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# VME Applications to the Daresbury SRS Control System

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*Abstract*

The control system for the Daresbury SRS has recently been extended with a VME based alarm system which is operational. A further development is a steering system to provide servo control of the electron beam orbit position in the storage ring.

## I. INTRODUCTION

The Daresbury SRS is a 2 Gev electron storage ring dedicated to providing synchrotron radiation to approximately 32 stations on 10 beamlines. It came into operation in mid 1981 and was upgraded with a high brightness lattice in 1987.

The control system for the SRS was designed and constructed in the period 1975-1980 and the original computers were upgraded in 1985.

The original control system provided an alarm condition monitoring system with a sampling resolution of 2 minutes. Recently, a dedicated VME system has been added which provides alarm monitoring and indication with sampling at the level of 5 seconds.

The high brightness lattice upgrade in 1987 reduced the source size by a factor of 10 and this led to difficulties with beam alignment and positional drift over the period of a stored beam. Work is under way to provide a VME based beam steering system to provide servo control of the electron beam position.

This paper will give a brief description of the SRS control system followed by a description of the new alarm system. A description of the beam steering system and its present status will be given.

## II.THE SRS CONTROL SYSTEM

The SRS control system consists of a network of 4 Concurrent Computer Corporation(CCC) 3200 series computers as shown in Fig 1.

All computers in the network have a CAMAC system crate and communicate via CAMAC fast serial data links. CCC3230 is the operator interface computer providing service to three operator consoles in the main control room via a CAMAC parallel branch. Two of the operator consoles contain a colour display and keyboard (Tektronix 4207), a knob and tracker ball and a monochrome graphics display. The third console contains a Tektronix 4207 colour display and keyboard and serves as the personnel safety console.

CCC3205A and CCC3205B computers provide the interface to the plant via serial CAMAC highways. CCC3205A has two serial highways, one for the linear accelerator and Booster synchrotron and one for the Storage ring and Beamports. CCC3205B provides control for the beamlines with one serial CAMAC highway. Local control at the plant is implemented with Tandy 102 computers. The total parameter count presently stands at approximately 1800.

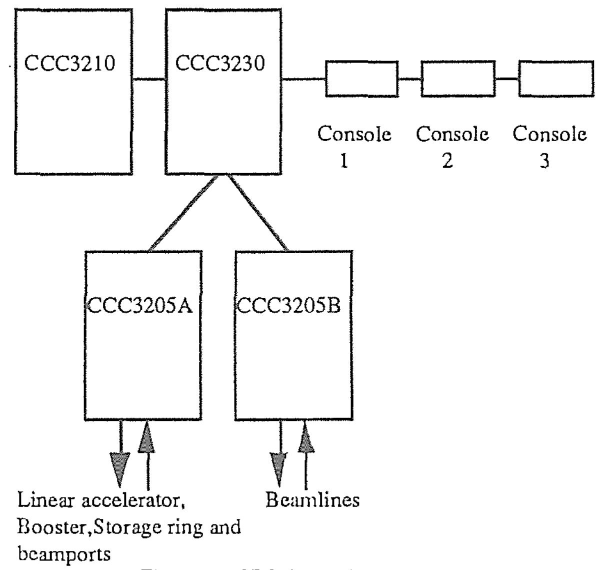


Fig 1. The SRS Control system

CCC3210 is offline to the control system and is used for programme development and testing.

High level programming is done in RTL/2 with more recent applications written in C.

## III. THE ALARM SYSTEM

The original SRS alarm system was in operation for 9 years from the start up of the machine. Over this period, the system has been found to have several disadvantages:-

1. Noisy analogue input signals gave spurious alarm indication which led to alarms being ignored by operators.
2. Alarm conditions were applied to large numbers of parameters which led to 'swamping' of the alarm display and the operators being presented with more information than they could reasonably handle.
3. The large number of alarmed parameters led to difficulties in administration of the system.
4. The 2 minute sampling rate meant that the system was in fact no more than a fault indication system rather than a true alarm system.

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5. The monochrome,text-only display did not provide an eye-catching indication of alarms.

Whilst it would have been possible to improve the existing system for points 2. and 3., the system could not have been enhanced to address points 1. and 4. without seriously effecting control system performance. It was therefore decided to produce a new alarm system with separate intelligence. The new system was to have the following features:-

1. The number of alarmed parameters would be kept to a relatively small number of important parameters.
2. Faster sampling of alarmed parameters was required.
3. Operator interaction with an alarm display was essential.
4. Audible alarms in the Control room were desirable.
5. Alarm history for at least the last 24 hours should be available.
6. A hard copy of alarms was required.
7. A clear,unambiguous display of alarm conditions was essential.

A VME based system was chosen both for its long term expandability and to allow us to gain experience with VME and the chosen operating system,OS/9.

The hardware chosen consisted of a Motorola 68020 processor running at 16MHz with floating point co-processor, 4 Mb Ram, 5 RS232 channels, interface for high resolution coloured graphics device, keyboard and mouse and 40 Mb hard disc and floppy disc drive. The system is shown in Fig 2.

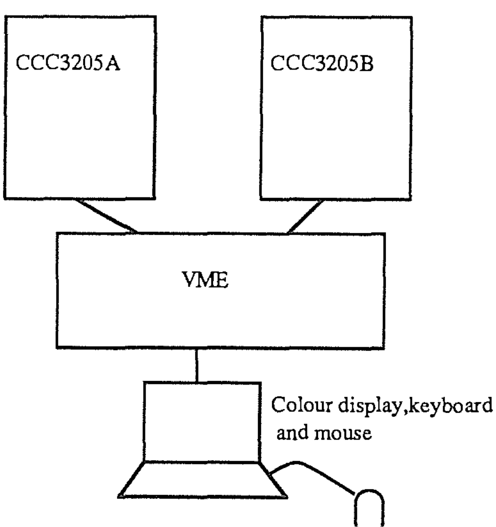


Fig 2. Alarm system

CCC3205A and B are connected to the VME crate with RS232 links operating at 9600 baud. A future improvement will be to remove the main control system CAMAC fast serial data links and replace with an Ethernet LAN to which the alarm system would be connected. Simple, low priority processes in the 3205 computers monitor a table of parameters every 5 seconds and transmit raw analogue and status data over the RS232 links to the VME crate.

A matrix type display consisting of various zones corresponding to different machine areas, forms the alarm system indication. Each box on the matrix is normally depicted in black and white with a change to flashing red when an alarm for that zone is detected. By selecting the flashing zone with the mouse, the operator is presented with detailed information on the alarms in that zone and flashing ceases although the box remains red until the alarm is cleared.

The software is arranged as a ring of processes communicating via OS/9 signals as shown in Fig 3. Data from the 3205s is transmitted over the RS232 links to the input processes and piped to the alarm monitor process which performs alarm checking and passses information for display and logging to the display manager and then onto the disc logger for history storage and to the print logger for hard copy. All processes have access to the alarm system database. The alarm monitor process checks supplied analogue and status data against limits in the database to determine the presence of an alarm condition. Warning and danger levels may be specified for the alarm condition. The operator may request the system to ignore or notice individual alarmed parameters. Future extensions to the system include the implementation of rate of change alarm conditions and the provision of audible alarms.

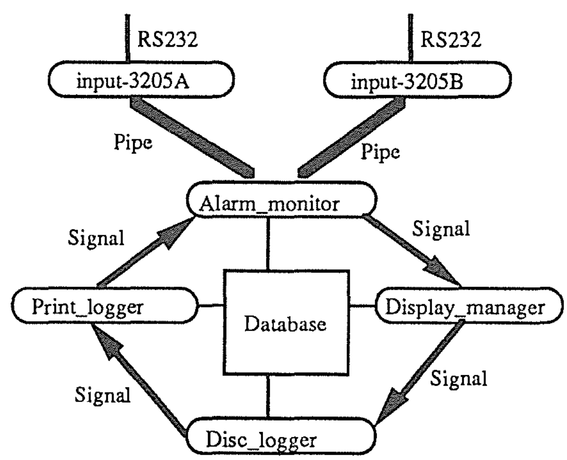


Fig 3. Alarm system software

## IV. BEAM STEERING SYSTEM

Since the upgrade of the SRS to a high brightness configuration in 1987[1] there has been a growing requirement from the user community for improved beam position stability.

Beam stability measurements on the SRS and requirements for a new steering system have been described elsewhere[2]. Vertical beam position stability is most critical for users, with the largest movement being a peak displacement of 250±100μm in the first 3 hours of a beam fill followed by a roughly linear decay of approximately

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20μm/hour for the remainder of the fill which typically lasts 24 hours. The existing electron beam monitors have an accuracy and repeatability of ±50μm and are capable of providing only gross orbit correction. A two wire photon beam monitor has been used at Daresbury to monitor photon beam position and has shown a useful range of 3mm with a resolution of 10μm at 21m from the source[2].

Steering elements on the SRS consist of 16 vertical steering magnets, 16 dipole trims produced by backleg windings on the main dipole magnets and 16 multipole magnets each made up of 12 individually powered windings which provide a combination of horizontal steering, vertical steering,octupole and quadrupole fields. In total there are 224 individual power supplies which are driven from 12 bit CAMAC DACs.

Planned improvements to the steering system are:-

- Upgrade of the steering magnet supply DACs from 12 to 16 bit resolution and accuracy.
- A VME based system to provide local intelligence and increased bandwidth for steering magnet servo control.
- Production of tungsten vane monitors for photon beam position monitoring.
- Provision of improved electron beam monitors having a resolution of 10μm[3].

The aim is to achieve a photon beam stability of 50μm at 20m from the source.

## V. VME-BASED STEERING SYSTEM

The new steering system will involve disconnection of the steering magnet DACs and ADCs presently in CAMAC serial crates and connection to VME DACs and ADCs housed in VME plant interface crates. Fig 4. shows the arrangement of the new system.

The Steering Process system crate contains three processors, Gateway, Database server and Servo. The Gateway processor is the interface to the existing control system and contains code which makes it appear as another 3205 processor to the 3230. The 3230 and the Gateway processors are nodes on a dedicated Ethernet LAN. The Database server processor contains the steering system database and is connected to another Ethernet LAN which also has plant interface crates as nodes. The Servo processor contains global and local feedback algorithms. All three processors have access to the database which is held in shared memory. The plant interface crates contain a processor (PIP) and enough DACs and ADCs to service one quarter of the storage ring steering magnets. In addition, these crates will have ADC channels to read in signals from electron and photon beam monitors and various environmental parameters.

The Gateway processor has access to the hard and floppy discs while all other VME processors in the system are ROM based systems. The database will be continously updated by a process in the Database server communicating with the plant interface processors.

The processors are MVME147s with a Motorola 68030 cpu with a clock speed of 25MHz, 8 Mb RAM, 4 serial and 1 parallel ports and floating point processor. There is an 80Mb Winchester disc and 1Mb floppy drive in the steering system process crate accessible to the Gateway processor.

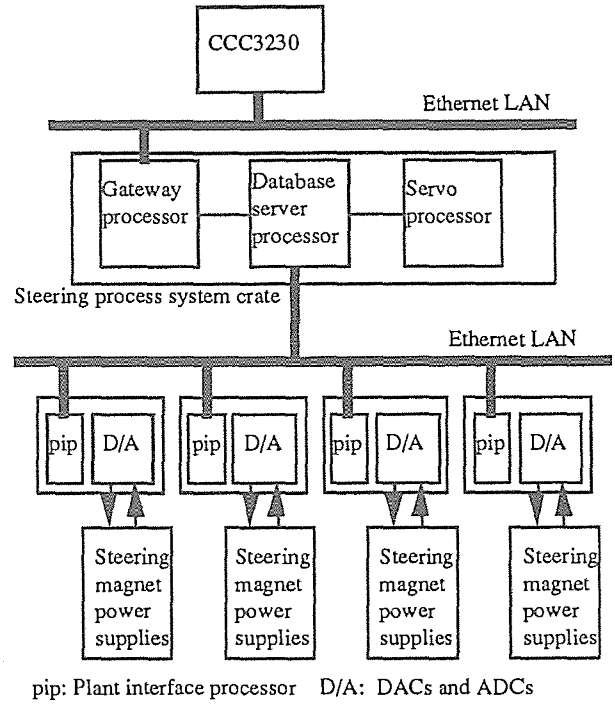


Fig 4. VME based steering system

The Gateway processor runs under Professional OS/9(V2.4) while all others run under Industrial(ROM based) OS/9. Application software is written in C. The communication protocol is TCP/IP.

## VI. PRESENT STATUS AND CONCLUSIONS

The new steering system hardware has been purchased apart from the DACs and ADCs which are presently being evaluated. The interface software both in the 3230 and Gateway processors has been written and tested and the Database structure has been established. Work is progressing on the processes in the Database server and Plant interface processors for database updating. Further work is necessary to design and write code for the Plant interface processors. It is intended to install and test a minimal system without the new electron beam monitors in 1992.

The power and versatility of VME make it a strong contender to form a major part of a future accelerator control system at Daresbury.

## VII. REFERENCES

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