Automatic RF Conditioning System for SPring-8 Linac

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1. Introduction

The SPring-8 Linac was completed at end of July 1996, and the beam commissioning has begun since 1st August. The Linac is driven by the high power RF system, the first stage of operation, the system often cause high power discharge. Therefore, the system need carefully warm up that called "RF conditioning". Generally, the RF conditioning waste very long time, about 600 hours[1]. However the construction of Linac was tied to a schedule, and the RF conditioning have to do less than two months. It will be short time for the RF conditioning. For the efficient conditioning, so we designed the automatic RF conditioning system using the VME computers.

In this paper, the system and the result of RF conditioning are described.

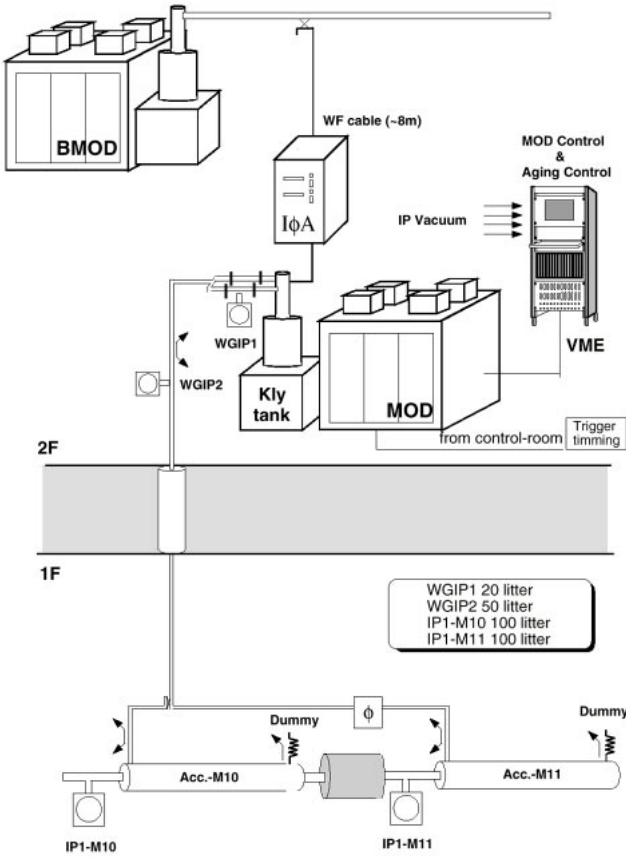

Fig. 1: Outline of Automatic RF Conditioning system

2. Guideline of RF Conditioning

We choose 80MW klystron (Toshiba E3712, 2856MHZ) RF system which is the largest average RF power in the world. The number of E3712 are 13, and we usually drive one about ~60MW, ~4 micro sec, ~60pps. We must achieve near this power until the beam commissioning , however, the staff of the Linac have very few. We thought it will be short time for it. For these problems, we design the Computer Aided Operation (CAO) for the RF conditioning system which have no holiday.

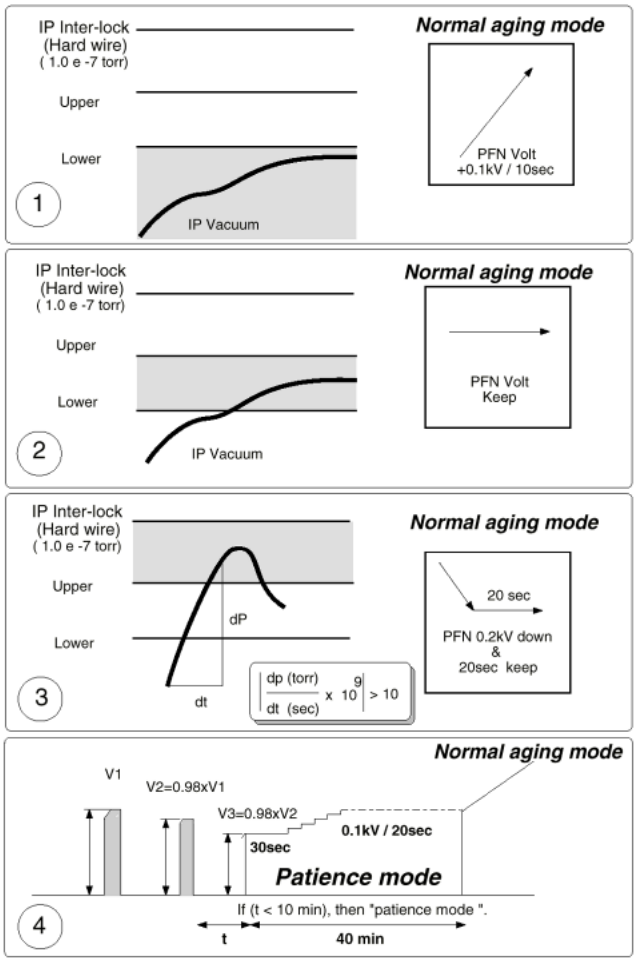

Fig. 2 The Conditioning sequence for the system

3. Construction of Software

We divided the RF conditioning into some operation sequences based on an expert LlNAC operator [2]. He has operated some LINAC for about

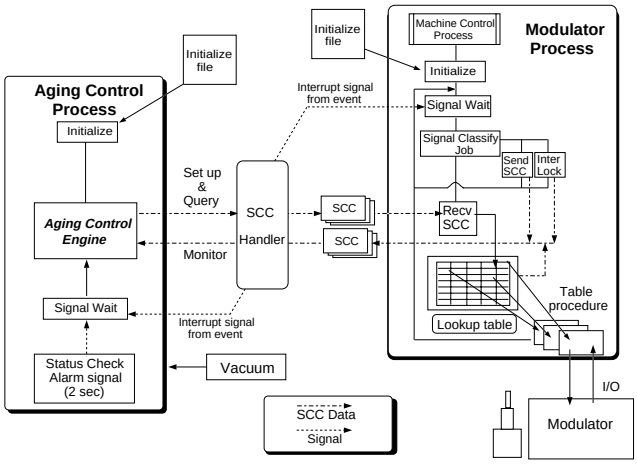

Fig. 3 Construction of Software

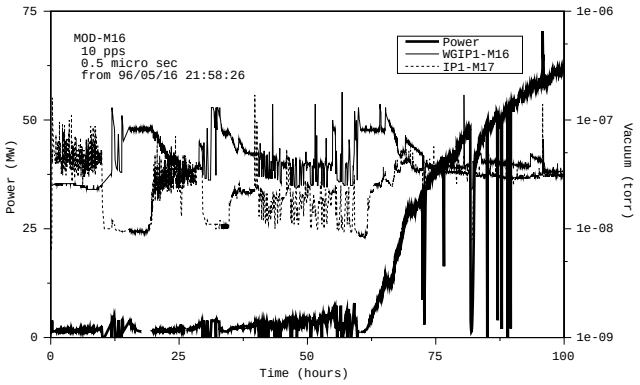

Fig. 4: Progress of the RF conditioning using the automatic system

35 years. He have four sequence, like figure 2, and we inserted this into the automatic RF conditioning process (figure 3). This process follows on our control concept [3], so it constructs that, Spring-8 linac Control Command (SCC), Spring-8 linac Control Datagram (SCD), Machine Class Object (Modulator Process), and Communication process (SCC Handler) which behavior like a midleware.

At first, this process was going to insert Artificial Intelligence (AI) type sequence [4]. But we inserted like a PID control sequence into one, because of little experience of AI control.

4. Results of Conditioning System

The automatic RF conditioning system is very stable and good job, so that it finished 400~550hours. Figure 4 shows a progress of the RF conditioning. When RF power is low-level, the RF window have many out-gas mechanism, so it had operated more carefully and wasted long time. Figure 5 is the spectrum of RF conditioning. The horizontal axis means input power of the system, and the vertical axis means the vacuum value of input power. As stated above, low-level input power (~5MeW) cause the electronic discharge on the RF window. The spectrum shows bad vacuum value on it)s levels. After this levels, the system is very stable, and input power is getting high.

5. Conclusion

We get high efficient RF conditioning, and some conditioning data was measured using this system. This system is not based on AI control that is Fuzzy, Neuro-net and Genetic etc. But it takes us many knowledge for AI control design. If these AI operation will insert, into the operation sequence, as our control system have good reproduction, so that it

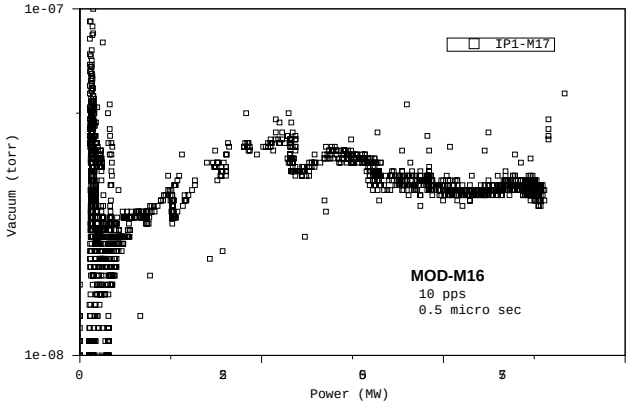

Fig. 5 Spectrum of the RF conditioning

will be impossible to get some new scientific data.

References

[1] K.Satoh et al., Proc. of THE 20TH LINEAR ACCELERATOR MEETING IN JAPAN, 263-265 (1995), in Japanese.

[2] H.Sakaki et al., Proc. of THE 21TH LINEAR ACCELERATOR MEETING IN JAPAN, 50-52 (1996), in Japanese.

[3] H.Sakaki et al., Proc. of PAC'95, p2208-2210 (1996).

[4] H.Sakaki et al., Proc. of ICALEPCS'95, p726-732 (1997).

[5] H.Sakaki et al., Proc. of IWCSMSA96, in Tsukuba in Japan (1996).