Rutherford Laboratory

Technical Leaflet

A9

NIMROD CONTROL ROOM

In designing and operating NIMROD's control system the following main considerations apply.

1. The usual function of a control room viz. to coordinate and control operations.

2. Entry into the Magnet or Injector halls whilst proton beams are being run is highly dangerous and a very secure system is provided to ensure no one gains access to the area during full machine operation. Also when entry into the area is made the proton beam cannot be switched on.

3. It follows that all apparatus situated in the Magnet and Injector halls must be capable of operation from the Main Control Room for long periods (e.g. 10 days) without the necessity of local attention or even inspection. An entry into the area will mean switching off the beam and an accelerator of this sort (and certainly this machine) is more prone to fault during start up and shut down than during operation. Any interruption tends to breed further interruption. We must provide sufficient monitoring to tell the state of apparatus.

4. Since accelerator commissioning and development work is always in progress there is room left for further expansion. Indeed some of the equipment in present use is still in prototype form. It was deliberate policy that the main control desk would be finally designed in the light of operating experience. Vital controls and monitoring will be brought out to the control desk.

5. The Main Control room therefore houses some fifty or so racks in present day use. The following are the main functions dealt with.

(i) The switching on and control of all equipment situated in the magnet and injector halls and vital to the operation of the accelerator.

(ii) Measurement of the injected (15 MeV) beam current e.g. 20 mA, the final machine energy e.g. 7 GeV and the accelerated beam intensity e.g. 6×10^{11} protons/pulse.

(iii) Measurement of vacuum pressure in the machine at upwards of 20 different places.

(iv) Three separate television systems.

(a) For general purpose injector studies. Tripod mounting, remote pan, tilt and focussing controls provide a flexible system. Up to five separate cameras may be switched into use.

(b) A split field system to give a display of eight pictures on one 15 in. monitor. Each picture is taken from a separate camera which views a grid situated across the beam path in the synchrotron vacuum system. The system is used for studying the circulating 15 MeV beam. The grids can be swung out of the way when accelerating.

(c) A 15 channel closed circuit system for personnel monitoring.

(v) Alarms covering equipment trips, smoke, flood and hydrogen.

(vi) The final destination of that part of the injected beam which is not accelerated can be tracked down. This reduces the possibility of damaging the vacuum vessel with the injected beam.

(vii) Communications systems comprise tannoy, GPO telephone, an internal machine telephone and centrum intercomm. between beam lines and the main control room.

(viii) NIMROD contains many items of plant which dissipate heat, some of these in vacuum, and in most cases this heat is removed by closed circuit cooling water and heat exchanger systems. Advantage has also been taken of water cooling to reduce physical dimensions to a minimum and operate with high current densities in conductors. A failure in cooling can result in very serious damage to equipment. There is therefore a large quantity of quite vital coolant flow monitoring. Flow in about 1000 circuits and temperature at about 1500 points are monitored. In most cases the appropriate power supply is interlocked so that a coolant failure will disconnect it from its load before damage can result. Some of the temperature monitoring is quite fast e.g. in one system 120 points are checked in 90 milliseconds between every machine pulse.

(ix) Radiation levels are checked at various places inside and outside the main shield walls.

(x) General purpose cables are available for the distribution of signals round the area, e.g. from the Main Control room to the local control rooms in the experimental areas.

(xi) Monitoring of radio frequency waveforms and the state of the timing system.

(xii) State of machine interlocks and beam stops.

6. The Main Control room crew consists at present of 1 Duty Officer in charge, 4 technicians and 1 general worker. Assuming a healthy machine and good vacuum system it takes about eight hours to get on the air i.e. achieve a 7 GeV beam with targets set up to give four or five beams into the experimental areas. This includes locking up and searching the magnet and injector halls, switching on and setting up all apparatus.

At present we run for eighty hours continuously. This will be extended (we hope) as we and the machine improve.