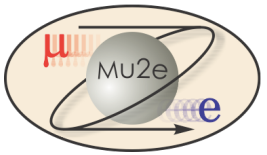
Fermilab

Mu2e CD-2 Integration Presentation



Kurt Krempetz
Mu2e Mechanical Project Engineer
10/21/2014

Credentials

- Kurt Krempetz
  - Over 36 years of Mechanical Engineering Experience at Fermilab. Served as the Mechanical Project Engineer for the Meson Superconducting Beam lines, Dzero Liquid Argon Calorimeters, Dzero Run 2, Dzero Run 2b, and DeCAM/DES projects. Also was in charge of the operations of many of these projects.
  - Head of Mechanical Engineering Department in Particle Physics Division for over 10 years, where one of my primary jobs is to allocate resources and match skills to support Lab Projects.

Mu2e Integration Team

- Team Leaders
  - Dervin Allen- Floor Manager (over 30 years at Fermilab)
  - Dee Hahn-Safety
  - George Ginther- Muon Beamline Level 2 Manager
  - Kurt Krempetz- Mechanical
  - Marcus Larwill- Electrical
    - One or more of us typically attend:
      - Mechanical Integration Meetings
      - Electrical Integration Meetings
      - Target Station Meetings
      - Muon Beamline Meetings
      - Mu2e Weekly Meetings
      - General Solenoid Meetings
      - Tech Board Meetings

Mu2e Integration Team

- Team Members
  - Everyone involved in Mu2e
    - Specifically includes:
      - All L2's
        - Accelerator –S. Werkema
        - Conventional Construction- Tom Lackowski
        - Solenoids-M. Lamm
        - Muon Beamline- G. Ginther
        - Tracker- A. Mukherjee
        - Calorimeter- S. Miscetti
        - CVR- C. Dukes
      - Mu2e Collaboration
        - Spokespersons- J. Miller, D. Glenzinski

Definition of the Integration task?

- Process of attaining close and seamless coordination between subsystems

- This is the Integration Team's goal:
  - During the design process
  - During the installation process
  - During commissioning and operations of the experiment

- Throughout the Integration process, Integrated Safety Management, Quality Assurance, Risk management and the principles of Value Engineering are applied

Mu2e Integration Philosophy

- Each L2 is responsible for the Integration of their systems:
  - Internal within their L2
  - External with other L2's.
- Muon Beamline has a significant role in the overall Mu2e Integration effort
  - Almost all the other L2's have interfaces with the Muon Beamline
    - Muon Beamline vacuum volume:
      - Contains the Primary Target and the HRS serves as portion of the vessel wall (Accelerator L2)
      - Is within the Solenoid warm bore (Solenoid L2)
      - Contains the Tracker (Tracker L2)
      - Contains the Calorimeter (Calorimetry L2)
      - Accommodates signal and power cables that must pass through the vacuum volume, into the detector hall and into a cable trench (DAQ L2)
    - Muon Beamline Shielding
      - CRV is supported off the shielding (CRV L2)
      - Shielding sets the scale for the required building space (Conventional Construction L2)
- Substantial Integration effort remains after the KPP's have been met.

Mu2e Integration Documentation/Tools

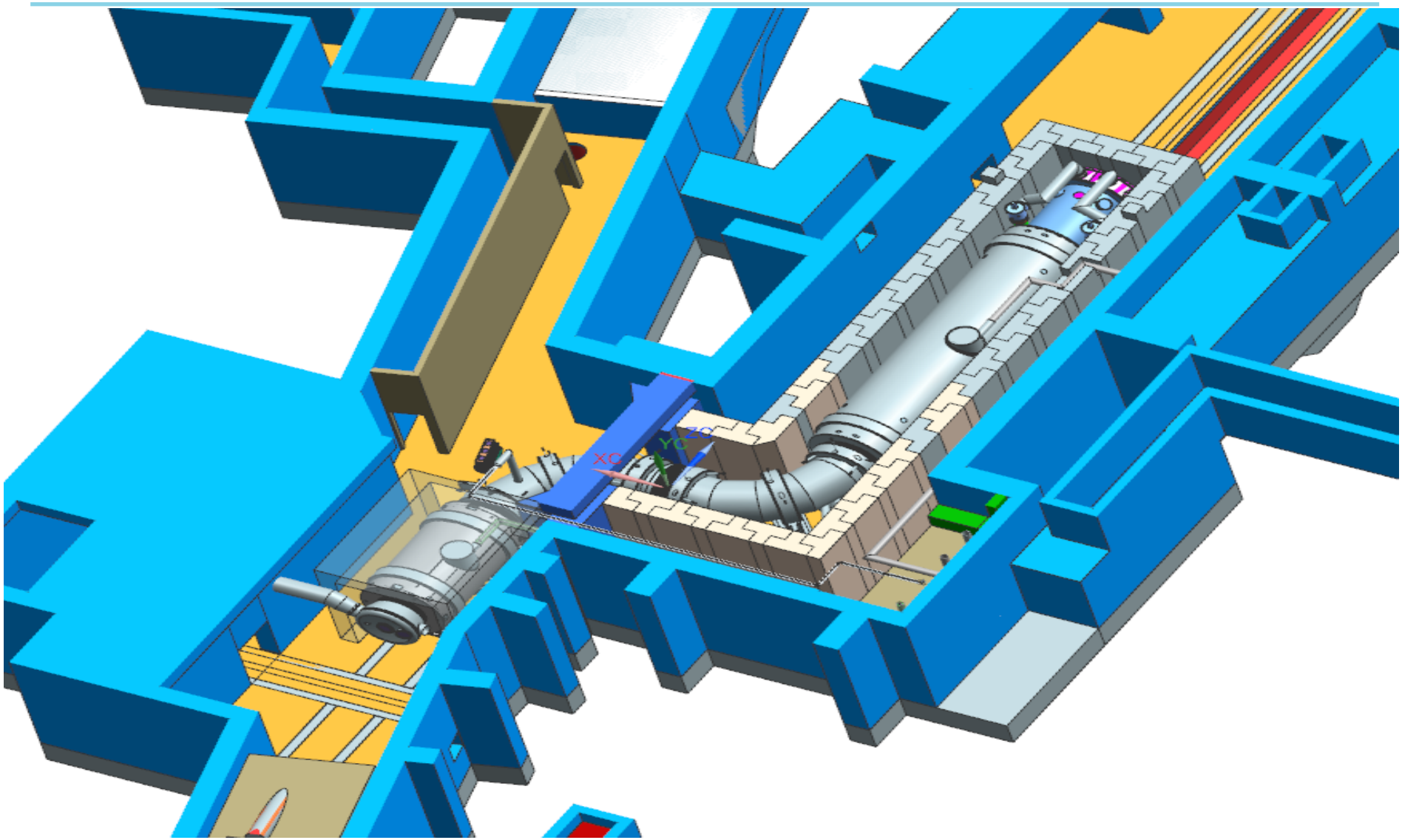
- Requirement Documents
- Interface Documents
- CAD Integration 3D Model
- Drawings
- Mechanical Integration Meetings Agendas and Minutes
- Electrical Integration Meetings Agendas and Minutes
- Muon Beamline Meetings Agendas and Minutes
- Tech Board Meeting Meetings Agendas and Minutes
- Simulation Studies
- WBS Dictionaries
- P6 Schedule

- For the Muon Campus GPP /AIP projects:
  - Lab's PMG's and POG's Meetings
  - Beamline Enclosure and Cryo Documents in the Beamdocs database

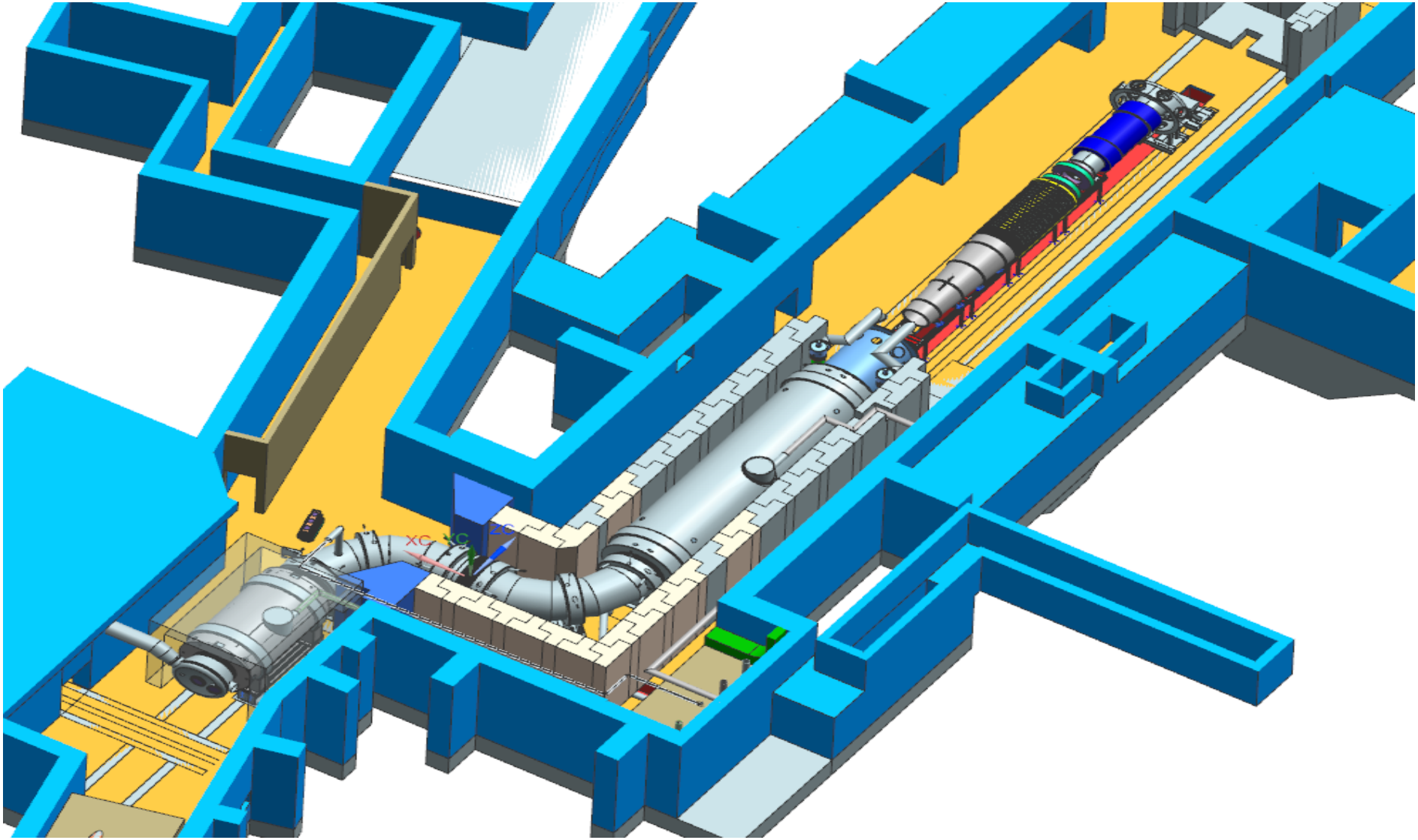
Requirements/Interfaces

- Requirements are documented and stored in the Mu2e docdb
- Interfaces are documented and stored in the Mu2e Docdb.
- The Web link showing the approval signoff of Requirements/Interfaces
  - http://mu2e.fnal.gov/atwork/project/Approvals/Approval_Summary.php
  - WBS Numbers 0-99 reserved for Requirements
  - WBS Numbers 100-120 reserved for Interfaces.
- An Interface Matrix is in Mu2e Docdb-4111

3D CAD Model



3D CAD Model



Mu2e Integration Issues

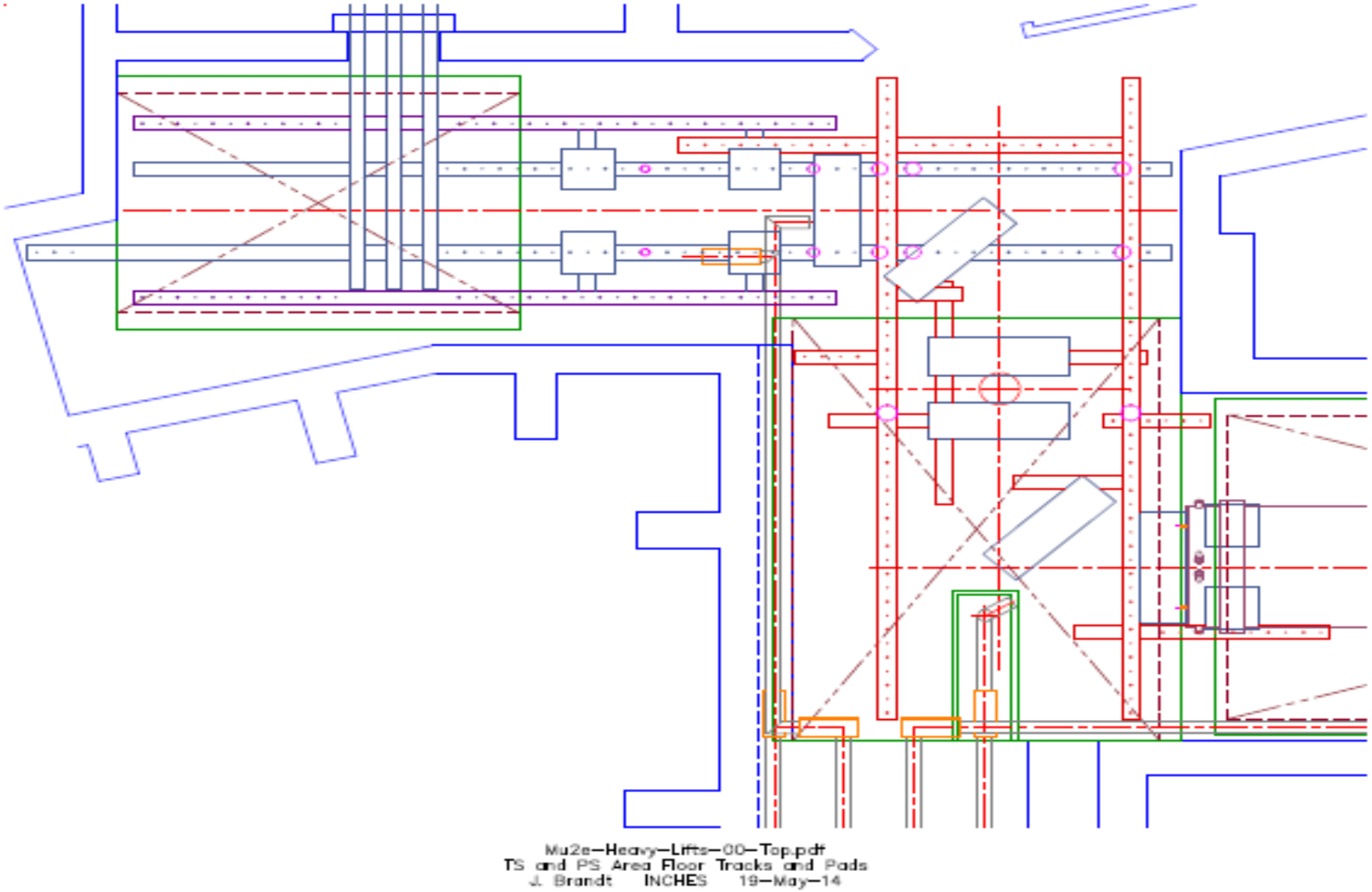
- Visible
  - Space Constraints
  - Parts Mating
- Non-visible
  - Radiation
  - Stray Magnetic Field
- Common Systems
  - Building (where everything comes together)
  - Chilled Water System
  - LCW System
  - Instrument Air System
  - Roughing Vacuum System
  - HVAC System
  - Process Control System
  - Detector Grounding
  - Power Distribution
  - LN2 Distribution
  - Alignment

-Infrastructure/Outfitting
-Safety Systems
-Installation Schedule/sequencing
-Crane usage
-Hatch access
-Routing of services(Wi-Fi)
-Cable Plant
-Control Center/Lunch Room
-Tech Shop

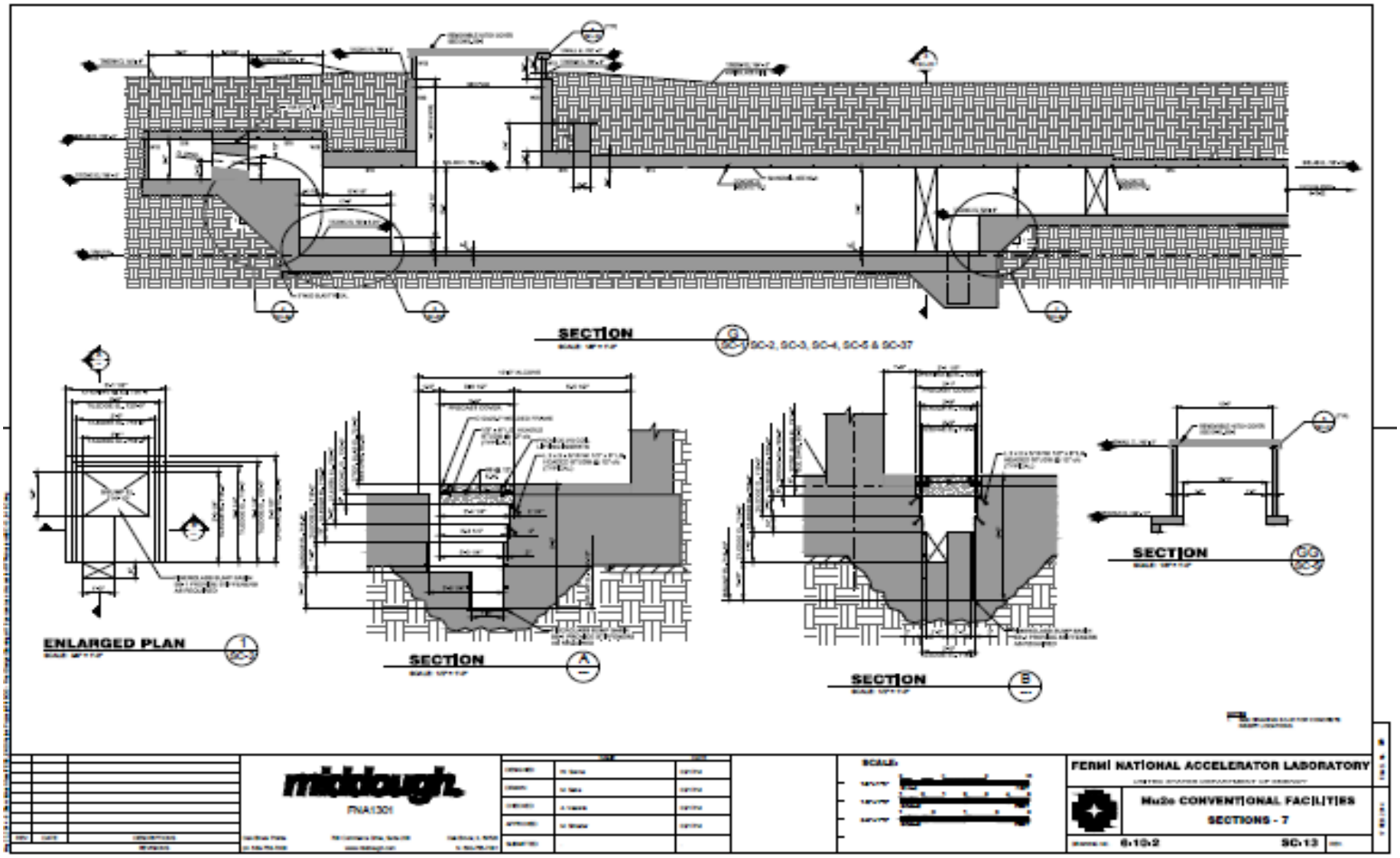
Recent Examples

- Plan for installing the PS and HRS
  - Originally planned to be installed through the PS Hatch, now planned to be installed through the TS Hatch.
    - Saves the cost of a large crane but requires careful integration between the Solenoid group, the Target group, Muon Beamline group and the necessary track plates in the Mu2e building.
- DT Calorimeter Calibration System
  - Original plan had lead/poly/concrete shielding all around the generator, now its planned to be placed in a pit and flush with the floor.
    - Saves the cost of much of the shielding, and increase the amount of useful basement floor space but requires careful integration between the Calorimeter group, the Muon Beamline group and Conventional Construction group.

Track Plates



DT Source Pit



Examples-Stray Magnetic Field

- Integration meetings had and will continue Magnetic Field Abatement Discussions on :
  - Power Transformers for the Mu2e Building
  - Re-bar in the Mu2e Building walls
  - Re-bar in the concrete Shielding Blocks
  - The Stands for PS, TS, DS and the Detector Train
  - Mu2e Building Lighting and Fire System
  - Mu2e Elevator
  - Vacuum Pumps and Actuated Valves
  - Magnet Power Supplies
  - DT Calorimeter Calibration Source
  - The Target Remote Handling System
  - Some relevant documents in docdb are,1381,2444 and 2881.

Backup Slides

Summary

- A great Team has been created
- Good Communication Lines have been established.
- Documentation is in place
- Being able to compromise and being flexible are keys to success.

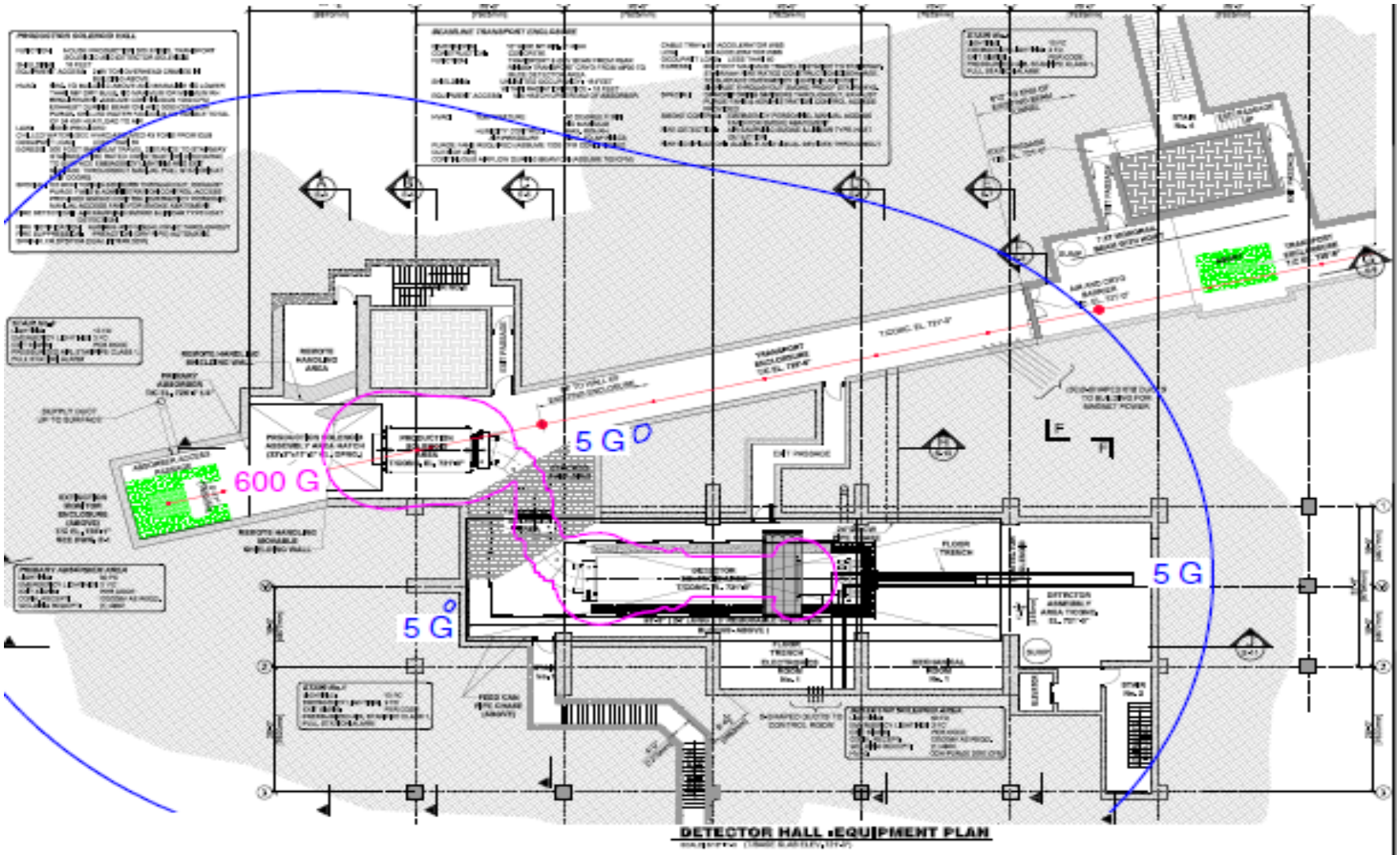
Magnetic Fields

- Earth's Magnetic Field varies from .3 gauss to.6 gauss at surface
  - At Fermilab it is about .55 gauss
  - Fermilab FESHM 5062.2 addresses Magnetic Field SafetyPosting required;
    - at >5 gauss –for pacemakers and other very sensitive devices
    - at >600 gauss for rotational and translational forces

Approximate field strength		Rotational force observation summary
mT	G	
< 6	< 60	No perceptible rotational force
≈ 60	≈ 600	Rotational force clearly interferes with use of ferrous objects
> 200	> 2000	Rotational force makes normal handling of ferrous objects almost impossible

- From Dzero experience some solenoid valves did not operate at 300 gauss, depending on valve's orientation.

Mu2e Stray Magnetic Field Calculations



Stray Magnetic Field Documentation

- Mu2e Stray Field-Docdb 1381
- Estimate of the forces on the support structure and other equipment located at the Mu2e experimental hall due to the stray magnetic field-Docdb 2444
- Preliminary Mu2e Stray Magnetic Field Abatement Plan-Docdb 2881