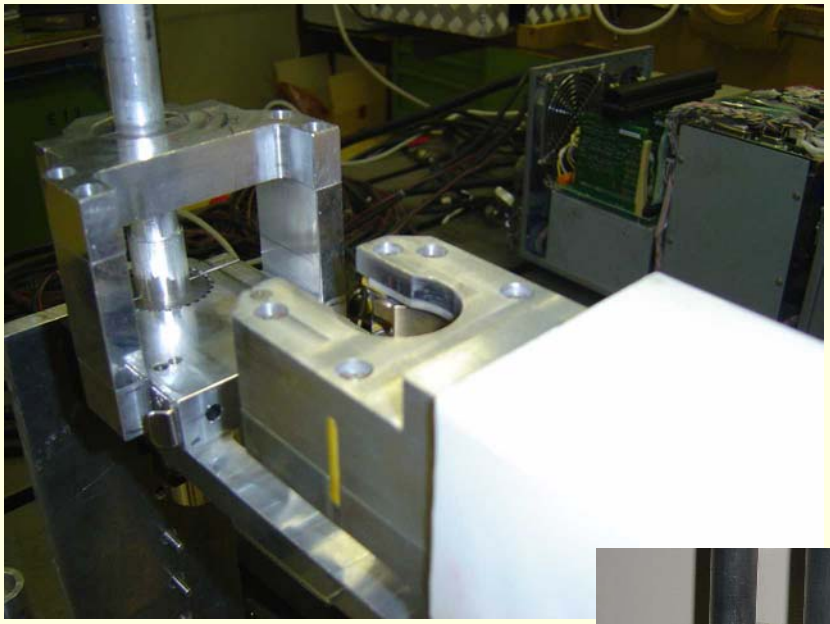


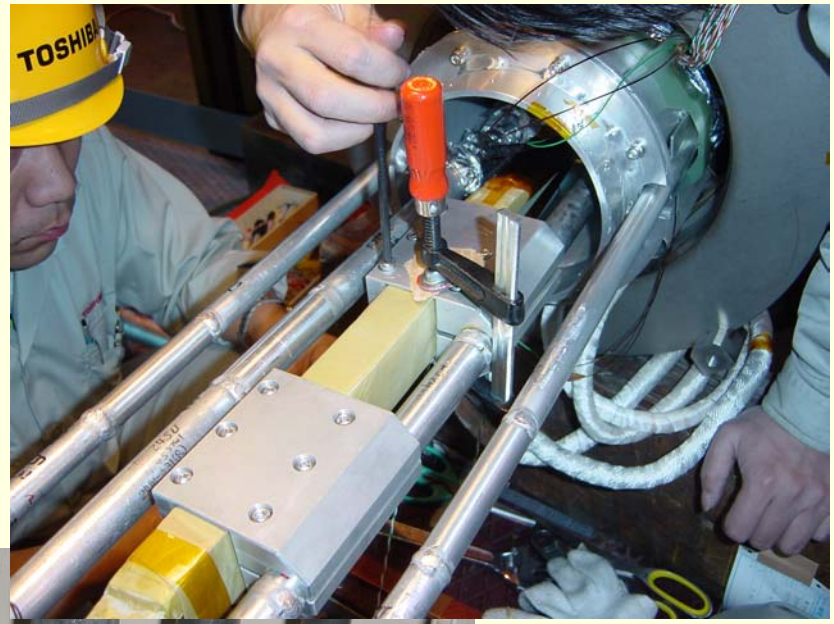
Services Integration

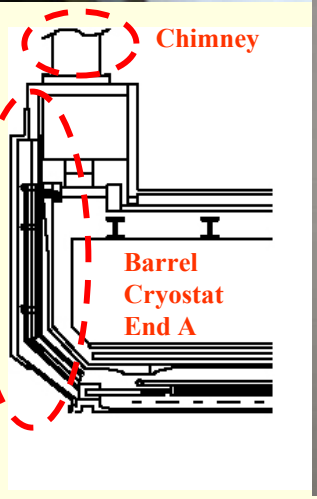


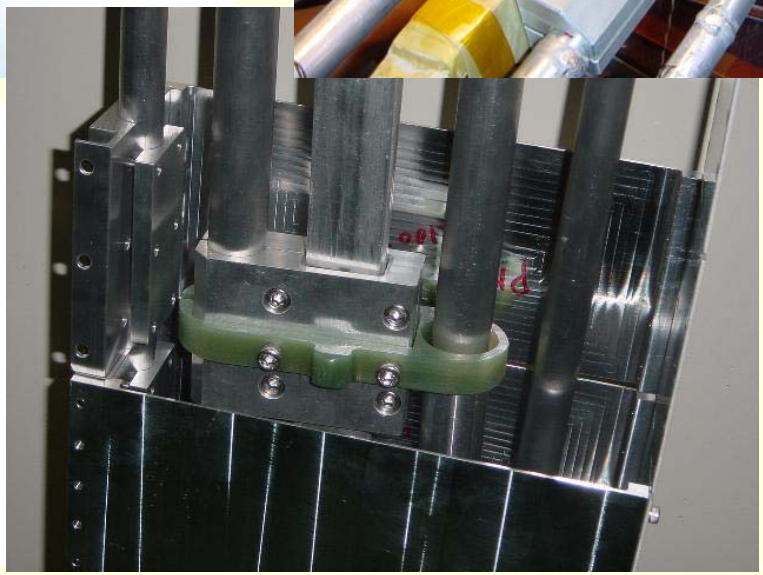
Conductor: 4 cables, main + side, supply & return
Cryogenics: 4 tubes, 4.5K + 80K, supply & return

Integration Work

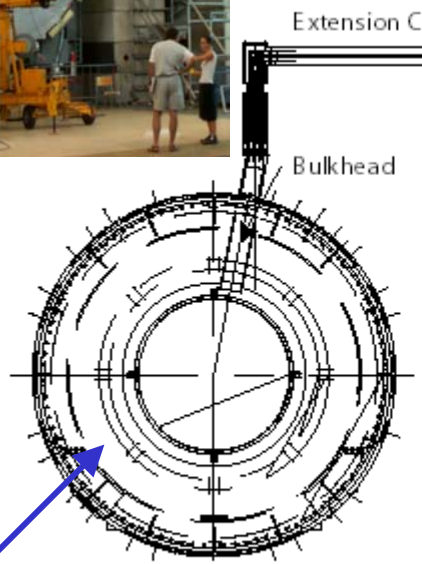








On-surface Test



Chimney

Valve Unit

Control Dewar

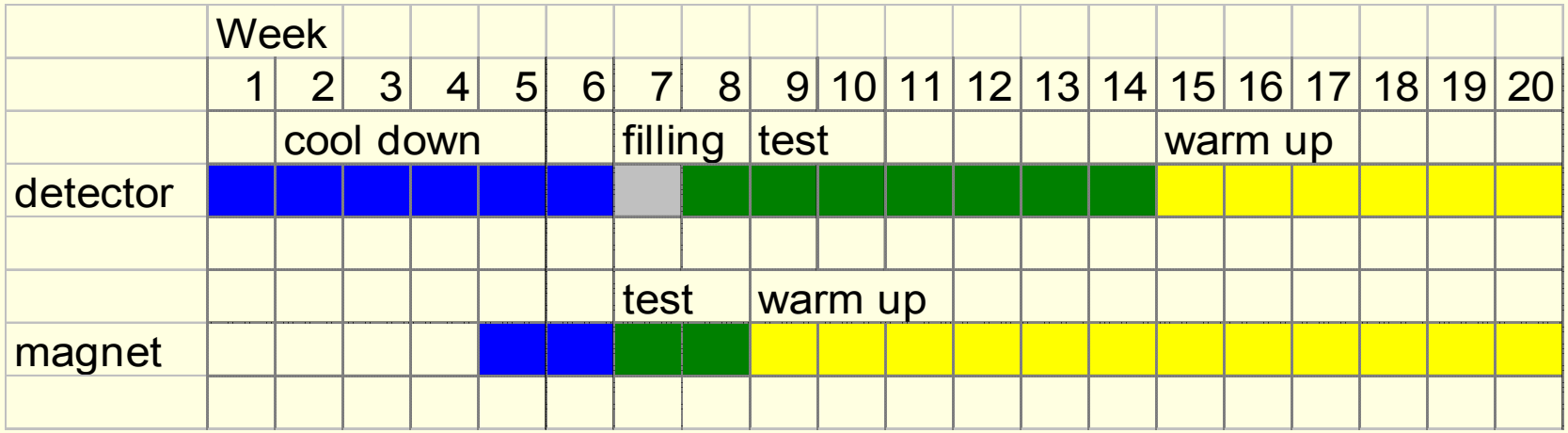
Solenoid Coil +
Barrel Cryostat

Bus-bars

Test Objectives

- confirm operation
  - run at nominal current + 5% (8kA)
  - safety for quench
- study interaction with detector
  - influence of magnetic field and eddy currents
  - thermal shielding of warm coil & bulkhead
- test final control and safety systems
  - including interlock with detector

Test Schedule



- cool down magnet (1 – 2 weeks)
  - in parallel with detector
- magnet test (2 weeks)
  - confirm operation in parallel with LAr filling
  - interaction studies in begin phase detector test
- warm up of magnet
  - monitor temperature distribution with cold detector

Conclusions

- all components manufactured & tested
- successful commissioned chimney and proximity cryogenics
- confirmed save chimney operation at 9kA and in event of cryogenics' failure
- survey of CS+IWV completed
- ready for full on-surface test by March

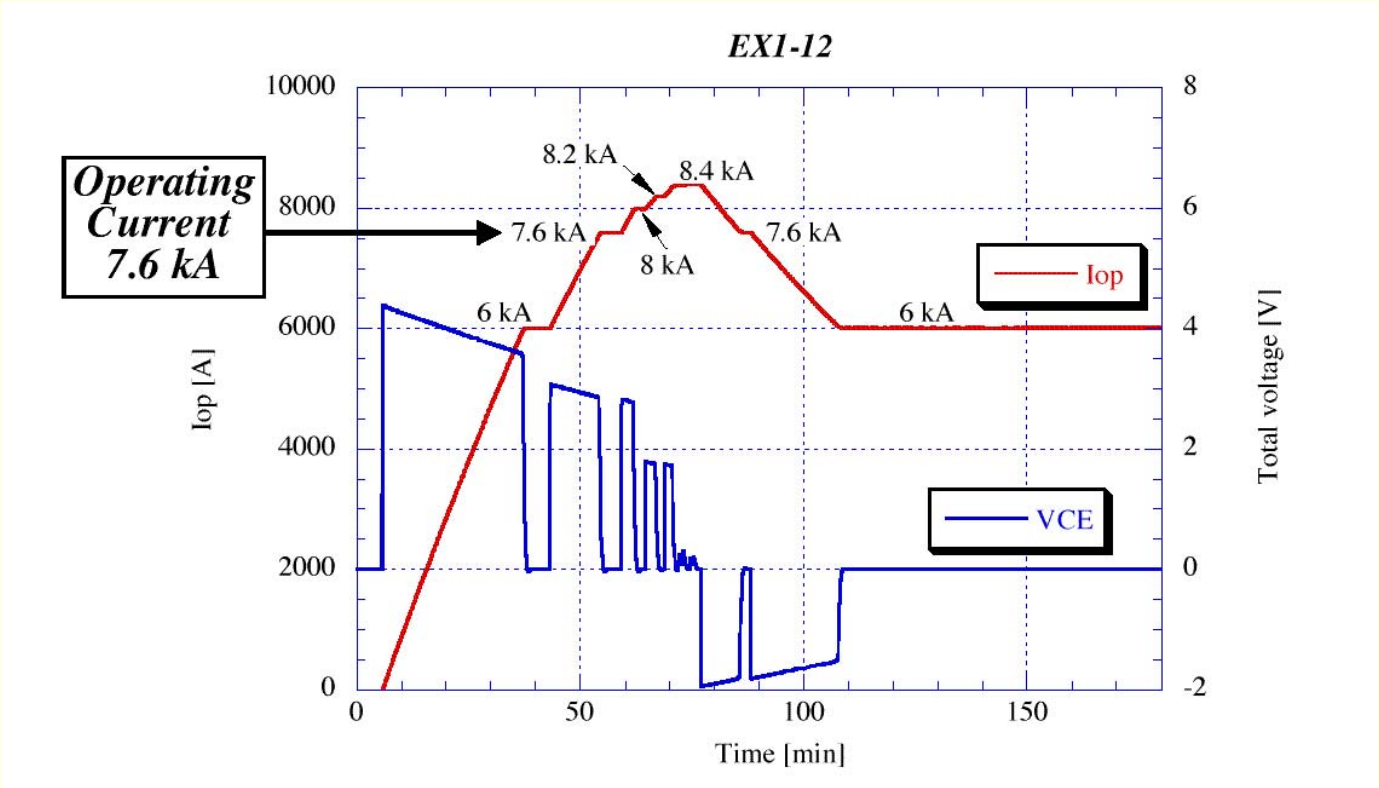
Acknowledgements

All my colleagues at

- KEK:
  for design and test
- CERN and ATLAS:
  for integration and on-surface test
- Toshiba Co.:
  for realization of the solenoid and welding machine

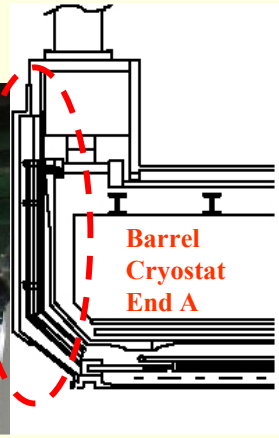
Back-up Slides

Factory Test Results



- maximum current 8.4kA (chimney: 10kA)
- quench & cooling flow stop tests up to 7.6kA

Bulkhead Mock-up

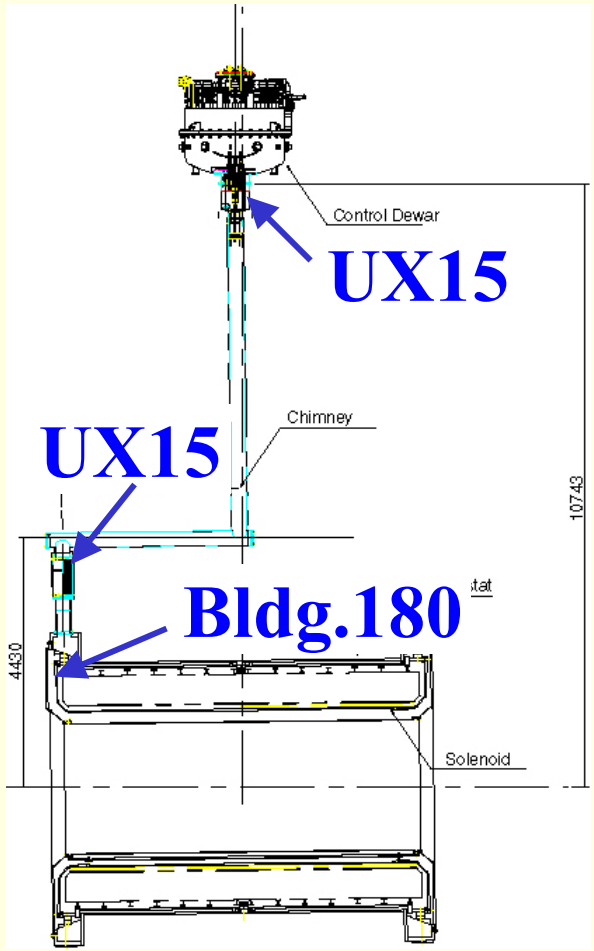


Services Integration UX15

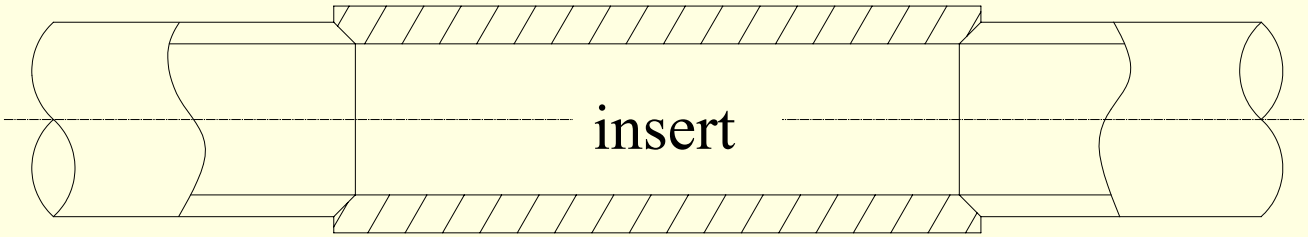
Field work:
3 permanent joints

- 4 cooling tubes: 4.5K + 80K, supply & return (qualification ISO10042-B).
- 4 SC cables: main + side, supply & return

An orbital welding machine has been developed by Toshiba.



Welding Scheme



central insert, adjustable in length, edge of 30^{o}

- pipe ϕ18mm (t=2mm); insert ϕ21 (t=3.5mm)
- pipe ϕ24mm (t=3mm); insert ϕ27 (t=4.5mm)

pipe is A6063; insert is A5083