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THE MAGNET DATABASE SYSTEM

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Abstract: This paper describes the current status of MagCom, a central database of SSC magnet information that is available to all magnet scientists via network connections. The database has been designed to contain the specifications and measured values of important properties for major materials, plus configuration information (specifying which individual items were used in each cable, coil, and magnet) and the test results on completed magnets. These data will help magnet scientists to track and control the production process and to correlate the performance of magnets with the properties of their constituents.

SCOPE

The Data Management Group in the Test and Data Management Department of the Magnet Systems Division (MSD) at the Superconducting Super Collider Laboratory (SSCL) is developing a user-friendly, central database of magnet information that will be available to magnet scientists both at SSCL and elsewhere. This database, designated MagCom, concentrates on magnets produced by the SSCL Magnet Systems Division and industrial vendors under contract to MSD.

The database will include test results for critical component materials, configuration information (design drawing numbers, and serial or batch numbers for actual part used) for critical components in all magnets, data collected at major production steps, and test results on all magnets. It will serve as the prime source for the magnet technical information needed by the magnet analysis programs, the QA monitoring system, the Accelerator Division controls databases, and any *ad hoc* requests for information. It will contain summaries of data collected by other groups working on MSD magnets, with reference "pointers" to the computer files that have the full data. Eventually, interfaces will be established between this database and the external data sources (the pointer-referenced files) and databases developed by magnet builders and users in the Accelerator Division.

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A summary of the major categories of data and the sources for each is given in Figure 1. Detailed lists of typical data items to be recorded during the magnet production stages are given in the original design study.[1]

MagCom Data Scope

For magnets produced by the SSCL Magnet Systems Division (MSD) and the industrial vendors under contract to MSD.

MTL = SSCL Magnet Test Lab
MAAS = SSCL Magnet Acceptance and Storage Facility
SMTF = SSCL Short Magnet Test Facility
MDL = SSCL Magnet Development Lab

component and production information:

- summary of superconducting strand and cable test results & pointers to detail files on other nodes
- configuration information: drawing number plus serial or batch/lot numbers for critical components in each magnet
- critical data on critical magnet components
- critical data on critical production steps
- QA FRACAS (Failure Reporting, Analysis, and Corrective Action System) reports on parts and production steps
- interface to configuration management 'as built' information for all drawings and part serial or batch numbers, if available

warm tests:

- summary of all warm test results from vendors, MAAS, MTL, and SMTF
- detailed results (calibrated data files, analyzed data files) of all MTL and SMTF warm tests
- pointers to raw data files and calibration information for all MTL warm tests
- pointers to data files on other nodes for detailed results, raw data files, and calibration information for all non-MTL warm tests

cold tests:

- summary of all cold test results from vendors, MTL, and SMTF
- detailed results (calibrated data files, analyzed data files) of all MTL and SMTF cold tests
- pointers to raw data files and calibration information for all MTL cold tests
- pointers to data files on other nodes for detailed results, raw data files, and calibration information for all non-MTL cold tests

Figure 1. MagCom Data Scope.

HARDWARE AND SOFTWARE CONFIGURATION

The MagCom database is implemented using the SYBASE relational database management system in a UNIX environment on a SUN 4/280 server connected to Internet (grumpy.ssc.gov) and DECnet (SSCSUN). This server handles the database, mail, and printing functions for the Test Department. A SUN 4/470 (cranky.ssc.gov) is the workstation server for user accounts and analysis computations.

The database system has exclusive use of two 1-gigabyte (GB) disks; one is used for databases and the other for transaction logging and data that is waiting for import to the database. There is also a 1.6-megabyte (MB) optical WORM drive that is used for archive files. We have approximately 16 client SUN SPARC workstations, one of which is equipped with an 8-mm tape drive that is used for automatic backups of files.

We have implemented a menu that can be run from any SUN or vt-100 type terminal, and gives access to the most commonly requested information without requiring any database knowledge (see Figure 2). Knowledgeable SYBASE users can browse through the data with either dwb (the point and click data workbench) or isql (the SYBASE extension to Structured Query Language).

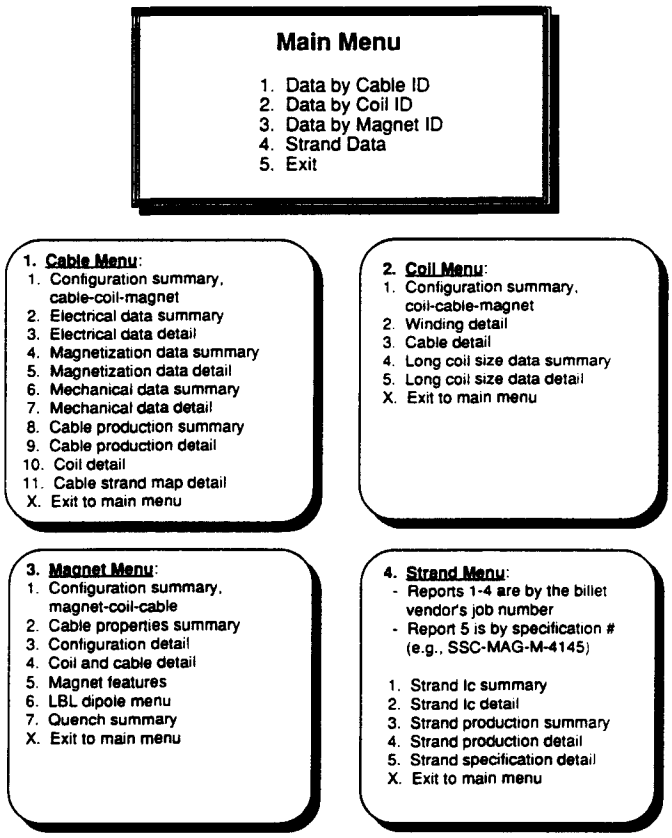

Figure 2. MagCom Menu Structure.

CURRENT STATUS

The initial emphasis of the database was on conductor data, especially the electrical test results on cable and the configuration records of which cable was used in each coil and which coils went into each magnet. A presentation at the 1990 IISSC gave examples of these reports.[2] Figure 3 gives an overview of this portion of the database structure.

In the past year, the SSCL Quality Assurance Group has instituted a program of collecting data on cable and its constituent strands and billets at the vendor site when cable is produced.[3] These data are collected with an IBM PC running a dbase application and are later transferred to the MagCom database, where they are easily accessible through the cable and strand sub-menus. (See Figure 2.)

The current emphasis is on bringing the R&D magnet test data (strain gauge runs, quench runs, and magnetic measurements) under the control of the database, via summary records and pointers to the complete data files. The R&D magnets have been built and tested at Brookhaven National Laboratory (BNL), Fermi National Accelerator Laboratory (FNAL), and Lawrence Berkeley Laboratory (LBL). Each laboratory has developed its own test facilities and computer programs, so it is necessary to design a system that can consolidate the results from these three labs and serve as the prototype for the SSCL Magnet Test Laboratory (MTL) data collection. We have been working closely with members of the Test Data Analysis Group and the Instrumentation and Controls Group on this activity. An overview of the design for strain gauge data is shown in Figure 4.

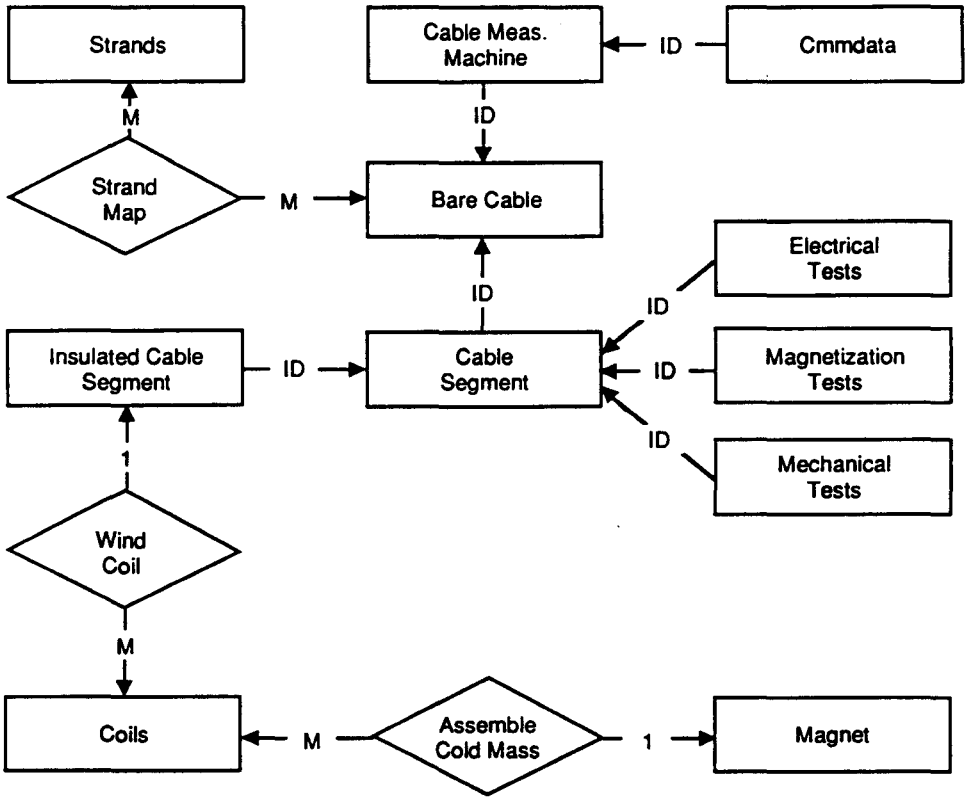

Figure 3. Overview of Cable Data Structure.

We have been gaining experience with import of data from various personal computer data systems. The database contains BNL dipole coil size measurements imported from an IBM PC SuperCalc spreadsheet, BNL cable test results imported from an IBM PC R:BASE database, SSCL/MSD/QA vendor cable production information imported from an IBM PC dBASE database, and LBL coil production data imported from a Macintosh Fourth Dimension database.

We also are expanding the information on magnet production. A table of the main design features of each R&D magnet has been added; it indicates which features are according to the "baseline" values and which are variants. (See Figure 5 for a list of features and Figure 6 for a sample of a report that combines this information with cable data for a specified magnet.) Information from the magnet production QA FRACAS forms (Failure Reporting, Analysis, and Corrective Action) will be entered in the MagCom database, and procedures to automate the data collection process will be developed.

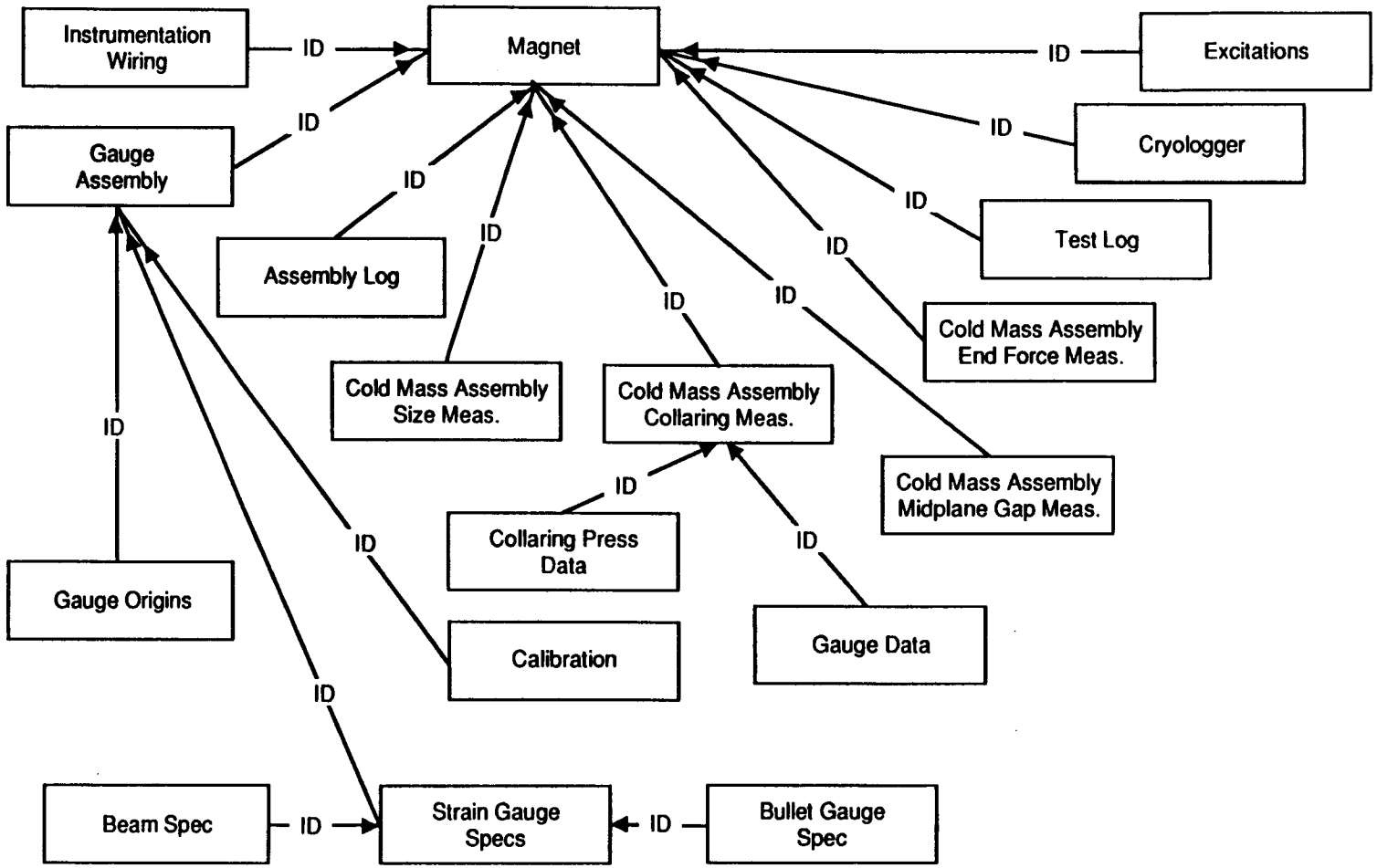

Figure 4. Overview of Strain Gauge Data Structure.

type	category	keyword
B	xsection	ID
B	cable	STRAND(I)
B	cable	STRAND(O)
B	cable	CU:SC(I)
B	cable	CU:SC(O)
B	cb_insul	LAYER1
B	cb_insul	LAYER2
B	collar	KEY
B	collar	MATERIAL
B	collar	ASSEMBLY
B	pole_shim	ASSEMBLY
B	coll_yoke	ASSEMBLY
B	yoke	SPLIT
B	yoke	END
B	yoke	LAMINATION
B	yoke	PACK
B	cryo	COOLING
B	quenchprot	TYPE
B	coil	WEDGES
B	coil	CURING
B	coil_insul	GROUND_WRAP
B	coil_insul	LAYER
B	coil_ends	SPACERS
B	outershell	THICKNESS
B	outershell	MATERIAL
B	shell_weld	METHOD
B	bore_tube	PLATED
B	end_plate	MATERIAL
B	end_plate	ASSEMBLY
B	end_plate	THICKNESS
B	splicing	LOCATION
B	splicing	RAMP
B	heater	STRIP
B	heater	SPOT
I	volt_tap	SCHEMATIC
I	coil_gauge	LOCATION
I	end_gauge	BULLET
I	thermo	SENSORS
I	shellgauge	NUMBER

B = Baseline
I = Instrumentation

Figure 5. Magnet Features Being Tabulated.

MAGNET FEATURES SUMMARY
FOR DD0027

Fabricated at BNL

POSITION	CABLE ID	RRR	CU:SC	R(10)	Ic
LOWER INNER	SC12-00007	38	1.48	0.66	13037
UPPER	SC12-00007	38	1.48	0.66	13037
LOWER OUTER	SC22-00005	60	1.75	0.48	9770
UPPER	SC22-00005	60	1.75	0.48	9770

CATEGORY	FEATURE (40mm Baseline)
collar	Tapered key, Spot welded, Armco Nitronic 40, Alternating L/R stainless steel
yoke	No iron on end, Monolithic block treatment - s.s. spacers with midplane alignment keys, Horizontal gap alignment, Bonded yoke modules in end, .060" laminations (carbon < .04%)
cryo	He flow through yoke with natural convection from beam tube
splicing	Ramp splices internal to collared assembly

CATEGORY	FEATURE (Variations)

End of Report

Figure 6. Sample Report: Magnet Features and Cable Electrical Data for A Specified Magnet.

FUTURE PLANS

Standard "travelers" (process specifications and data forms that follow the magnet through its production stages) are being developed by the Magnet System Division's QA and Production Departments for the 50 mm aperture dipole. The database staff will implement procedures (for either manual or electronic data entry) to make the important data tables available in the database.

Interfaces for transfer of data files from the SSCL Magnet Evaluation Lab's Short Magnet Test Facility will be developed soon. We will also start acquiring tools for database development (object oriented or entity relationship design and documentation) and end-user interface development (forms and report generators, and application generators that produce systems that can be run on multiple platforms).

Longer range plans include development of a GUI (graphical user interface) to the MagCom database and remote data collection procedures, with interfaces to MTL, the SSC Magnet Acceptance and Storage Facility (MAAS), and vendor databases. An ASST (Accelerator Systems String Test) application will be developed to allow easy access to the magnet production and test data.

At some point, we would like to add image data items to the database, begin working with distributed databases, and develop interfaces to vendor systems and the Accelerator Division databases. Expert systems and natural language interfaces should be investigated also.

REFERENCES

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2. M. J. Baggett, R. Leedy, C. Saltmarsh, and J. C. Tompkins, "The Magnet Components Database System," *Supercollider 2*, M. McAshan, ed., Plenum Press, New York (1990).

3. Douglas A. Pollock, Penny Baggett and Donald Capone, "The Quality Assurance of Superconducting Wire and Cable for SSC Magnets," 1991 IISSC.