SESSION 2: INJECTION, EXTRACTION AND BEAM DUMP

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Abstract

This paper summarises the main conclusions from the second workshop session on Injection, Extraction and Beam Dump.

The four presentations made in session 2 are:

- LBDS kickers (Nicolas Magnin)
- Dump System Protections (Brennan Goddard)
- LHC Injection Systems Modification in Long Shutdown 1 (Wolfgang Bartmann)
- Changes in SPS interlocking (Jorg Wenninger)

MAIN CONCLUSIONS AND DISCUSSION

LHC Beam dumping System

Although all beam dump request were correctly executed during the LHC Run I, and the LBDS showed a good availability, some lessons are to be learned.

Considering the operational statistics, the wearing out of the system is more likely to happen from testing and reliability runs than from normal operation. This will have its effect on dependability numbers and maintenance and one might have to reconsider the justification of all these (test) pulses in local mode.

A study has been launched to assign all system failures to the different failure modes. During operation some failures have been masked while operation continued. Clear expert procedures should be put in place for these circumstances and masking of (redundant) signals should be made more visible so everybody is aware of running in a 'degraded mode'.

Too many false eXternal Post Operational Checks (XPOC) results leading to beam inhibits occurred, generally coming from those modules which can be reset by the operations team. Solutions for overcoming this are being implemented in LS1.

The MKB vacuum interlock due to noisy signals resulted in 13 false dumps in 2011 and 2012. It is not clear if a solution has been found by the vacuum group.

Some serious and unexpected failures of the beam dumping system occurred. As counter measures the powering of the LBDS will be modified, the TSU configuration changed and there will be a direct connection from the BIS to the LBDS re-trigger system. This last change allows for an asynchronous beam dump without the use of the TSU.

The LS1 LBDS commissioning is already starting in 2013. A full system re-commissioning is required. The new BIS – LBDS connection will be tested as part of the reliability run foreseen in 2014. A scan of the MKD waveform with beam and a testing of the direct BLM with beam are foreseen at start-up.

No asynchronous beam dump with a full machine at top energy has yet occurred. With repeated beam dumps at 6.5 TeV beam energy the venting of the TDE dump block, under nitrogen overpressure, could become an issues and should be verified.

The TCDQ absorber will be upgraded in LS1 from 2 to 3 absorber blocks. It is also foreseen that the TCDQ position will be surveyed by the Beam Energy Tracking System (BETS). The BPMS used for the interlocking at point 6 will also be improved in LS1, as improving their availability will also improve the machine safety. The abort gap monitoring will be made more reliable so it can be used automatically for abort gap cleaning and dumping the beam when required.

It was proposed to keep the system tolerances as used by IPOC, XPOC and the BETS 'tight'. This will detect any anomalies as early as possible. Standardisation is required to define when asynchronous beam dump tests should be performed. Also more detailed procedures in case of interventions or non-conformities are required. In this context, the continuation of the rMPP as active 'online' body was strongly supported.

Injection System

The LS1 upgrade of the LHC injection kickers MKI should reduce the temperature increase, due to beam induced heating by a factor 3 – 4 for the same beam currents. This should be sufficient for future operation. NEG coating of the bypass tubes is foreseen to counteract e-cloud effects. Improved cleaning procedures have already proven to be effective against UFOs.

The injection absorber TDI will receive a more rigid beam screen during LS1 and a general revision of its moving parts. This is an intermediate solution before the complete LHC Intensity Upgrade (LIU) compatible change foreseen for LS2. Connection of the TDI gap and the MSI current to a BETS are also under study for LS1.

The settings of the transfer line collimators TCDI will in the future be checked against the applied optics of the transfer line. A solution for correctly measuring the injection losses and not dumping the beams by the BLMs when reaching the measurement range is being studied. A combination of Little Ionisation Chambers (LICs) and temporarily blinding out the BLM interlocks will most likely be used. Improvements of the Injection Quality Check (IQC) are also foreseen. IQC resets should become rare after LS1, and as such will contribute actively to the machine safety.

Changes of the SPS Interlock System

It was pointed out that the Software Interlock System (SIS) was initially designed for the SPS where it is heavily used. For the SPS the BIS and the SIS need to be cycle dependent. Up to LS2 no major improvements of the present systems are expected.

The SPS will possibly have new extractions towards the proposed facilities AWAKE and SBLNF. These should be confirmed before 2016. The different beams are identified by the different extraction energies (dipole field), a system which works very well. The interlocking of the beam position at the extraction points is under-performing for LHC beams.

CNGS beams have been a success story for the SPS with Peta Joules of integrated beam energy on target and activation levels of only a few μSv/h in the transfer lines.

The diagnostics of timing problems for the LHC beams remains rather tricky. This resulted once in sending the wrong beam to the LHC.

In LS1 the SPS power converters FEC will move from the actual ROCS to FCG. A proto-type crab cavity is foreseen to be installed in LSS4. This is a movable device and the interlocking needs to be studied in detail.

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