MPS for a multipurpose, pulsed high intensity accelerator

Group 7

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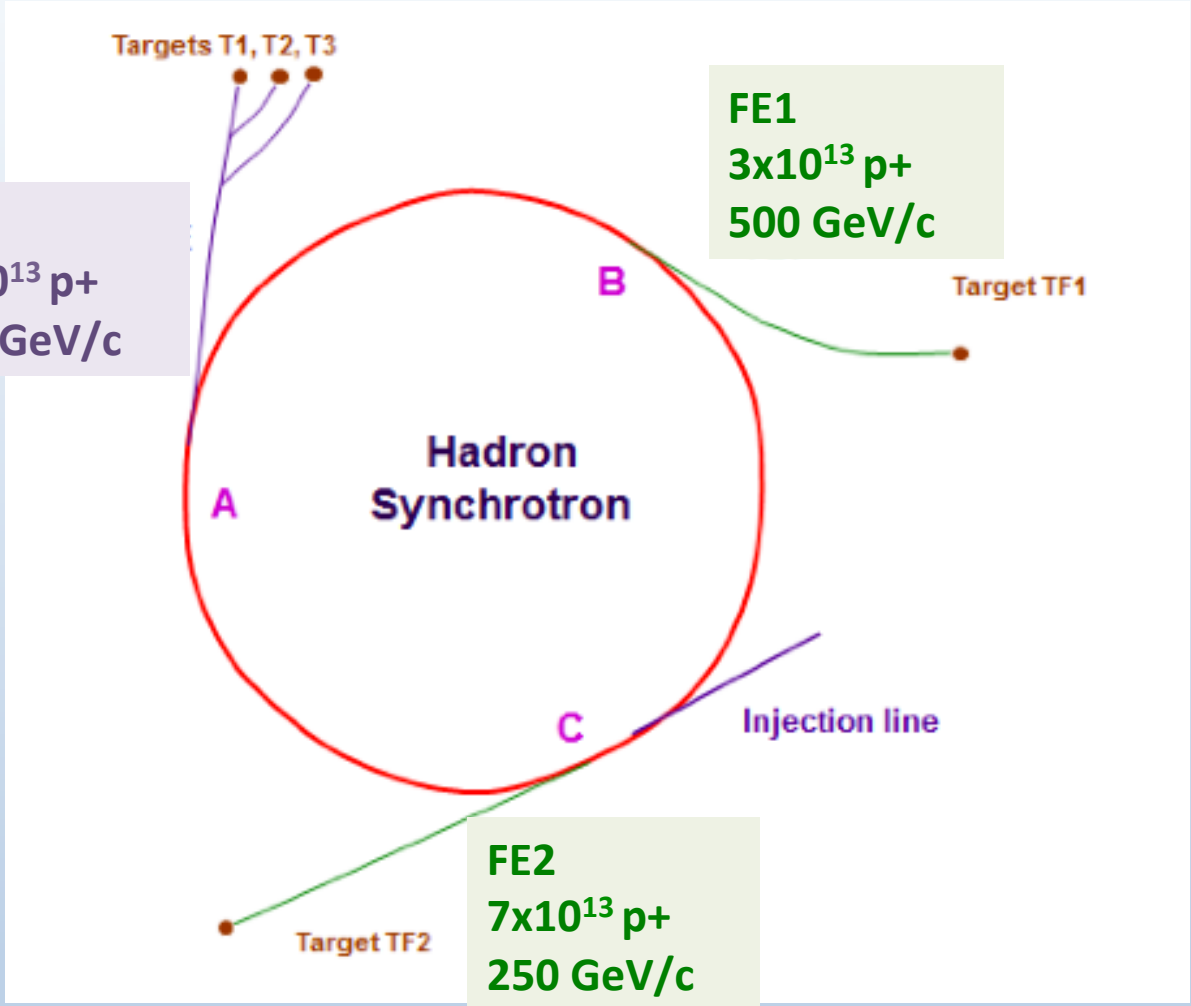


Design a MPS to protect the extractions of this accelerator (active and passive protection). Requirements of the system?

Additional constraints:

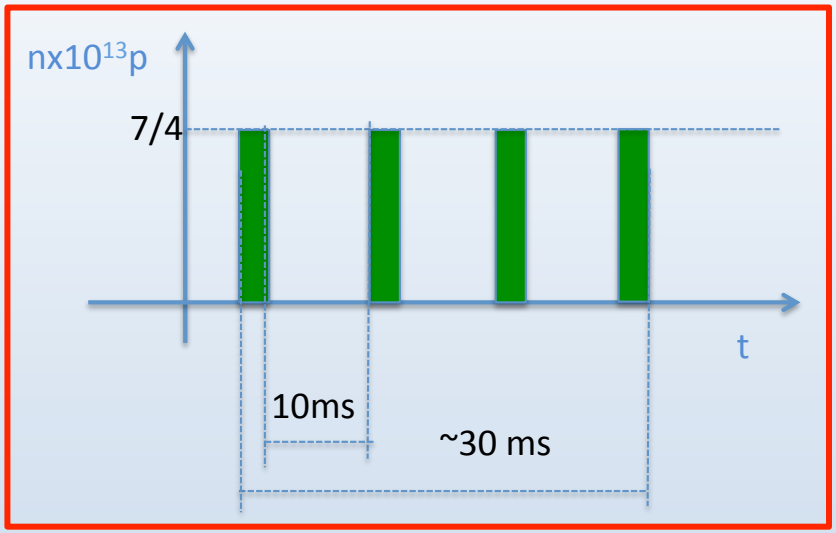
1. Make sure that the beams cannot be sent to the wrong destination

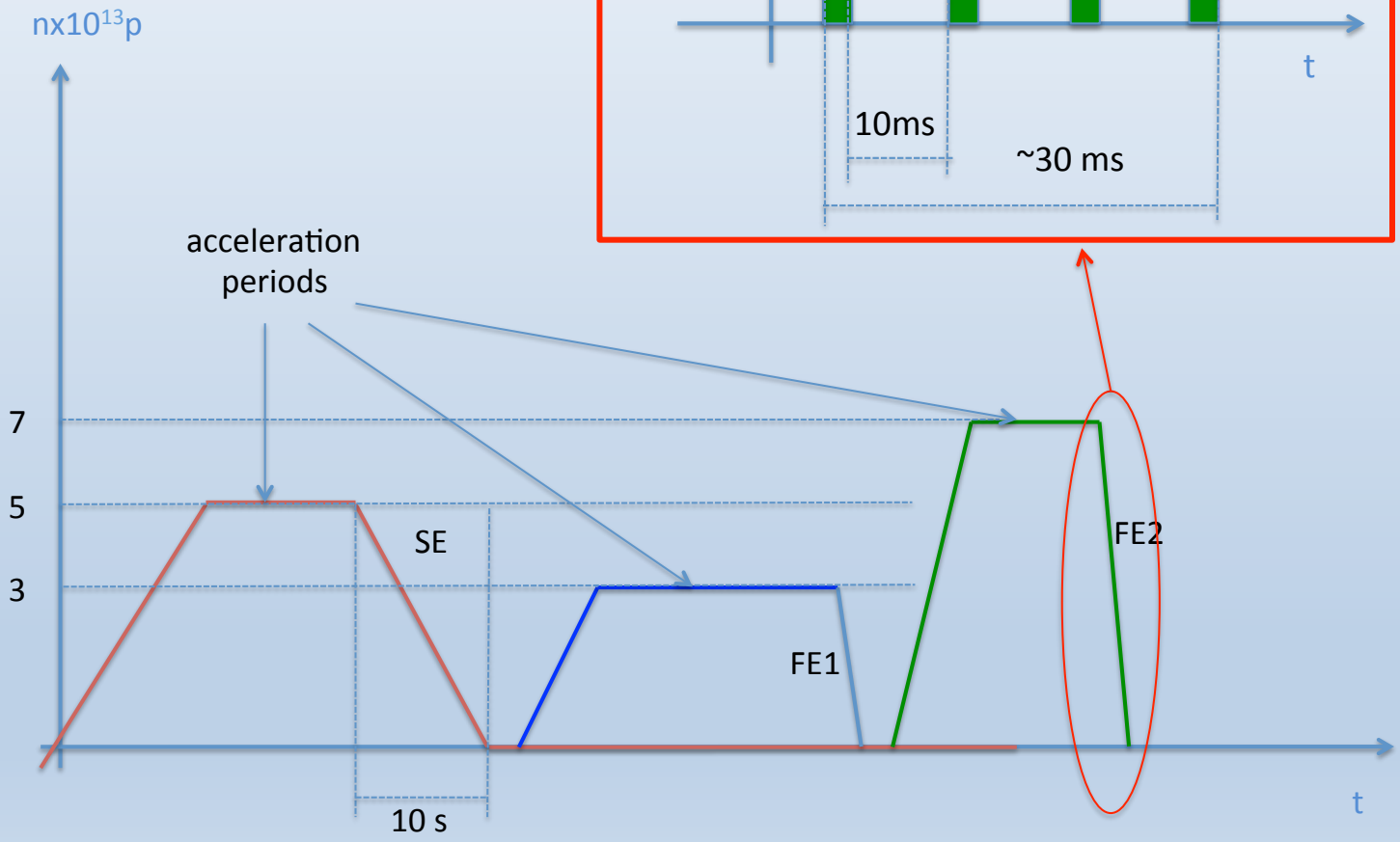
2. Consider the commissioning phase

CASE STUDY DESCRIPTION (1/2)

3 Different Extraction:

SE – slow extraction (10 s)
FE1 – fast extraction in one shot
FE2 – fast extraction in four shots





CASE STUDY DESCRIPTION (2/2)

CHARACTERISTIC OF THE BEAM

	Ep [eV]	Np	E [J]	T [s]	P [W]
SE	3.00E+11	5.00E+13	2.40E+06	1.00E+01	2.40E+05
FE1	5.00E+11	3.00E+13	2.40E+06	-	-
FE2	2.50E+11	7.00E+13	2.80E+06	3.00E-02	9.33E+07

Slow Extraction

– N= 5×10^{13}p ; E=300 GeV; E beam = 2.4 MJ

Fast Extractions

– N= 3&7×10^{13}p; E=500&250 GeV; E beam = 2.4&2.8 MJ

IS ACTIVE PROTECTION REQUIRED?

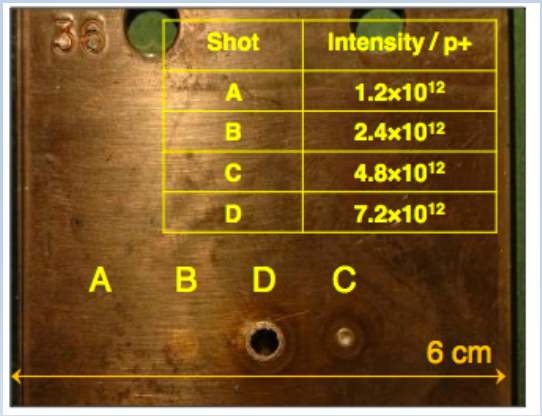
: YES

3 LINES, SINCE THE ENERGY OF
M COULD CAUSE DAMAGE TO THE
RACTION EQUIPMENT.

otons.

mm², 10¹² p.

Damage onset is ~200 kJ



MPS REQUIREMENTS:

- To protect the extraction lines & the machine beam elements from failure of the extraction magnets (i.e. septum (SE) and kicker (FE)).

- To protect the possible delicate targets.

- To avoid the mixing of the beams

  → i.e. right beam on the right target.

MPS PASSIVE PROTECTION DESIGN

- The MPS for the extraction lines & the machine should include at least:
  - Beam intercepting absorbers to catch the particles kicked incorrectly because of the extraction magnets failure (e.g. kicker not fired or asynchronously fired or power converter failure)
  - In the case of the extraction also absorbers to protect the septum itself.

- The MPS for the machine should include dump elements.

MPS Active Protection DESIGN

- The MPS for the extraction lines should include at least:
  - Beam Loss Monitors (BLM)
  - Beam Current Monitors (BCM)
  - Beam Energy tracking system
  - MPS Controller
  - Timing Signal (Post Mortem)
  - Target Readiness Signal
  - Diluter Magnets (optional)

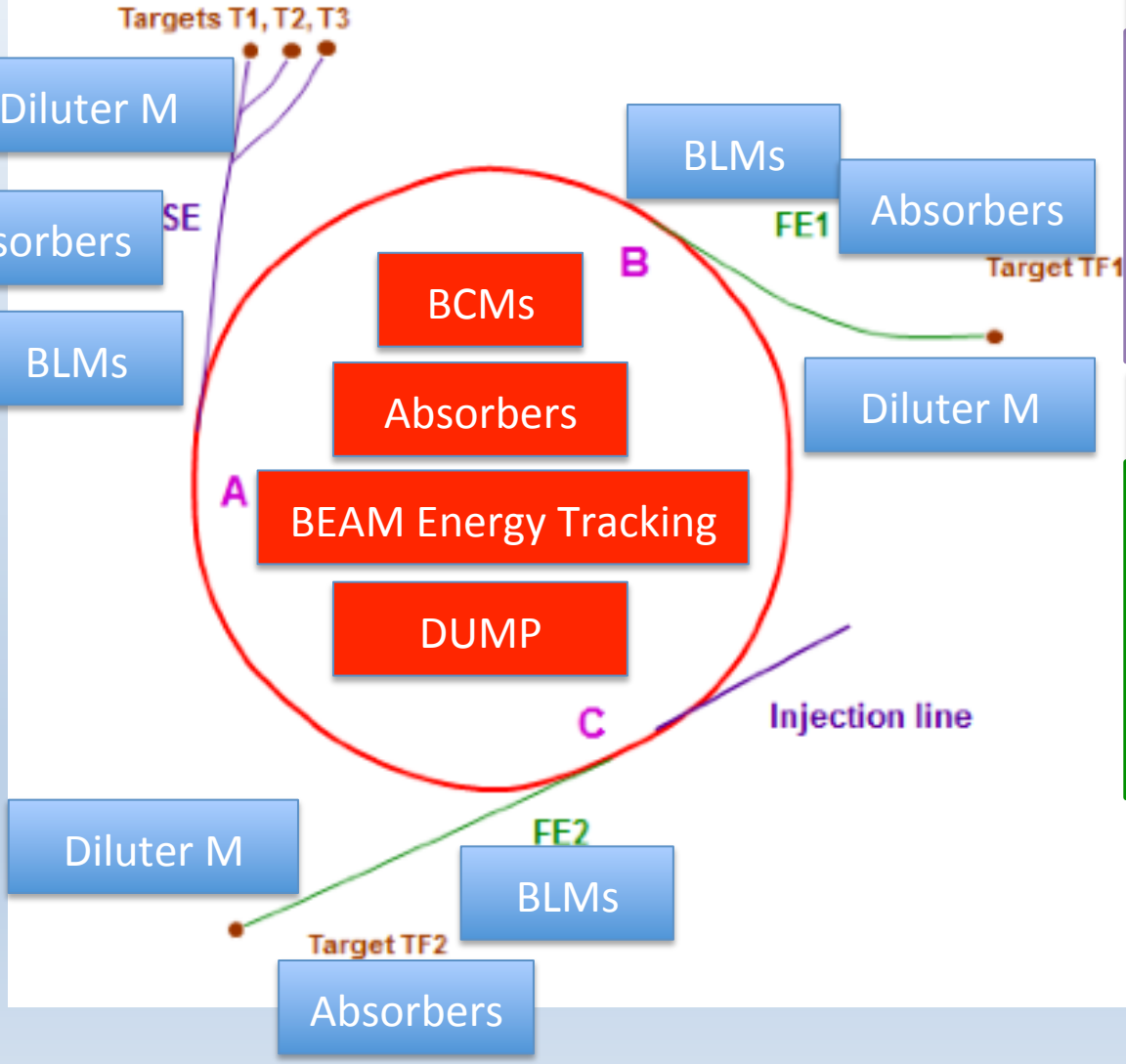
- The MPS for the machine should interface with the dump control system.

Extraction Permit (Active Protection)

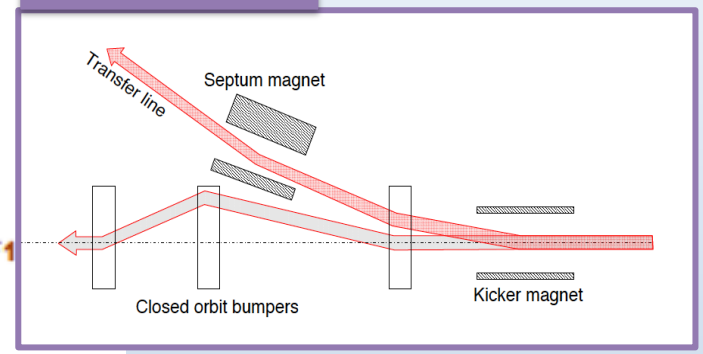
→ i.e. right beam on the right target.

- Extraction permits for each line depend on
  - Powering of the kicker/septum magnets
  - Target readiness signal
  - Beam Current Measurement
  - Energy of the beam derived from the main bending current

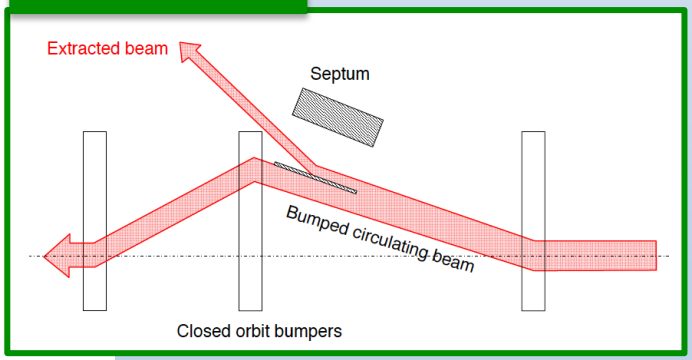
WHERE?



Fast

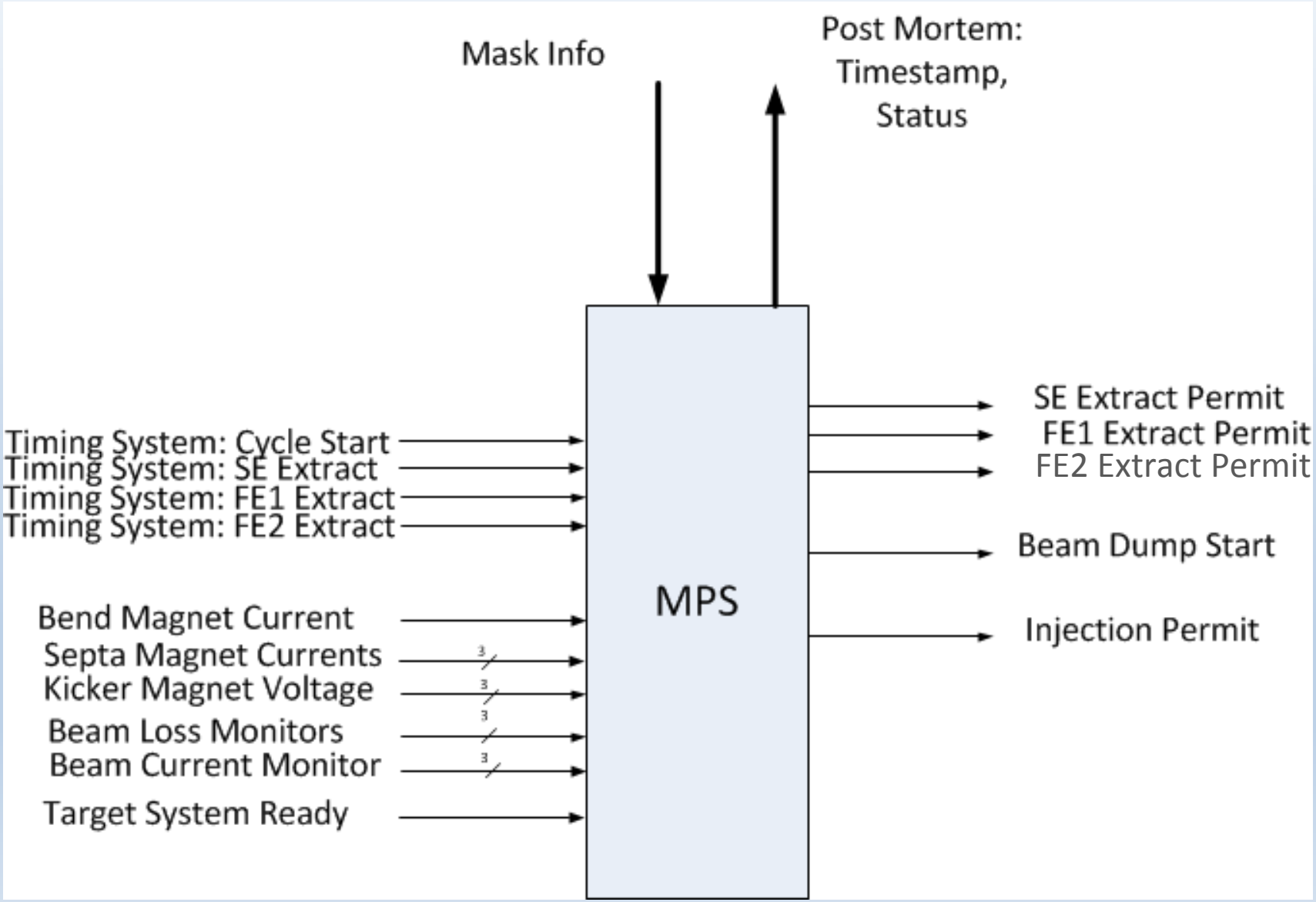


Slow



NB: Optional BCMs and BPMs in the extraction lines, BLMs in the main ring.

MPS CONTROLLER DIAGRAM



COMMISSIONING STRATEGY (ONLY OF EXTRACTION EQUIPMENT)

- Individual system tests of the extraction equipment & controls
- Powering & Beam Interlocks dry run
- Pilot beam to check the optics & trajectory (with BPMs)
- Instrumentation calibrations for the extraction lines with reduced beam power in accordance with the diagnostic specifications.
- Reduced power extraction checks, including asynchronous dump loss map validation.
- Full beam final check.

CONCLUSIONS

- A basic MPS for our case study was presented.
- The idea was to highlight the MPS main components that have TO BE PRESENT to allow the protection of the extraction lines.
- The major aspects for the commissioning of this MPS have been outline.

SPS

CASE STUDY DESCRIPTION