EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH
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CERN - PS DIVISION

PS/ PA/ Note 94-07 (MD)

PULSING THE PSB RING 3 EXTRACTION KICKER FOR THE "LHC TEST"

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Geneva, Switzerland
16 February, 1994

1. Object of the MD

The aim of the two week long MD in december 1993 was to determine whether the PS chain of accelerators could provide a beam as required by the LHC injection scenario. Our particular contribution to the MD was to eject a 1.4 GeV beam with LHC qualities from PSB ring 3 into the transfer line towards the PS.

2. Hardware set-up

The LHC injection scenario foresees a PSB ejection energy of 1.4 GeV. The actual PSB ejection kickers can only cope with beam up to 1 GeV. The limitations are in the charging power supply, the main switch thyratron, the spark gap and the voltage hold-off capabilities of the magnets themselves; the existing system is schematically shown in Fig. 1.a).

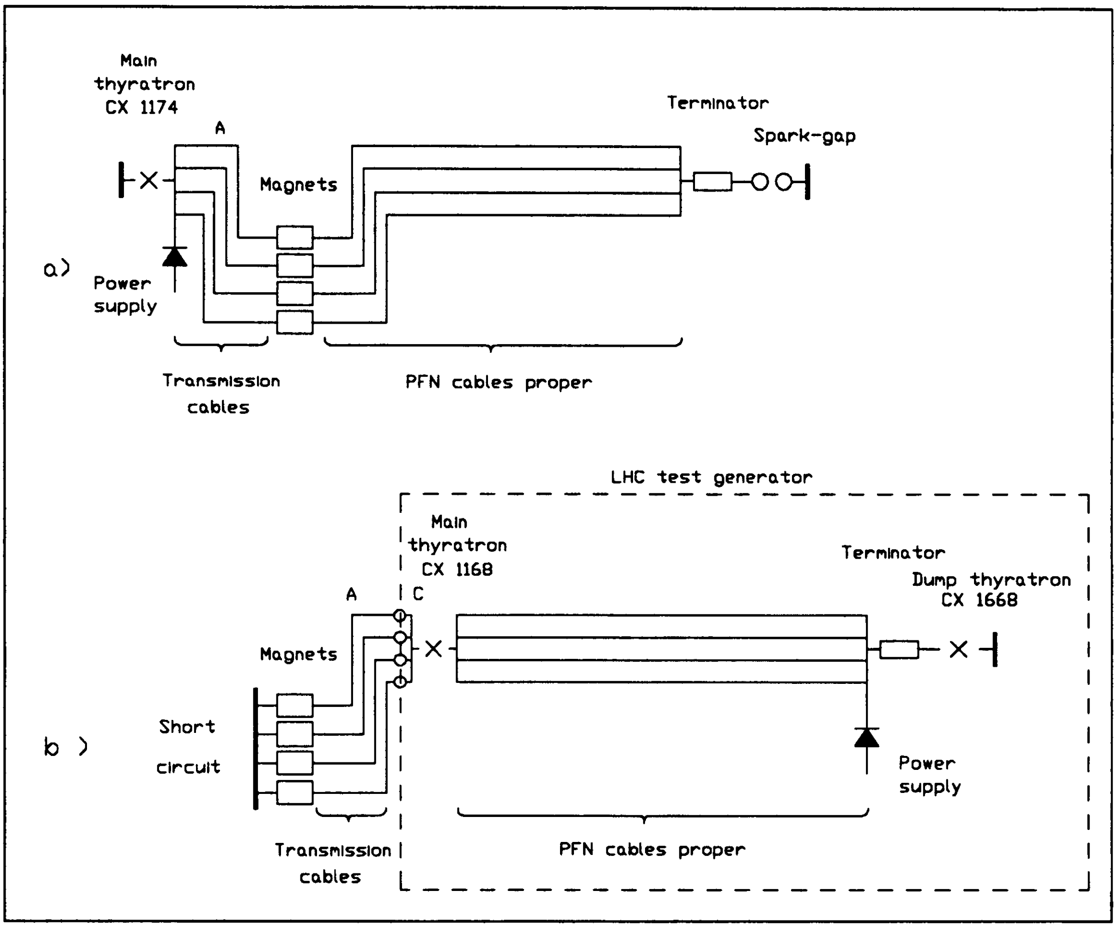

Fig. 1 a) Standard PSB ejection kicker generator schematic

b) LHC test PSB ejection kicker generator schematic

In order to work at 26 % higher than normal operating voltage, the circuit was completely reconfigured to that shown schematically in Fig. 1 b).

Under normal conditions the magnets are slowly charged to the PFN voltage of ~ 36 kV (and thus have to sustain high voltage during several milliseconds) before being rapid discharge pulsed by the main thyratron.

For the LHC test the magnets were not subjected to the PFN charging voltage but pulsed with one half of this voltage (~22.5 kV) and that during only ~500 ns from a dedicated test generator. To obtain the same kick for the same pulse current, the magnet had to be short circuited. The price to pay for this "easier life" was an effective doubling of the kick rise time. In the present case this was not of importance as the ring was only filled with one bunch.

As pulse generator, the laboratory unit previously developed for use as COSY test generator was upgraded to a 50 kV capability with two stage ceramic thyratrons and the system impedance matched to that of the PSB ejection kickers (6.25 Ω). Spare PSB kicker pulse cables (four 25 Ω cables in parallel) were used as PFN's. This stand alone test generator (requiring water cooling) was installed in Bat. 361 BCER and coupled to the kicker magnet transmission cables via connection boxes.
These kicker transmission cables (A in Fig. 1) were connected at the magnet ends in place of the PFN cables, while short circuits took the place of the transmission cables, as depicted in Fig. 1b).

3. Timing and controls

The timing needed for the pulse generator was derived from the normal kicker timing. The fast timing was routed via a delay unit which provided fine manual control for proper synchronisation.

The kicker power controls were stand alone manual and situated in the electronic rack installed next to the pulse generator.

4. Operation conditions

The pulse generator was operated for a total of 48000 pulses, with a PFN voltage of 34.5 kV, for the 1 GeV extraction tests. This voltage corresponded to a kicker current amplitude of 1.4 kA per magnet. The pulse generator was operated for a total of 40000 pulses for the 1.4 GeV extraction tests which were made with a PFN voltage of 44.5 kV, corresponding to a kicker current amplitude of 1.78 kA per magnet. Lack of suitable transducers in the PSB ring 3 magnets precluded taking any meaningful magnet current waveform records. However, test pulsing into a dummy load prior to the MD showed an expected risetime of load current (10 to 90)% of the order of 35ns. The kick rise time itself was estimated to be ~ 90 ns (10 to 90)%. The kick pulse width was set to ~ 400ns.

5. Conclusions

The test generator installed and the ensuing modifications to the system configuration permitted the ejection of a beam from PSB ring 3 with the qualities as required for the LHC test.