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A PROGRAMME OF EJECTION HARDWARE AND OPERATION

This note gives a frame for the operation and development of ejection equipment for the next years. It resumes the outcome of discussions during the first half of this year and will have to be brought up to date from time to time.

Starting from the present situation, which is subject to severe hardware limitations, some planned modifications and acquisitions and some further steps should lead to a system of substantially improved capability, flexibility, and reliability. It is important to realize that good and reliable ejection will become even more than now the backbone of most activities around the P.S. in the forthcoming years.

1. Specifications

Three varieties of ejected beams are provided at the C.P.S.

- fast ejected beams (between one and twenty bunches of the R.F. structure)
- slow ejected beams (continuous beam of up to a few hundred ms duration)
- "fast slow" beams (where the procedure of slow ejection is performed within a few hundred μs).

Broad specifications call for free selection of the number of ejected bunches and for repeated ejection at 100 ms interval*) ("multishot") within the same acceleration cycle in

*) a new proposal would also require repeated ejection at a few ms interval.

the case of fast ejection and for pulse lengths of up to 500 ms for slow ejection. In general, the ejection energy must be adjustable between 10 GeV and the top energy, the spatial jitter of the external beam spot should be of the order of tenths of millimeters, and a versatile programming facility should permit alternating ejection programmes in subsequent machine cycles ("sequencing"). All components must be rated such that the machine cycle be only limited by the P.S. magnet.

Deduction of the detailed specifiactions for the various systems as well as consideration of some particular requirements of ISR operation would lead too far in the present context.

2. Facilities

At present there exist or are planned septum magnets (S.M.) in straight sections 58, 62, 74 and 16 respectively. They shall be used to provide

- fast and fast slow ejection from s.s. 58 (FE 58, FSE 58)
- slow ejection from s.s. 62 (SE 62)
- fast ejection from s.s. 74 (FE 74)
- fast (beginning 1970) and slow (1971) ejection from s.s. 16 (FE 16, SE 16).

The beam is deflected into the gap of one of the septum magnets by combinations of slow dipole magnets and fast kicker magnets (FK) or lenses (septum lenses (SL) and machine multipole lenses) for fast or slow ejection respectively. Of these, only some crucial elements, in most cases hitting the limits of technological feasibility, will be discussed below.

2.1 Components

At the end of the 1968 shut-down will be available:

Kicker magnets

- FK 97 with substantially improved pulse-generator and controls including free selection of ejected bunch numbers and multishot and sequencing facilities.

- FK 66 with full aperture and selection facility only between three and six ejected bunches.

Septum magnets

- Septum magnets in s.s. 58 and 74 with pulse generators provided for fast ejection.
- SM 62 with the Schneider-Westinghouse slow pulse generator (S.P.G. 1) for slow ejection.
- SL 63 with increased septum thickness.

In total, three pulse generators for septum magnets are available for FE, and one for SE.

2.2 Limitations

Ejection schedules will be impaired by the following essential hardware limitations:

- the incompatibility of fast and slow pulsing with the existing septum magnets
- the lack of a separate pulse generator for FSE or of a second S.P.G.
- restriction to approx. 650 ns of the pulse duration on FK 66.

The detailed operating schedules for the coming years which to consider would lead too far in the present context (cp. MPS/Int. DL 68-2) will furthermore be restricted by power limitations on S.P.G. 1, recharging and movement delays on the FK 97, little flexibility in the FK 66 system, and restrictions of the kick strengths of both FK's.

2.3 Reliability

The reliability of operation with the present set of apparatus will be marginal. It will be particularly impaired by having only one SE pulse generator (of low reliability),

by the installation (for the first year of operation) of all auxiliary gear for FK 66 in the PS tunnel and by having only one magnet FK 66 with no spare, and in the case of serious accidents by the lack of spares for the hydraulic pumping station for FK 97 as well as for the H.V. supply for SM 74. Last not least, a septum lens type of proven reliability does not exist. The optics of the slow ejected e5 beam depend however on the operation of the septum lens SL 63.

3. Developments

The following developments to improve the ejection situation are under way or will soon be started:

a) improvement of the existing S.P.G. (Schneider-Westinghouse) (filter, power, interlocks)

b) purchase of a second S.P.G. for 1970

c) purchase of a third S.P.G. after sufficient experience with the first ones has been acquired, for 1972,

d) serious development work on septa (simplified design, compatibility of slow and fast pulsing, thin septa)

e) installation of fast septum magnets for the first stage of ejection 16 and of SE type septum magnets only in 1971

f) installation of a second KM of the FK 97 type in s.s. 5

g) removal of the controls of FK 66 from the P.S. tunnel

h) installation of spares of the hydraulic pump and some auxiliary gear

i) location of all supplies in the ring centre and development of some switching facilities between the various S.P.G.'s

j) a new set of FK's is being planned in connection with the ISR and high intensity operation for 1972

k) septum magnets of larger aperture will be developed in connection with some more sophisticated acceleration schemes for ISR.

In parallel with these developments of hardware, research into the most

efficient mode of slow ejection from the CPS has been started.

4. Schedules

Attached are tentative schedules for ejection operation and for some essential components for the years 1968 till 1972. It is supposed that the P.S. will run for periods of approx. 12 months, with intervals of the order of six weeks normally.

The following remarks apply to the various running periods:

period 68/69 :
- FE 74 is run with FK 66 or FK 97 and SM 74.
- FE 58 is run with FK 66 or FK 97 and with a septum magnet identical to SM 74, pulsed by a Smit pulse generator or the fast (FE 74) pulse generator.
- SE 62 is run with a septum lens (SL 63) and a SM of twice two turns, and with the pulse generator SPG 1 (still to be tested).
- For FSE 58 the fast SM in s.s. 58 will be exchanged against a magnet identical to the previous SM 62 for a limited period and supplied by the pulse generator SPG 1. The change will be done by mechanics from TC division, once or twice per year.

period 69/70 :
- The ISR tests will use FK 97 and a FE septum magnet similar to the s.s. 1 and 74 type (to be made).
- The new slow pulse generator (S.P.G. 2) will be used to alleviate the East Area situation such that FSE 58 can be provided more easily and SPG2 can be used as a spare for SPG 1 (rather than using it for FE 16).
- A second KM of the FK 97 type will be installed in the PS (e.g. s.s. 5).

period 70/71 :
- Continued as in the second half of the previous period. At a certain moment, SE tests and SE 16/SE 62 sharing tests for the West Hall operation will have to start, and SE type septum magnets for s.s. 16 will be required. These should then be the final 30 mm gap magnets, pulsed

by SPG 2. FSE could only be provided by alternating the pulse generator SPG 1 between FSE 58 and SE 62, and by alternating SPG 2 between (F+S)E 16 and SE 62.

period 1972 : - Another SPG should come into operation during this period. (F+S)E 16, (F+FS)E 58, SE 62, and FE 74 can then run almost independently, and the supplies of the first three can be each other's spares.

- In this period at the earliest, a new set of FK's could come into operation.

5. Conclusion

The present situation of ejection facilities around the PS is, with some pleasant exceptions, quite unsatisfactory, considering the importance of these facilities in daily operation. Particularly with respect to slow ejection some components listed as available may still fail, thus placing us into a really unfortunate situation. Only sustained effort for several years will bring about a definite improvement.

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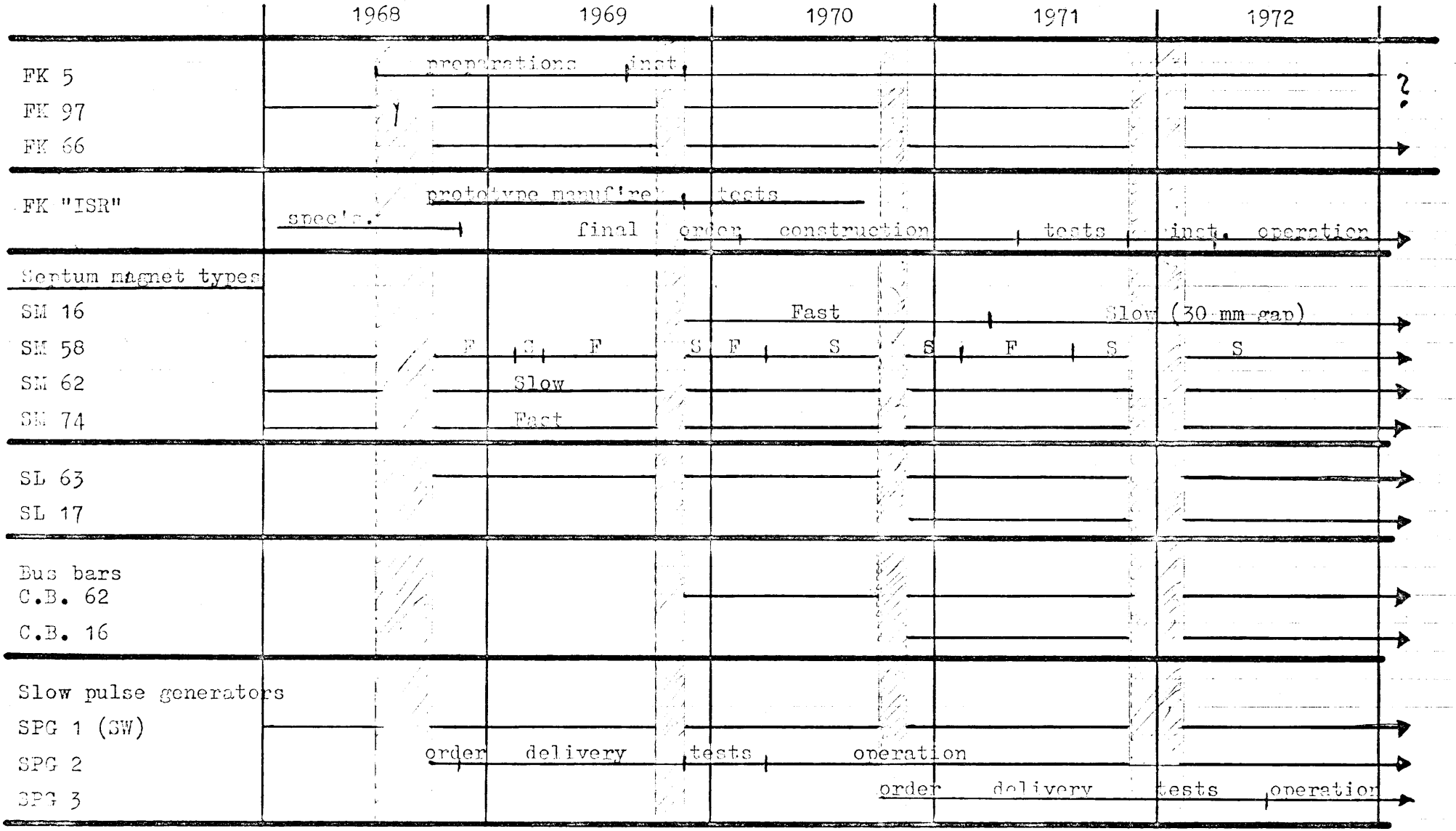
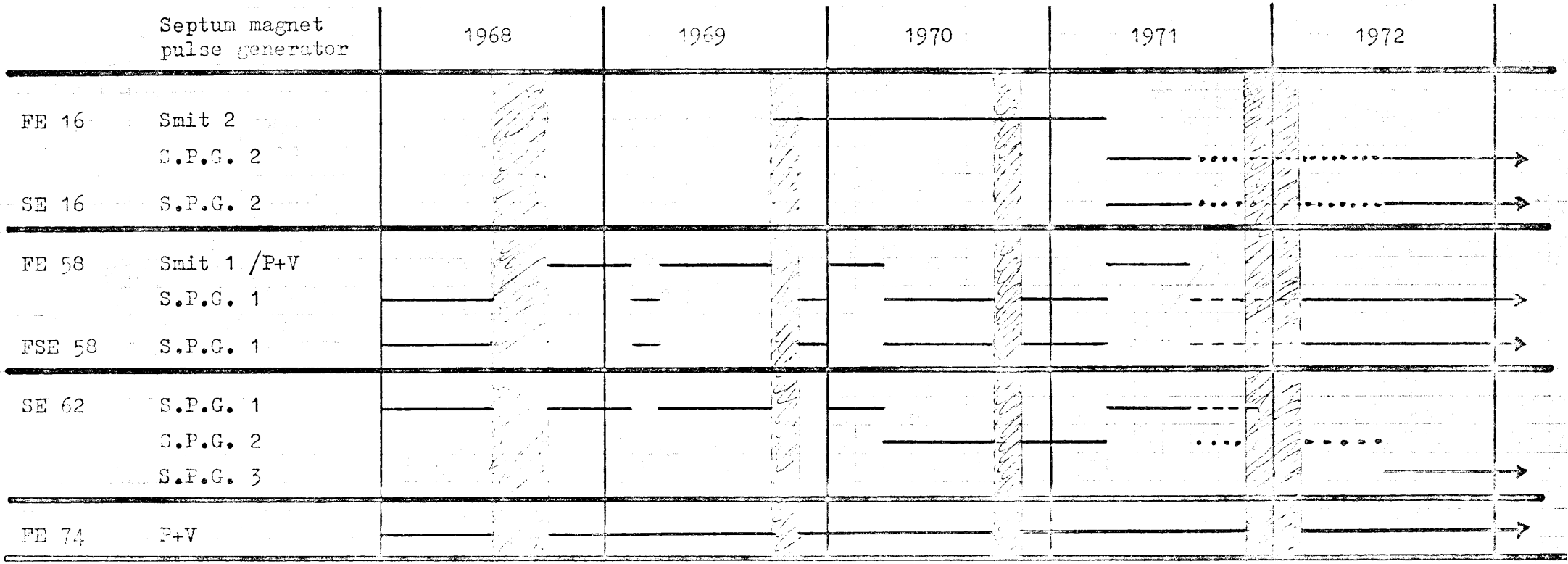
Tentative ejection hardware schedule



Tentative ejection operation schedule



P + V : Charging unit for fast septum magnets. In service since 1963.

Smit 1 : Pulse generators for fast septum magnets. In service since 1967.
Smit 2 : In service since 1968.

SPG 1 : Slow pulse generator for slow ejection septum magnets (Schneider-Westinghouse). In service since 1966.

SPG 2 : Slow pulse generators. Under design.
SPG 3 : Proposed.