

SPS CONSOLIDATION FOR LS2 AND BEYOND

J. Ridewood, CERN, Geneva, Switzerland

Abstract

As a major part of the LHC injector chain and with its own dedicated physics program it is essential that the SPS remains capable of reliably providing high quality beams.

This presentation will give an overview of the consolidation plans concerning the SPS and its transfer lines as provided by each of the equipment groups to the IEFEC committee. The overview will be presented from a perspective of machine operation.

These consolidation plans will be reviewed focusing principally on the impact on operation with beam and will endeavour to highlight any of the works that are of particular interest or represent a particular concern for operations.

This presentation will not focus on LIU or other project work unless there is a direct consequence of one upon the other.

INTRODUCTION

A brief overview of each equipment group's main consolidation plans, as presented to the IEFEC, was shown detailing a brief explanation of the works and the reasons behind their necessity also some detail, where available, of budget and approximate dates of execution.

Each consolidation project was then considered by SPS operations as to its importance to be able to effectively operate the SPS complex. The following rating system was used

- **Activities not approved but needed to operate the machine effectively.**
- **Activities approved and needed to operate the machine effectively.**
- **Activities approved and needed to operate the machine effectively.**
- **Activity partially covered by LIU or depends upon LIU**

It was felt that this grading system did not allow the possibility to establish a level of priority amongst those works which were deemed as needed to effectively operate the machine therefore we added a further prioritisation: High, Medium and Low with a brief explanation as to why the prioritisation was given.

The activities highlighted in red were deemed necessary to operate the machine however this grading is not always simple to apply as the systems currently in place could be considered as functioning correctly and not causing significant machine downtime but their upgrade could be necessary to provide newly required functionality or as part of a longer term view towards reliability.

Also for those groups whose equipment does not have a direct impact on operation with beam they are often evaluated as having a low priority from an operations

standpoint but their correct functioning may indeed have a secondary impact on operations or impact other factors important to the safe operation of the beam.

During the presentation the consolidation plans were considered alphabetically by group.

BE-BI – L. SØBY AND R. JONES [1]

Installation of TT10 Beam Loss Monitors (BLM)

At the present time there are no BLMs installed in TT10 however this is the only beam line in the SPS complex which is not equipped with BLMs and is therefore considered as part of a coherent strategy to renew all systems from LINAC4 to SPS with the same system. They estimate the cost to be 150kCHF in electronics and 500kCHF in cabling during LS2. SPS operations consider this to be of medium importance as this does not hinder machine operation but BLMs could be of use particularly during periods of setting up and to identify injection trajectory issues more quickly and therefore potentially reduce doses to those having to work in the line.

SPS Ring BLM Electronics Renovation

This project was originally intended as part of LIU but due to manpower constraints it cannot be executed until after LS2. BE-BI propose to install new, radiation hard ASICs (Application Specific Integrated Circuit) devices connected via the new BE-BI fibre optic network due for commissioning during LS2). They estimate a cost of 900kCHF and would intend its installation to take place from 2019-2024. SPS operations consider this to be an important upgrade as this should allow us to read the beam loss rate throughout the cycle and not simply the integral, which is currently the case. This would allow us to apply what we call "sunglasses" meaning that we can hide the losses which we consider "normal" such as injection, scraping or dumping losses so that any abnormal losses are more easily identified. For this reason SPS operations consider it a high priority.

Mechanical Spares for Critical Injector Complex Monitors

A number of BE-BI's spares for critical injector complex monitors are more than 20 years old and therefore no longer compliant with modern vacuum requirements. SPS operations has already evaluated the importance of each instrument and its effect on operations as part of the BI BOSS workshop and the overall outcome was that the majority of beam instrumentation is essential for the efficient functioning of the SPS complex. It is for this reason and the fact that the unavailability of spares could potentially increase machine downtimes that SPS

operations evaluated this as a high priority. They estimated a cost of 300kCHF from 2015-2017

SPS & Transfer Line BCT Renovation

BE-BI propose to renovate both the LSS4 DCCT, sensor and electronics due to a reliance on an external company whose future may not be certain. They also propose the upgrade of the 6 transfer line fast BCTs to LHC standards. They estimate a cost of 200kCHF from 2016 to 2018. SPS operations evaluated this as a medium priority as the current systems are working but it's important that we are not left with unsupported equipment in the longer term.

BE-CO – S. DEGHAYE [2]

Upgrade of OASIS VXI, Multiplexers and Triggering System

This is an approved project to upgrade obsolete hardware and software for the OASIS digital scope system. The replacement of this legacy equipment is intended to provide greater reliability and performance to meet operation's needs. The cost is 1100kCHF from 2014-2016 shared between the SPS and PS (3 systems in SPS and 10 in PS).

Operational Database Hardware Consolidation

The current database hardware is approaching the end of its five-year warranty period and after will no longer be supported. They estimate costs of 230kCHF in 2016 and 365kCHF in 2018. SPS operations evaluated this as a high priority as these databases are essential for systems needed to operate the machine (laser alarms, diamond, data logging, etc.).

Removal of the SPS Intercom

BE-CO propose the removal of the old SPS intercom system due to ageing equipment and soon to be disappearing expertise. They estimate 200kCHF in 2016 for the removal of equipment and cables. The opinion of SPS operations is that this is a low priority because, although old, the intercom system is regularly used and is an important means of communication and has on several occasions proved essential for diffusing important messages to those working in the tunnel. GS-ASE will propose a new public address system and SPS operations requests that the old BE-CO system not be decommissioned until a replacement is operational. It is also noted that the removal of intercom cables could be integrated into the EN-EL campaigns to remove obsolete cabling in the SPS.

Consolidation of Intel Single Board Computers (CPU Boards)

The currently installed boards are not compatible with 64 bit Linux and the end of support for 32 bit SLC5 is announced for 2017. They estimate a cost of 75kCHF in 2015 which covers the SPS and PS. SPS operations

considers this a high priority as these machines are required for essential systems (RF, ABT and OASIS).

Replacement of Obsolete Analogue BTV Video Systems

BE-CO propose to replace the obsolete analogue system for BTVs by the new systems developed for LHC. They estimate costs of 400kCHF from 2015-2016. SPS operations considers this to be a medium priority as the majority of the SPS has already been converted to the new digitised system with only TT20 remaining on the obsolete analogue equipment. TT20 should however be updated as soon as possible as BTVs are one of the primary means of re-commissioning this complex extraction channel and transfer line.

BE-RF – C. ROSSI [3]

Renovation of 18kV Power Converters

The RF power converters date from the 80's and have a life expectancy of 20-30 years and over recent years have been showing signs of deterioration. The main part of the consolidation works which consist of replacing HV transformers, capacitors and cabling will be executed by TE-EPC who will take responsibility of this equipment once the consolidation is complete. The cost will be shared with 500kCHF for BE-RF from 2018-2019 and 3MCHF for TE-EPC from 2016-2019. SPS operations consider this a high priority as it will improve the reliability and safety of this essential equipment.

Replacement of the 40 year old Cooling Pipework

To be consolidated for reasons of reliability and personal safety. Costs are estimated at 500kCHF in 2018. SPS operations considers this a medium priority as it is currently functioning satisfactorily but for the safety and reliability of this essential equipment these issues should be addressed soon.

YL Tube Replacement

An approved consolidation plan which is currently underway and entails the replacement of YL tubes due to the original manufacturer ceasing production. BE-RF are currently transferring to a pin for pin replacement provided by Thales costing 2.7MCHF from 2014-2018.

DGS-RP & DGS-SEE – D. PERRIN [4]

Radioprotection Monitoring

The SPS currently uses the ARCON (ARea CONTroller) radiation monitoring system and there is an approved project: GROAC (General Renewal Of Area Controller) to extend its life until the full arrival of RAMSES (RADiation Monitoring System for the Environment and Safety) in LS2.

Site Gate Monitors and Hand Foot Monitors

DGS-RP propose to consolidate the site gate monitors (700kCHF 2016-2017) and the hand foot monitors (340kCHF 2016-2017). SPS operations consider this a low priority as there is no immediate impact upon operations.

EN-CV – S. DELEVAL [5]

Replacement of the Control System for Chilled Water Systems

This entails the replacement of an obsolete TRANE™ system with the current LHC standard at a cost of 300kCHF from 2015 to 2018. The works are intended to take place during the year-end technical stops.

Upgrade Input/Output Cards of Cooling Control Systems

Upgrade to a full Siemens S7 infrastructure at a cost of 100kCHF from 2015-2017. EN-CV currently has a mix of S5 and S7 generation equipment which is proving unreliable. SPS operations considers this a relatively low priority as up to now this does not appear to have incurred any significant machine downtime.

Replacement of The Control And Power Cubicles, Sensors and Actuators for BA Ventilation

EN-CV propose to replace the control and power cubicles along with sensors and actuators for BA surface building ventilation costing 2060kCHF from 2015-2019. SPS operations consider this to be a low priority as it was clarified that these works will not affect the tunnel ventilation however certain surface building equipment may be indirectly affected e.g. Faraday cage, RF power equipment, power supplies, kicker systems, etc.

Renovation of the SPS Sumps

The SPS sumps level switches and pumps are ageing and starting to become unreliable. EN-CV estimate costs of 350kCHF from 2015 to 2018. SPS operations consider this to be a medium priority as although it has no direct impact on operations with beam it is essential for the evacuation of infiltration and floodwater during periods of prolonged heavy rain.

SPS Cooling Towers Upgrade

The SPS cooling towers require upgrade by the addition of a fifth cooling cell during LS2. This upgrade is primarily to cover the increased power needs coming from LIU and AWAKE however the cooling towers are already working at or above their limit. EN-CV explained that they currently have a derogation from HSE to be able to purge a minimal amount of warm water to the local river system during periods of high load. This is a situation which obviously should not exist in the longer term. Discussions are on-going as to the budget split

between LIU and consolidation. SPS operations consider this a high priority as the system is already working at its limit and must be able to cope with future needs.

EN-CV concluded by stating that the technical needs exceed by far the possibilities and that a reduction of operational performance has to be taken into account. They also said that the works foreseen for LS2 are already double what was planned for LS1.

EN-EL – D. BOZZINI [6]

Consolidation of SPS Substations Switchgear

EN-EL has approved plans to consolidate the switchgear at each BA as a continuation of the 18kV cabling works executed during LS1. This is to cost 12.1MCHF from 2014-2018.

Consolidation of SPS HV and LV (BA4 and BA5) Secured Network

EN-EL also propose to consolidate the SPS HV and LV secured network supplying BA4, BB4, BA5 and BB5 which is currently fed from a single, 40 year old infrastructure. They estimate the cost at 1.45MCHF from 2016-2017. The current configuration allows no discrimination in the event of a fault and would therefore trip all four areas should there be a fault on any one. The secured network provides power to certain systems needed for personnel safety such as lifts and smoke extraction and therefore SPS operation. SPS operations have given this a high priority because of its importance for those having to intervene in the tunnel and its inevitable impact on operations.

Clean up of Obsolete Cables

EN-EL have highlighted a massive overcrowding of the SPS cable trays with obsolete cables all around the SPS but particularly in BA5. They propose, as part of a campaign, to begin removing those cables which are no longer used. Cable tray space will be required with future upgrades and unused cables represent a fire risk as they are one of the main sources of combustible material in the machine. They estimate the cost at 5.2MCHF in LS2. SPS operations consider this a low priority from an operations point of view but feel it needs to be addressed urgently for future upgrades and for fire prevention.

Irradiated Cable Campaigns

EN-EL proposes to continue the on-going irradiated cable campaigns in the SPS during LS2 with the next location likely to be either TS6- or TS4+. These campaigns are to ensure that cables are replaced ideally before they show signs of deterioration due to radiation. The cost is estimated at 3.2MCHF during LS2. SPS operations consider this to be a high priority as cable breakdowns can cause potentially long stops and are often not trivial to repair without damaging other delicate cables.

LV Distribution Network Consolidation

EN-EL has highlighted problems with the LV distribution network in that the equipment dates from the 70's and approximately 20% are now deemed dangerous. They also state that there are almost no remaining spares and soon the equipment will become unmaintainable. EN-EL propose to consolidate the 20% which are considered dangerous and any others that are required by LIU and suggest a complete revision taking into account both current needs and those of the foreseeable future to strengthen the electrical integrity and in turn reduce downtime and improve safety for EN-EL operations. They estimate the cost at 2MCHF over the next 5 years. SPS operations consider this a high priority because of its inevitable consequences on operations and its impact on personal safety.

48V DC System Consolidation

For very similar reasons EN-EL propose the consolidation of the 48V dc system. This is again equipment dating from the birth of the SPS and consequently there are almost no spares remaining. The 48V dc system provides, amongst others, power for the tunnel emergency lighting. EN-EL indicate that the current system has no redundancy and therefore intend to upgrade the system so that it is fully independent and redundant thus greatly reducing downtime and facilitating maintenance. The cost is estimated at 2.1MCHF for the SPS from 2015-2019 with the majority focused around LS2. SPS operations consider this a medium priority from an operations point of view but suggest it should be addressed urgently due to its impact on personnel safety.

EN-HE – I. RÜHL [7]

Crane Consolidation

EN-HE proposes the consolidation of three large cranes in the SPS:

- BB5 75t PR565
- ECA4 40t PR570
- ECX5 40t rotational PR567

EN-HE also propose the replacement of two smaller cranes in BB3:

- BB3 7.5t PR554
- BB3 7.5t PR555

This work was originally planned for LS2 but they propose to advance to 2015-2016 so that the equipment can be ready and available for use in LS2. The cost would be 750kCHF. SPS operations consider this to be a low priority as there is no direct impact on operation however this could have an indirect impact through delayed return to service.

Goods Lifts Consolidation

EN-HE also state that if major works such as removal and coating of a large number of SPS magnets be

undertaken for LIU then the goods lifts would then need consolidation.

EN-STI – R. LOSITO [8]

TIDVG Consolidation

Until recently EN-STI had little consolidation work foreseen in the SPS however with the recent discovery of damage to the TIDVG they have had to consolidate with new core internals blocks costing 250kCHF, which is perhaps a conservative estimate. They also say they have 4 outer shells available in case of a need of replacement, however three of the shells require a cooling circuit modification, the one which does not is the one which was removed from the tunnel this August and is therefore the hottest. Hardware interlocks will be put in place to prevent similar issues reoccurring. SPS considers this to be a medium priority as to reduce any extended downtime in the event of another problem.

As the TEDs have a very similar construction they may also be susceptible to the same issues however their different conditions of use and separate vacuum suggest that consequences would perhaps be slightly less critical.

Beam Intercepting Devices Consolidation Studies

For the reasons mentioned above and due to the fact many of these BIDs (Beam Intercepting Devices) are inherited equipment from other groups, EN-STI propose to initiate consolidation studies for BIDs across the entire injector complex to reconstitute full documentation and ensure compatibility of the currently installed designs with present and future beams. For this they estimate 1640kCHF from 2014-2018.

GS-ASE – P. NININ [9]

Replacement of SPS Access System

GS-ASE has an approved consolidation project to replace the SPS access system bringing it up to the standard now installed in the LHC and PS. This is due to take place from 2014 to LS2 with the majority of installation taking place during LS2 at a cost of 14.5MCHF.

BIW (Beam Imminent Warning) and Evacuation Alarm Upgrade

GS-ASE also propose to consolidate the BIW (Beam Imminent Warning) system in the SPS in parallel with the access system upgrade at a cost of 1.1-1.3MCHF from 2016 to LS2. SPS operations consider this to be a high priority as there have been inconsistencies noted between the access system and BIW system sectorisation which must be addressed.

Renewal of SPS Smoke Detection Pipework

GS-ASE requests the renewal of around 20km of PVC air sampling pipework for smoke detection costing

600kCHF during LS2. SPS operations consider this a low priority due to it not having a direct impact on operations but feel that it should be addressed in conjunction with other fire prevention upgrades.

Installation of SPS Public Address System

GS-ASE has also proposed a public address system as a replacement to the BE-CO intercom system, which is approaching end of life. The investigations are still at an early stage so budget and planning are yet to be established however first estimations indicate a cost of around 250kCHF. At the present time a public address system is the only efficient means of evacuating the tunnel therefore SPS operations consider this a high priority and recommends that the BE-CO intercom not be decommissioned until the new GS-ASE system is operational.

SPS Fire Safety Improvements

GS-ASE in conjunction with HSE and GS-FB have been considering general fire safety improvements to the SPS including modified sectorisation, advanced fire alarms and auto extinguish systems, amongst others. Discussions are still in the early stages but the outcome of recent presentations to the SPS CSAP suggest that a full study of improvements relating to fire safety should be requested. These improvements should comply with external standards for insurance and the safety of external fire fighters. SPS operations consider this a low priority from the point of view of machine operation but recognises that the SPS requires urgent attention in terms of fire safety and it has the full backing of the SPS CSAP.

GS-SE – L. SCIBILE [10]

Monitoring of Sensitive Tunnel Sections

The main component of GS-ASE's consolidation work is in the monitoring of the SPS tunnel infrastructure. Phase one being the installation of fibre optic monitoring of the recently consolidated TT10 tunnel to gain experience and phase 2 being the extension of this and other monitoring techniques such as photogrammetry and geo-radar to other potentially sensitive tunnel areas. They estimate the cost to be 500kCHF from 2015 to 2018. SPS operations considers this to be a low priority as there is very little chance this would have an impact on operations however we need to know if there are serious structural issues in the tunnel infrastructure.

SPS Technical Ducts Consolidation

The recent failure of an SPS technical duct at the tunnel entrance at BA4 during the transport of the TIDVG due to degraded concrete coupled with an insufficient design highlighted that these ducts were no longer capable of withstanding the necessary transport loads. A temporary solution is in place with a permanent repair for BA4 planned during the Christmas 2014/2015 technical stop and a permanent repair in all other BAs by LS2 or before. It is understood that these works are covered under an

approved budget for SPS studies and works underground. SPS operations consider this a high priority as this poses a serious risk to the transport of potentially radioactive equipment.

TE-ABT – B. GODDARD [11]

Assemble MKDH Spare

TE-ABT propose to assemble a spare horizontal dump kicker magnet (MKDH) as currently there is no spare available. The cost is estimated at 160kCHF in 2018. SPS operations considers this to be a medium priority as TE-ABT say that the risk of an MKDH failure is relatively slim and in most cases the return to service would be largely dictated by its reconditioning.

Upgrade MKP Thyatron Switches

TE-ABT has an approved project to replace the thyatron switches for the MKP in an effort to reduce the number of different types and therefore increase spare availability costing 200kCHF in 2017.

Construct New Septum Yokes

TE-ABT has another approved project to construct new septum yokes for MSE and MST magnet spares costing 200kCHF in 2015

Radiation-hard Potentiometers for Septa

Another approved project is the procurement of new radiation resistant potentiometers for septa girder position measurement.

Replace ZS HV Generator

TE-ABT propose also to replace the Electrostatic septum (ZS) HV generator at a cost of 230KCHF however due to a fault it has recently been refurbished and its replacement has been postponed until 2021 Therefore SPS operations consider this a low priority.

Renew Kicker Timing and MS Controls

Another approved consolidation project for TE-ABT is the renewal of kicker timing and magnetic septa control electronics costing 210kCHF in 2017.

Upgrade Fast Thyatron Interlocking

TE-ABT propose to upgrade the fast thyatron interlocking system as it is still using LEP era electronics. Estimated to cost 250kCHF in 2018 SPS operations consider this to be of medium priority as this would hopefully help reduce the frequency of damaged switches and therefore reduce downtime.

Modernise Kicker/Septa Controls

TE-ABT also intend to modernise the kicker and septa controls to current standards and to standardise the control electronics across installations and machines. This is estimated to cost 1460kCHF in 2018 for both the PS and SPS with the SPS representing approximately 30%. SPS operations evaluate this to be a low priority as the

current systems function adequately and the new system does not appear to offer significant operational advantages.

New MKDV Generators and Controls

This is motivated by the replacement of the mercury ignitron switches by solid state switches both for reasons of safety and reliability. It will also include the reconfiguration of the MKDV so that the risk of damaging one of the MKDV magnets is reduced. This work will cost 800kCHF in 2019 and will also be partially covered under LIU with the eventual budget split still to be decided. SPS operations consider this to be of medium priority as it will reduce the risk of damaging MKDV magnets.

New Electrostatic Septa Cables

An approved project exists to replace the ageing cable that descends the vertical access shaft in BA2 costing 240kCHF and scheduled for 2017

Renew MKP RG200 Cables

This entails the replacement of injection kicker (MKP) cables due to normal HV cable degradation which is exacerbated by radiation. SPS operations considers this to be a low priority as these cables have been recently replaced during the LSS1 irradiated cable campaign and TE-ABT have said they would have some spare stock available from the new PS injection kicker installation should a breakdown occur. For these reasons SPS operations consider this a low priority for the foreseeable future.

Upgrade Thermal Interlocks

This is an approved project to upgrade the thermal interlocks to ensure their reliability and safety. The cost is 110kCHF in 2017.

Kicker Oil System Fire Prevention

To bring deficient kicker system areas up to the current standard as installed in LSS4 by means of firewall partitioning, fire detection etc. Cost is estimated to be 290kCHF in 2016. SPS operations consider this a low priority from an operations standpoint however it remains important from the need to improve SPS general fire prevention measures.

Kicker Discharge and Earthing Switches

To install automatic capacitor discharging and earthing systems as it is currently a partially manual system with a small risk of human error. Estimated to cost 180kCHF and scheduled for 2016. SPS operations consider this to be a low priority for operations but important for personnel safety.

Consolidation of SPS LSS4 Extraction Kicker Configuration

To reconfigure the extraction kickers in LSS4 now that the fast rise times required by CNGS are no longer

needed. They propose to have the same configuration as in LSS6, which is effectively five times less complex. The removal of pulse forming networks (PFN), switches and magnets would mean greater reliability due to fewer components, better spares availability and removal of unnecessary impedance. Cost and schedule are still to be confirmed. SPS operations for the reasons indicated above consider this to be a medium priority.

TE-ABT explained that manpower is their main limiting factor for consolidation and requested that consolidation budget be used for manpower.

TE-EPC - J-P. BURNET [12]

Replacement of SVC BEQ1

This is the approved replacement of the end of life of the BEQ1 static var compensator costing 10.2MCHF during LS2

Replacement of Electronics for Main Dipole and Main Quadrupole Power Supplies

As a follow up to the LS1 converter and transformer consolidation the main dipole and quadrupole electronics are to be consolidated at a cost of 400kCHF in 2017

Replacement of MUGEF by FGC Converter Controls

TE-EPC propose to convert SPS converter controls to FGC in a move to standardise systems across machines and to replace the ageing 70's MUGEF system at a cost of 2MCHF from 2016-2019. TE-EPC also propose to advance the replacement of COD (Orbit Corrector Dipole) power supplies including their upgrade to FGC from LS3 to LS2 at a cost of 3MCHF thus transferring the entirety of the SPS, with the exception of TT20, to FGC controls. TT20 would be upgraded in conjunction with the north area in LS3. SPS operations consider this to be a medium priority as it would allow greater reliability, versatility and flexibility.

Renovation of 18kV Power Converters for RF Power

As previously detailed as part of BE-RF consolidation. TE-EPC will be heavily involved in its consolidation and will take responsibility once complete.

TE-MPE – B. PUCCIO [13]

Installation of WIC in TT10 and TT20

TT10 and TT20 are the only lines remaining in the SPS that are not covered by the WIC (Warm magnet Interlock Controller). TT10 is therefore the missing link in the injector chain. TE-MPE propose to install TT10 in 2017-2018 in conjunction with TE-EPC converter upgrades at a cost of 400kCHF and TT20 after LS2 at a cost of 900kCHF in conjunction with north area upgrades. TE-EPC point out that approximately 75% of these cost are for cabling. SPS operations consider this to be a low

priority as the currently installed system, although ageing, functions satisfactorily.

Installation of BIS System in TT10

To install the Beam Interlock System in the TT10 transfer line. TT10 and TT20 are the only lines not yet covered by the BIS meaning TT10 is again the missing link in the LHC injector chain. Costs are not yet fully established but are estimated in the region of 200-400kCHF with execution to take place during LS2. SPS operations consider this to be a medium priority as future higher energy and intensity injected beams will require greater protection.

Replacement of SPS Ring Magnet Interconnection Boxes “Trèfles”

The “Trèfles” are local magnet over temperature indicators that are designed to latch at a predetermined temperature to indicate magnet or cooling circuit issues. With age these mechanical devices are starting to become unreliable, not always latching as they should. Their replacement is estimated to cost 100kCHF in 2018. SPS operations consider this to be a low priority as to date this has not caused any significant delay to the diagnosis of magnet issues.

Increased WIC Granularity for SPS

The WIC currently identifies problems by demi sextant. TE-MPE proposes to upgrade the system to be able to identify issues by individual or small groups of magnets at a cost of 600kCHF from 2020-2022. SPS operations consider this to be a low priority as this would represent only a relatively small improvement to the speed of magnet fault diagnosis.

TE-MSC - D. TOMMASINI [14]

Procurement of New SPS Magnet Coils

TE-MSC have an approved consolidation project to procure three new magnet coils to ensure spare availability. One TT10 quadrupole coil (SPQI_NWP) at a cost of 30kCHF, 30 of which are installed in the SPS. One SPLSFN_FWP type and one SPLSDN_FWP SPS ring sextupole coils of which there are 54 of each installed in the SPS. Each sextupole coil will cost 50kCHF.

Manufacture of 10 MBB Dipole Coils

In an effort to return stock to original levels TE-MSC propose to manufacture 10 MBB dipole magnet coils. The MBB magnet coils are susceptible to inter turn short circuits which are not repairable and 10 of the original 22 magnets have been used for this reason. Since 2011 capacitive discharge testing has been used as a means to identify weak magnets before the physics run commences. SPS operations consider this to be a high priority as although it has no immediate impact on operations it is essential for the long term future of the SPS. There are, as yet, insufficient statistics to determine

if the rate of failure is increasing and potentially long lead times need to be taken into account.

New Vertical Bumpers MPLV and MPLV

With current stock levels at 2 spares for 3 MPLV type magnets in service and 1 spare for 10 MPSV type magnets in service TE-MSC propose, in conjunction with LIU, to fabricate a new vertical bumper compatible both with the proposed new LIU scraping scheme and the replacement of MPLV and MPSV magnets at a cost of 330kCHF 70% of which to be covered by LIU and 30% by consolidation. If the new LIU scraping scheme does not go ahead TE-MSC propose to manufacture an MPSV type magnet to existing specification. SPS operations consider this to be a medium priority to ensure sufficient spares for operation.

TE-VSC – J. FERREIRA SOMOZA [15]

Replacement of 850 Obsolete Ion Pump Controllers

Ageing ion pump controllers and their associated power supplies are outdated and require replacement to reduce failure rates, reduce downtime and generally improve vacuum performance along with improvements in safety standards. Estimated to cost 3.1MCHF from 2017-2019. SPS considers this to be a medium priority as reliable pumps will be needed for future beams and faster recovery after interventions affecting vacuum.

Installation of RXVA in BA2, BA5, BA6

RXVA are connection boxes local to the ion pumps that, when disconnected, isolate the 6kV power supply. These boxes are not yet implemented in BA2, BA5 or BA6 TE-VSC propose to install these during LS2 at a cost of 180kCHF. SPS operations considers this a low priority for operations but important for the safety of those working in the tunnel, particularly TE-VSC personnel.

Replacement of 1000 VPJA Ion Pumps

To be executed as part of the LIU carbon coating upgrade should it go ahead. To replace ageing vacuum pumps which are working at a reduced capacity meaning degraded vacuum performance and slower recovery. If not executed as part of the LIU coating upgrade then one additional industrial support staff would be required. Costing 2.5MCHF from 2016-2018 with installation taking place during LS2. SPS operations consider this to be a medium priority as good vacuum performance is essential for good beam performance and fast recovery.

Replacement of Ageing Vacuum Valves

TE-VSC propose to replace several of the ageing SPS vacuum valves at a cost of 300kCHF during LS2 as the risk of valve blockage is increasing. A valve blocked closed is an obvious interruption for operations but a valve blocked open can also pose a risk to sensitive, conditioned equipment. It is for the above reasons that SPS operations consider this to be a medium priority.

Re-establishment of Regularly Used Spares

Following LS1 and in preparation for LS2 TE-VSC propose to restock the regularly used spares such as enamelled flanges, damper resistors and chambers needed for maintaining the correct SPS grounding scheme at a cost of 200kCHF from 2015-2016. SPS operations consider this to be a medium priority as, in conjunction with TE-VSC, we have recently been aiming to re-establish correct vacuum grounding to avoid earth loops.

Industrial Support – Manpower

TE-VSC requires additional manpower to be able to meet their consolidation commitments. They estimate that approximately 80% of their LS1 work was support for other groups. Currently only 3 technicians take care of the SPS and as a result they are all approaching their annual dose limits. They request 1 industrial support staff per year with another during LS2 at a cost of 150kCHF per IS per year.

TE-VSC also explained that they are in the process of reviewing their consolidation needs in an effort to reduce costs.

CONCLUSIONS

Many of the consolidation plans depend upon or are awaiting LIU decisions.

Recent events, not detailed in this presentation, indicate that the responsibility for cables between magnets and power supplies needs to be clarified. Since the presentation the responsibility of these cables has officially been assigned to EN-EL.

Consolidation for safety reasons is a recurring theme for several equipment groups in the SPS. Many of the systems in the SPS date from the 70's and have the associated safety standards.

It was also highlighted that once consolidation was approved details of the works should be communicated to EN-MEF for proper planning and integration if not already done.

ACKNOWLEDGMENT

I would like to thank Karel Cornelis especially for his advice in evaluating the priority of each consolidation task.

REFERENCES

- [1] Chamonix IEF Session: Beam Instrumentation Consolidation, R. Jones, L. Søby, 18th June 2014, 104th IEF, <https://indico.cern.ch/event/325142/>
- [2] Chamonix IEF Session: BE-CO Consolidation, S. Deghay, 29th August 2014, 112th IEF, <https://indico.cern.ch/event/337432/>
- [3] Chamonix IEF session: BE-RF Consolidation, C. Rossi, 11th July 2014, 106th IEF, <https://indico.cern.ch/event/329923/>
- [4] Chamonix IEF Session: DGS-RP Consolidation, D. Perrin, 18th July 2014, 107th IEF, <https://indico.cern.ch/event/331195/>
- [5] Chamonix IEF Session: EN-CV Consolidation, S. Deval, 1st August 2014, 108th IEF, <https://indico.cern.ch/event/333383/>
- [6] Chamonix IEF Session: EN-EL Consolidation, D. Bozzini, 5th September 2014, 113th IEF, <https://indico.cern.ch/event/338872/>
- [7] Chamonix IEF Session: EN-HE Consolidation, I. Rühl, 22nd August 2014, 111th IEF, <https://indico.cern.ch/event/335579/>
- [8] Chamonix IEF Session: Beam Intercepting Devices Consolidation, R. Losito, 18th June 2014, 104th IEF, <https://indico.cern.ch/event/325142/>
- [9] Chamonix IEF Session: GS-ASE Consolidation, P. Ninin, 29th August 2014, 112th IEF, <https://indico.cern.ch/event/337432/>
- [10] Chamonix IEF Session: GS-SE Consolidation, L. Scibile, 29th August 2014, 112th IEF, <https://indico.cern.ch/event/337432/>
- [11] Chamonix IEF session: TE-ABT Consolidation, B. Goddard, 11th July 2014, 106th IEF, <https://indico.cern.ch/event/329923/>
- [12] Chamonix IEF Session: Power Converters Consolidation, J-P. Burnet, 6th June 2014, 103rd IEF, <https://indico.cern.ch/event/321213/>
- [13] Chamonix IEF Session: TE-MPE Consolidation, B. Puccio, 8th August 2014, 109th IEF, <https://indico.cern.ch/event/334158/>
- [14] Chamonix IEF Session: Magnets Consolidation, D. Tommasini, 18th June 2014, 104th IEF, <https://indico.cern.ch/event/325142/>
- [15] Chamonix IEF Session: TE-VSC Consolidation, J. Ferreira Somoza, 22nd August 2014, 111th IEF, <https://indico.cern.ch/event/335579/>