



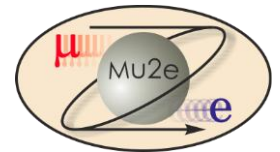
Solenoid Procurement Strategy

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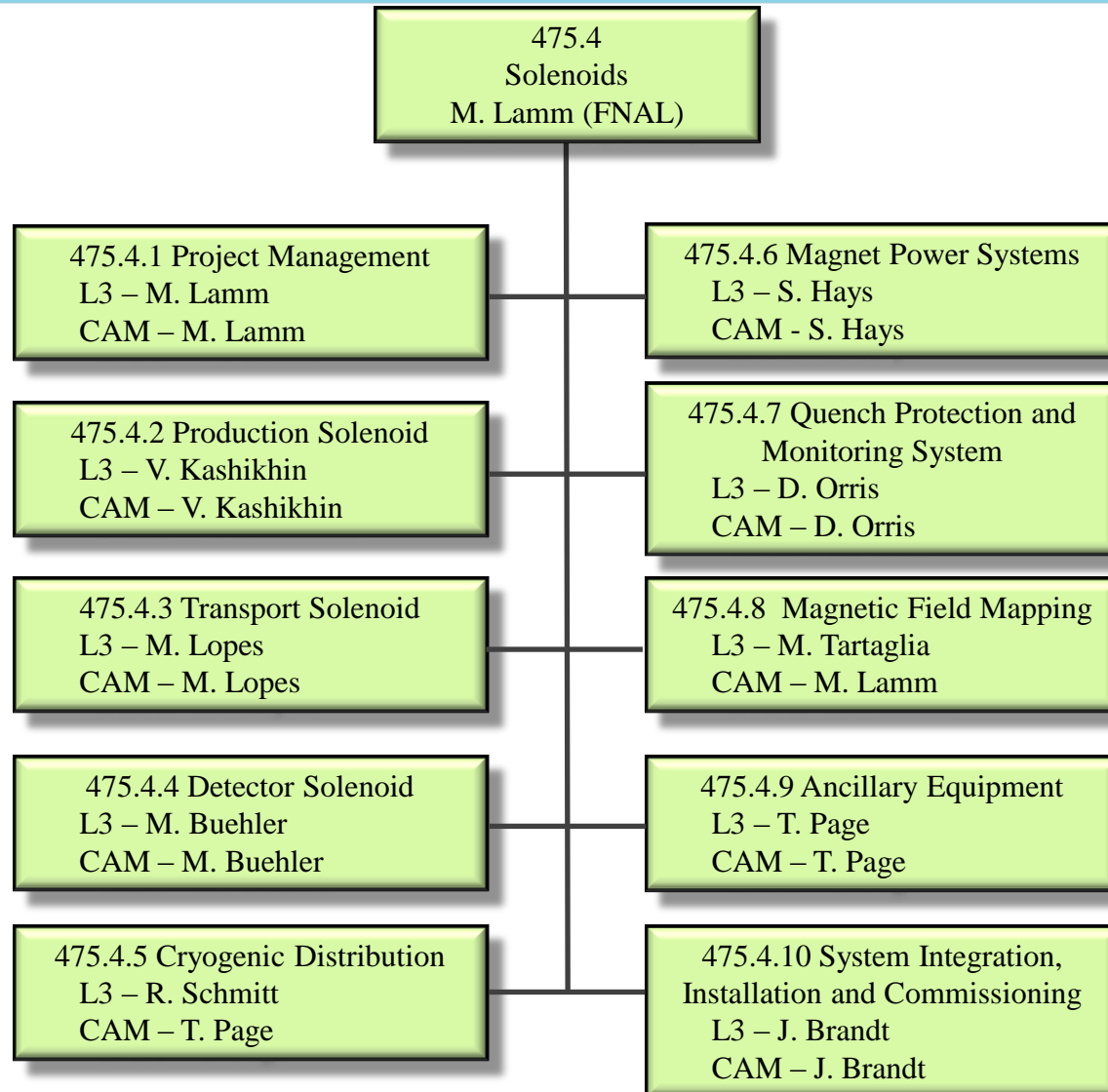
References

Title	Reference
Detector Solenoid Procurement Specification	DocDB 3670
Detector Solenoid Reference Design	DocDB 3664
Detector Solenoid Interface Drawings	DocDB 3733
Production Solenoid Procurement Specification	DocDB 3669
Production Solenoid Reference Design	DocDB 3647
Production Solenoid Interface Drawings	DocDB 3732
DS-PS Vendor Management Plan	Contains proprietary information, available upon request
Acquisition Oversight Committee (AOC)	Charge and membership: DocDB 2437
AOC URL: http://mu2e.fnal.gov/public/project/reviews/SolenoidAOC/index.shtml	

Scope of Solenoid WBS

- Magnet system
 - Production solenoid
 - Transport solenoids: TSu and TSd
 - Detector solenoid
- Supporting systems
 - Cryogenic Distribution
 - (4) Feed boxes and power leads; (4) Transfer lines with LTS bus inside; Insulating vacuum system; interconnect components; Distribution box
 - Magnet power system
 - Magnet quench protection system
 - Field mapping system
 - Ancillary equipment (tooling)
- Installation and commissioning of above deliverables.
- Interfaces with other Level 2's within Mu2e Project

Solenoid Organization



Procurement Leads:

Vito Lombardo for the
Conductor procurements.

Tom Page for the PS/DS
procurement.

WBS Summary

- WBS 475.04.01 covers Project Management. This consists of travel for procurement oversight and the level of effort for managing the project.
- WBS items 475.04.02 through 475.04.09 cover the deliverables of the project.
 - This includes design, procurement, fabrication and/or assembly of each component or system.
 - Each component / system WBS ends with delivery to the Mu2e experimental hall.
- WBS 475.04.10 covers the integration, installation and commissioning of the above deliverables. This WBS consists of mostly labor activities.

Acquisition Oversight Committee (AOC)

- Mu2e set up an Acquisition Oversight Committee (AOC):
 - Goal: help mitigate risks during the acquisition process for the (3) solenoids as well as the superconductor.
 - Solicit advise on procurement documentation and strategy.
 - Review requirements and specifications.
 - Review QA/QC plans.
- Committee comprised of an international team of experts: magnet and conductor procurement, quality assurance.
- Meetings
 - Have met prior to each large procurement: before going out for bid and before placing the contract.
 - Frequency has been approximately 2–3 times per year.

Lessons Learned

- We have contacted other Labs about recent magnet procurements.
- Many of these Lessons Learned have been incorporated into our procurement strategy.
- Mike Lamm has a separate presentation summarizing these discussions and the Lessons Learned.

Procurement Strategy

Conductor Procurement

- All (4) conductor types went through a successful prototyping stage.
- Mu2e received CD-3a for procurement of the long lead conductor in July, 2014
- Three out of the four conductor production orders have been placed: DS1, DS2, TS
- The PS conductor order has been negotiated
 - Met with Furukawa on 22-Sep-2014 to negotiate details.
 - As part of our risk mitigation we are ordering 2 extra piece lengths so we have enough conductor to re-build the largest PS coil if necessary.
 - Vendor is updating the quote.
- All contracts have hold points and QC checks at key milestones.
- Dedicated engineer (Vito Lombardo) to oversee procurements.
- Vito has a separate presentation on the status of the procurements.

Production and Detector Solenoid Magnets

- The Production Solenoid and Detector Solenoid will be procured from industry.
- Contract details
 - Fixed price, phase funded contract.
 - Contract will be funded in phases:
 - Final design phase
 - Tooling phase
 - Pre-production phase
 - Fabrication phase
- FNAL provided a Procurement Specification, a Reference Design and a set of interface drawings including a solid model to the vendors during the Request for Proposal (RFP).

Production and Detector Solenoid Magnets

- Team from FNAL visited all potential vendors during the bid process.
 - Ron Ray, Ron Evans, Mike Lamm, Tom Page, Marc Buehler, Vadim Kashikhin
 - Visited 5 vendors: 2 in US, 2 in Europe, 1 in Japan
- These visits provided valuable input to our technical evaluation
 - Allowed us to meet and talk to the vendors face to face
 - Clarify our requirements and expectations
 - Evaluate their facilities and discuss their experience and capabilities

Production and Detector Solenoid Magnets

- Three vendors provided fixed price bids for all phases of the contract (2 vendors no-bid).
- Bid Evaluation
 - FNAL set up a Source Selection Board to evaluate the bids.
 - Same team that visited the vendors with the addition of a QA professional (Jamie Blowers)
 - Evaluation split between technical and cost.
 - Technical: 70%, cost: 30%.
 - Technical evaluation was performed with the costs removed from the bids so the evaluators did not see the vendors costs.
 - After technical evaluation complete, costs were added into the equation.
 - Based on the evaluation there were two acceptable bidders. A third bidder was disqualified due to the inability to perform all of the required QC tests.

Production and Detector Solenoid Magnets

- Decision was to give one vendor both magnets.
 - Looked at splitting the order between the two acceptable bidders.
 - Splitting the order was cost prohibitive due to the high tooling costs. Tooling is approximately 25% of the cost.
- Total cost for both magnets was within our CD-1 cost range, including contingency.
- Vendor chosen has capability to perform full power test at their facility.
 - This was included as an option on the proposal.
 - We are going to exercise this option and include this in the initial contract.

Production and Detector Solenoid Magnets

- Vendor capabilities.
 - Experienced in building superconducting magnets.
 - Currently building large solenoids for an international project.
 - Extensive engineering capability within company that will be utilized during the design phase.
 - Extensive fabrication capability within company that will be utilized during the fabrication phase.
 - Fabrication space available and identified for Mu2e project.
 - Full power test at vendor facility.

PS/DS Magnet Procurement Phases

- Final Design
 - Vendor will complete a final design for each magnet.
 - FNAL reviews and approves final designs.
- Tooling
 - The winding and curing tooling are long lead items and must be ordered early in order to meet the Mu2e project schedule.
 - Funding is needed approximately 5-8 months after contract award.
- Pre-production
 - Vendor will build a model coil.
 - Vendor will perform splice testing and qualification.
- Fabrication
 - Fabrication can begin only after FNAL has approved the final design and funding is available after CD-3c.
 - Final testing is included in the fabrication phase.

Production and Detector Solenoid Magnets

- Acceptance Criteria
 - Detailed acceptance criteria called out in Procurement Specification.
 - Initial vendor plan submitted as part of the proposal, includes criteria in Procurement Specification.
 - Detailed plan will be finalized during the design phase.
- Acceptance Criteria will be incorporated in the Quality Management Plan and traveler system.
- Full power test prior to delivery to FNAL.

PS/DS Magnet Quality Management

- Approach to Quality Management Plan similar to other contracts with vendor.
 - FNAL supplies requirements, including QA requirements, to vendor.
 - Vendor prepares Quality Plan.
 - FNAL reviews and approves the Quality Plan.
- Procurement Specification requires the QA Plan to include the following:
 - Organization and responsibilities, Specific quality assurance requirements, Material control, Work processes, Quality control tests, Hold points, Non-conformance reporting, Corrective action, Etc.
- All of these items will be incorporated into a traveler system.
- The traveler system will be used throughout all fabrication and assembly processes.
- The quality plan and traveler system will be fully developed during the design phase of the contract.
- The vendor provided sample documents as part of their proposal.

PS/DS Magnet Vendor Management

- Dedicated engineer (Tom Page) to oversee the procurement.
- Roles, responsibilities and communication path between FNAL and vendor clearly defined.
- Weekly conference calls. (Have already started meetings with vendor.)
- Monthly status reporting and meeting.
- Regular visits to vendor facility.
- Looking into adding incentives to the contract to give us some leverage in keeping tasks on schedule. Vendor and FNAL have agreed to look into this for the fabrication phase.

PS/DS Magnet Vendor Oversight Team

- Team
 - Tom Page – Technical Lead / Contact with vendor.
 - Mike Lamm – Project Manager.
 - Vadim Kashikhin – L3 manager / CAM for PS. PS magnet design.
 - Marc Buehler - L3 manager / CAM for DS. DS magnet design.
 - Sandor Feher – Deputy manager for DS. DS magnet design.
 - Jeff Brandt – Senior mechanical engineer in charge of interfaces.
 - Cryogenic engineering support
 - Rich Schmitt – L3 manager for Cryogenic Distribution.
 - Yuenian Huang – Senior Cryogenic engineer.
 - Ron Evans – Senior Contract Administrator
- We have experts in place from all relevant technical disciplines who are available to help address problems that might arise.
- We have the engineering and analysis tools in place:
 - To validate design choices / changes during the design phase.
 - React and respond quickly to discrepancies or issues during the fabrication phase.

PS/DS Magnet Vendor Oversight

- Vendor Oversight
 - Design phase
 - Weekly meetings and data exchange.
 - Monthly visits and reviews.
 - Special trips as necessary.
 - Fabrication and testing phase
 - Weekly meetings and data exchange.
 - Team member(s) will be present for all critical activities.
 - Team member(s) will be available to travel to vendor any time necessary.
 - Detailed plan will be developed during the design phase.
- Resources currently in schedule
 - ~5 costed FTEs (8,700+ hrs) over 4 years for oversight of vendor.
 - ~\$250K for travel; => ~125 – 175 person trips
 - ~20 person trips during design phase (year 1).
 - 35-50 person trips per year during fabrication phase (years 2-4).

Conflict Management

- Negotiations start with Technical leads and contract administrators from FNAL and vendor.
- If conflict can't be worked out between technical leads, escalate issue to Project Manager (R. Ray) and counterpart at vendor for upper management negotiation.
- Fixed price contract so any changes have to go through formal change control.

Discrepancy example

- A common issue during coil fabrication is the coil being out of dimensional specification.
 - Coil may be out of specified tolerance.
 - Out of tolerance condition will be captured in traveler, observed by oversight team member and a discrepancy report written.
 - Mu2e team would perform analysis and identify any impacts on the performance of the magnetic field and/or mechanical structure. Mu2e team would then make a recommendation to solenoid management on how to proceed.
 - Conditions like this can be accounted for by changing the spacers between coils to account for larger or smaller coils.
 - These types of out of tolerance conditions have been studied as part of the reference design so the infrastructure is in place to quickly respond to such a condition.

Transport Solenoid Magnets Plan

- Components built in industry, final assembly at FNAL.
- Production coil modules will be built in industry. Coil modules include the coil, support shell and attached cooling tubes.
 - Coil design completed at FNAL, industry will have an opportunity to modify final coil and shell design details.
 - FNAL will approve design changes prior to winding.
 - Each module will be cold tested at FNAL in the Solenoid Test Facility as part of the acceptance testing.
- Cryostat components will be fabricated in industry as a build-to-print.
- Final magnet and cryostat assembly will be completed at FNAL in the Heavy Assembly Building, HAB (formally CDF).

Transport Solenoid Magnet Prototype

- Prototype coil module being built in industry through a collaboration with INFN.
- Module will be tested in the Solenoid Test Facility.
- Lessons Learned from this prototype experience will be included in the coil module procurement.
- The prototype will be discussed in detail during the TS breakout session.

Transport Solenoid Vendor Management

- Vendor management strategy will be similar to conductor and PS/DS magnet procurement.
- Dedicated person to oversee procurement. Currently evaluating potential candidates.
- We will continue to incorporate Lessons Learned:
 - From our experience with the TS prototype currently being fabricated and tested.
 - From our experience with the PS/DS magnet procurement as necessary.

Cryogenic Distribution Components

- 10kA power leads
 - Re-purposing HTS leads from Tevatron inventory and re-configuring for conduction cooling operation. All leads have been validated at 10kA.
 - FNAL will provide power leads and detailed integration specifications to the feed box vendor.
 - Prototyping and testing re-configured leads in the Solenoid Test Facility at full current (10kA).
- Feedboxes
 - FNAL/Argonne will complete the feed box designs.
 - Solid model will be provided to vendor along with interface drawings and specifications
 - Vendor will complete final detailed fabrication drawings.
 - FNAL reviews and approves design and drawings prior to fabrication.
 - Dedicated engineer to oversee procurement.
 - This procurement model has been successfully applied to recent procurements of cryogenic distribution boxes for projects at FNAL.

Cryogenic Distribution Components

- Transfer Lines
 - FNAL will complete the transfer line designs.
 - Plan to go to vendors to produce transfer line sections.
 - Final assembly is performed in place at the Mu2e building.
- Vacuum System components
 - Catalog components.
 - Assembly of sub-systems at FNAL.
- Distribution Box
 - Same model as feed boxes: complete design at FNAL, send solid model to vendor.
 - Vendor prepares fabrication drawings.
 - FNAL reviews design and drawings prior to vendor fabrication.

Other Components

- All other components are standard purchases, either ordered to specification or build-to-print.

Summary

- Have had many discussions with other Labs about their experience and Lessons Learned from recent magnet procurements.
 - Lessons Learned incorporated into our procurement strategy.
 - Mike will give a detailed talk on these discussions.
- Incorporated comments from discussions with the Mu2e AOC.
- Consistent engagement, early intervention strategy.
 - Constant monitoring of small issues to keep from becoming large issues.
 - Resources are in place to execute our plan for the conductor and PS/DS magnet procurements.
- Plans for transport solenoid modules will be similar to the plans for the conductor and magnet procurements and will be in place prior to procurement.