national accelerator laboratory

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Subject

RF System Control Computer Plans

This note describes the RF Section's plans for the use of a control computer. The primary need for such a computer is to insure the proper mating of the rf system components with the computer-based monitoring and control system. A number of secondary benefits can be derived from the computer's capabilities during the design and construction of the accelerator. A local computer interfaced with the rf hardware is essential in order to carry out the plans described in this note.

The computer will be used in the areas of:

1) rf system control design
2) prototype module evaluation
3) component acceptance testing
4) beam monitor construction.

The booster rf system and the main ring rf system will share the computer during the development period of rf system control and monitoring.

Control System Philosophy

The physical distances in the accelerator coupled with the large number of control and monitor points suggests the use of several small local processors communicating with a central computer to provide an efficient system for machine control. The local processors relieve the central unit from the task of digesting all the information available by collecting, processing, organizing and condensing information from the machine components. Only essential information is passed to and from the central processor, which is the operator's prime communication channel to the accelerator.

The local processor also serves as a local storage area for set points, tables, etc., necessary for control of its associated components. The use of computers in the control system will result in an accelerator with greatly expanded capability to meet the requirements of experimental physics in the EPB area, where there will be a changing spectrum of requirements for the extracted beam. A criterion in the design of the system, however, should be that the only capabilities lost by the failure of the computer system are those gained by its inclusion. Without the computer, the accelerator should still function under manual control at design energy and intensity.

Design of RF System Controls

In every area of the accelerator, the local processor hardware and software must be intimately related to the machine components. In order to arrive at a control system design which fits the needs of the accelerator, the machine designers must have the major role in determining which functions the local processor monitors and controls.

At this time it is not clear whether the control of the rf systems in the booster and main accelerators should eventually be done with separate dedicated processors or by more general computers assigned to several machine systems. Therefore, if the rf systems are to be effectively mated to the computer-based control system, it is necessary for the rf system designers to start gaining experience with such a system immediately. Tacking on a control system at some future date after the components are designed would lead to an inadequate system which is an appendage rather than an integrated part of the overall design.

Prototype Module Evaluation

The hardware development work to be done by the RF section includes the prototype construction and evaluation of one complete accelerating module for each of the booster and main ring systems. In the case of the booster system, our present schedule calls for actual machine component construction to begin by 11/1/69. Since these components are to include provision for convenient connection to a local processor, it is necessary to develop facilities for evaluating proposals to accomplish this as soon as possible.

During the period of the prototype module evaluation, it will be necessary to have a working control computer system attached to the modules for control of the rf station and for data taking and analysis. This will give a flexible and rapid means of exercising the various parameters of the rf module over a range of operating values and measuring the performance of the components.

The high design intensity of the NAL accelerator poses significant beam loading to the booster and main ring accelerator rf systems. The interaction of the beam-current harmonic components with the resonant modes of the cavity-amplifier system is a subject requiring a great deal of detailed model measurement and evaluation. We must develop a cavity-amplifier system whose mode spectrum is known and determined to be free of responses at harmonics of the beam current waveform. The narrowly-bunched beam contains appreciable energy at high-order harmonics. This necessitates the detailed measurement and evaluation of system responses over a very wide frequency range. Since the same computer planned for the design of RF system controls can be utilized to make the measurements and acquire, store, and partially analyze the data, an important time saving can be realized in this program.

Component Acceptance Testing

The NAL construction schedule calls for the accelerating module components to be delivered to NAL for acceptance and installation starting July 1, 1970. At that time a comprehensive test procedure is required to assure that the components accepted will have a good assurance of performing satisfactorily as a total system. To accomplish this testing on schedule, a versatile and efficient test facility is required. We plan the original design of the test facility around the computer.

Beam Monitoring

A task-team responsible for devising suitable beam monitors throughout the accelerator is currently being formed. A computer will be used in designing the beam monitoring equipment, testing the hardware and developing data reduction algorithms compatible with the accelerator's computer-based monitoring system. Since this task-team is coached by the RF Section, the RF control computer can conveniently serve this function.