Summary of MP meeting on Roman Pot operation (02.12.2011)

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Outline

- Short summary of the seven presentations

- List of Actions

- Follow-up

Several **issues** observed **with RPs**:

- **RPs stuck** due to PXI problems.

- **Inconsistencies** between motor positions and LVDTs.

- **Wrong direction of movement** (towards beam instead away).

- Issues with **position RESET** procedure.

- RPs **outside the shadow** of TCTs.

- Issue on **6/11/2011**.

The **high luminosity operation of RPs** in physics settings is **not acceptable** under these conditions. We need to take these things as warning and take **measures for improvements** during the Xmas stop.

- **IP 1&5** have been **studied** in detail earlier but **without RPs**.

- RPs will be **treated as collimator**s.

- A **FLUKA RP model (TOTEM)** was built from the production drawings (modular approach: V-H, H-V units, detector).

- **TOTEM RPs integrated** in IR5 LHC FLUKA framework model.

- Additional detectors (BLMs, RadMon, etc.) can be added on request.

- **Missing information**:

  – Prepare **accidental scenarios** with MPP; Define beam **optics cases** (thick lens TWISS, beam offsets); Input **parameters** (optic, physics case, ?).

  – Normalization factors, aperture/positions of the detector.

  – **Detector model**, integration, drawing (help by ALFA, TOTEM for FLUKA model of detector?)

  – **Contact person** for detector.

- Schedule depends on arrival of missing information and the scenarios.

- TOTEM and ALFA **design and position the same** (ALFA only vertical)

- RP are **only moved** from the **CCC**.

- HW switches protect mechanical damage of the pots.

- Pots can be **extracted by mechanical springs** or via emergency button (only in ALFA and TOTEM control room, not in CCC).

- Position **measurements by resolver** counter (problem in case of moving out by springs, reset needed), **LVDTs** are only used **for interlocks**.

- **Interlocks**: RP position, User Permit, Injection Permit, BLMs

- BIC level interlocks are **not maskable**, Position limits can never be overwritten!

Description of the HW system (M. Deile)
Impacts limiting LHC availability:

- *Stable beams*=0 causes **extraction of pots by springs** even when in HOME (i.e. pot position lost), no masking possible ➔ change to avoid extraction of all pots are in HOME ➔ less recalibrations needed.

- **New inner limit without warning level** (un-necessary dumps, as pots would be extracted when reaching the warning). ➔ add warning level.

- **FESA/PXI crashes or reboots**: no new limits, no interlocks, pots move out

- **PXI crash**: no new limits loadable, no interlock if limits were not violated.

- **Soft reset of PX**I: move out pots, but no dump.

- **Hard reset** of the PXI causes **beam dump.**

Description of the HW system (M. Deile)
Used Solutions when blocking LHC:

- TOTEM: Jumpers to bridge LVDT comparison signals from PXI to interlock card. Afterwards disable all power of RPs.

- ALFA: Key panel instead of jumpers to overwrite the LVDT signals from PXI. Power for the pots needs to be cut.

- **Both solutions should not be used again!**

- **Operation should never encourage the Roman pot teams to go for such bricolage because of efficiency.**

- **TOTEM and ALFA are requested to specify an interlock system that guaranties that this functionality can only be used if the power was cut in all RPs (TOTEM/ALFA) and the out switches of all RPs (TOTEM/ALFA) are active. The details and drawings should then be provided to MPP.**

Software and Controls for RP (S. Ravat)

- **Same FESA class code** and **RBAC map**s in ALFA and TOTEM

- Electrical stoppers used as **mechanical reference** for step counters (repeatability ~10µm). **RESET procedure** initializes the step counters. **Always needed** when pots were extracted by the spring.

- **Update** of RESET procedure to avoid mismatch (LVDT, Resolver) as on 06.11. ➔ improved **state machine** (two new states: un-configured, calibrating)

- **Cross talk** (spikes) between the stopper signals can compromise the RESET procedure. In the past this caused the observation of *non-moving* pots.

- Mitigation: filter or **logically combine stopper & home** switch signals

Operational Procedures (S. Redaelli)

- **RP movement** under control of OP (**CCC**), positions must respect collimation hierarchy.

- RESET of the motor counters is only done in Stable Beams or with overwrite key=true (otherwise RPs cannot move). RESET is done manually.

- RP operational modes:
  - Beam based alignment in dedicated low-intensity.
  - Data taking during high intensity fills.
  - **Special runs** with high intensity fills became *standard* **in 2011**.

- Operational **settings** are **qualified by loss maps**.

- Procedures for high-intensity fills were followed without problems until 6th of November.

Only two incidents during first season of running (for ALFA) in 2011 (PXI reboot, reset during ION loss maps).

Plans for 2012:

- Loss maps, standard optics ~1 bunch (pots @ 7~mm).

- Commissioning data at 25mm during high intensity fills.

- Maybe have to repeat 90m data taking due to background problems.

- Reach coulomb nuclear interference region ➔ go to compatible (highest possible) beta* (with 2011 beam parameters this would mean ~800-900m).

If possible it should be **avoid**ed to perform **beam based alignments**/qualification for commissioning runs at high intensity fills(**RPs ~25mm**).

How to use the Roman Pots in 2012 and beyond (TOTEM, M. Deile)

- Repeat beta* = 90m run.

- Run at high beta* of ~850m.

- Running at standard fills in *Stable Beams* at low beta*. More conservative settings have to be explored for the horizontal pots couldn't be put the 18 sigma, as the loss level was too high. Running with the vertical pots at 14 sigma worked well.

- Intensify the collaboration with CMS for the high intensity fills.

- **No end of Roman Pot operation** in the foreseeable future, i.e. it is worth to **improve the systems** for the long term.

List of Actions - 1

- Provide missing information to FLUKA team (TOTEM, ALFA).

- Provide contact people for FLUKA (TOTEM, ALFA, MPP, Collimation).

- Define accident scenarios (MPP, Collimation, LBDS, TOTEM, ALFA).

- Update the switch positions in the DB to make sure that the *out switch button* in the application works (S. Redaelli).

- **Jumper/key panel** (TOTEM/ALFA) to bridge LVDT comparison signals from PXI to interlock card should not be used again in their current status.

- TOTEM and ALFA are requested to **specify an interlock system** that guaranties that this functionality can only be used if the power was cut in all RPs (TOTEM/ALFA) **and** the out switches of all RPs (TOTEM/ALFA) are active.

- TOTEM/ALFA will propose/specify a procedure to safely **allow the reboot** of the PXI **without** causing a **beam dump**.

List of Actions - 2

- Allocate time for the **RP**s during the **commissioning** after the Christmas stop. Note: All interlocks, the modified state machines, etc. need to be fully re-commissioned before RP can be allowed in 2012.

- Discuss possibilities to ensure that the **correct position interlocks** are loaded for the RPs **for different operation modes**. This is especially relevant, when the modes are switched, e.g. from special RP fills to high intensity fills. Would it be possible to implement a **software check** of the redundant inner position limit? (MPP, OP, Collimation).

- **Implement and commission** the modification of the **state machine** for 2012 start-up (ALFA/TOTEM).

- **Implement and commission** the mitigation for the **cross-talk** between stopper signals for 2012 (ALFA/TOTEM).

Follow-up - 1

- ALFA (P. Fassnacht): **CATIA drawings** of the ALFA Roman Pots: https://cbault.web.cern.ch/cbault/alfa/CAD000041862.zip. Should this not be adaptable to FLUKA, **Tom Sykora**, coordinator of the ALFA Soft/Sim activities, can be contacted. He will help to get the right description of the detector.

- Milestones for the non-controversial improvements of the ALFA/TOTEM systems (email from M. Deile):

  - 20.01.:

    - **Completion of the movement system upgrade in the lab** (modified FSM, improved reset procedure).

    - Completion of Ben's and Federico's work on the **RBAC table**s in FESA.

    - Completion of the implementation of the **new interlock logic** in the spare interlock box (which will be the production system); the implementation of the logic in the presently installed interlock box (which will become spare) has more time.

Follow-up - 2

- 03.02.: **New movement system ready** and tested in the LHC.

- 10.02.:

  - Completion of **calibration curves** LVDT vs. motor steps.

  - Start of **interlock tests** (to be coordinated with machine).

- In parallel in January: make **test movements** of all vertical pots **to verify** the minimum inter-pot distance allowed by the **anti-collision switches** (needs someone in the tunnel to adjust them if necessary).

- Installation of the **spare TOTEM FESA** computer in **IP5**: at any time during TS.

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