



# Update ME4/2 Chambers and Tooling

A construction of new ME4/2 prototype at CERN

Factory tooling, preparation for shipping

Updated factory plan in 904

Production scenario



Goal is to construct 75 ME4/2 chambers of the largest (1.5m x 3.4m) CSC chambers.

Major chamber milestones in 2009:

- Construction and testing of new ME4/2 chamber prototype with using a production factory tooling and new material (FR4 skins).
- Installation of 5 spare ME4/2 chambers (one of them is a new chamber) on the YE+3 disk. Chambers are fully operational and integrated into the EMU system.

It is very good progress for EMU upgrade project

## Goal is to make new ME4/2 prototype at CERN (Bldg.904) in 2010

### List to do:

#### ➤ Chamber parts

- procure new FR-4 skins, anode and gap bars, cooling plates
- make 10 panels from new skins

#### ➤ Shipping of factory tooling from FNAL to CERN

- tooling preparing, crate making, packing

#### ➤ Preparing 904 for prototype production

- cleaning, painting
- prepare engineering communication (power, vacuum, gas and pressure lines)

#### ➤ Prototype construction

- factory tooling installation and commissioning
- personnel learning and training
- prototype production with using standard procedures and travelers

## Procurement:

- placed order for production of anode wire fixation bars, gap bars and cooling plates
- placed order for making 20 FR-4 skins with option to make 1100 (production quantity)

Target is to have parts for making of 3 chambers

## 5ft x 12ft copper clad FR-4 skin production:

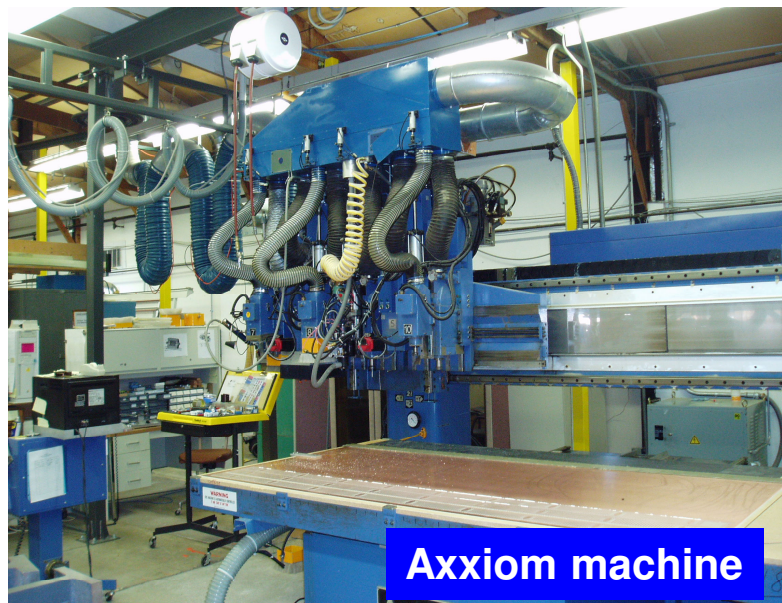
It is the most critical chamber part because old vendor GE who made FR4 skins earlier has been disconnected this line of production.

What we did:

- focused efforts to find new vendors capable to make this size FR-4 skins
- found 4 vendors (US Laminates, AAR composite, Plascore and Aurora Technologies)
- obtained reasonable quotes for making FR-4 skins for small quantities
- got quotes for production quantities that are higher than we have had few years ago

**We expect to place a final order to make 20 skins this week**

# Panel Production Tooling at FNAL



**Axxiom machine**



**Gerber machine**



**Vacuum Lifting system**



**Gerber control unit**

Both **AXIOM** and **Gerber** machines (panel cutting, drilling and strip milling) are fully operational.

## List of major factory tooling:

- Vacuum lifting system
- Epoxy strip gluing machine
- Clamping tables for anode and gap bars
- Winding machine
- Automatic soldering machine
- Wire spacing and tension machine
- Automatic strip connectivity tester
- Automatic wire and strip capacitance setup
- Ionized air knife cleaning machine
- Ionized air gun
- Panel and chamber carts
- Assembly table
- RTV sealing equipment
- Scope, capacitance meter



Tooling stored at FNAL in few buildings.

Preliminary, we will need 1-2 40ft containers (depends how many tables we can get)

We have started preparation for crate making and packing.



# Overseas Shipping to CERN

## Shipping:

40 ft overseas container: 5 crates/stack or 15 crates / container  
Shipping container: panels + chamber parts

Panels (38 crates) → 3 containers

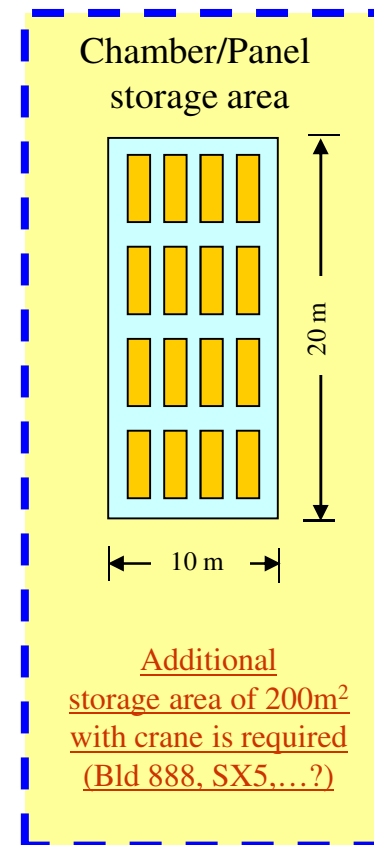
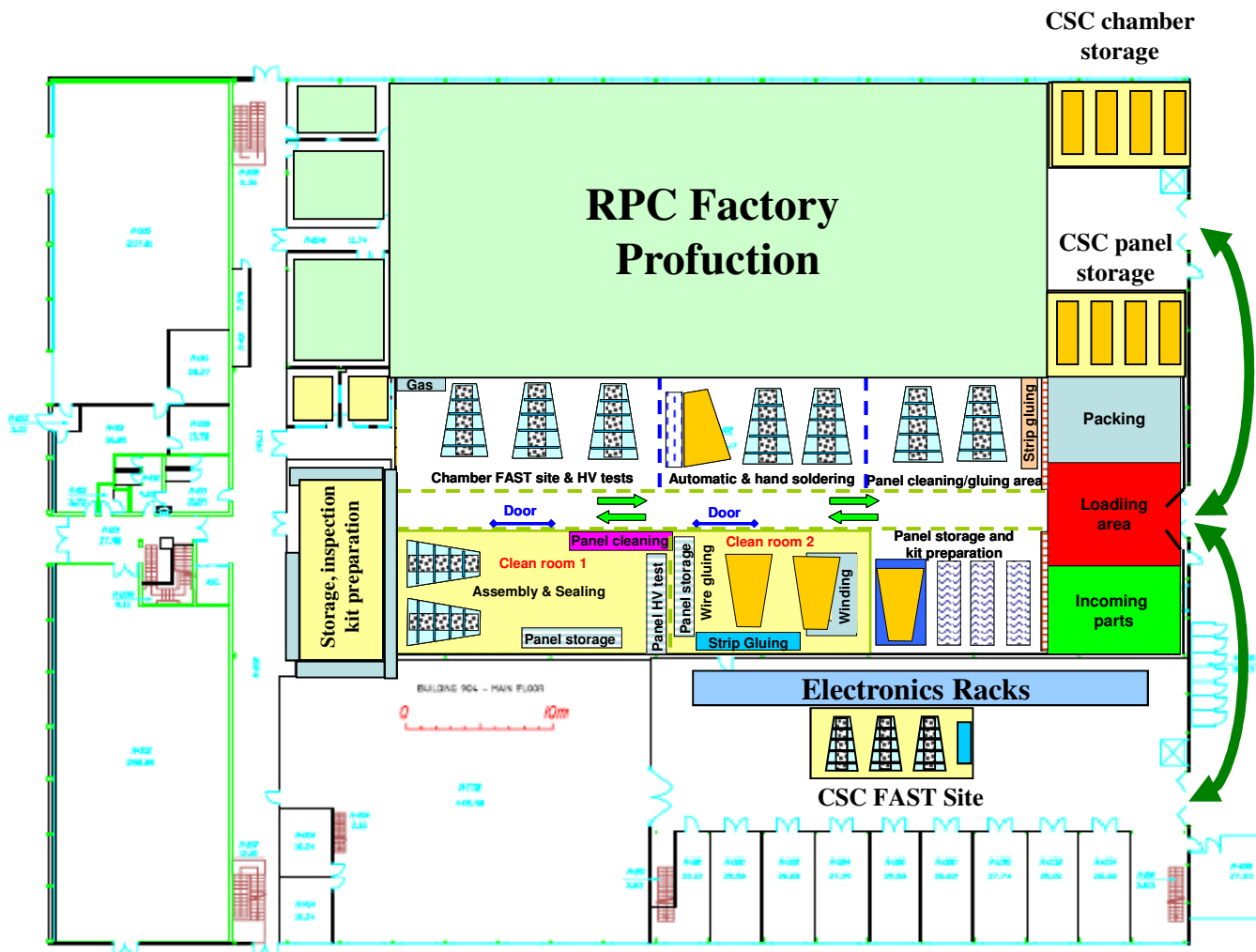
Factory tooling → 1-2 containers

Chamber parts → 1-2 containers

**Total: ~ 6 40ft containers**

**Shipment by air: chemicals, small parts,....**

# Updated CSC Factory Plan at 904







# Storage Area for ME4/2 Chamber Production

## Panels:

Production: vendor → FNAL → CERN (shipping: 14 panels / crate)

Panels: 75 chambers × 7 panels = 525 panels → 38 crates

Crate: 2.0m × 3.7m × 0.4m, maximum 5 crates per stack

Storage area for panels (904) : 2.5m × 4.5 m = 11 m<sup>2</sup> /stack × 8 = ~ 90 m<sup>2</sup>

## Chamber parts:

- Big parts: Al frames, Z-brackets (open shelf storage)
  - FR4 parts: anode wire fixation bars, gap bars, spacers, ...
  - small parts: wires, electronics components, bolts, nuts, ...
- } Inspection/storage room

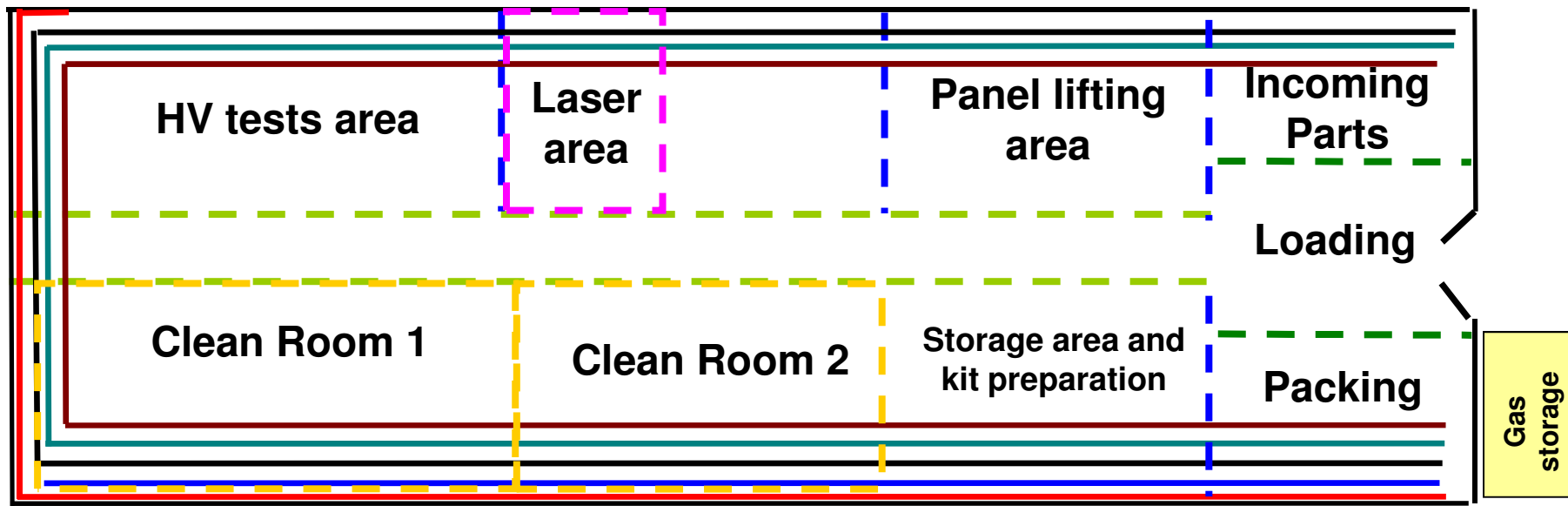
## Chambers:

- Chamber Crate: 2m × 3.7m × 0.4m, maximum 5 crates per stack
- Reuse the panel crates remained from panels
- Need 75 crates for ME4/2 chambers (shortage ~ 20 crates)

Chamber storage: 5 chambers per stack → 15 stacks × 11 m<sup>2</sup> = ~ 165 m<sup>2</sup>

**Total storage area required for ME4/2 CSC production is about 250 m<sup>2</sup>**

# Engineering Services for CSC Factory



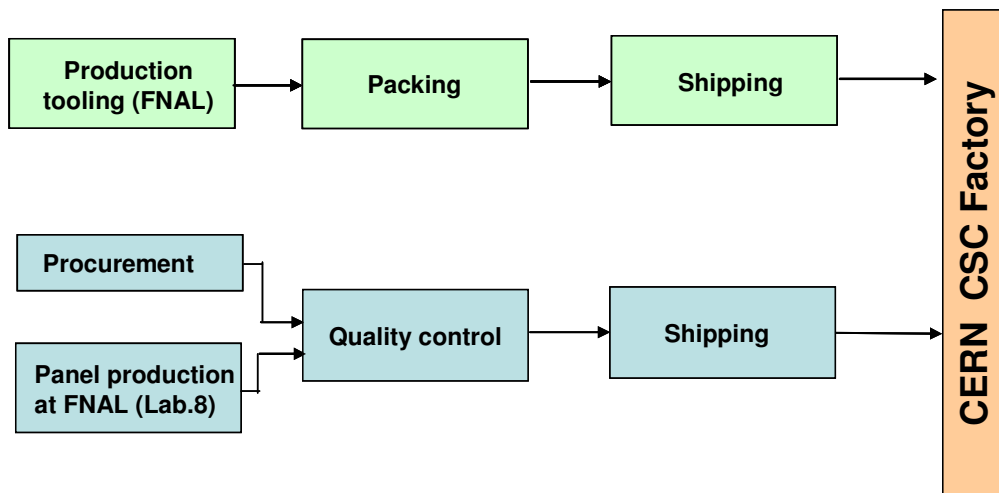
- Gas mixture pipelines (copper tube, 12 mm OD), test area
- Pure nitrogen line (SS tube, 25 mm OD, P = 20 atm, flow ~0.5 m<sup>3</sup>/min), clean rooms
- Pressure line for pneumatic tooling (10 atm)
- Vacuum line
- Power 220V & 110V (will be discussed with CERN engineers)

**Clean rooms: Class 1000**

**Vendor: Clean Rooms International, Inc <http://www.cleanroomsint.com>**

# ME4/2 Prototype Production at CERN

- ❑ FNAL: Factory tooling shipment to CERN
- ❑ FNAL: Panel production, strip milling (Lab.8)
- ❑ FNAL: Chamber parts procurements, control, shipment to CERN
- ❑ FNAL: Supervising production, training and learning technicians
- ❑ CERN: CSC factory preparation (Bldg 904)
- ❑ CERN: Prototype production and testing





# Preparation at Bldg.904

## CSC factory setup (3-4 months):

- ❑ Clean, paint production area
- ❑ Engineering services (gas, vacuum, power lines)
- ❑ Clean room construction ???
- ❑ Tooling installation and testing
- ❑ Personnel training, learning, start prototype production

### Manpower:

- 2 technicians, one of them will be a flow manager in the future
- 1 technician from FNAL for 1-2 months for training of CERN personnel

### Engineering support:

- 1 engineer from CERN
- 1 engineer from FNAL/Purdue for 1- 2 months to help with tooling startup

## Prototype production (2-3 months):

- 2 technicians
- 1 physicist
- 1 engineer

Preparing 904 area and engineering communications



# Production Scenario and Time Schedule

Tooling and chamber parts shipping:	Mar-Apr 2010
Readiness CERN site (Bldg 904):	May, 2010
Factory tooling setup, personnel training:	Jun - Aug, 2010
Prototype production and testing:	Sept - Nov, 2010

If a prototype production will go smoothly we will continue a production for additional 2 chambers (parts will be available) to keep technicians busy. Also, electronics component preparation (resistor and capacitance bending, ground foils cutting, cables preparations) could be considered as filing time before ME4/2 chamber production.

Making new chamber prototype with factory tooling at CERN will allow to save 6-9 months for ME4/2 production since a project will be approved. It is a good reason to make prototype in framework of R&D program.

With a proposed plan and project approval in 2010 the first 36 chamber production could be completed in the end of 2011.



# Summary

Construction of ME4/2 chamber prototype of production quality is important milestone for EMU Upgrade project.

New ME4/2 prototype that will be produced at CERN with using of factory tooling will allow to save time significantly for factory setup and personal training

Preparation of 904 building and engineering communications for prototype construction is a crucial point of factory setup at CERN.