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MAGNET TEST FACILITY CONTROL SYSTEM FOR SUPERCONDUCTING MAGNETS OF UNK

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1. Introduction

An UNK Magnet Test Facility (MTF) is being constructed to provide cryogenic, electrical and magnet tests of superconducting (SC) magnets of UNK. The main parts of it are:

- The cryogenic system consisting in its turn of the central liquefier, ten satellite refrigerators, two compressors, purification system and transfer lines. The central liquefier supplies the satellite refrigerators with liquid helium. The liquefier is manufactured according to the scheme incorporating precooling by liquid nitrogen, two turbine expanders and a wet expander.

- Four 8 KA, 24 V, ramped Power Supplies (PS) for cold testing of SC magnets, two 3 KA PS's for instrumentation testing and calibration.

- Test facility in its turn consisting of:

a) two dipoles and one quad benches for warm measurements;

b) eight dipoles and two quad benches for cold measurements;

c) two benches for instrumentation.

Relevant parameters and technique are given on table:

	Item	Parameter	Technique
1	Reference and calibration dipoles	Axis field	NMR - method in the central region and Hall - method at the end parts
		Multipoles	Rotating coils
2	Dipoles and quads measurements	Effective length Multipoles	Rotating coils NMR
		Field angle Magnetic axis	Stretched wires
		Dynamic multipoles	Stepwise coil rotation Measurement of transition process after dB/dt→0

The systems for warm measurements of SC coils and cold measurements of quads, including measurements of the magnetic axis location and alignment of the reference target, are being developped jointly with Saclay (France).

Total production rate of facility intended to be 2,4 SC magnets per day.

Such a complex of equipment requires a Control system which provides automatic monitoring, control of equipment, data aquisition and storage into files of magnets. Taking into account the difference between 3 pieces of an equipment (cryogenics, PS's and electrical/magnet measurement stations) Control system is designed as a mixture of 3 different subsystems with different phylosophy, but connected by LAN, sharing the same Host Computers, and based on the same hardware and computers.

2. Hardware Configuration

The hardware configuration is shown on Figure. PC/AT's were chosen as a suitable computers for real time control of groups of equipment and measuring benches.

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PC's present the middle level of computers hierarchy. The upper level is formed by two Host Computers of DEC - family. All computers are connected with Ethernet.

The interface electronics is based on IHEP version of CAMAC. In cryogenics the groups of CAMAC crates communicate with PC's through RS-232 lines, connected to crate controllers. CAMAC crate houses:

- intelligent crate controller with 16 bit, LSI-11-compatible processor;
- convertors for Allen Bradley thermometers;
- convertors for vacuummeters;
- 12 bit ADC;
- I/O - registers;
- restart memory module after power failure/restore;
- thyristor and relay drive amplifiers for Motors and valves;
- intelligent (16 bit, LSI-11-compatible) module for 4 control loops, aimed to provide reliability of the Control system itself as well as the cryo-complex.

Such a distributed processing means that all processors provide local control algorithms, gather local data pool of all related equipement, transmitting information to upper level only on request.

Control of PS's is provided with 16 bit computer, connected to CAMAC. Electrical/magnetic measurement station consists of 2 CAMAC crates, connected to PC, CAMAC crates house:

- 18 and 16 bit ADC, 20 bit DAC, timers, function generators for PS's control;
- amplifiers, filters, comparators for quench detection;
- NMR - convertors, voltage/frequency convertors, step motor drivers and so on for magnetic measurements.

3. Software

The purpose of software is to maintain functionality of all subsystems connected with production, testing and filing of magnets. In addition (independently of the serviced subsystems) software must maintain:

- automation of programming that includes the programming of low-level computers;
- communication between all computers that includes loading and start-up of programmes on low level, data exchange, subsystems interface through a middle-level computer;
- filing of the produced superconducting magnets and preparation of all necessary documentation about them;
- support of the bank of programmes that maintain execution of the system tasks.

All software may be devided into the system software and the application one.

The application software carries main functional load and includes algorithms of control, data acquisition, mathematical processing and representation of data that are individual for each technological subsystem. The software toolkit necessary for quick and qualitative writing of application programs is maintained by the system facilities.

The system software is all software that doesn't depend on the object of control and one that is common for various subsystems. It maintains the operational environment for application programs interfacing with operator and equipment and includes the following components:

- operating systems of high- and middle-level computers and their utilities;
- systems of automation of programming;
- software for intercomputer communications (TCP/IP) that includes the communication of high-level computers with the computers of IHEP central complex;
- automation system data base and its utilities;
- the operational bank of superconducting magnets tests results;
- packages of subroutines for organization of the operator dialog with computers, format data conversion and data representation on the information representation equipment;
- multiprogram real-time monitor for low-level computers;
- the tests for system equipment components.

The features of problems solved by high-level computers permit us to use the VAX/VMS operating system that maintains a parallel execution of some tasks in multiprogram and multiaccess modes. We want to use the mode of the RSX-11M operating environment emulation especially in the system of automation of programming of tasks for low-level microcomputers.

We have selected C and FORTRAN as the programming languages for high-level computers. The features of the programming of low-level computers are defined by two reasons: small amount of main storage (56 Kb) and the short response time requirements especially with respect to control programs. The first reason requires elaborate and accurate programming. Second one requires the use of specially developed monitors.

The middle-level computers may be used as the local console for subsystems that need a control.

4. Intentions

a) Analog electronics interlock is being constructed to protect the most important cryogenic equipment in case of Control system default.

b) Cooling of CAMAC crates with help of vortical air refrigerator will be tested.

5. Acknowleadgements

The author list of this status paper contains only names of group leaders. Much more people really take part in the designing of the Control system.

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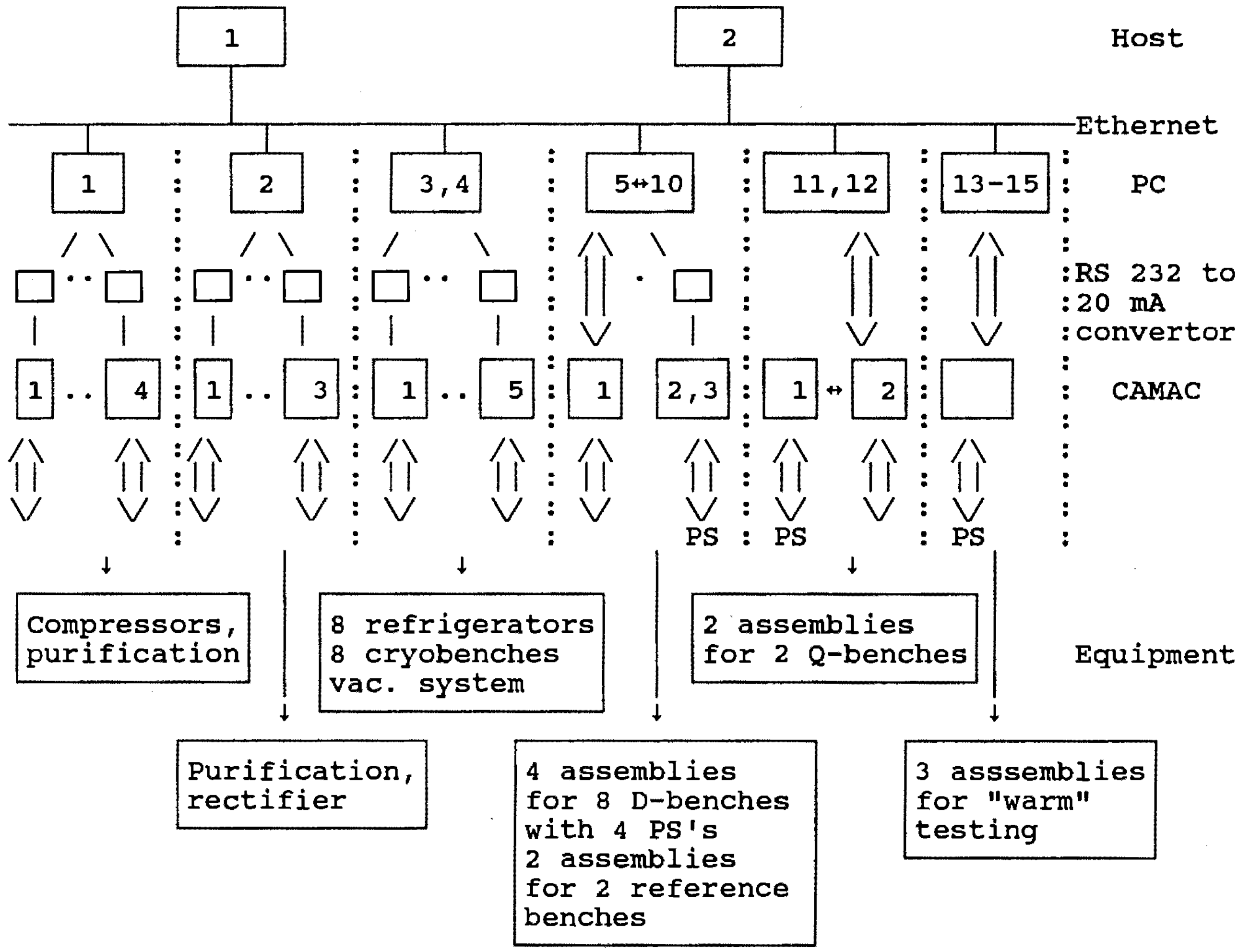

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