SC Magnet Division Directors Program Review - Overview

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Mission Statement

The output of the Superconducting Magnet Division is various superconducting magnets for use in both particle accelerators and experimental facilities. We:

- support the ongoing Brookhaven research program with emphasis on the RHIC complex.
- work within the U.S. HENP community on future facilities and technologies.
- collaborate with other science institutions world wide to both provide and develop superconducting technologies.

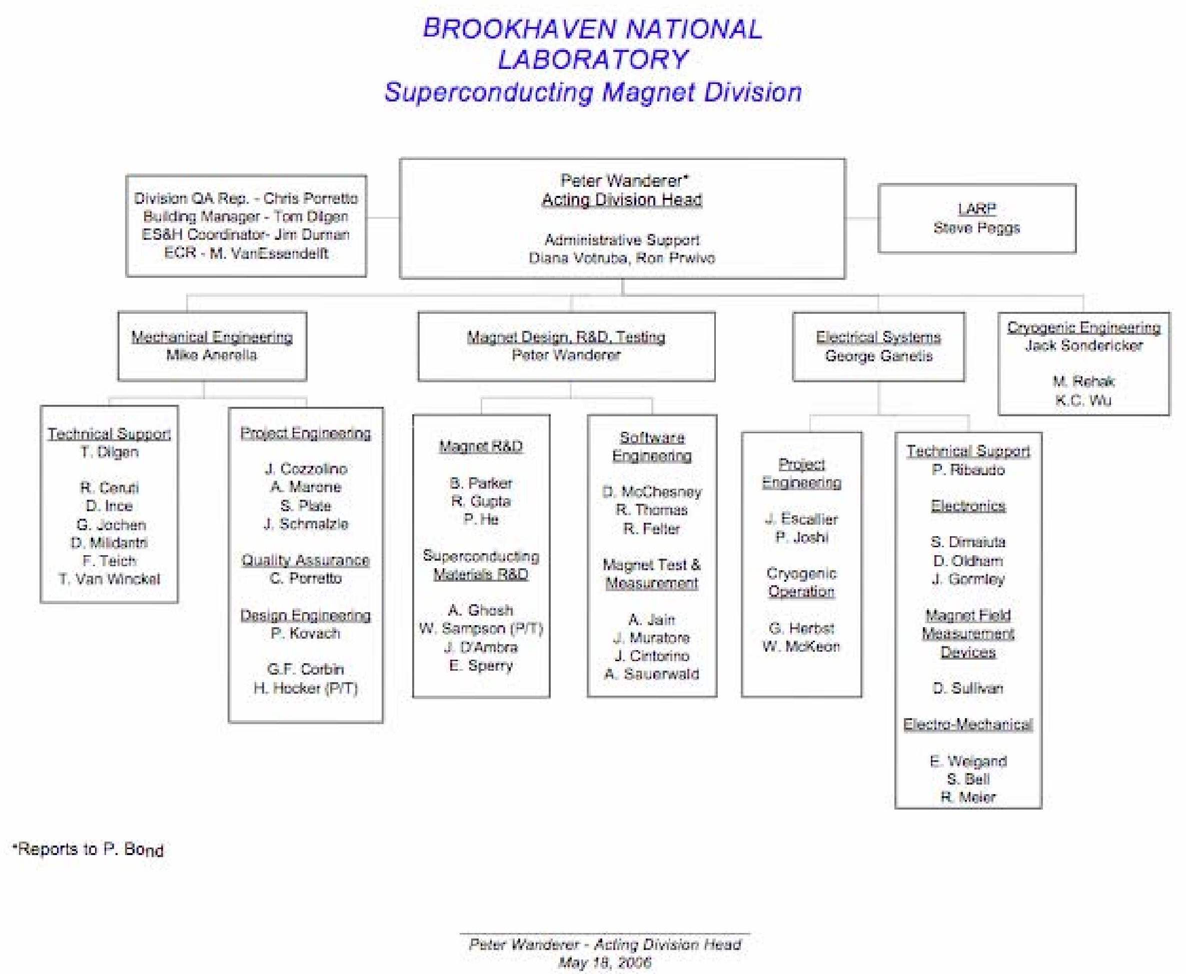
Core Competences

Capabilities include:

- Superconductor materials development/test facility
- Magnetic structure design
- Superconducting magnet fabrication
- Vertical and horizontal cryogenic testing
- Magnetic field measurements

Thus we can design, fabricate, measure and test full size superconducting magnets. If we remove any element from this chain then the system doesn't work.

Organization



~ 50 FTE's

Themes

A significant amount of the work in the Magnet Division falls under technical themes which define specialty areas

- Nb3Sn
  - Next generation magnet and materials development based on Nb3Sn conductor. Primarily under the US LARP program + some HEP generic R&D.
- High Temperature Superconductors
  - We are the leading world lab in R&D relating to the use of HTS materials in accelerator applications. Both tapes and wires. Pushing energy efficiency using HTS tape wound magnets.
- Direct wind magnet construction
  - Unique BNL capability has resulted in applications in many diverse projects (HERA, BEPC II, anti-hydrogen magnetic trap, ILC beam delivery system, J-PARC etc…). Derived from RHIC technology development
- Rapid cycling SC magnets
  - Multi-year collaboration with GSI, Germany has resulted in low loss designs, rapidly varying field measurement capabilities, > 2T/s demonstrated. The rest of the world is starting to get interested in this topic.
- Accelerator design/ Magnet technology integration
  - Significant accelerator expertise within Division (Peggs, Harrison, Parker, He) results in technical programs with a somewhat different perspective.

We deliberately seek to distinguish ourselves from the other (Fermilab, CERN, LBL) magnet centers.

Strategic Plan

Superconducting magnets and SRF are enabling technologies for accelerator facilities of all kinds (HEP, NP and increasingly BES). It is thus important for BNL to have access to cutting edge technology to facilitate our ability to propose, execute and operate large projects.

However there is (and we believe there will continue to be) no requirement for any volume production/testing. Thus since the end of the RHIC Project we have been removing production/testing capability while endevouring to maintain and nurture our special capabilities.

There is a significant infrastructure investment over several decades which we can leverage.

This is done with an admixture of devices for operating facilities (RHIC, LHC, HERA etc..), targeted and generic R&D, and projects deemed to be work-for-others (WFO's). The desired mix is RHIC 40-50%, HEP related 40-30%, WFO's 20%.

Ongoing Program

- RHIC - NP

  Magnet repair, spin program (snakes, spin rotators), quench detection, power supplies, e-cooling, magnetic measurements

- RHIC Spares- RIKEN

  Spare helical dipoles

- RIA (Rare Isotope Accelerator) R&D - NP

  Radiation resistant HTS magnet R&D

- LARP (LHC Accelerator Research Program) - HEP

  Nb3Sn magnets for LHC IR upgrades (with Fermi & LBL)

- ILC - HEP

  Direct wind final focus and extraction line magnet R&D. Several specialty elements related to MDI. HTS extraction lines (??)

- Materials - HEP

  Superconductor R&D on the HEP base program

- NSLS II - BES

  X-ray ring HTS dipole feasibility study, VUV ring HTS dipole R&D, conventional dipole design, SC undulators

Ongoing Program

- ALPHA magnetic trap - WFO

  CERN anti-hydrogen experiment. Just completed a direct wind coil package.
- BEPC II upgrade - WFO

  Direct wind final focus magnetic package completed ~6 months ago. Currently in the installation phase.
- DAPHNE II - WFO

  Feasibility study for direct wind final focus magnetic package for proposed DAPHNE upgrade
- J-PARC - US/JAPAN and/or HEP

  Direct wind neutrino line correctors as part of T2K proposal. Prototype under test at KEK.
- ASACUSA coil - WFO

  Feasibility study on direct wind coil for CERN anti-hydrogen hyperfine splitting expt

Future Possibilities

Rapid Cycling Medical Synchrotron

RIA (or son of)

Funding/Manpower - HEP

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
High Energy Physics					
LHC - Operating	$2,224	$1,747	$1,379	$298	$6
Capital	7,356	4,354	1,840	332	63
Total LHC Project	$9,580	$6,101	$3,219	$630	$69
LHC R&D	100	167	364	630	2,416
Total LHC	$9,680	$6,268	$3,583	$1,260	$2,485
Effort - FTE	*38.8*	*28.9*	*15.42*	*5.3*	*7.1*
Supercond Magnet R&D	$1,093	$1,097	$1,829	$2,780	$1,429
Effort FTE	*3.5*	*4.4*	*5.4*	*8.1*	*6.12*

Funding/Manpower - NP + Other

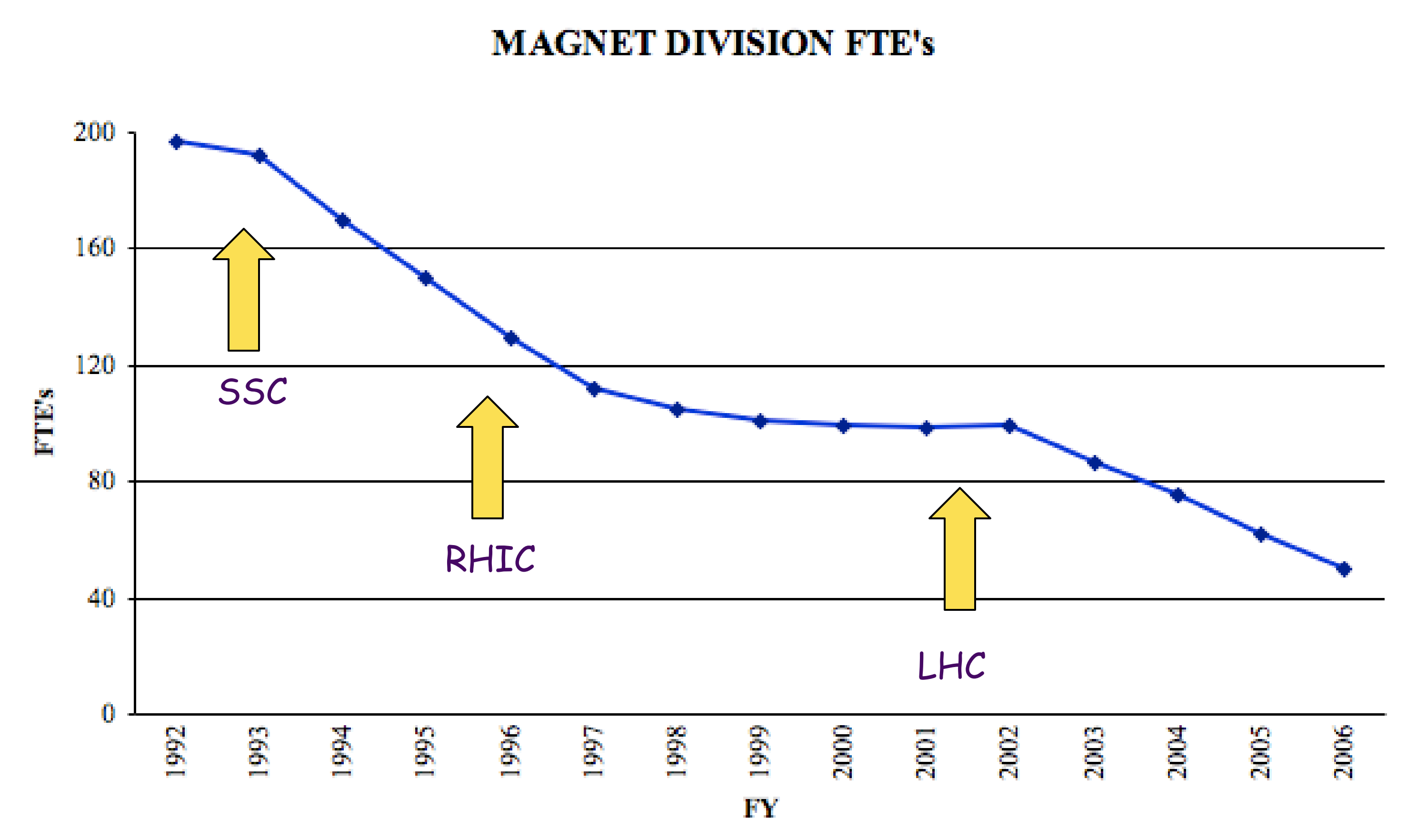
Nuclear Physics	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
RHIC Operations	$4,765	$5,404	$5,754	$6,095	$5,016
AIP	0	859	875	242	0
Effort - FTE	*29.3*	*36.7*	*35.1*	*30.1*	*21.1*

Other Work					
PRC - IHEP - BEPC II	$0	$2,000	$1,960	$632	$7
GSI	431	93	200	423	188
Bio-Med	156	163	162	26	0
LDRD	245	273	287	0	0
WFO	1,086	622	674	875	1,543
Total Other	$1,918	$3,151	$3,283	$1,956	$1,738
Effort - FTE	*27.3*	*16.9*	*19.7*	*26.1*	*15.9*
Total Magnet Division	$17,546	$16,779	$15,324	$12,741	$10,668
Effort - FTE	*98.9*	*86.9*	*75.6*	*69.6*	*50.2*

FY06 Funding Breakdown

- Direct Labor Cost $6225K
  - Salary, Wage & Fringe
- Labor - Dept Charges $1271K
  - So called organization burden: space charges, ITD, telephones, cars, fuel surcharges, power etc… (includes effective rebate of ~$700K on space)
- Labor - Lab G/A $2527K
  - Lab overheads
- Direct Materials $1452K
- Material O/H $555K
  - Burdens + handling costs

Funding/Manpower



Issues

- Manpower sub-critical. Estimate a need of ~60 FTE's to cover the core competences
  - We are currently operating with a much reduced design group. Engineers design with Pro-E (finite element) and we work using the models. This is not tenable in any large project.
  - Cryogenic operations are less than straightforward (only 2 cryo techs)
- RSVP, BTeV major multi year projects cancelled in 2005
  - This was projected to be the backbone of the WFO program for 06 -> 09
- Minimal capital investment. Rotating machinery 30 years old
  - Isabelle was the last serious investment in the plant
- 15 years of manpower reductions have produced a less than desirable demographic profile
  - Our biological clock is ticking

Issues

- Large building footprint produces corresponding lab space charges.
  - Facilities are not well matched to current size/scope
- Many funding sources are programmatic and thus subject to large year to year fluctuations
  - We have no operating funding base other than RHIC i.e ~ 50% of the SMD funding is open to large variations.
- HEP base program funding steadily reduced over past decade
  - BNL is now an 'NP' lab. The HEP programmatic funding however would say otherwise.
- Steady increase in effective lab overhead rates during the past decade
- We are expensive for WFO jobs
  - Many DOE requirements on how to perform business, do not necessarily lead to efficiency.
  - Internal BNL regulations (central shops $106/hr)
  - DOE WFO regulations (additional O/H rates, esoteric invoicing)

Future Outlook

- RHIC
  - Operational support will continue. Future program for RHIC (RHIC II e-RHIC) would require SMD contributions. As long as BNL continues to operate one of the only 2 superconducting hadron colliders in the world then some form of technology support is required.
- NSLS II
  - Possible HTS technology (X-ray and/or VUV ring), magnetic measurements, SC undulators, girder integration, etc…. There is obviously large potential opportunities for SMD involvement though probably not largely based on SC technology.
- LARP
  - Near term (FY07) is defined, but how does this program evolve beyond that period ? Fermilab will do the prototype quads.
- ILC
  - Irrespective of the ultimate fate of the ILC, the R&D program will proceed for the next several years. Our request is for $2->3M/yr for the final focus prototype program.

Outlook

- HEP Base program R&D
  - Marx sub-panel will comment on generic accelerator R&D. Indications are that they will not emphasize SC magnet R&D. There is also the 'BNL is not an HEP lab" factor
- WFO
  - 'If you build a better mousetrap the world will beat a path to your door'. It's difficult to quantify this though the sentiment appears valid.

Parameters for a Super-Flavor-Factory

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A Super Flavor Factory, an asymmetric energy e^+e^- collider with a luminosity of order 10^{36} cm^{-2}s^{-1}, can provide a sensitive probe of new physics in the flavor sector of the Standard Model. The success of the PEP-II and KEKB asymmetric colliders [1, 2] in producing unprecedented luminosity above 10^{34} cm^{-2}s^{-1} has taught us about the accelerator physics of asymmetric e^+e^- colliders in a new parameter regime. Furthermore, the

Recent work at Brookhaven National Laboratory on precision conductor placement of superconductors in large-bore low-field magnets has led to quadrupoles in successful use in the interaction regions for the HERA collider in Germany [12]. A minor redesign of these magnets will work well for the Super F Factory.