EMU Integration

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DOE / NSF Review

5-6 June '02

Integration Status

CERN infrastructure

- Walkways, corner posts, shielding

EMU installation

- Installation fixtures
- Procedures and safety
- Schedule

EMU services

- Gas
- Cabling
- Water cooling
- Low voltage

CERN infrastructure

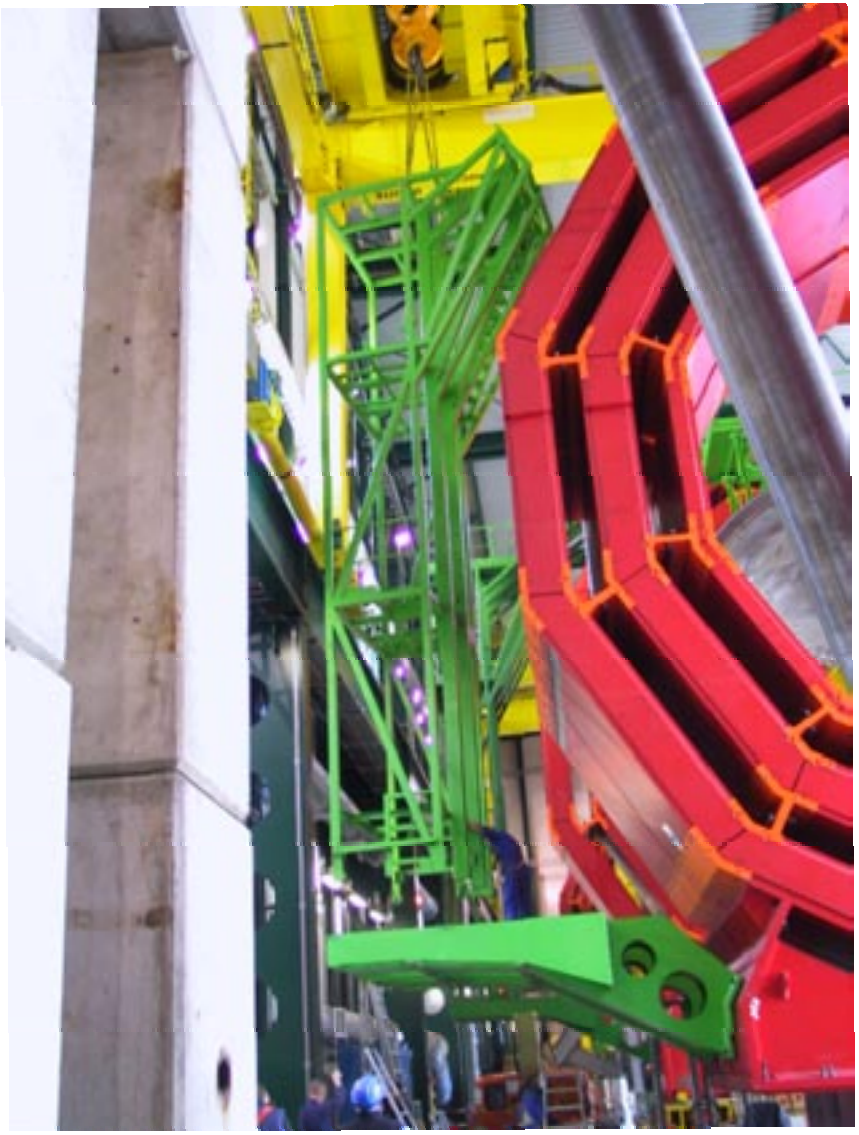
General points

- Critical path items - must be completed **before** EMU installation begins
- Design done by Wisconsin - finished
- Manufacture and installation by CERN

Walkways

- Manufactured by Shawton (Great Britain)
- Final manufacturing drawings signed off
- Installation scheduled for July-Aug '02
  - Barrel walkway installation has begun

Walkways



Installation of barrel walkways May '02

CERN infrastructure

Corner posts

- Manufacture in Zastava Alati (Serbia)
- Most parts are finished - assembly at factory under way
- Installation in late summer or early fall

Shielding

- Boron-poly slabs with lead plates
- Contract with Goslar (Germany) for manufacture of the lead

Corner pieces in Serbia

Assembled corner pieces

CSC Mounting Posts

Production is going well:

- **All ME2 and ME3 posts finished**
- **All ME1 posts are finished machining**
  - Welding delayed until RE1 designs are more complete

Installation of mounting posts on YE2

- **After large infrastructure items (walkways, disk connections, Pb shielding)**
- **Estimate approx. Sept - Oct '02**

Welded Mounting Posts

EMU installation status

Install CSCs on vertical faces of disks

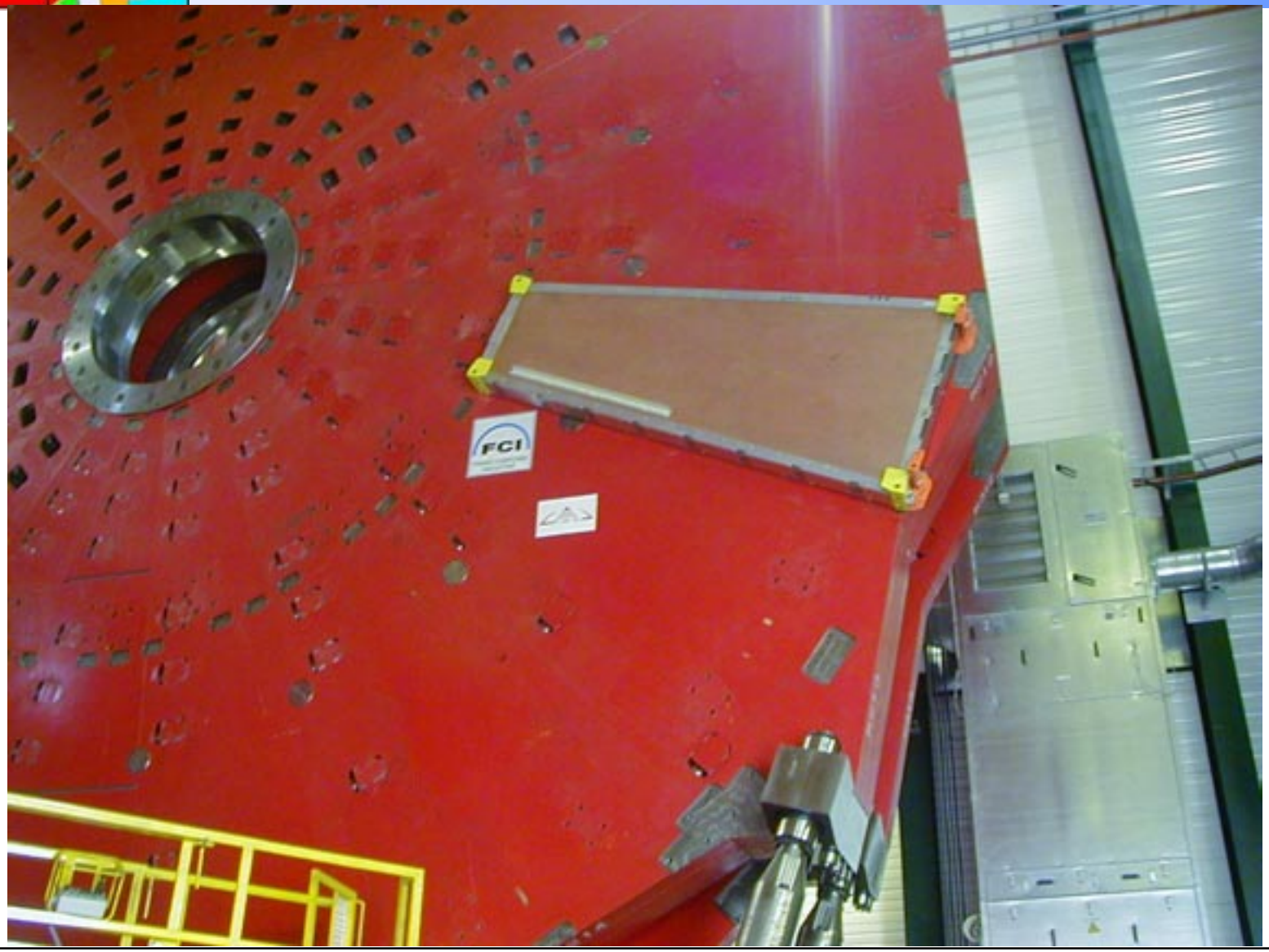
- Installation fixture constructed and tested
- Inspected and approved by CERN Safety
- CSC prototype installed on YE2 disk

Schedule

- Endcap walkways installed in Jul-Aug ‘02
- CSC mounting posts installed during Sep-Oct ‘02
- CSC installation begins in Nov ‘02
- Team comes from Wisc., installs during windows
- Stations ME2 & ME3 installed during ‘03
- Station ME1 installed during ‘04

Installing prototype chamber

Prototype wire chamber



EMU gas system

Responsibilities

- **EMU specifies gas, flow rates, requirements**
  - Ar(40%) - CO_2 (50%) - CF_4(10%)
- **CERN designs gas system so that Atlas, CMS, LHCB, Alice all use similar components**
- **CERN manufactures system up to detector (including gas racks) -- EMU pays for racks**
- **On-detector piping (10/12mm Cu) done by commercial contract up to bulkheads - contract in place -- EMU pays**
- **EMU designs and manufactures bulkheads and piping between bulkheads and chambers**

Gas System

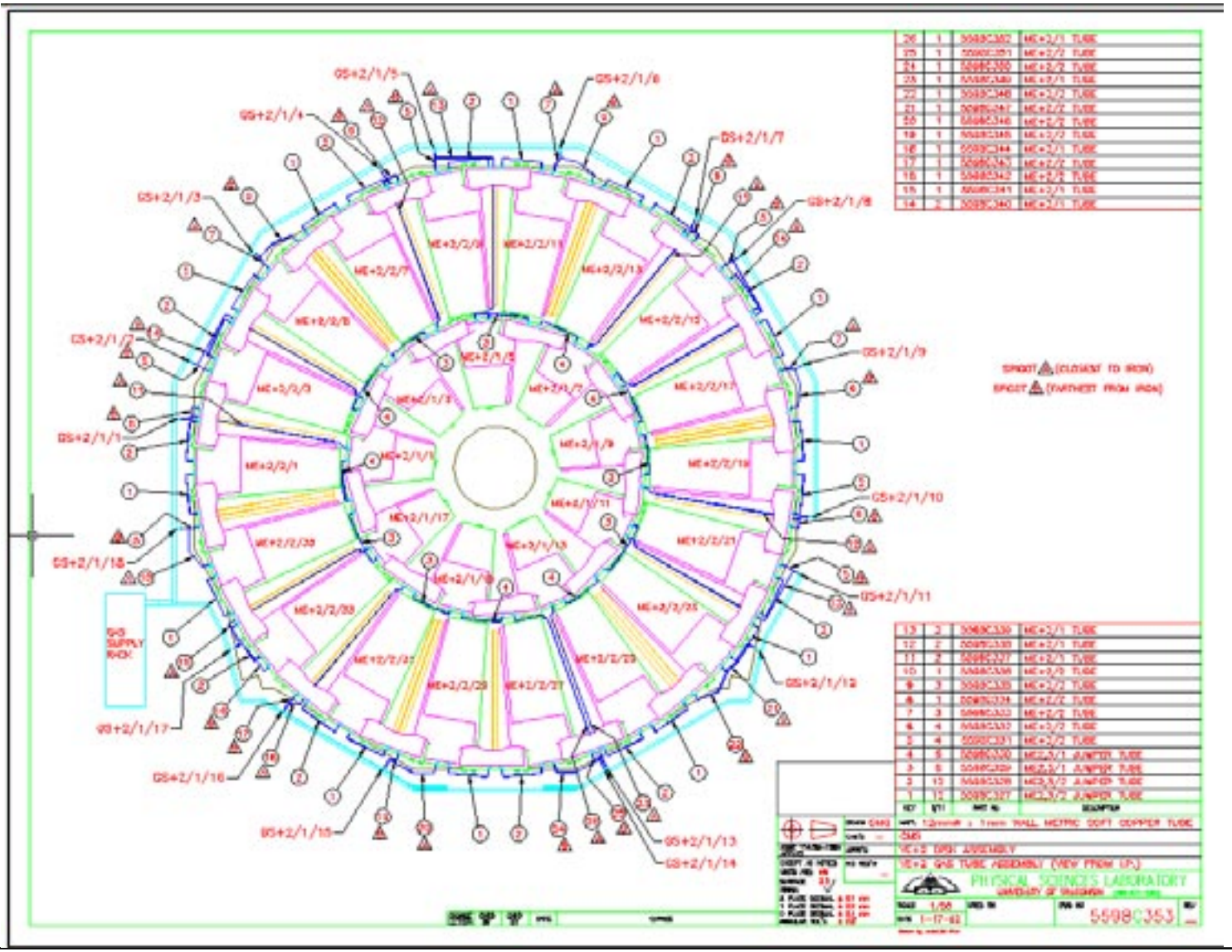
Gas Bulkheads

- **All bulkheads are finished (including ME4)**

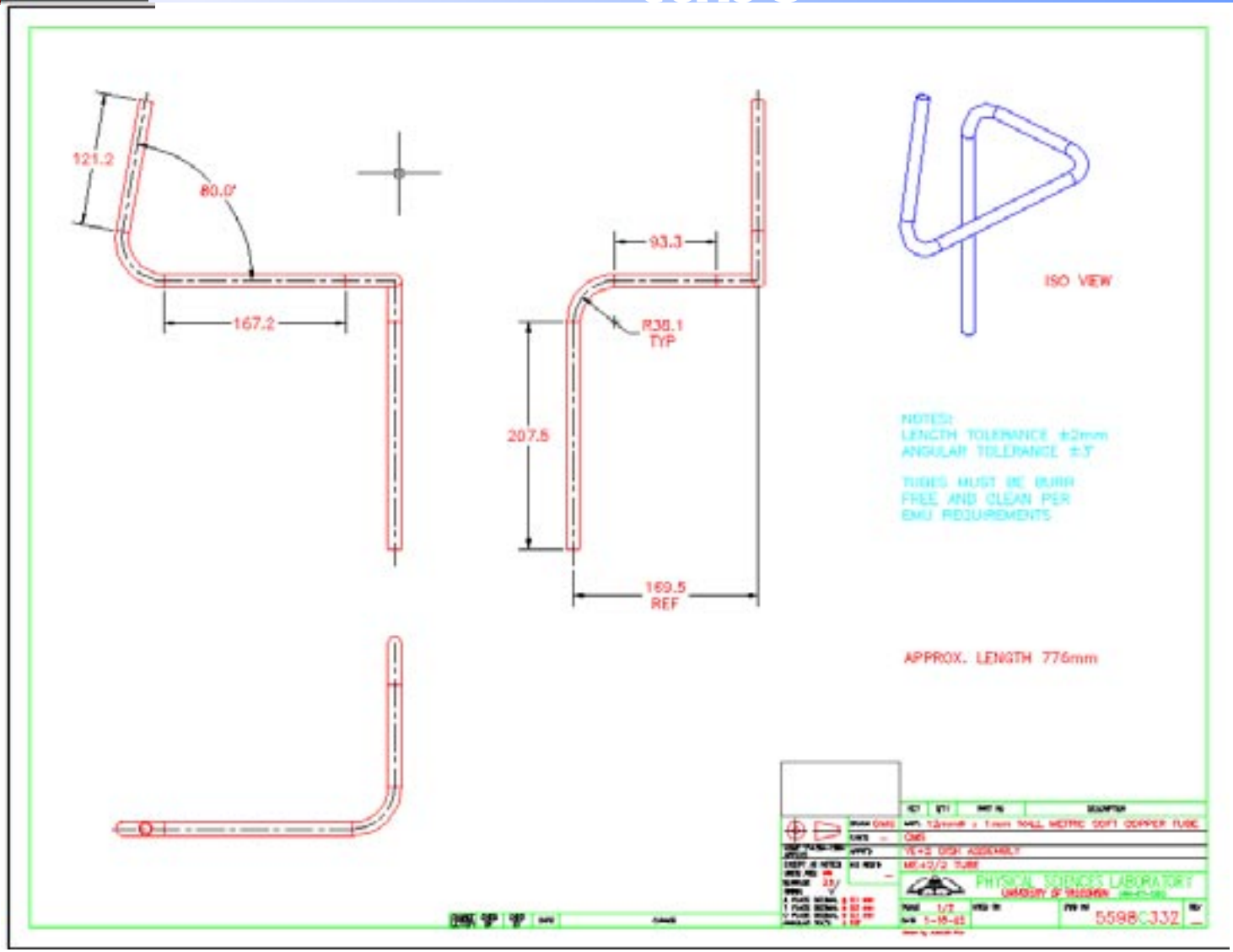
Connection Piping (bulkhead to CSC)

- **Drawings for each individual pipe**
  - Cut, formed, and labeled at Wisconsin
  - Shipped to CERN and installed with CSCs
- **Added additional copper piping to CERN order**
  - Want piping cleaned according to CERN specs
  - Need roughly 28 spools (each 50 m long)

ME2 gas assembly drawing



Typical ME2 connection tube



ME1 cabling

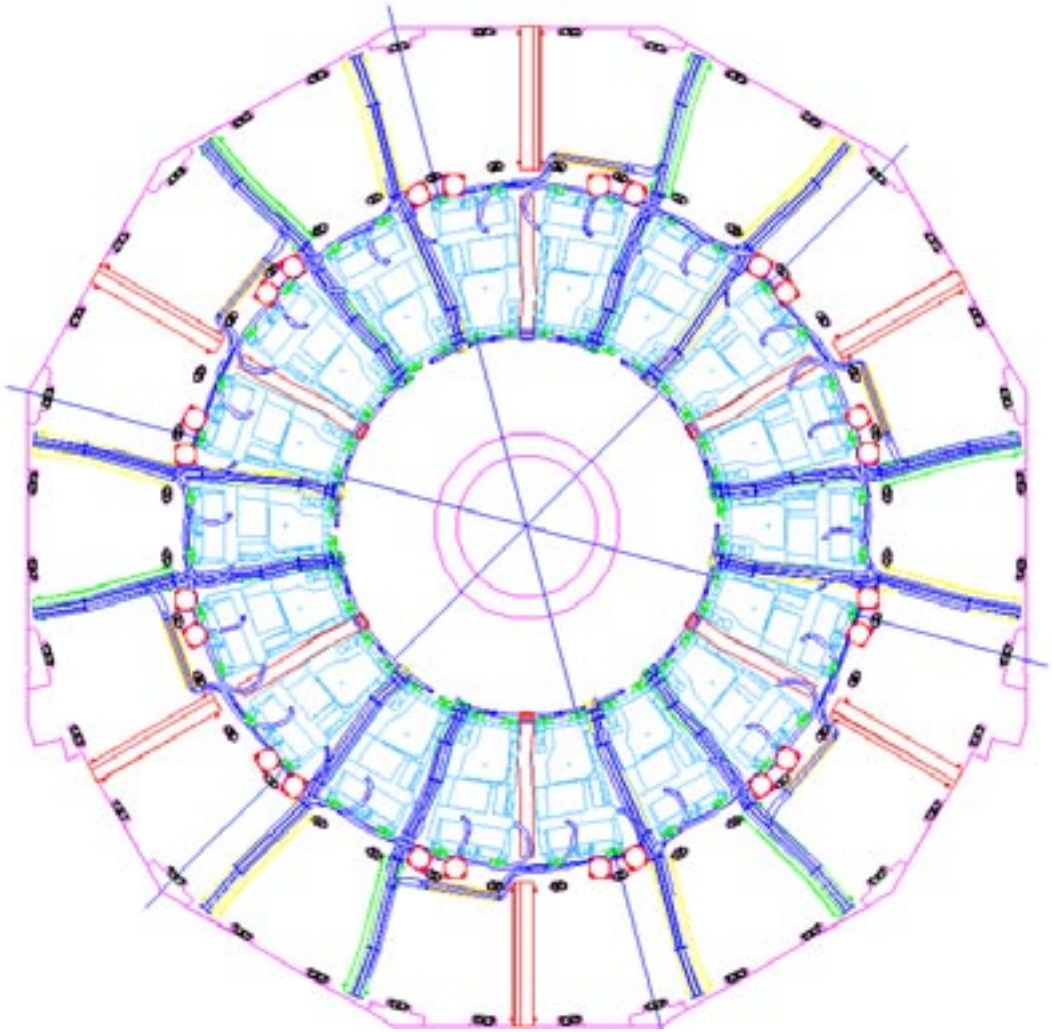
Cable layout

- Mount VME crates in pairs every 60 degrees
- Use 12 cable trays (instead of 18)
- Mount VME racks between the cable trays to minimize the cable length
- Lower racks mounted at 60 degrees to vertical

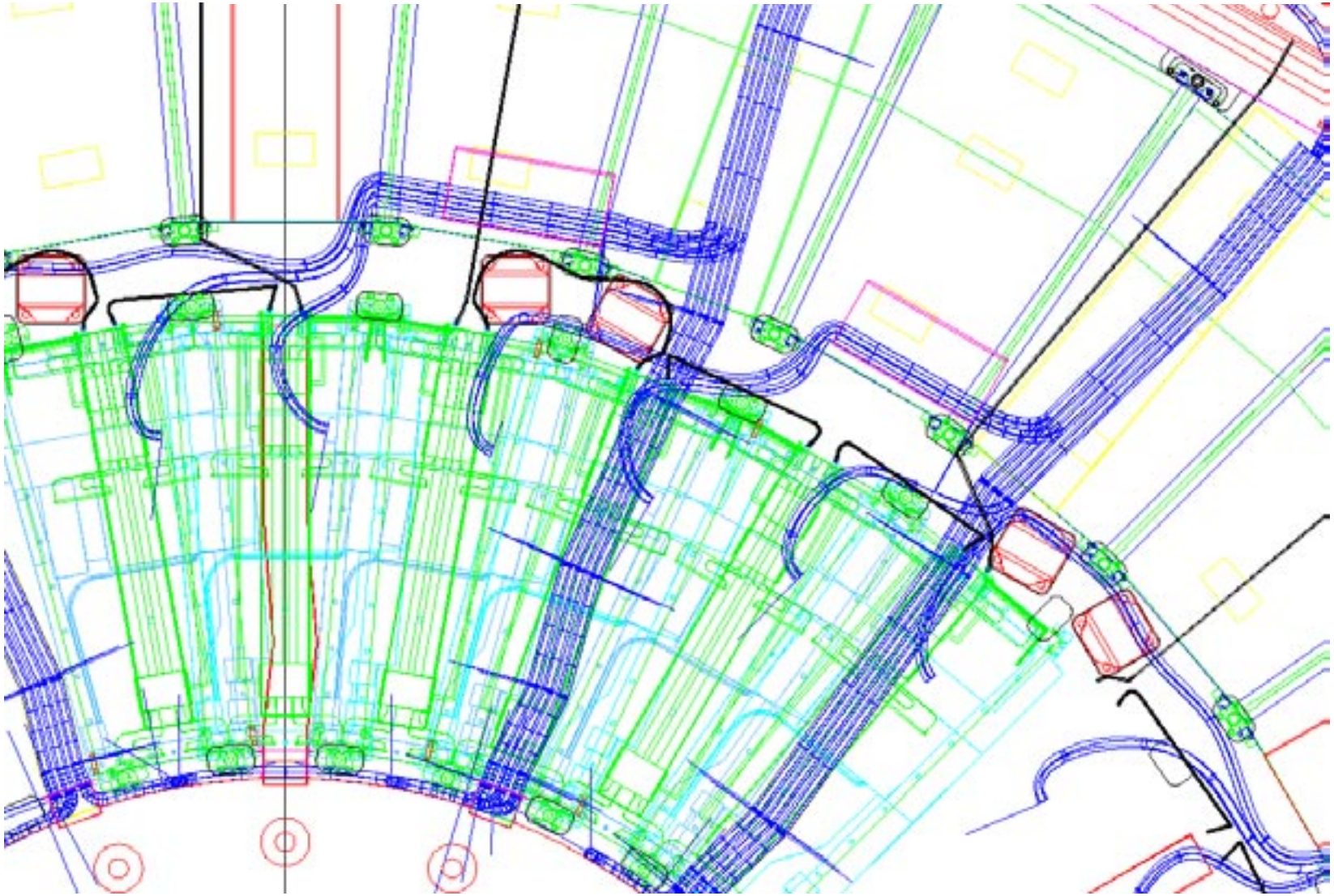
Design status

- ME1/1 layout in good shape - finalize in Jun ‘02
- ME1/2 layout in good shape
- ME1/3 conceptual layout is approved and detailed integration work has begun

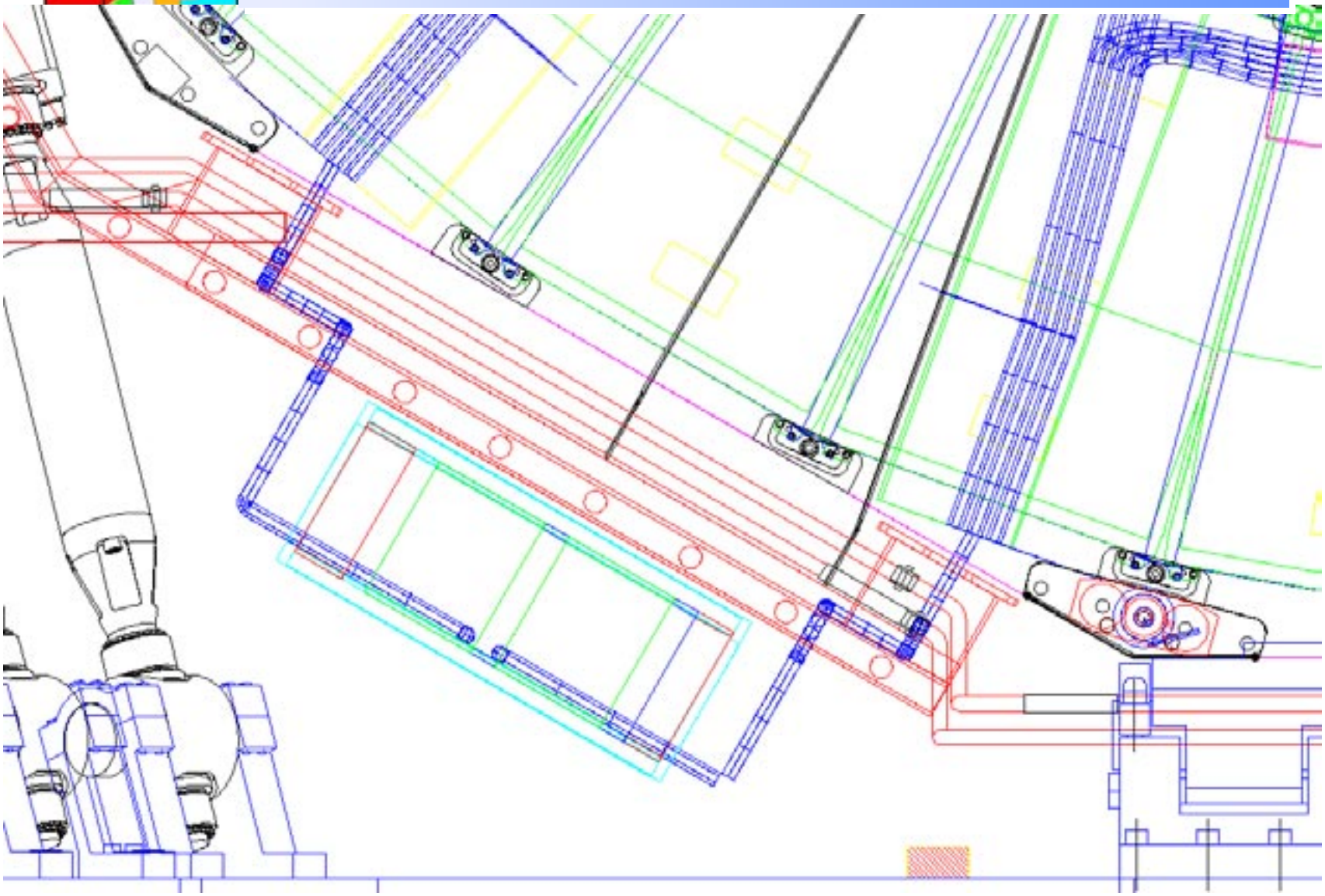
ME1 cabling



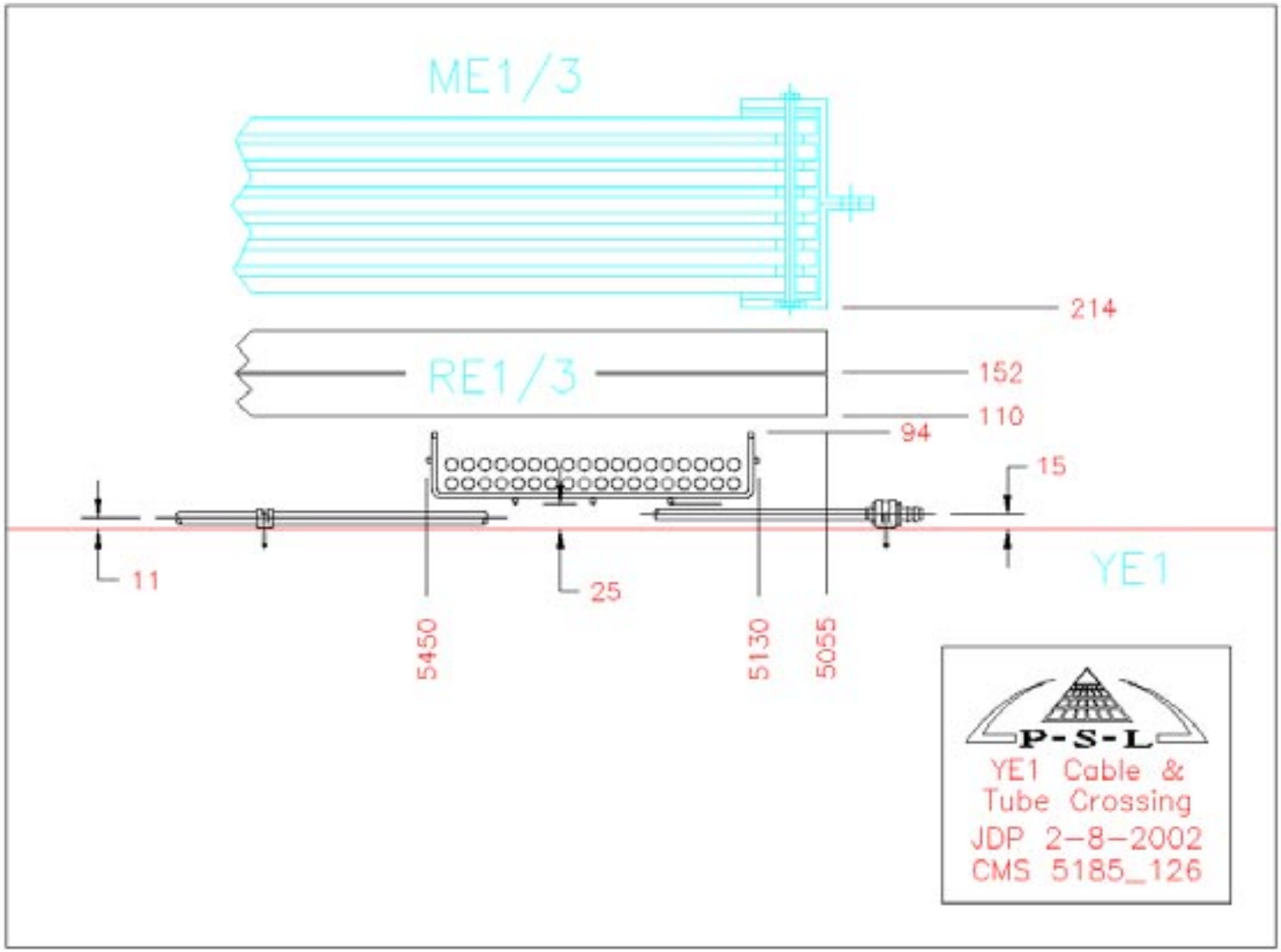
ME1 cabling



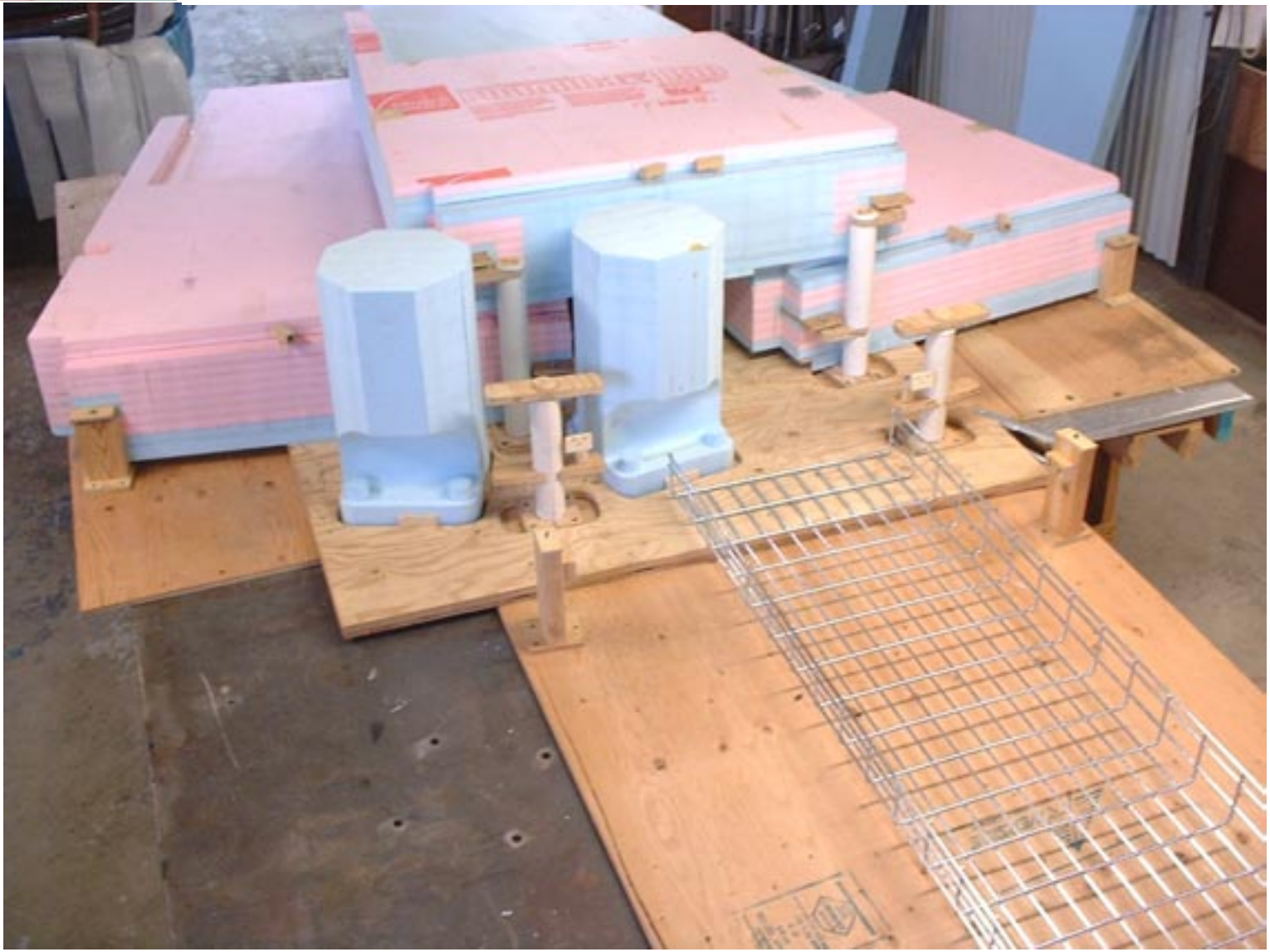
ME1 - lower rack cabling



ME1 cable tray profile



Model of ME1 area



Water cooling

On-detector parts

- CERN approval for hoses (Parker 831)
- Valves, hoses, regulators, O-ring fittings purchased

Water manifolds

- YE2 manifolds designed - ready for production
  - Waiting for final details on the low voltage cooling requirements
- YE1 manifolds still need input from low voltage, RPC and other subsystems

LV Supply Status

400 Hz 3-phase AC-DC prototype design

- Built and tested at Wisconsin
- Supplies 7.5 V at 100 amps
- Must operate in a magnetic field of 1.2 kG

AC-DC system magnetic field simulations

- POISSON for 2-D simulation
- OPERA for 3-D (V. Klioukhine)

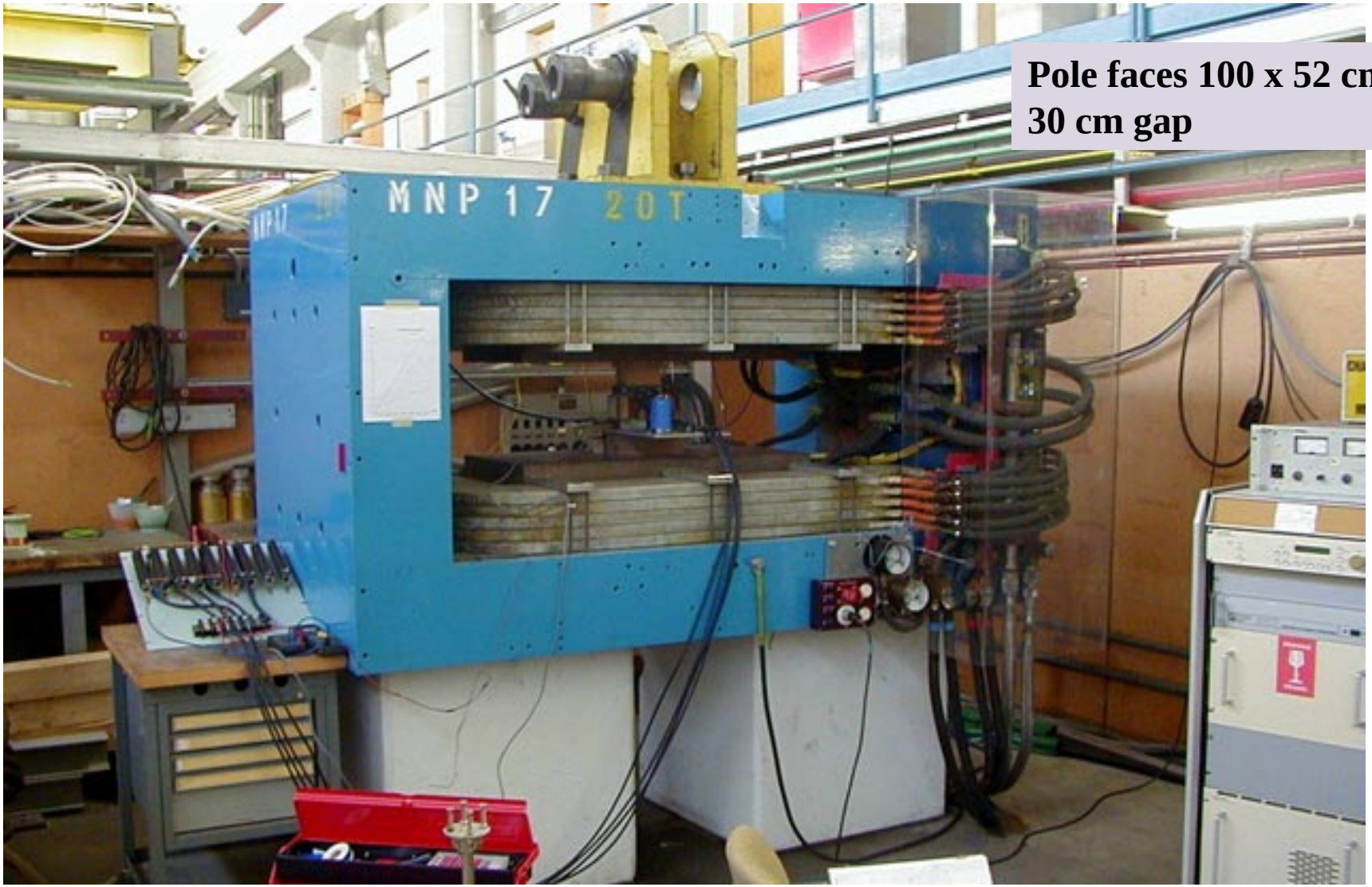
Magnetic field tests at CERN

- Performed 11 Feb 02, 12 Mar 02
- Transformer operates successfully in 1.3 kG field

Construct production prototype

- Shipped to CERN for tests with 400 Hz
- CERN is likely to adopt EMU system for most (all?) subsystems

Test Magnet at CERN

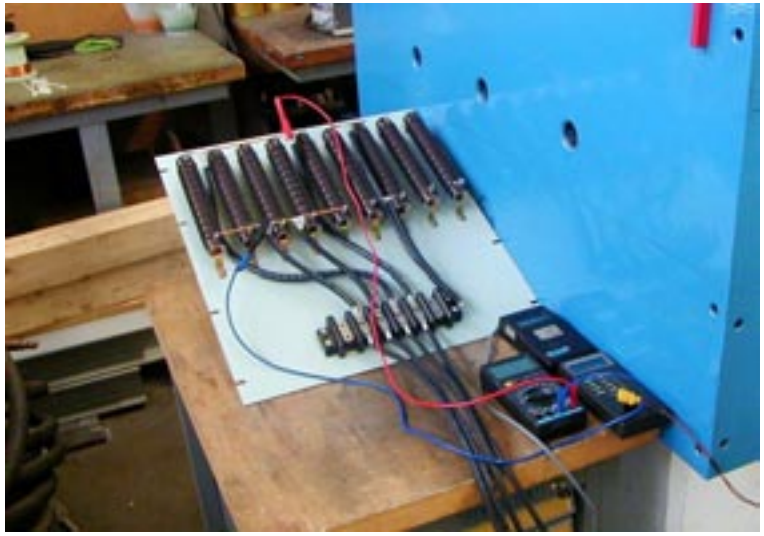


Pole faces 100 x 52 cm, 30 cm gap

Transformer test setup

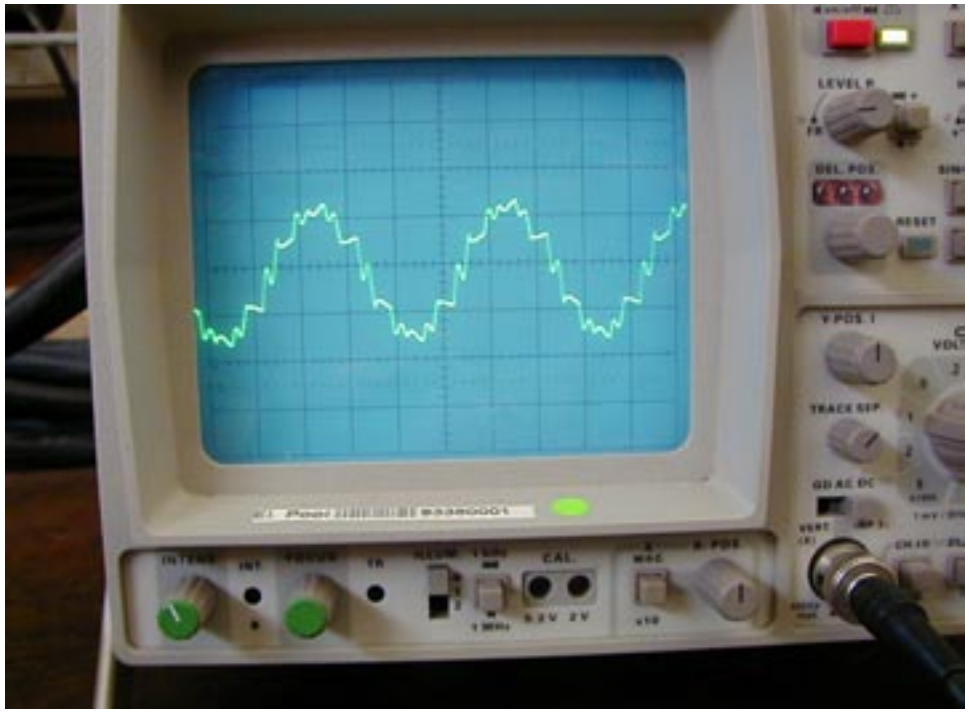
Transformer in magnet, core ~7cm away from each pole face to prevent magnet iron from acting as part of transformer magnetic circuit

Gaussmeter probe location



0.1 Ohm load, 5 kW

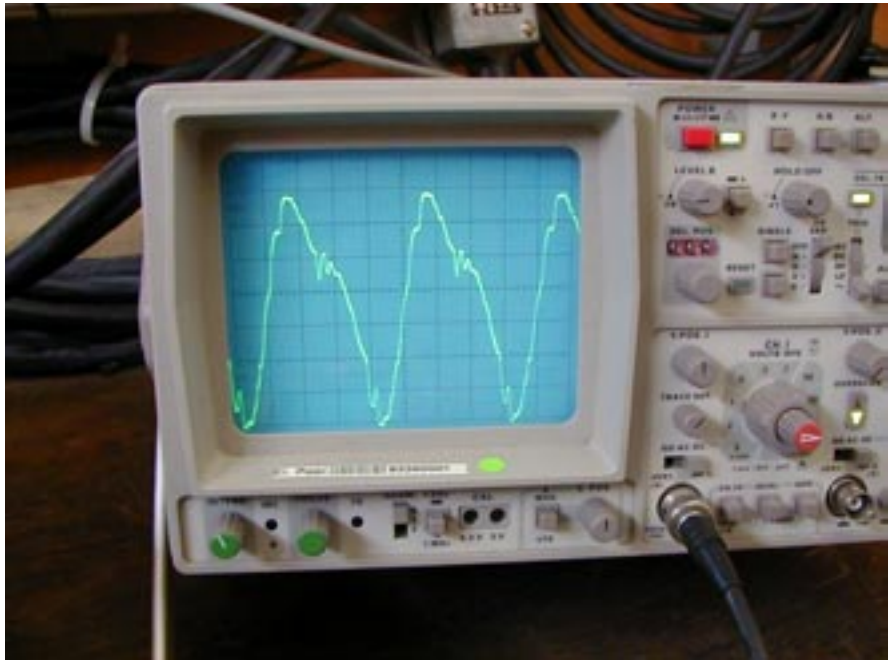
Current probe measurements



"Normal" trace

B (asymptotic)= 1.0 kG

B (local) = 1.8 kG



Core saturation

B (asymptotic) = 1.5 kG

B (local) = 2.9 kG

Magnetic Field Test Results

Magnet current	B nominal	B local	Load voltage	Primary current
32.5 A	0.50 kG	0.93 kG	7.26 V	14.0 A (p-p)
49.9	0.75	1.39	7.27	15.0
66.6	1.25	2.51	7.26	15.0
88.7	1.30	2.66	7.27	15.5
89.8	1.35	2.68	7.26	15.5
93.1	1.40	2.78	7.20	17.0
99.8	1.50	2.97	6.93	24.2
106.4	1.60	3.16	6.18	34.0

Conclusions

CERN infrastructure

- Designs final, manufacture underway, on-track

Installation

- Fixture tested, ready to go
- Mounts for ME2/ME3 finished, ready for installing

Services

- Gas - under contract
- Cabling - ME2/ME3 specified, ME1 will be specified in summer ‘02
- Water cooling - on-detector parts purchased
- Low voltage - prototype tested