Sequence Program of Programmable Controller for Linac Pre-injector

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1. Introduction

A pre-injector of the SPring-8 Linac was constructed in 1993 at Tokai Establishment of JAERI, to test an electron gun and an bunching section, and also to test a performance of a control system.

In this system, four Programmable Controllers (sequencer) were mounted.

The sequencers were located in
1. A modulator for the gun (Power supply of the gun)
2. A grid pulser of the gun
3. A booster modulator for bunching section
4. Remote control panel (A temporary controller)

The two modulators and the grid pulser were locally controlled by the sequencer, for example, starting up, shut down, running control or interlock system. Their running statuses were indicated on each control panel by the sequencer, too.

A remote control panel sequencer was temporary used in Tokai. It will be replaced with VME computers in the Harima Site.

The VME computers send commands for a sequencer. The VME commands are managed by VME software as if operator operate on the control panel.

The reason of adopting the sequencer for the pre-injector control is to give flexibility to the system, or for simple maintenance. And further more, all modulators for the main accelerator section will be controlled by a sequencer too. So, in this system, we have been testing adequacy of the sequencer for the machine control system, and designing sequencer programs for the actual pre-injector (in the Harima Site) and for the main accelerator section. Concepts of designing the program are described below.

2. A Outline of Sequencer

The sequencers drive the relay coils in the relay sequence circuits (hardware sequence) directly. And sequencers are connected to a local control panel (man machine interface unit). The signal from a button in a local panel is accepted by the sequencer. And the sequencer makes output signals for lamps in a control panel.

The VME signals which are outputs to the modulators or a grid pulser, are processed by sequencer too. (FIG.1)

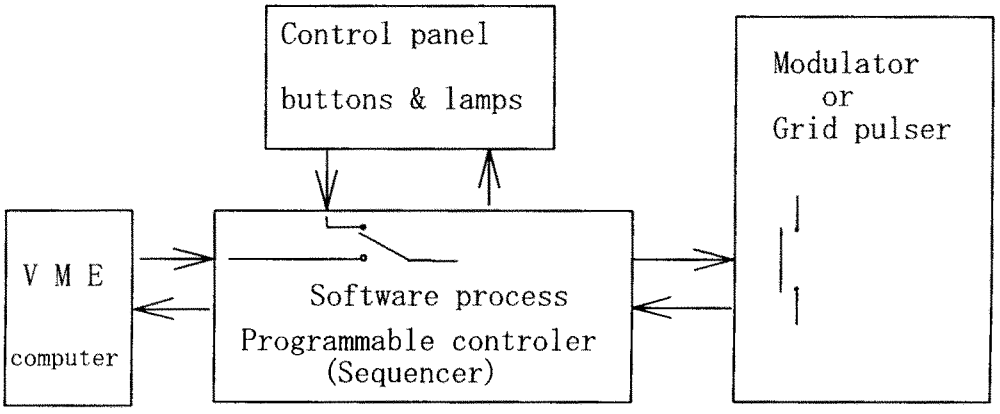


FIG. 1 Control signals connection

3. Solution of Problem in the Design

We modified the sequencer program on test a pre-injector. Because there were problems in the program for a interlock. The programs were provided by a manufacturer of a pre-injector. We needed the modified programs for proplsion to test.

A characteristic example is described below. In the case of the optimized signal flow for interlock, a meter for interlocks must indicate fail by opening circuits. So that, a sequencer uses "0" flag in its own processes for the machine.

3.1 Sequencer Program before Modified (FIG. 2 a)

A process for indication must be consistent with the for fail of machine before modification as show in FIG. 2. The existence of two process that has likeness programing, is not agreeable for maintenance. Because, it would be two revision whenever we modified it.

3.2 Sequencer Program after Modified (FIG. 2 b)

Process for interlock judgment give common to the indicators and the modulators. The modify produce good results for maintenance.

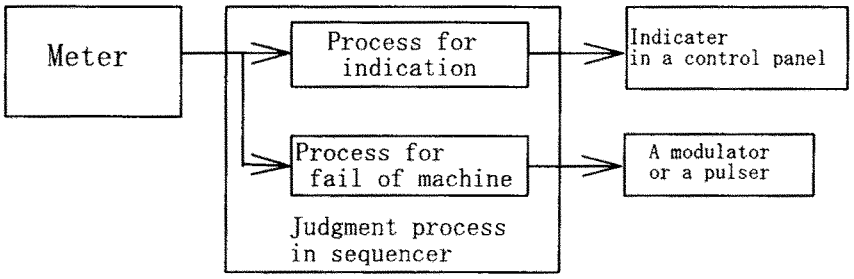
4. Conclusion

A most important point of sequencer programing signal flow. The programs are protected from bugs by simple signal flow.

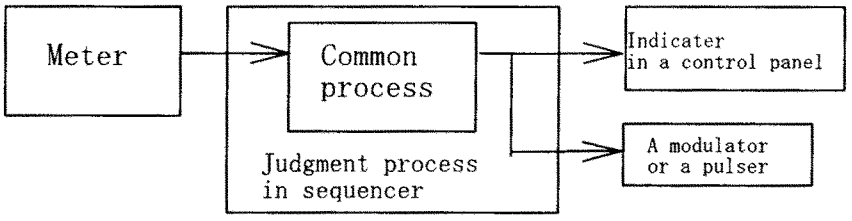
And accurate indication of machine condition important too.

A compricated signal flow will be difficult for objectives.

Concept design of sequencer programming for the pre-injector was finished in 1994. And now, we are designing in detail for the actual pre-injector and for the main accelerrator section.



a) Before modified



b) After modified

FIG. 2 Modification of signal flow for interlock