CERN
CH-1211 Geneva 23
Switzerland

EDMS NO.	REV.	VALIDITY
1585135	0.2	DRAFT

REFERENCE
PS-LJ-EC-0003

Date: 2016-03-14

SPACE RESERVATION REQUEST

New PS Ring Internal Dumps

This document describes the future possible locations for the PS internal dumps, to be installed during the Long Shutdown 2 (LS2).

DOCUMENT PREPARED BY:	DOCUMENT TO BE CHECKED BY:	DOCUMENT TO BE APPROVED BY:
François-Xavier Nuiry EN-STI Giulia Romagnoli EN-STI	J. Borburgh, M. Calviani, J. Coupard, J. Ferreira Somoza, R. Folch, S. Gilardoni, E. Grenier Boley, J. Hansen, J.-M. Lacroix, J. Lendaro, A. Masi, S. Mataguez, Y. Muttoni, F. Roncarolo, R. Steerenberg, M. Tavlet + Members of the LIU-PS WP Holders e-group + Members of the ecr-ps e-group	K. Hanke, G. Rumolo, M. Meddahi, (on behalf of the LIU Project) R. Losito (on behalf of the IEFC)

DOCUMENT SENT FOR INFORMATION TO:

Members of the IEFC

SUMMARY OF THE ACTIONS TO BE UNDERTAKEN:

Reserve space for the installation of two new internal dumps in the PS Ring

Note: When approved, a Space Reservation Request becomes an Space Reservation Decision.

1. EXISTING SITUATION AND INTRODUCTION

Two PS internal dumps are presently installed in the straight sections 47 and 48 (SS47 and SS48) of the PS machine. These two pieces of equipment shall be removed during the long shutdown 2 (LS2) and replaced with two new internal dumps [1].

The two new objects should be built and installed by the EN-STI Group. A new shielding will also be designed for the two new dumps to allow for easier access to the parts to be maintained. At least one, or perhaps two spares should also be built.

Internal dumps are used during PS operation by the machine operators for several reasons. A dump is used automatically as a machine and material safety system and as a protection preventing to extract the beam to TT2 or East Hall, when needed. It is not used for personnel safety purposes. The dumps are used to absorb the proton beam pulses, in case of a dump request, and to prevent the beam extraction towards the East Area in case of East cycles with parasitic n_TOF bunch.

1.1 DUMP OPERATION MODES

Four main operation modes are to be considered for the future PS dumps

Beam Study Mode

This operation mode is used to verify the beam parameters during the commissioning of the new beams, or to help debugging an issue during normal operation. The mode consists of asking the PS dump to dump every time a given cycle is occurring in the super-cycle, while also setting a certain time after which the dump has to dump. The dump can be used in this operation mode for a day or two (commissioning) and then this use is discontinued for several months during normal operation.

Machine Development Mode

This operation mode is used when the beams are developed or when tests and measurements are being made while the beam cannot be extracted. The operator is choosing when the dump has to trigger during the PS cycle.

Machine Protection Mode

This is a safety mode to protect the machine; the dump can be triggered in every moment of the super-cycle. Three possible cases are covered by this operation mode:

- LHC beams dumped at any time when an external signal occurs
- n_TOF beams not extracted going to East Area
- n_TOF protons flux sent to the experiment

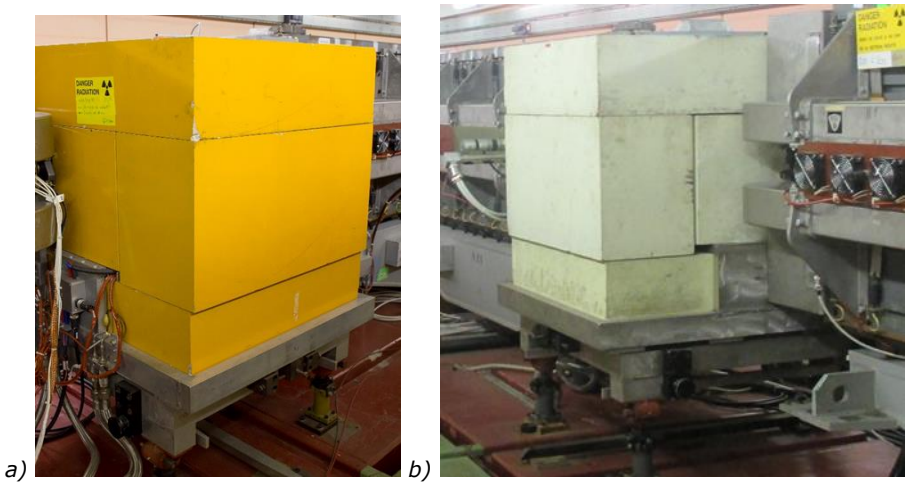
Ralentisseur Mode

The dump used in this operation mode, should replace the Ralentisseur currently installed in SS12 of the PS ring. The ralentisseur is a device in charge of protecting the 3 Secondary Emission Monitor Grids (SEM-Grids) present in the PS in sections 48, 52 and 54. The SEM-grids typically are working in single-passage mode, meaning that the beam has to be dumped after a single passage through the grids to prevent detector damage (burning of the wires).

In order to work as a ralentisseur (with single-turn operation), at least one of the PS internal dumps, should be placed in a position downstream of SS54 and upstream of SS42.

1.2 EXISTING DUMPS

Current internal dumps are installed inside a shielding cover 400mm thick, initially made of painted Vaurion stone and now replaced with concrete or marble (characteristics not well defined). The shielding is 980 mm long along the beam axis, 1586 mm width perpendicular to the beam axis, and 1742 mm high, including the foot (Figure 1.1).



a) *b)*

Figure 1.1: Internal dumps installed in SS47 (a) and SS48 (b) with the dump shielding.

2. REASON FOR THE CHANGE

There is a need to replace the current dumps because it has been shown that they would not be able to withstand Run 3 beam parameters [2]. Several consecutive cycles made of higher intensity (up to 5×10^{13} protons) and high energy (up to 26 GeV) are expected to be dumped in the future. In addition, present dumps are old devices (designed in 1973), requiring an occasional but complex maintenance (difficult to access, behind the shielding), and with a cooling system efficiency difficult to assess.

If the space reservation request is not approved, the installation of the new internal dumps will be impossible, except if two other spaces are founded, with the same dimensions as the present slots (SS47 and SS48).

3. DETAILED DESCRIPTION OF POSSIBLE LOCATIONS

In principle, the following straight sections are all possible locations for the new internal dumps: SS47, SS48, SS75 and SS31 (if the extraction Septum SEH31 in SS31 is obsolete and can be removed).

The characteristics of each SS are described in Table 1.

It is proposed to finalize the decision of the two final locations when the mechanism and the shielding design will be completed. An ECR will be prepared to fully detail this.

Table 1: Characteristics of the possible dump positions in PS.

SS75	SS47
– Free space (wire scanner now not in use) – No rotation table – Section length: 0.95 m – SS75 is the place for the loss point if KFA71 is used to dump the beam when using the SEM-grid in multi-turn mode – NO MAIN dump: for close location to LHC RF cavities and emergency door EAST hall – Position compatible with ralentisseur mode	– Current dump position – Rotation table present – Section length: 0.95 m – Insulation of PS tunnel OK – Position NOT compatible with ralentisseur mode
SS31	**SS48**
– Available SS if Extraction septum (SEH31) removal will be validated – No rotation table – Section length: **2.4 m** – NO MAIN dump for tunnel radiation protection problems? (RP analysis needed to check the tunnel roof shielding) – Position compatible with ralentisseur mode – Possibly in competition with RF request	– Current dump position – Rotation table present – Section length: 0.95 m – Insulation of PS tunnel OK – Position NOT compatible with ralentisseur mode – SEM-grids detector – SS48 is the closest point (would be SS49) for the loss point if KFA45 is used to dump the beam when using the SEM-grid in multi-turn mode

In SS47 and SS48 spaces, both current dumps shall be removed during LS2 and they could both be selected for the installation of the new internal dumps together with the straight sections SS75 and SS31.

SS31 can be considered available only if the decision of removing the extraction septum is taken[1]. Reservation for SS31 should also be reconsidered if more RF voltage will be required from the main acceleration system for faster acceleration (not within LIU). From the design point of view SS31 would be the best one, since it is the longer one allowing more freedom in the equipment design, an easiest shielding integration and an expected better local shielding efficiency. Installing one of the PS dumps in SS31 requires additional radiation protection work in order to check if the radiation level escaping the dump towards the tunnel top (sky-shine effect already observed at 14 GeV/c during the extraction process) is acceptable. In SS47 and SS48 it is already known that no similar radiation protection risks are present.

[1] The performance of the MTE with the LIU upgrades can only be validated with beam after LS2, therefore it seems extremely unlikely that the septum 31 will be decommissioned until sometime during Run 3, even if MTE becomes the default for FT SPS operation - and in addition, other uses or operational modes for this septum may well justify keeping it in the ring, in addition to its role as a backup for MTE.

Reservation for SS75 should be reconsidered in the unlikely case of a third 40 MHz cavity in the PS ring. Furthermore, to be more complete, SS75 cannot be the main dump site because of the presence in the close location of the LHC-beam RF cavities and the emergency door of the EAST hall, both requiring low radiation levels. In addition the increased radiation due to an internal dump in SS75 to existing 40 MHz cavities in SS77/78 and RF electronics in the annex to be cross-checked carefully.

As already mentioned in 1.1, the SS48 and SS47 are not suitable positions for a dump working in ralentisseur mode with the SEM-grid working in single-passage mode. Seen the functional specification of the device to work as a dump and as a ralentisseur, not both positions SS47 and SS48 will be chosen for the future location but just one of the two.

A simplified scheme of the PS ring is available in

Figure 3.1 with the possible installation positions for the PS dumps (in red) and other relevant positions for this project (in black).

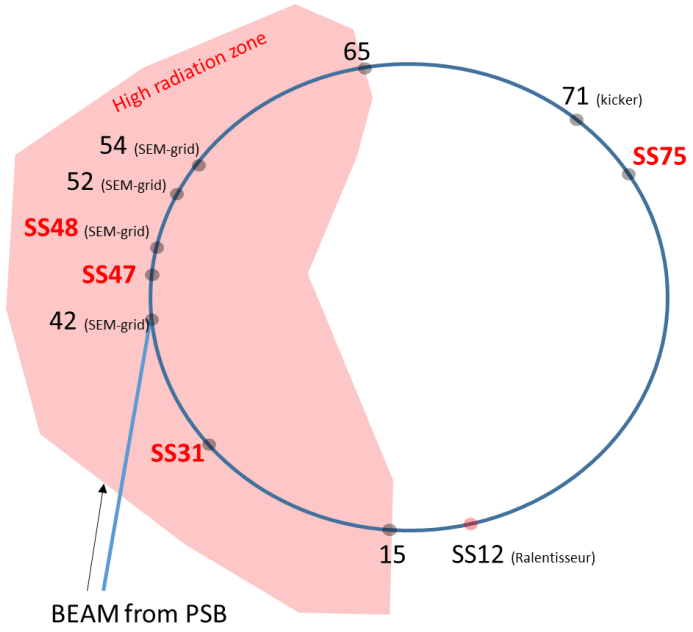


Figure 3.1: PS radiation zones and future dumps possible locations[2].

Pictures of the four possible locations are shown below. Further views can be seen inside the Layout Database, under the PS Machine here.

Figure 3.2 shows the straight section 75 in the PS machine. The rectangular steel box sitting at the left of the blue table is a wire scanner, currently not in use, measuring the vertical profile of the beam. No rotation table on the floor is present in this location.

[2] See the last PS radiation surveys on the following link for more information about the radiation dose.
https://espace.cern.ch/rpps/public-portal/_layouts/15/start.aspx#/Shared%20Documents/PS_Ring

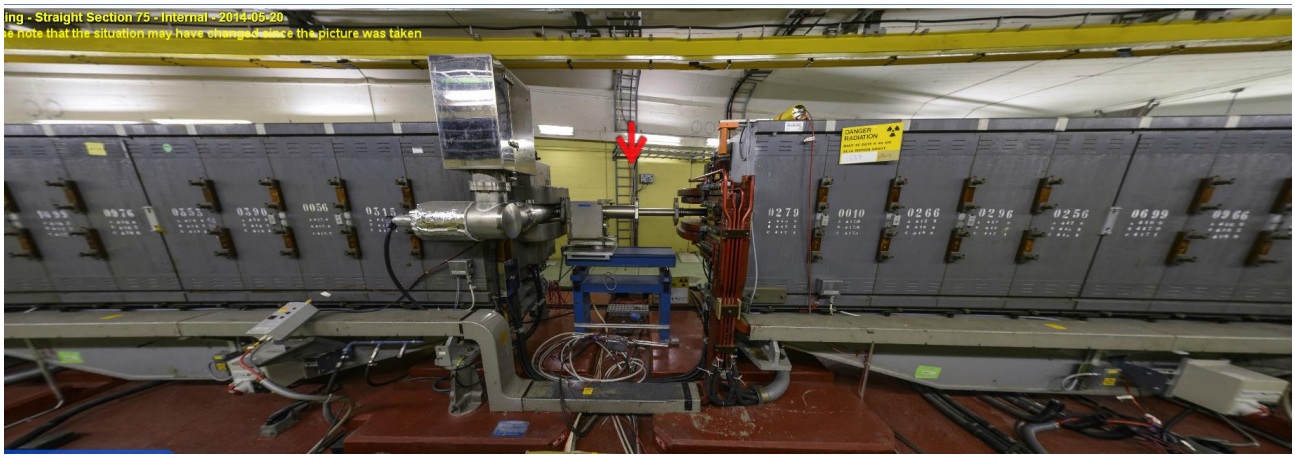


Figure 3.2: Straight section 75 overview.

Figure 3.3 shows the straight section 31. No rotation table on the floor is present in this location. The red arrow is pointing on the extraction septum (SEH31).

Figure 3.3: Straight section 31 overview.

In straight section 47 (*Figure 3.4*), there is one of the pick-ups of the orbit measurement system (CODD) between the pole pieces of the bending magnet.

Figure 3.4: Straight section 47 overview.

An internal beam dump is present in straight section 48 (*Figure 3.5*), covered with concrete shielding blocks. At its left, the actuator of a SEM grid sticks out between the bending magnet's pole pieces.

Figure 3.5: Straight section 48 overview.

4. IMPACT ON OTHER ITEMS

As explained in Table 1, there are four possible slots for the two future internal dumps.

Impacted items related to the new dumps:

Item/System	Wire scanner and its support in straight section 75.
Layout Drawings:	PS_LM___0160
Layout Database:	Location: PR.SD75 Type ID: 2192074
Integration Models:	-

Item/System	Electrostatic septum SEH31 in straight section 31.
Layout Drawings:	PS_LM___0072 ind B
Layout Database:	PE.SEH31 ID: 2253286
Integration Models:	-

Item/System	PS Internal dump. To be removed during LS2, including the shielding.
Layout Drawings:	PS_LM___0104 ind C
Layout Database:	Name: PR.TDI47 ID : 2254075
Integration Models:	-

Item/System	PS Internal dump. To be removed during LS2, including the shielding.

Layout Drawings:	PS_LM___0106 ind B
Layout Database:	Name: PR.TDI48 ID : 2254092
Integration Models:	-

In all cases, the following items will be impacted:

→ Vacuum chambers and ion pumps in SS47 and SS48 (drawing: MPS.5B11.200.2). If the dump positions will change, the pumps need to be moved or replaced with new ones.

→ Water cooling circuits;

→ Cabling and electronic control system (electronic racks):

Item/System	Electronic control rack A(RA12-K45
Layout Drawings:	-
Layout Database:	Bd: 365/1-404
Integration Models:	-

5. REFERENCES

[1] LHC Injectors Updrage, Technical Design Report http://cds.cern.ch/record/1976692?ln=en

[2] W. Kozlowska, M. Brugger, PS Internal Dump in the Fluka Monte Carlo simulations, Reference, EDMS 1403161 V.1