PRESENT STATUS OF THE SRS CONTROL SYSTEM UPGRADE PROJECT

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Abstract

The SRS Computer Control System is undergoing a programme of upgrade from a system of Concurrent Computer Corporation computers to a network of PCs. This upgrade has been introduced progressively while normal user operations continue; this has posed additional problems as there is a need to quickly switch between the old and new systems. This paper will explain the advantages of the particular choice for the new system and it will describe the present status of the project and future plans.

1 INTRODUCTION

The SRS is a second-generation 2 GeV synchrotron radiation source dedicated to providing synchrotron radiation to approximately 40 stations on 12 beamlines. The facility has been operational since 1981 and was upgraded with a higher brightness lattice in 1987. The beam steering system was upgraded in 1993 with a VME based sub-system which has been described elsewhere[1].

There is an ongoing programme of upgrade of the control system which is based on 3 Concurrent Computer Corporation 3200 series computers to a system based on a network consisting of a file server, PC consoles and PC and VME front end computers. Software and hardware development and commissioning of the new system must not conflict with normal operation of the facility and this can pose severe problems and lengthens time scales for completion of the various phases of upgrade.

2 THE SRS CONTROL SYSTEM

The Control System for the SRS was designed and implemented in the mid to late 1970s . The computers on which it was originally based were upgraded in 1985. At this point it appeared as in Figure 1. The three Concurrent Computer Corporation Machines were linked by CAMAC serial data links. A CAMAC parallel branch provided the interface between the 3230 and the three operator consoles in the main control room. The 3230 was also responsible for supervisory control of the personnel safety system. The plant interface computers (3205s) provided control and monitoring of the equipment using three serial CAMAC highways connecting to the injector system, storage ring and beamlines. The beamline system also provided 34 local control consoles.

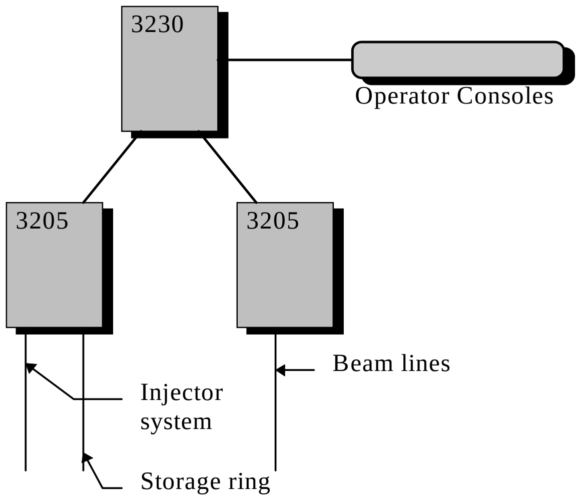

Figure 1: The SRS Control System

Following the higher brightness lattice upgrade to the SRS in 1987, which reduced the source size by a factor of ten, users of the facility identified problems with optimising beam alignment due to beam positional drift over the period of a stored beam. A project was started to improve the beam steering system with a VME-based system [1] and in 1993 the Control system appeared as in figure 2.

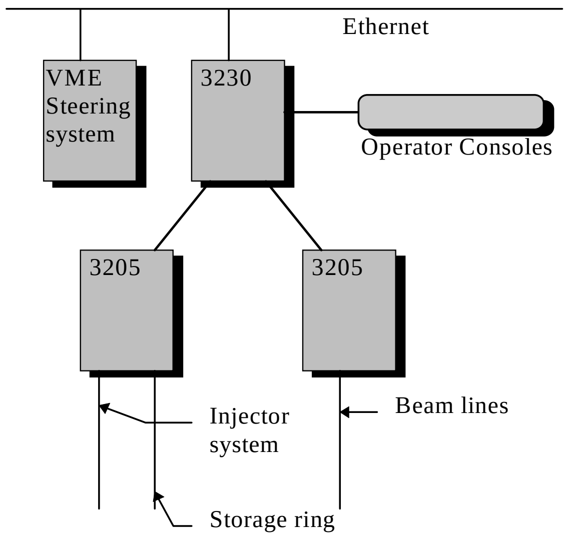

Figure 2: SRS Control System in 1993

3 THE UPGRADE PLAN

A study was undertaken in 1992 to examine the options available for upgrade of the SRS Control System [2]. As a result of this study an upgrade plan based on the CERN PS ISOLDE Control system [3,4] was formulated. The ISOLDE system is a control system based on a Novell network of PC consoles, front end computers and a file server using Windows at the console level and DOS at the front end level. The major advantages of this system were perceived to be:-

- Minimum requirement for in-house developed software.
- Maximum use of 'market-leader' application packages such as Microsoft Excel and Microsoft Visual Basic for application development. The use of such packages has the advantage that Accelerator Physics and Operations staff are more readily able to write their own applications relieving the workload on Control System staff and allowing more flexible and immediate control of data during experiments..
- PCs are inexpensive and easily manageable.

The upgrade was divided into four main phases:-

Phase 1. Control of the 5 main magnet families on the storage ring. These comprise the main dipoles, F-quadrupoles, D-quadrupoles, F-sextupoles and D-sextupoles.

Phase 2. Control of the steering magnets , beam position monitors and beamline tungsten vane monitors. There are 224 magnet windings, 32 beam position monitors and 12 tungsten vane monitors.

Phase 3. Control of a serial CAMAC highway. In the first instance the injector system (linear accelerator and booster synchrotron) would be moved onto the new PC-based system.

Phase 4. Following successful completion of Phase 3 , the next step is to control the storage ring and beamlines serial CAMAC highways. It would also be necessary to provide means of ramping the two superconducting wiggler magnets. For the beamline system the present user consoles would need to become PC consoles. The final move in order to remove the Concurrent computers would be to provide PC control of the personnel safety system.

4 PROGRESS AND PRESENT STATUS

The first step in converting to the PC-based system was to introduce PC consoles to the Main Control Room desks to replace the Tektronix 4207 colour terminals which provided the interface to the 3230 via a CAMAC serial module. It was necessary to purchase a Tektronix 4207 emulator, to run under Windows 3.11, for the PC to allow normal 3230 control of the machine.

In mid 1994 the main magnet power converters were replaced by converters designed to CERN LEP standards[5]. The five converters are interfaced to the control computer using 20mA current loop. Initially, control of this system was done using a stand-alone Macintosh computer for controlling the five converters and a connection to the SRS Control system to control the timing signal for ramping. To convert to the new PC-based control system it was necessary to write an equipment module for the front end computer (FEC) containing the power converter specific code and a console application capable of setting up the power converters for an energy ramp. The equipment module was written in C and the console application was written in Microsoft Visual Basic using Microsoft Excel worksheets for the ramp information accessed using OLE automation. This system was installed and became operational in early 1995 completing Phase 1 of the upgrade.

For Phase 2 of the project it was necessary to take the FEC code for the PC (running DOS) and produce a version for the VME steering system (running OS/9). It was also necessary to produce at least one equipment module in the FEC for the steering system elements. In addition it was found useful to provide two further equipment modules; one for handling beam bumps and orbit information and one for handling groups of steering elements and monitors. Additionally, there was a requirement to provide at least enough applications at the console level to enable routine machine operation. To complete Phase 2, however, it would be necessary to also provide a basic set of applications of use to Accelerator Physicists to use in beam study periods (typically 6 machine shifts per month). In order to be able to test applications offline it was necessary to provide code to be run on the existing VME development system to simulate static plant behaviour. Dynamic behaviour could only be tested on the machine, and to this end short periods of beam studies time were used. It was relatively easy to switch between the old and the new systems for testing but the operations schedule dictated the rate of progress.

Early testing was done using Windows 3.11. Problems were experienced when running more than one application at a time. This was due to the limited multitasking nature of Windows 3.11. This problem was solved by moving to Windows NT which additionally provided a more stable environment. Further benefits of Windows NT include integrated network support and easy system management. Many of the applications were converted to 32 bit using Microsoft Visual Basic V4.0 and DLLs were also converted.

Console application software was mostly written in Microsoft Visual Basic with some use of Microsoft Excel. Applications were written to provide closed orbit correction, the capability of applying steering configurations, beam steering by application of magnet bumps, control and monitoring of beam feedback as well as a range of diagnostic software and applications to collect machine data for beam study purposes. Additionally, the software to control the energy ramp produced in Phase 1 required modification to include the ability to apply steering files at points up the energy ramp.

Early in 1996 the system was ready to be introduced into operation but it was necessary to familiarise machine crews with it during normal operations. There is pressure on operations staff to refill the machine in the shortest time possible and so any serious malfunction of the software during the course of a refill led to immediately switching back to the old control system. For most weekday morning refills over the period of a few months the control system was switched over to the PC-based system and operations staff were able to try the new system. The switch over, which could be done in 10 minutes, involved swapping one network connection and reloading software. Over this period some final improvements to the software were made and the system became operational in April 1996 completing Phase 2 of the upgrade.

The present configuration of the upgraded control system is as depicted in Figure 3.

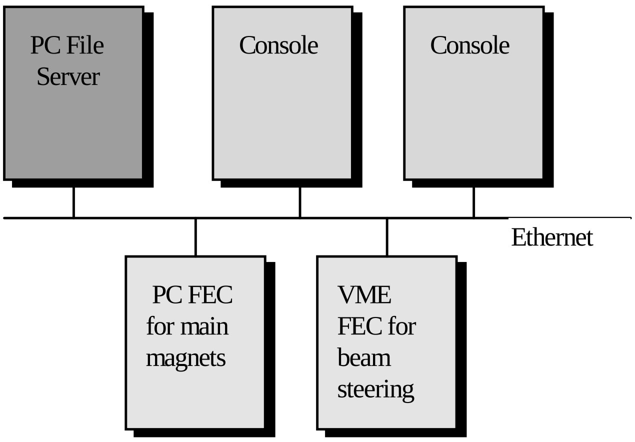

Figure 3: The Upgrade Control System

Work is currently underway on Phase 3 of the project. An Industrial PC running DOS has been equipped with an interface to system crate CAMAC and software is being developed to enable control of a serial CAMAC highway. Following this, it will be necessary to provide equipment modules for all the various types of plant on the injector system before tests on the injector system can be started. It is hoped that this will be early in 1997.

5 CONCLUSIONS

The new upgraded beam steering system has been operational for a short time but it is already apparent that it provides many benefits over the original system. Apart from the obvious advantage of graphical user interfaces it is much easier to put together useful applications. Accelerator Physicists and Operations staff are already writing quite sophisticated applications which in the past would need to have been written by Control System personnel.

Addition of new PC front ends for new control functions is quite straightforward with the bulk of the work being the writing of C language equipment modules. With the implementation of front end code for VME OS/9 systems, there is the option for a powerful, multitasking front end and a broader choice of I/O options.

Already, the time to achieve useable beam has decreased with the introduction of an application to provide steering of user beams.

6 ACKNOWLEDGEMENTS

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