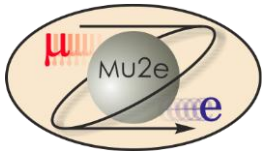
Fermilab

U.S. DEPARTMENT OF ENERGY Office of Science

WBS 475.04.10 System Integration, Installation and Commissioning



Jeff Brandt

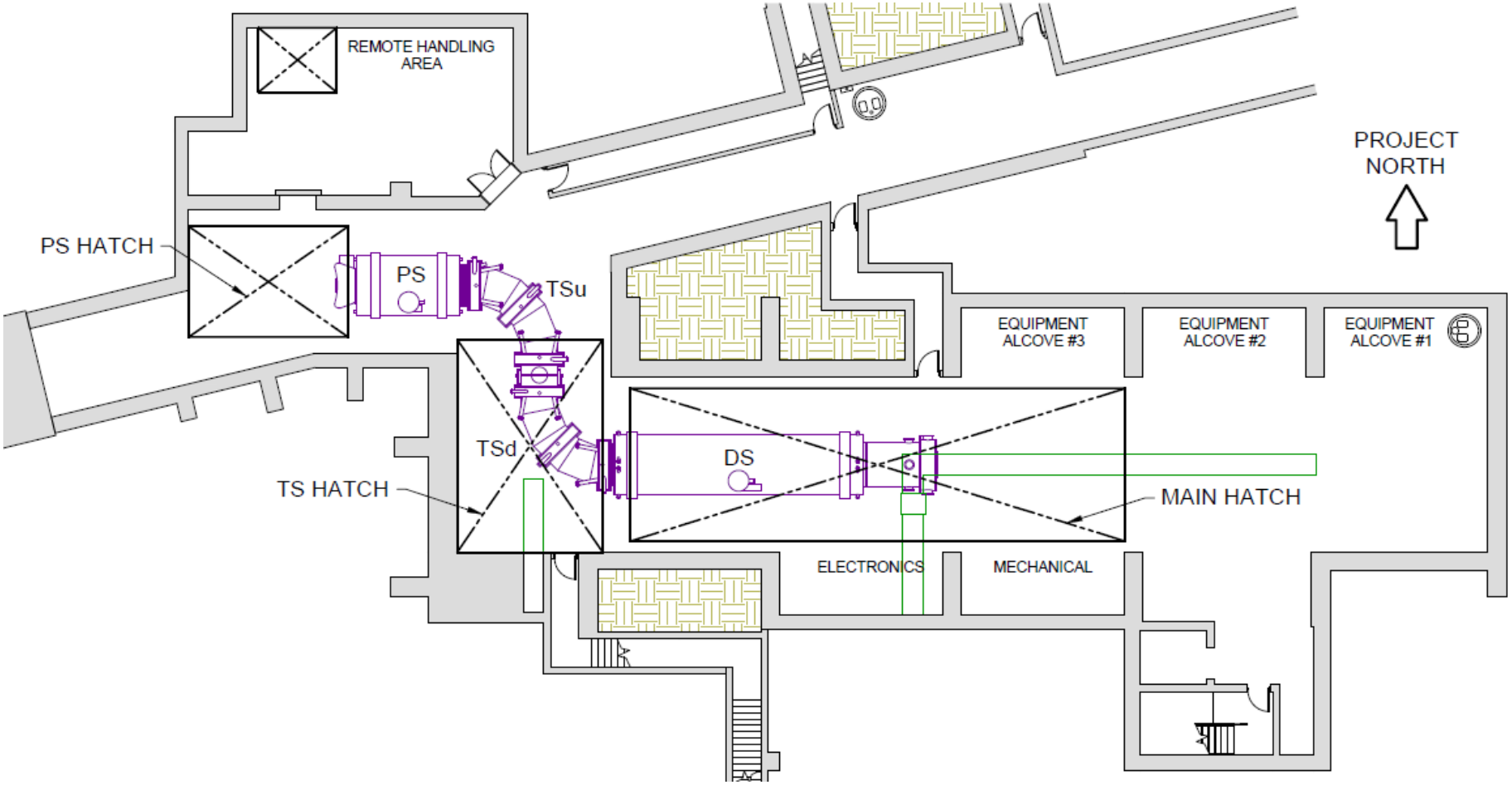
Mechanical Engineer

08-Jul-2014

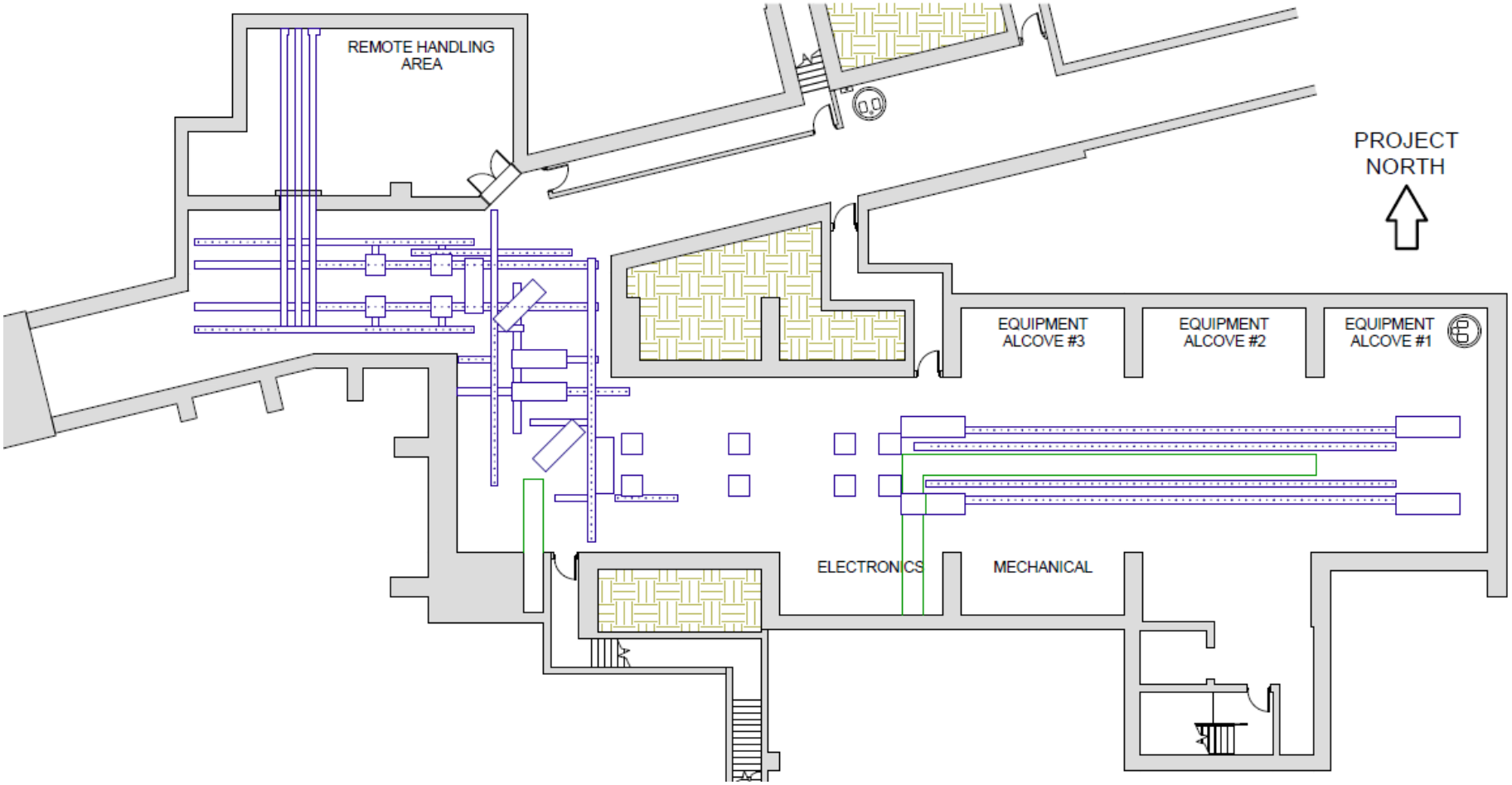
Requirements

- Two 30 Ton cranes which can be connected and controlled in tandem for use as a 60 Ton crane – needed for all solenoids.
- All heavy lifts through MAIN and TS hatches.
- An embedded floor track system to transport PS, TSu, and TSd solenoids into place.
- Embedded solenoid floor pads must accommodate large forces from magnet system interaction.
- Infrastructure to support solenoid power and cryogen delivery, insulating vacuum, and instrumentation needs.

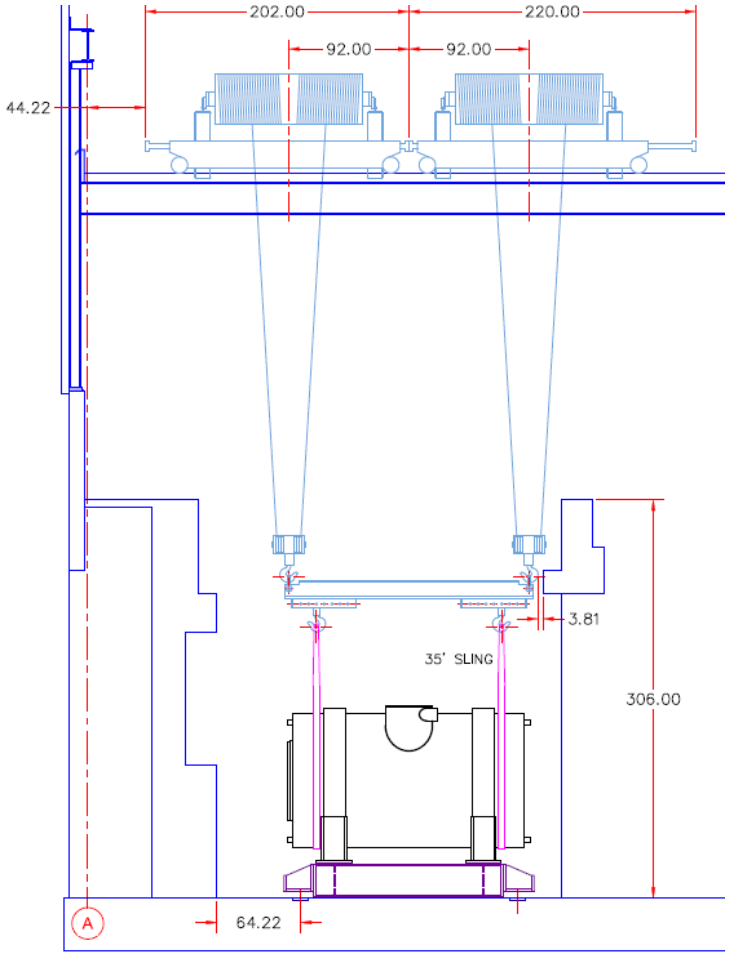
Design – Solenoids, Building and Hatches



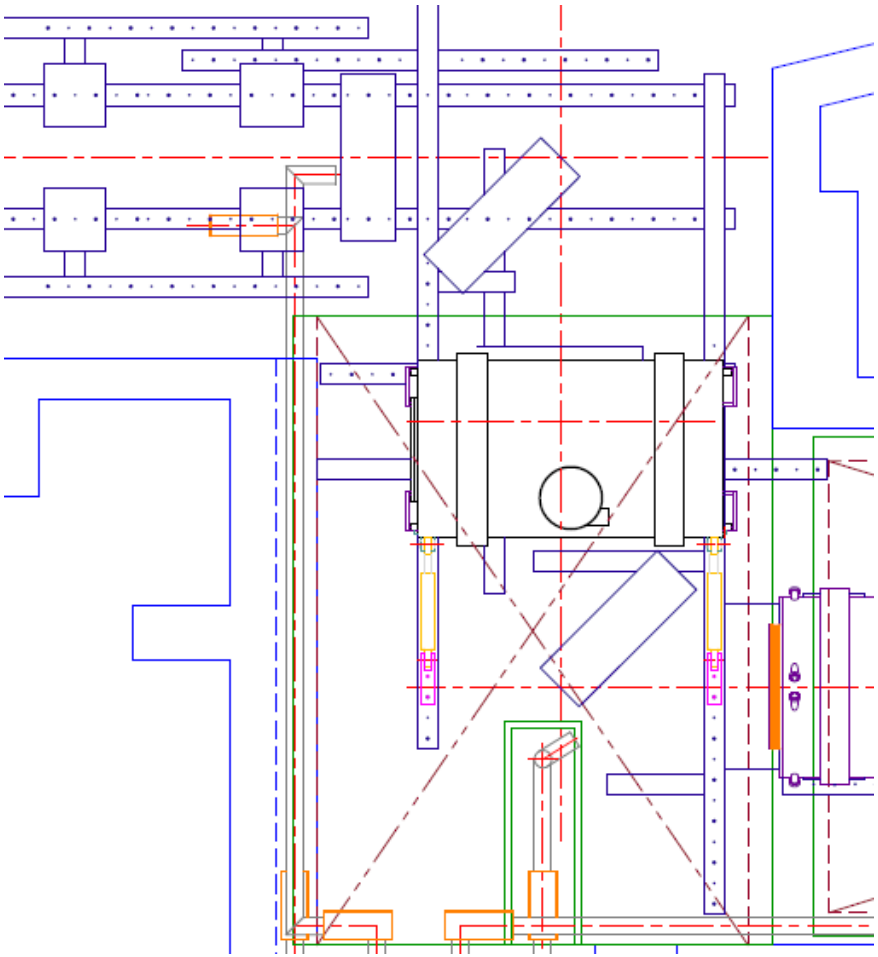
Design – Floor Tracks and Floor Pads



Design – PS Installation

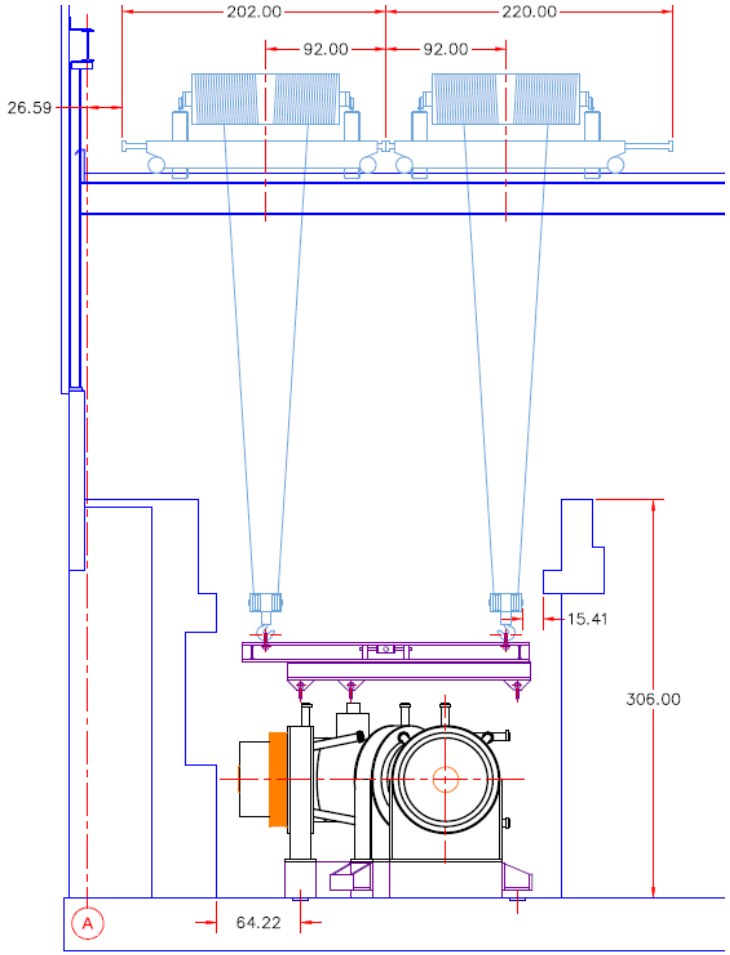


Side view – lowered into place

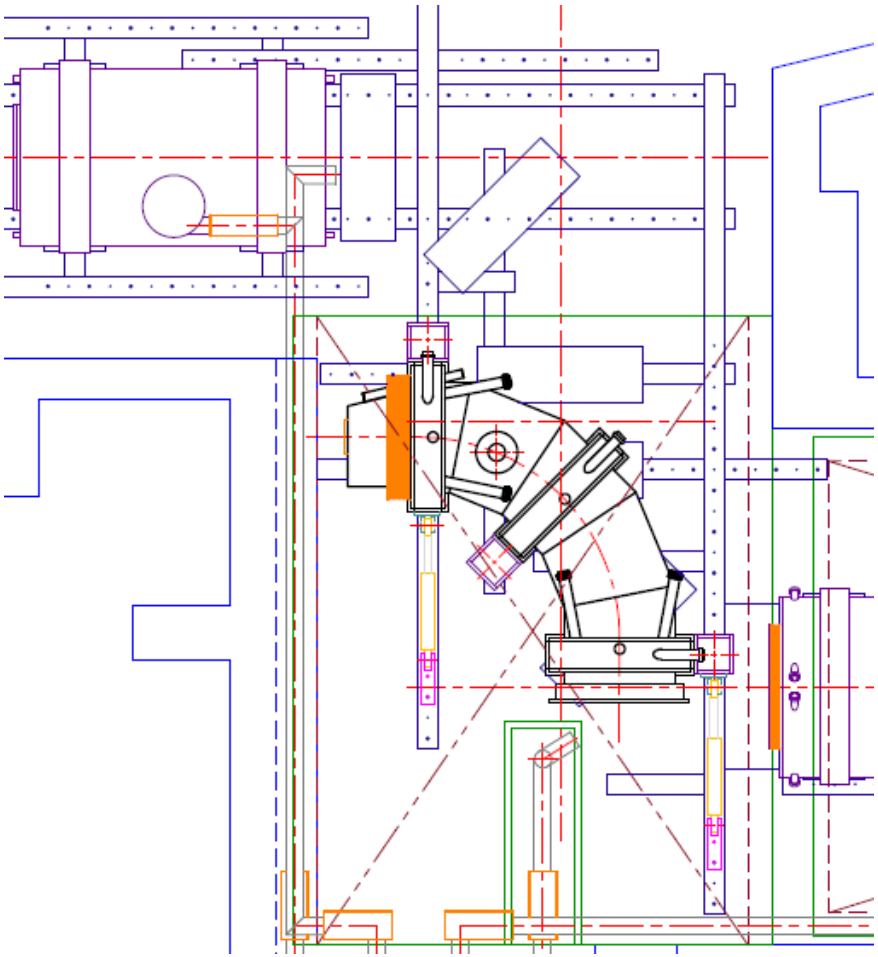


Top View – ready for transport

Design – TSu Installation

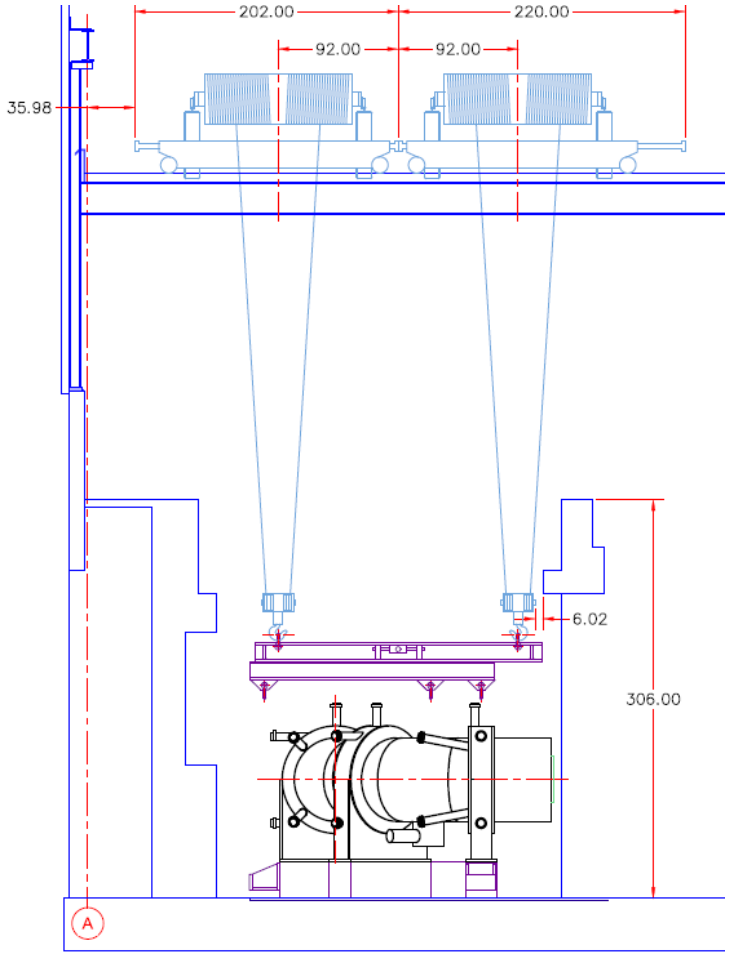


Side view – lowered into place

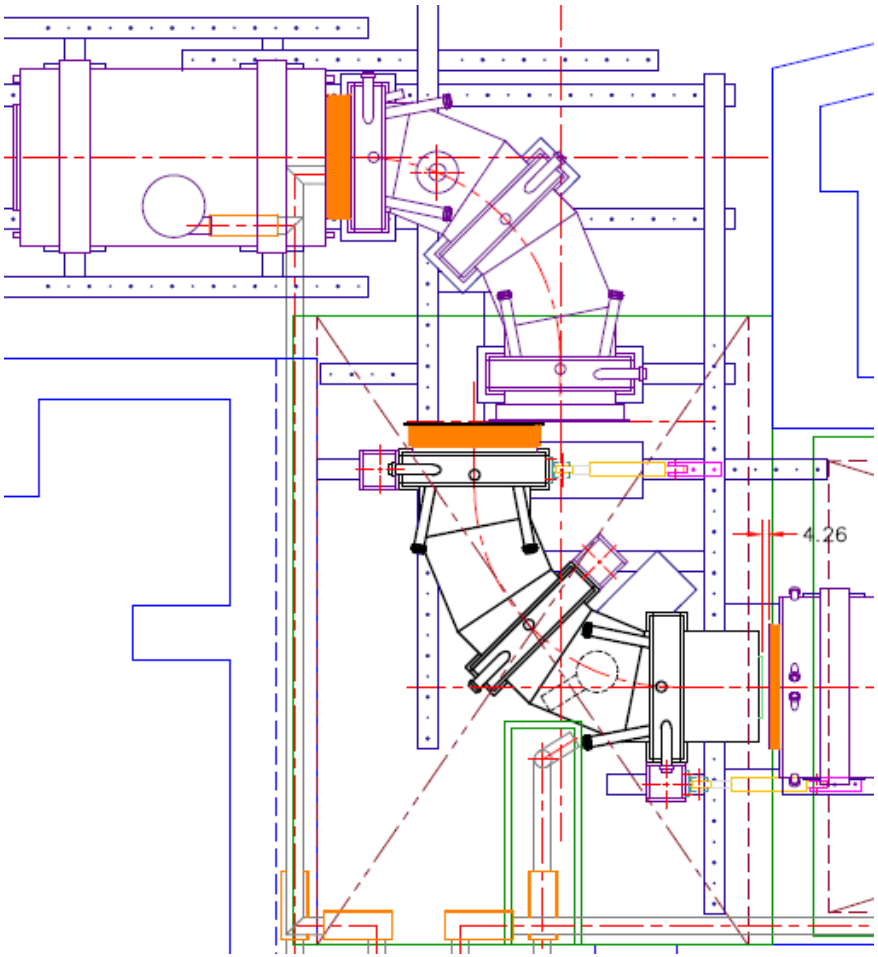


Top View – ready for transport

Design – TSd Installation



Side view – lowered into place



Top View – ready for transport

Changes since CD-1

- Decision to perform all heavy lifts through MAIN and TS hatches, avoiding crane and climate issues with PS hatch.
- Revisions and additions to embedded floor track system.
- Location of transfer line routing and connection to each solenoid – addition of cross trench for TSd connection.

Value Engineering since CD-1

- Significant cost savings in avoiding large crane rentals for PS hatch lifts.
- Common outriggers attach to all solenoid support feet and frames, as well as Heat and Radiation Shield tooling.
- Transport system tooling common for all major solenoid, equipment, and shielding moves.

Remaining work before CD-3

- Finalize solenoid interfaces.
- Finalize alignment design for solenoids.
- Complete detailed installation plan integrated across project.
- Complete detailed commissioning plan integrated across project.
- Complete incorporation of all systems into 3D Integration Model.
- Produce final design engineering drawings.

Quality Assurance

- Building will be fully networked by metrology experts.
- Detailed installation plan, integrated across project, will be implemented using Travelers.
- Work will be performed by local experts and overseen by responsible engineer.
- All tasks will be signed off, critical tasks will be verified by metrology and responsible engineer.
- Detailed commissioning plan, integrated across project, will be implemented using Travelers.

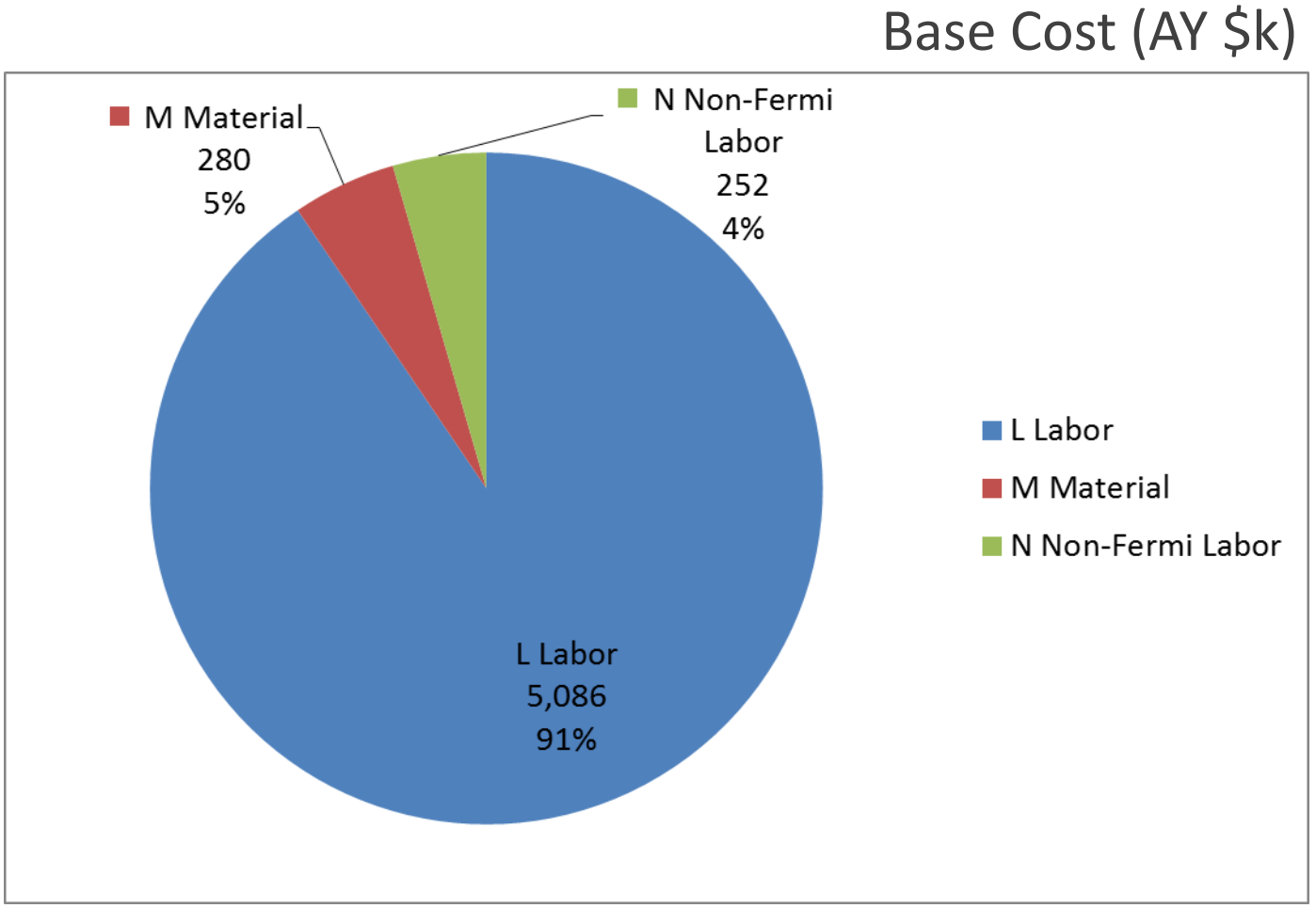
Risks

- SOL-066 – Critical path delayed due to solenoid delay.
  - Very high cost and high schedule impact potential. Mitigation by regular communication with vendors, regular vendor visits, flexibility built into installation plan, parallel installation efforts.
- SOL-070 – Interface problems with solenoids.
  - Very high cost and high schedule impact potential. Mitigation by regular communication with vendors, clearly specifying interface requirements, regular communication between responsible engineers on both sides of interface.
- SOL-148 – PS must be installed with external crane.
  - High cost but negligible schedule impact potential. Mitigation by solenoid contract requirement, careful analysis of internal lifts, regular communication with vendors.

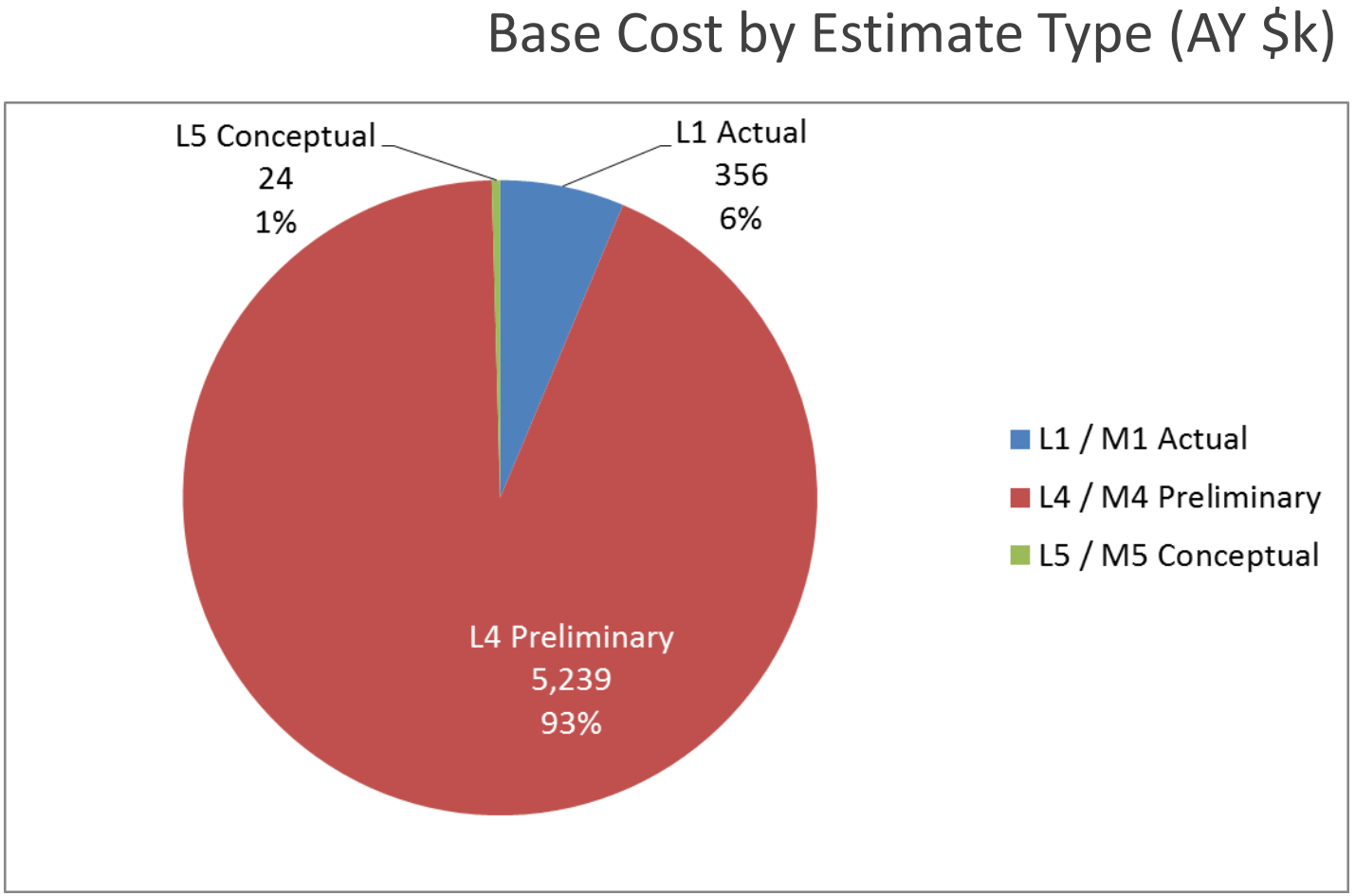
ES&H

- Very large and very heavy objects.
- Overhead lifts with cranes connected in tandem.
- High electrical currents to solenoids.
- Multiple cryogenic supplies.
- Large stored energy in powered solenoids.
- High fringe fields.
- Large magnetic forces between solenoids.

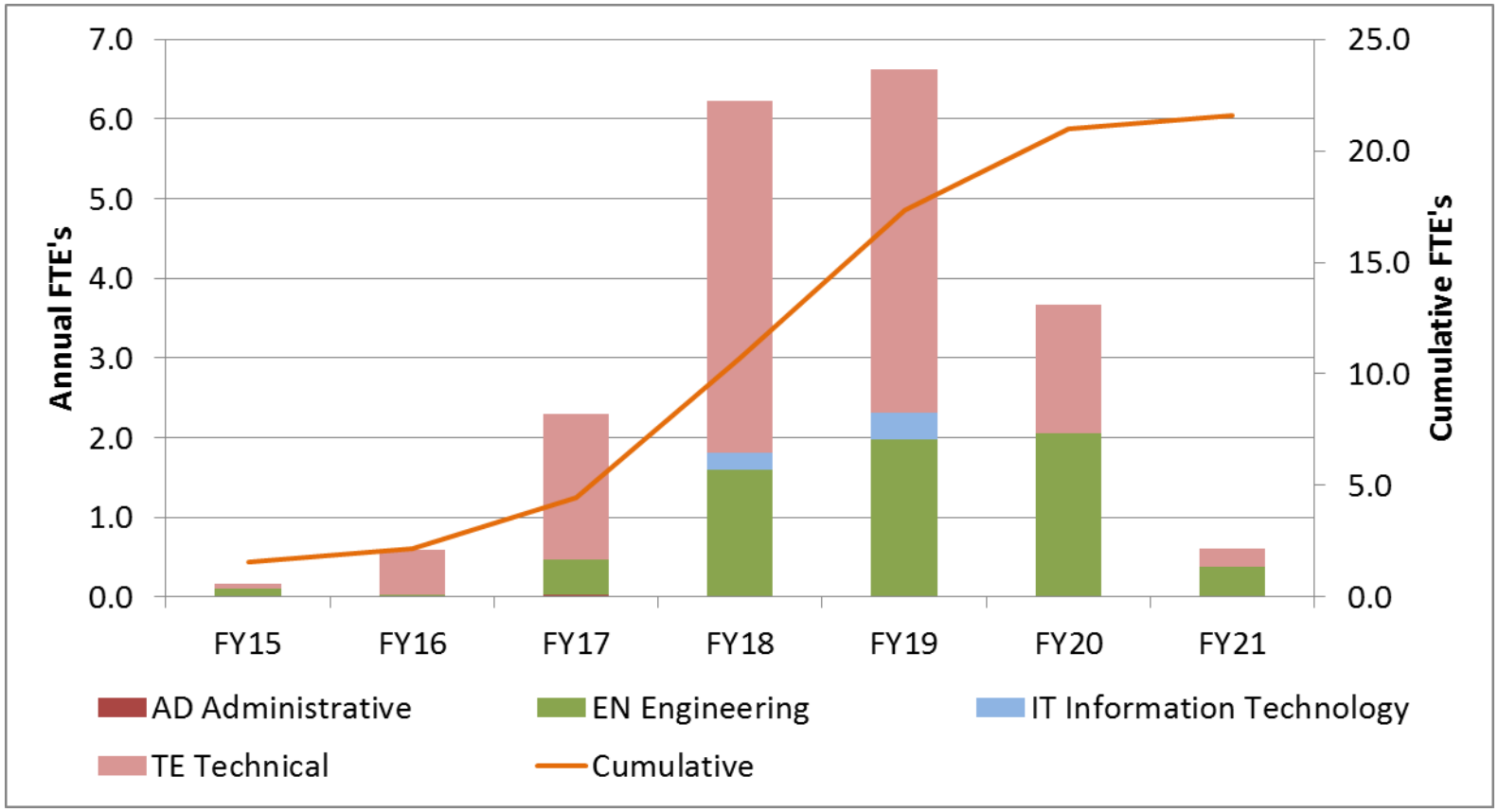
Cost Distribution by Resource Type



Quality of Estimate



Labor Resources



Cost Table

WBS 475.04.10 System Integration, Installation and Commissioning

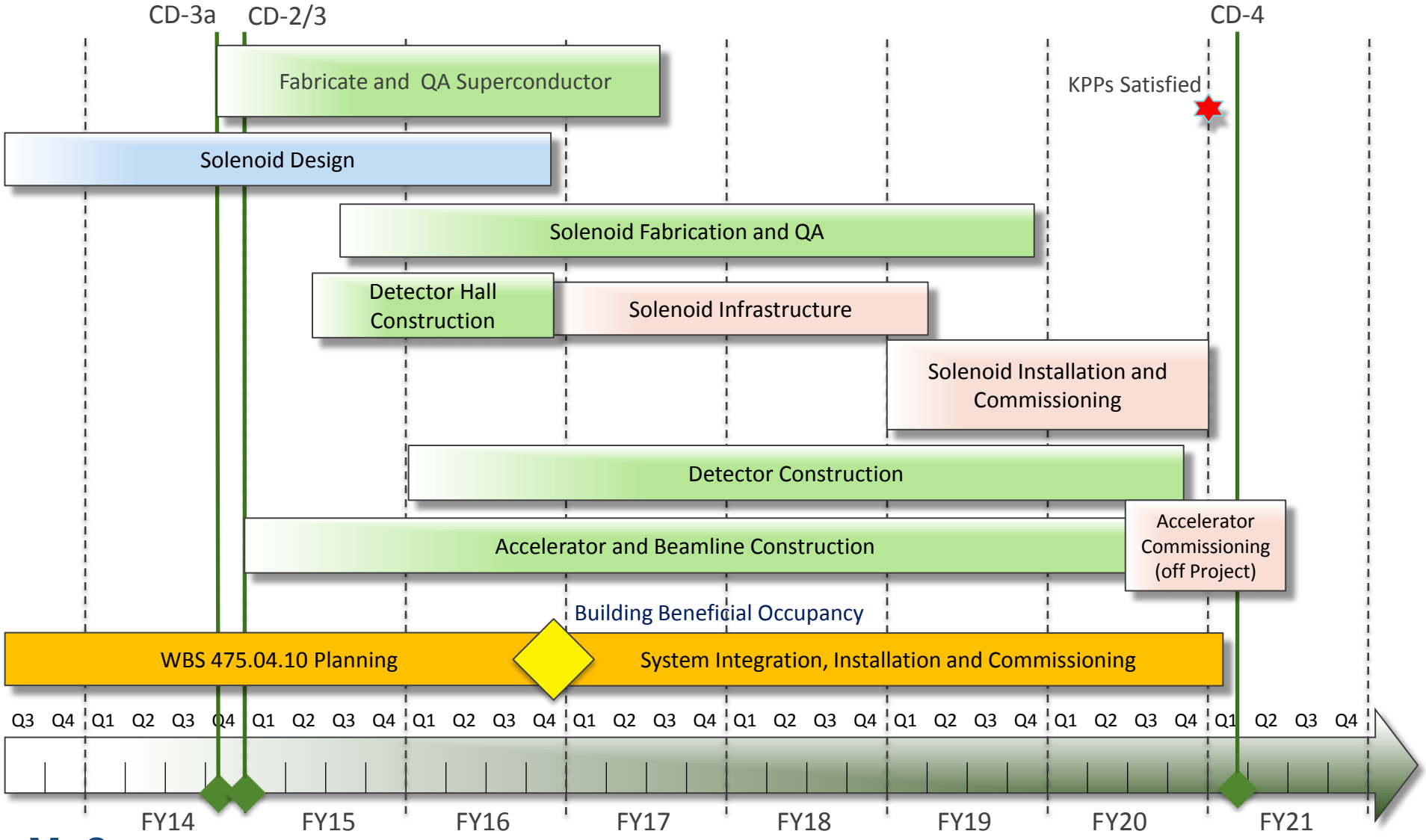
Costs are fully burdened in AY $k

	Base Cost (AY k$)					
	M&S	Labor	Total	Estimate Uncertainty (on remaining costs)	% Contingency on ETC	Total Cost
475.04 Solenoids						
475.04.10 System Integration, Installation and Commissioning	532	5,086	5,618	2,074	40%	7,692
Grand Total	532	5,086	5,618	2,074	40%	7,692

Major Milestones

- 000950 – Building ready for solenoid installation.
- 002900 – Cryo-plant operational (by GPP).
- 005950 – Solenoid installation complete, ready for cool-down.
- 006850 – KPP on-project solenoid commissioning complete.

Schedule


CD-3a
CD-2/3
CD-4
Fabricate and QA Superconductor
KPPs Satisfied
Solenoid Design
Solenoid Fabrication and QA
Detector Hall Construction
Solenoid Infrastructure
Solenoid Installation and Commissioning
Detector Construction
Accelerator and Beamline Construction
Accelerator Commissioning (off Project)
Building Beneficial Occupancy
WBS 475.04.10 Planning
System Integration, Installation and Commissioning
Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4
FY14
FY15
FY16
FY17
FY18
FY19
FY20
FY21

Summary

- Solenoid installation and commissioning needs fully integrated with conventional construction design.
- Systems required for solenoid operation well defined, supported by building, and included in preliminary design.
- ESH&Q, Risks, Labor, and M&S well understood.
- Integrated installation plan in process.
- Integrated commissioning plan in process.
- WBS 475.04.10 System Integration, Installation and Commissioning ready for CD-2.