Chapter 9. Schedule and Commissioning Strategy

9.1 Schedule

Construction schedule is shown in fig. 9.1. Three accelerators (Linac, 3-GeV RCS and 50-GeV MR) are expected to accelerate beams by the end of March 2007 and research facilities will be ready to accept beams by that time. Important dates for each accelerator are as follows.

a. Linac

Completion of building: Feb. 2005
Completion of linac installation: March 2006
Start of commissioning: March 2006
Start of injection to 3-GeV RCS: Sep. 2006
The 60-MeV linac will be relocated from KEK to JAERI during 2005.

b. 3-GeV RCS

Completion of building: June 2005
Completion of RCS installation: Sep. 2006
Start of commissioning: Sep. 2006
Start of injection to the 50-GeV MR: Feb. 2007

c. 50-GeV MR

Completion of building: March 2006
Completion of MR installation: March 2007
Start of commissioning: March 2007

This schedule is tentative. When budget profile changes, then the construction schedule will be rearranged accordingly.

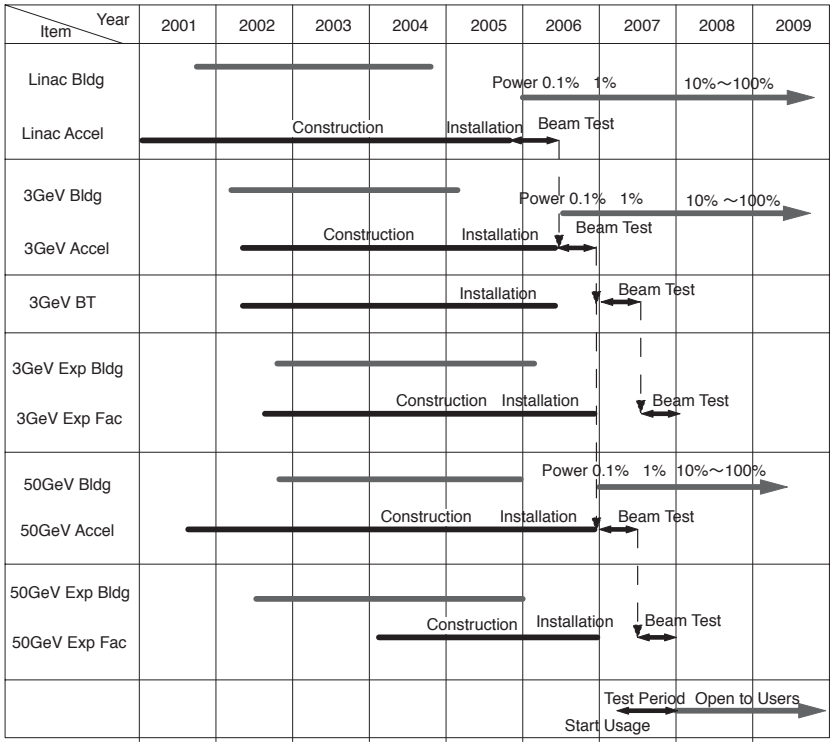

Figure 9.1: Construction schedule of the facility (fiscal year: April to March)

9.2 Commissioning strategy

Some members for beam commissioning are still working in an accelerator design group as key persons. After completion of the design of accelerators, a commissioning team will be reorganized. Details of beam commissioning will be discussed in the new commissioning group. We have six meetings since the first meeting on 11th October 2001 and have discussed requirement on beam parameters for commissioning. Furthermore, present commissioning group has responsibility of examining if there are some remaining matters toward commissioning. Design study concerning a timing system and a machine protection system are still insufficient. Both are very important and are being discussed in the group. Short comments on these two jobs are also described.

9.2.1 Beam parameters for commissioning

Followings are requirements concerning beam parameters. These requirements must be included in the design of the linac. In this facility, only a neutron target is capable of accepting 1 MW full beam power from the 3-GeV RCS. Capacity of the beam dump for each accelerator, which limits maximum beam power during beam commissioning, is 0.6 kW for the linac, 4 kW for the 3-GeV RCS and 4 kW and 10 kW for the 50-GeV MR. Time profile of beam is schematically shown in fig. 9.2. Beam current, width of intermediate pulse, width of macro-pulse and repetition rate are adjustable beam parameters. These parameters are combined to investigate machine performance, while keeping the limit of output power. In initial stage, very short macro pulse will be mainly used. Thus, selection of beam parameters depends on what are tested. Requirements on these parameters are summarized as follows.

a. Peak current: 5mA-50mA

Very low current is demanded especially at the start of 3-GeV RCS commissioning. All beams injected into the 3-GeV RCS will be lost inside the RCS at the very beginning of the commissioning. However, it is difficult to produce stable low-peak-current beams with the ion source, which is optimized to provide as intense beams as possible. It seems feasible to lower the peak current to 5mA, which is one tenth of the design peak current. We need to reduce duty factor to realize further reduction of the average beam current.

b. Width of intermediate-pulse: a few hundreds nanoseconds to about 440 ns

Timing of intermediate pulse is synchronized with the RF of 3-GeV RCS. Pulse width of intermediate pulse should be adjustable from the shortest to full pulse width. Beams with relatively high peak current and with full intermediate pulse width are crucial for commissioning of both linac and two synchrotrons. It is technically possible to produce shorter intermediate-pulses with a few tens nanosecond using the MEBT chopper system, but the time-response of beam monitors limits the usable intermediate-pulse length. We can reduce the intermediate-pulse length by improving the monitor time-response, if necessary.

c. Width of macro pulse: one-intermediate-pulse to about 500 μs

Single bunched beam in the 3-GeV RCS is requested.

d. Repetition rate: snap shot to 25Hz

Snap shot mode is very important in this accelerator facility. Allowable beam power at the beam dump is very small compared with the full output power. One pulse can be shot during several tens seconds.

e. Additional beam mode: sampling intermediate pulse mode

In additional beam mode, intermediate pulses are sampled at every n pulse. Then, time profile of macro pulse is same as full pulse mode and output power is reduced considerably. This mode is demanded to ensure painting scheme. Number n will be from several to several tens and is preset. In addition, more intricate sampling is also required. For example, we need to cope with the situation where we interrupt the injection to MR while continuing the beam supply to the neutron source target.

An RF deflector is used to modulate time profile of beams. To make short pulse, almost all of beams must be dumped in the chopper system at the MEBT. The beam dump must endure very high power. Beam test is planned to confirm endurance of the beam dump.

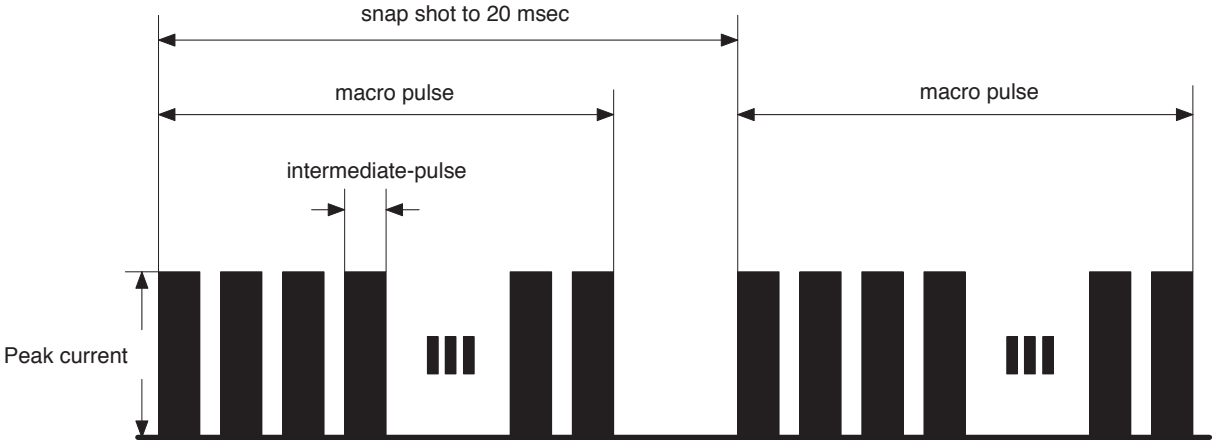

Figure 9.2: Time structure of the linac beam.

9.2.2 Timing System

Designing of the timing system, which is still conceptual, is progressed. Following is proposed.

- The master clock (MC) is 12MHz high stability synthesizer.
- Clocks for the linac (50 Hz), the 3-GeV RCS and the 50-GeV MR are generated by counting down the MC of 12 MHz.
- The neutron choppers are synchronized with the master clock. Allowable time jitter between beams and the rotors is assumed to be about ±300 ns.

Details of the timing system are to be determined. (New group has started and make more detail conceptual design. Results are described in Chapter 6.)

9.2.3 Machine protect/others

A machine protection system (MPS) is now being discussed. We need more discussion to make final scenario. Simple and reliable system is desired for the MPS. Followings are summary of discussions (related matters are included).

a. Beam switching to 50-GeV MR

The operation mode in which beams are switched to the 50-GeV MR, while neutron facility is accessible for maintenance. The switching magnet is pulsed operation. When some failure of the switching magnet occurs, beam must be stopped within one pulse in the front-end. Fast and redundant protection is crucial.

b. Current limit

Operation modes are defined by the location to which beam is delivered. Current limit of each operation mode must be included in some reliable protection system.

c. Fast protection

The fast protection system with response time of 10 μsec is necessary to protect the linac hardware. Detection of the protection signal results in beam cutoff within 10μsec. Inputs of the fast protection system would be bending magnets, quadrupole magnets, microwave modulators, vacuum gate valve etc. Details are to be determined.

d. Others and diagnostics

Run permit, fast protect auto reset and fast protect latched are very important and are being discussed. Details are to be determined.

(Machine protect sub-group has been organized in the integrated control group and is designing the machine protection system).