



Industrialization of previous projects

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Why look at industrialization?

- It could be that cryomodules built to jump start industry would be available for system tests and hence the system test is cheaper and can be bigger than otherwise would be practical.
- It could be that we feel system tests are needed to test industrial output.
- It could be that a large system test could be needed to provide some of the motivation and funding for industrialization that we think is needed.
- It could be that industrialization and our system tests are on different time scales and hence unrelated.



Overview

- Have gotten information on SSC and RHIC SC magnet industrialization
- Intend to get LHC magnets, LEP SC cavities
- See how it was done, and in particular **when** it was done compared to funding of the project and how **production rate was ramped up**.
- Collect any lessons learned



SSC Info from Gerry Dugan

- It's been a long time so Gerry was a little fuzzy on some details, but was pretty sure he had the broad brush strokes correct.
- He commented that the **SSC was not a model to be copied as he didn't think it had worked very well.**
- The original development of the SSC SC magnets was done primarily at FNAL, LBNL, and BNL.
- They were told to design magnets to a certain specification and they succeeded in designing and building such magnets.
- **The industrialization started after formal approval and funding of the SSC in 1989.**
- In a first step, General Dynamics and Westinghouse won bids to build magnet factories. They may have won these bids without ever having built an SC magnet or maybe there was a small bid for a small quantity production first. (Gerry was fuzzy on this.)



SSC Info from Gerry Dugan

- They definitely visited FNAL and BNL to get trained on how to build the magnets.
- They were paid to build factories without having submitted final bids for the full quantity production.
- The bid for the full quantity was done as a build to specification (as opposed to build to print).
- There were some options in the contracts to allow SSC to steer more or less of the production to one company or another. This was supposed to provide them incentive to keep their bids low.
- The first bids were **very** high. This happened because the companies assumed that all parts without detailed specifications had to be mil-spec. This got straightened out, but the final prices were still considerably higher than the engineering estimates.
- The string test was done after project approval and was finished in 1992. Gerry thinks it was done with magnets made at the labs, not the companies.
- He thinks the companies did build some magnets before the SSC project was shut down.



RHIC info from Mike Anerella

- FY89 R&D funding started
- March 1989 – Final Design Review (Internal Review Panel)
- FY91 (October 1990)-- construction funding started
- November 1990 – Industrialization Program
 - **Prospective vendors came to BNL for 2 day lecture and tour. (First introduction to SC magnets for many vendors)**
- May 1991 – Request For Proposals.
 - **Basis**
 - Fully engineered assembly and parts drawings created for production
 - Complete set of procedures and material specifications
 - 12 complete magnets built at BNL
 - **Elements of proposals**
 - Manufacturing plan, Tooling and equipment plan, QA plan
 - Business Response
 - Schedule
 - Cost and pricing



RHIC info from Mike Anerella

- 1991 – 1992 Source Evaluation Board for Contract Review
- June 1992 – Contract Award
 - **Phase 1 – 30 10M magnets, “Cost Plus Fixed Fee”**
 - **Phase 2 – 268 remaining 10M magnets, “Fixed Price Incentive Fee”**
 - **Phase 3 – 75 insertion dipoles (3 lengths), “Fixed Price Incentive Fee”**
- February 1993 – Technology Transfer
- May 1994 - 1st dipole delivered
- May 1996 – Contract Complete
- FY99 construction ended.



Summary

- Both started after funding
- The details mattered (but not to S2)
- Very close communication and methods of allowing changes are needed.
- How much of these examples applies to us needs thought. E.g. SC cable was industrialized earlier than the magnets themselves.