Solenoid Procurement Status

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U.S. DEPARTMENT OF ENERGY | Office of Science

Debriefing

Procurement Strategy

- PS and DS will be built in industry with Mu2e actively managing these procurements.
  - For each magnet, Final design and Fabrication performed by the same qualified vendor, based on Mu2e-supplied reference design and technical specifications.
- Procurement will be “phased”
  - Final design contract awarded based on proposal for BOTH final design and fabrication (including cost and schedule)
  - Fabrication contract awarded after successful completion of final design, subject to DOE funding
- Allow for PS and DS to be built by same vendor

Procurement Strategy

- Mu2e solenoids being procured in a similar fashion to other recent large solenoids
  - ATLAS and CMS
- In both cases, conductor was procured separately and provided to the vendor.
- Strategy to develop detailed reference designs and procure conductor was developed after many discussions with our external Solenoid Acquisition Oversight Committee chaired by R. Stanek and various magnet vendors.
- This is not off-the-shelf conductor. We spent a year of R&D developing 4 different conductors. Magnet vendors would have done the same. Better that we control that process.

Procurement Strategy

- Asking the magnet vendors to procure the conductor would have required us to involve them at a much earlier stage.
- Solenoid design developed over several years of interactions and feedback between design teams and simulation teams. This would have been significantly more difficult with a vendor providing the reference designs.
- No vendor who could have built all 3 solenoids, so Mu2e control of the overall design and interfaces necessary to obtain an integrated design.

Request for Proposal Documents

- Procurement-Generated Documents
  - Terms and Conditions
  - Warranties
  - Explanation of “phased approached”
  - Bid options
    - For example opportunity to bid on one or both PS/DS
- Mu2e-Generated Documents
  - Reference Design Reports (on solenoid web site)
    - 139/116 p detailed design document for PS/DS
  - Procurement Specifications (on solenoid web site)
    - 41/40 p detailed procurement specifications that define buyer and seller responsibilities and QA/QC requirements.
  - Drawings and 3-D Models (available on request)

Reference Design Report

- Detailed description of PS/DS that meets our physics requirements
  - These physics requirements are in a separate document
  - Close cooperation between Mu2e Collaboration and Mu2e project
- Includes analysis to support the design
  - For examples:
    - coil position tolerances vs. field quality
    - stress on conductor during thermal and excitation cycles
    - quench analyses including possible error conditions

QA Requirements

- QA Plan Essential Features
  - Traveler system
  - Testing imbedded into fabrication process (in-process QA)
    - Outline of test plan provided in Proc. Spec.
  - Hold points in fabrication at major milestones
  - Regularly scheduled meetings to discuss fabrication status/issues
  - Monthly EVMS-style reporting
  - Acceptance tests upon delivery at Fermilab
- Vendor must provide Preliminary QAP as part of bid package
  - QAP is one of the metrics for awarding contract.
- Vendor must provide full QAP at the end of “final design phase”
  - Including detailed test plan

Bid Response

- Once request for proposals were launched 5 Vendors expressed interest in bidding
  - ASG
  - Babcock Noel
  - Everson Tesla
  - General Atomic
  - Toshiba
- We visited each vendor
  - Gave same presentations
  - We viewed the space where they would build our magnets
  - We saw tooling, winding machines and fixturing used for other magnets.
  - What we saw/learned was used in the proposal evaluation

BID Evaluation

- After Bid Cycle, proposals were evaluated by local committee
  - Using the Procurement Generated “Source Evaluation Board” guidelines

- Technical Evaluation based on 6 general criteria
- Facilities, Personnel, Experience, Quality, Project Management Plan, Schedule

  Vendors had to meet a minimum pass for each category

- Only after “technical ranking”, did we consider cost proposal
  - Cost/technical weight 30/70
- Duration of evaluation process ~4 weeks post end of bid cycle

Status of Procurement

- Source Evaluation Board has Selected PS and DS vendor
- Vendor has been informed via email
- Contract has not yet been signed.
- Setting up a Pre-Contract meeting to establish terms and conditions

Managing the Procurement

- Firm fixed price contract, two phases (design/build).
- Progress payments as they satisfy milestones, but we hold back a significant fraction (30%) until they deliver and we test and accept.
- We will develop travelers that describe the work in detail and requires sign-off at each step.
- Hold points at critical places that require our inspection and approval before they proceed to the next step. Can't get the next progress payment until they have completed all of the steps to our satisfaction.
  - Similar to our oversight of conductor vendors
- Significant presence at Vendor

Our responsibility for final product

- Items that we take responsibility for such as
  - Superconductor
  - Coil pack geometry
  - Coil Pack outer shell thickness and material
  - Thermal siphon geometry
- We take the risk for these items
- NOTE:
  - To the best of our knowledge, all LHC solenoids were fabricated under this model… at minimum the superconductor is supplied by BUYER + other design parameters specified by BUYER
  - LHC arc dipoles and quads used conductor and much of the tooling supplied by BUYER (LHC)

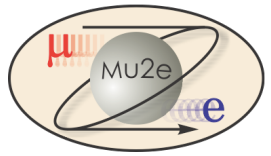
Our responsibility II

- What if seller or buyer finds a mistake in the buyer-supplied design?
- This is covered in Section 9.4 (Modification Management)
  - Impossible to estimate ahead of time, the cost of such an incident
  - It is has been proposed that we further implement prior to signing contract, specific rules for labor rates to fix problem.

Vendor responsibility

- Includes certain design features such as
  - the thermal shield
  - tooling for coil fabrication
  - Cryostat
- Vendor is responsible, prior to us awarding fabrication contract, for generating for our approval several key documents
  - Quality assurance plan
  - Detailed traveler with agreed upon sign off and hold points
- During fabrication vendor must faithfully execute the traveler plan or be responsible for consequences
- Related to this…
  - It is called out explicitly in section 9.4.2. of the procurement specs that all seller proposed modifications that affect performance, interface or contractual content have to be approved by the buyer in writing

Summary



- We know there are many potential pitfalls.
- We are open to suggestions.