ATS ACC-CONS day
TE-MSC group contribution

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ATS Cons Day 2024
25 October 2024

Methodology & table of content

Starting points:

- APT: ‘Approved ACC-CONS’ and ‘ACCCONS prioritization (without NA-CONS)’
- Last year presentation at ATS-CONS Day *(20 October 2023)*
- Mid-year update to ATS ACC-CONS program on the 2024 spending
- Current best estimate of the spending profiles (in green budget profile updated due to LS3 schedule change)
- Each project has been reviewed with the Project Leader and concerned Section Leader

Table of content

Approved requests with budget allocations *(TE-MSC w/o NCM)*

Project	EDMS *BC*	WU description	2024 *kCHF*	2025 *kCHF*	2026 *kCHF*	2027 *kCHF*	2028 *kCHF*		TOTAL	Comment*
LHC CONS	2965204 *98279*	LHC Inner Triplets Edge Welded Bellows *CMI*	50	285	400	305	130		**1170**	'24 CONS appoved
LHC CONS	1552875 *99369*	LHC corrector magnets (MCBC, MCBY, MQTL) *SMT*	35	350	304	300	80		**1069**	Reprofile minor 7/24
LHC SPARES	1552814 99101	S/C magnets components: busbars, insulation, other components *LMF*	32						**32**	Closing *end of '24*
LHC SPARES	1562307 99107	Current leads for DFB, SSS *HSD*	30	40	30				**105**	Reprofile *minor 7/24*
LHC SPARES	1552813 99301	Winding machine and presses *LMF*	50	153					**203**	Reprofile *minor 9/24*
LHC SPARES	1552808 99302	LHC MQ cold mass manufacture *SMT*	150	2410	1209				**3769**	Reprofile 7/24: 1y-shift

* Compared to 2023 ATS ACC-CONS Day presentation

Approved requests with budget allocations *(MSC-NCM)*

Project	EDMS *BC*	WU description	2024 *kCHF*	2025 *kCHF*	2026 *kCHF*	2027 *kCHF*	2028 *kCHF*		TOTAL	Comment*
AD CONS	2962714 *99105*	AD Consolidation main bending – quadrupoles *NCM*	49	180	690				**919**	'24 CONS approved
AD CONS	3014585 *99106*	Replacement of AD electron cooler *NCM*		160	562	32			**754**	'24 CONS approved
PS CONS	2962682 *98278*	Consolidation PSB Main Quadrupole magnets *NCM*	290	1130	844	1213			**3477**	'24 MTP/CONS approved
PS SPARES	2962654 98292	Consolidation PSB Main Bending magnets *NCM*	50	200	300	330	270		**1150**	'24 CONS approved
PS CONS	2321725 99393	Set of spare solenoids for the GTS-LHC ion source at Linac3 *NCM*	0	92					**92**	7/24: 1y-shift Closing *2025*
PS CONS	1545124 99395	ISOLDE: GPS separator *NCM*	30	81					**111**	Reprofile minor 7/24 Closing *2025*
PS CONS	1543390 99397	ISOLDE: Triplets *NCM*	80	53					**133**	Reprofile minor 7/24 Closing *2025*

* Compared to 2023 ATS ACC-CONS Day presentation

Approved requests with budget allocations *(MSC-NCM)*

Project	EDMS *BC*	WU description	2024 *kCHF*	2025 *kCHF*	2026 *kCHF*	2027 *kCHF*	2028 *kCHF*		TOTAL	Comment*
SPS CONS	*2963874* 98290	Electrical safety improvements of warm magnets (cat E and D *w/o SPS*) *NCM*	150	560	300	120	135		**1265**	'24 CONS appoved
SPS CONS	2588293 *98291*	Tooling and renovation of SPS QDA/QFA *NCM*	200 ~~*384*~~	310 ~~*0*~~					**510** ~~***384***~~	Cost increase request
SPS SPARES	2637599 98294	Spare MDLV magnets for SPS transfer lines *NCM*	30	250	100	120			**500**	'24 CONS appoved
SPS SPARES	1545130 99187	Spare coils for MBB magnets *NCM*	600 ~~*338*~~	528 ~~*146*~~	250 ~~0~~				**1378** ~~*484*~~	Cost increase request

* Compared to 2023 ATS ACC-CONS Day presentation

TE-MSC pending and new requests *(MSC-NCM)*

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New request # pEDMS	WU description	2025 *kCHF*	2026 *kCHF*	2027 *kCHF*	2028 *kCHF*	TOTAL	Priority
Pending 2962660	Consolidation of the PS Booster Multipole magnets *NCM*	100	300	330		**730**	1
MSC-1 3136317	Consolidation of the LHC Ion injectors nc magnets* *NCM*	150	425	475	600	**1650**	1
MSC-2 3141539	Polyurethane support replacement for dipoles in TT41, TI2 and TI8 *NCM*	152	165	165		**482**	1
MSC-3 3141534	Replacement of obsolete Power Converters for NC Magnet Testing *NCM*	280	400			**680**	1

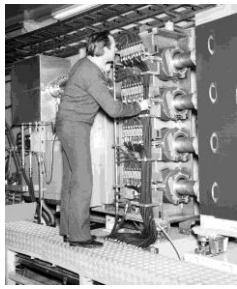
* This document updates, merges and replaces 3 Consolidation requests: EDMS 2579713, 2579714, 2579715

New request: Consolidation of the PS Booster Multipole Magnets

PENDING BY THE CONSOLIDATION PROGRAM MANAGER

- **Description** *(EDMS 2962660)*: Consolidation of the PS Booster Multipole Magnets *(manufacture of a total 28 multipole magnets depending on the quantity of each type installed in the machine, 12 spare coil sets for the orbit correctors*
- **Motivation**: Following the PSB Main Quadrupole Task Force investigations, inspections of the internal brazed joints from other magnet coils, were performed and indicated similar signs of corrosion. Some 112 water-cooled Multipole magnets of five different types are installed in the PSB ring. Following a previous (2019) consolidation campaign each magnet type is only covered by one or two spare units. In total there are ~2000 non-accessible brazed joints of phosphorus-based filler material as per the PSB main quadrupoles. To date we have only seen one brazed joint failure circa 2007 on an external brazed joint which was subsequently repaired.
- In addition, there are 52 orbit correctors installed around the PSB ring which are regularly exchanged during the interventions on the main quadrupole magnets.
- **Priority/consequence of delay**:
  - Procurement of 28 multipole magnets, 12 orbit corrector coil sets, and the associated acceptance tests, certification and magnetic measurements, within 30 months.
  - In case of an irreparable failure of one or more of the PSB Multipole magnets, the operation of the PSB and downstream machines may be compromised leading to reduced performance.

Project	EDMS *BC*	WU description	2025 *kCHF*	2026 *kCHF*	2027 *kCHF*	2028 *kCHF*		TOTAL	Priority
PS CONS	3136317 *n/a*	Consolidation of the LHC ion Injectors normal-conducting magnets for the Linac 3, Leir and related transfer lines	100	300	330			**730**	*1*



Consolidation of the LHC ion Injectors nc magnets for the Linac 3, Leir and related transfer lines

- **Description** *(EDMS 3136317)*: Consolidation of the LHC Ion Injectors Normal-Conducting Magnets for the Linac 3, Leir and related transfer lines. This document updates, merges and replaces three consolidation requests EDMS 2579715, 2579713, 2579714.
- **Motivation**: For eight magnet types no spare magnets are available. For four out of these 8 magnet types a failure would cause very long downtimes (up-to 2 years), and it is therefore proposed to procure spare coils and/or magnets. These magnets have internal splices similar to the PSB and SPS, with an expected similar failure mechanism.
- **Priority/consequence of delay**:
  - Failure of the Linac 3, Leir and transfer lines magnets may severely impact the CERN ion physics, with downtimes of up to 2 years
  - In order to have spares available for Run4, an approval is required in this round, otherwise no spares will be available for (the beginning of) Run4

Leir main bending

New

Leir steerer

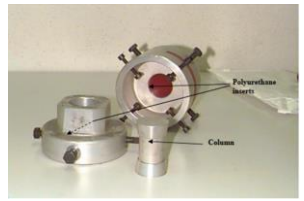
Project	EDMS *BC*	WU description	2025 *kCHF*	2026 *kCHF*	2027 *kCHF*	2028 *kCHF*		TOTAL	Priority
PS CONS	3136317 *n/a*	Consolidation of the LHC ion Injectors normal-conducting magnets for the Linac 3, Leir and related transfer lines	150	425	475	600		**1650**	*1*

* Includes graduate/students and FSU resources.

New request: Polyurethane support replacement for dipoles in TT41, TI2 and TI8 during LS3

New

- **Description** *(EDMS* 3141539*)*: The bending magnets installed in the transfer lines TT41 (85), TI8 (267) and TI2 (153) are all supported by polyurethane (“PU”) jacks. Previous experience in the SPS has shown that the PU-pads have a limited lifetime depending on the batch and the environmental conditions. At the end of the lifetime the pads will soften and break, extruding the PUR out of the housing.



- **Motivation**: If not changed, several magnets are expected to misalign themselves during Run4. The exact number is hard to predict.

- **Deliverables**: Refurbished jacks

- **Priority/consequence of delay**: Possible misalignment of several magnets during Run4 leading to difficulties in operation of the respective lines with impact on LHC and AWAKE operation

New request #	WU description	2025 *kCHF*	2026 *kCHF*	2027 *kCHF*	2028 *kCHF*	2029 *kCHF*	TOTAL	Priority
MSC-2	Consolidation of SPS magnet supports	152	165	165			**482**	*1*

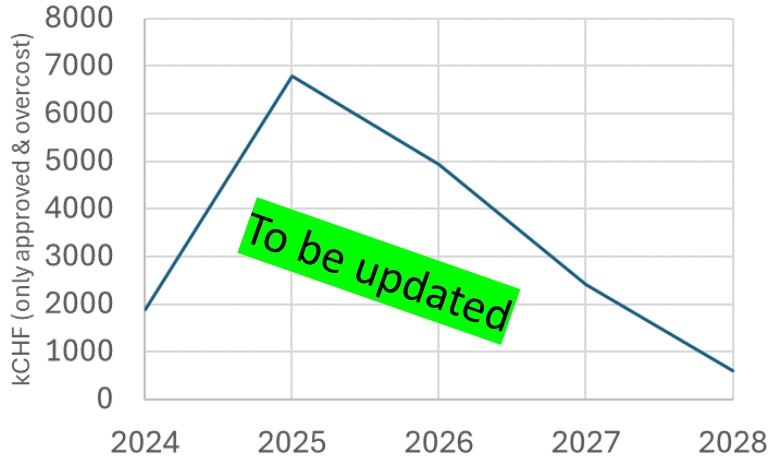
REPLACEMENT OF OUTDATE POWER CONVERTERS FOR MAGNET TESTING AND CERTIFICATION

New

- **Description** *(EDMS* 3141534*)*: Consolidation of the Power Converters in all TE-MSC-NCM workshops for magnet testing and certification
- **Motivation**: After around 50 years the existing power converters used in the workshops of TE-MSC-NCM show signs of degradation with recurrent faults, and they are based on obsolete technology, which cannot be maintained anymore by SY-EPC
  - Previous request (EDMS 2778195, non-approved now paid by OPEX) covered only magnetic measurements in 867 with the idea to share the power converter between magnetic measurements and TE-MSC-NMC
  - Further degradation of the existing power converters yields already now to availability issues; a review with SY-EPC concluded that **all** existing power converters of TE-MSC-NCM cannot be maintained and need to be consolidated
- **Priority/consequences of delay**:
  - Increasing risk of failures of existing power converters with longer downtimes or end-of-life scenarios
  - Reduction of the output of the workshop with impact on the accelerator operation (no certified spares available for installation): We certify for use ~70 magnets/year

Project	EDMS	WU description	2025 *kCHF*	2026 *kCHF*	2027 *kCHF*	2028 *kCHF*		TOTAL	Priority
CONS	2962682	Replacement of outdated power converters for magnet testing and certification *NCM*	280	400				**680**	*1*

Summary



- Approved projects
  - Cost increase of 1020 kCHF, mainly MBB coils: new total 16632 kCHF
  - Spending profile (major), mainly due to adjustments of MQ
  - 6 projects ending 2024/5 (i.e. before LS3)

- Pending requests
  - PSB main Multipole magnets: presented last year with lower priority compared to PSB quad and dipoles following 'discovery' of PSB conductor corrosion; shall start in 2025 to be ready for (end of) LS3 ….

- New requests
  - Consolidation of the LHC ion Injectors nc magnets for the Linac 3, Leir and related transfer lines; this request updates, merges and replaces three consolidation requests EDMS 2579715, 2579713, 2579714.
  - Polyurethane support replacement for dipoles in TT41, TI2 and TI8 during LS3 is a joint effort of EN-HE, BE-GM, TE-VSC, and TE-MSC
  - Replacement of outdated power converters required for normal-conducting critical spare preparation

- Note 1: LS3 planning considers the updated plan: no impact on overall budget but for some projects on the spending profile (updated)
- Note 2: First DOs and discussions with all major suppliers of normal conducting magnets reveal a challenging market environment

Spare coils for MBB magnets

- **Description** *(EDMS* 1545130*)*: The 385 SPS MBB magnets were commissioned in 1976, equipped each with one coil, which were produced by two manufacturers: 136 coils by Alstom, 249 coils by Lintott. The coils produced by Lintott are plagued by regular inter-turn shorts, with a failure rate of around 1 coil/year. The most probable cause for the inter-turn shorts is a corrosion issue at brazing locations (each coil contains 32 internal brazings), with water infiltrating (seeping) into the electrical insulation. The failure is indicated by BE-OP during operation (kick in the orbit) and confirmed by local capacitive discharge measurements. Such failures are non-repairable.
- **Motivation**: As of today, only 3 spare coils remain, making it a priority to produce additional ones. After refurbishing the existing 13 spare MBB magnets, no more spare coils will be available.
- **Deliverables**: Three conform MBB coils
- **Execution Risks**: Long delays due to missing manpower. Mitigation: New staff technician will be working on this project with priority; Technical non-conformities. Cu conductor for up to seven coils is available. Mitigation: Foresee production of several coils
- **Reason for overcost**: Change of strategy in-house vs procurement, tooling cost increased

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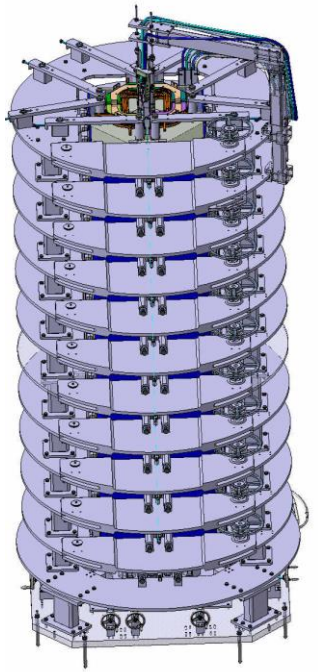
SPS SPARES	1545130 99187	Spare coils for MBB magnets *NCM*	600 ~~*338*~~	528 ~~*146*~~	250 ~~0~~				**1378** ~~*484*~~	Cost increase *(2015: Σ 1.3 MCHF new: Σ 2.738 MCHF including infrastructure)*

Tooling and Renovation of QDA/QFA Quadrupoles

- **Description** *(EDMS* 2588293*)*: The QDA/QFA renovation campaign requires specific tooling to be designed and built to open the yoke and to either refurbish or replace the coils. Similar tooling is used for the QF/QD refurbishment, but it is not compatible with the larger dimensions of the QDA/QFA magnets.
- **Motivation**: Refurbishment of QDA/QFA magnets, as no conforming spares exist at this stage
- **Deliverables**: Tooling for renovation
- **Execution Risks**: Project is now well advanced, with few missing components to be procured and assembly to be done
- **Reason for overcost**: Tooling cost and requirements for manpower increased



Project	EDMS *BC*	WU description	2024 *kCHF*	2025 *kCHF*	2026 *kCHF*	2027 *kCHF*	2028 *kCHF*		TOTAL	Comment*
SPS SPARES	2588293 *98291*	Tooling and renovation of SPS QDA/QFA *NCM*	200 ~~*384*~~	310 ~~*0*~~					**510** ~~***384***~~	Cost increase