

# ACCELERATORS AND NON LHC EXPERIMENT AREAS CONSOLIDATION UP TO LS3 - LINACS

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## *Abstract*

The consolidation requests for Linacs 2 and 3 will be summarised and prioritised, as well as the requests for the transfer line between Linac2 and the PSB which will be reused for Linac4 beams in the future.

## INTRODUCTION

Consolidation of the equipment of CERN particle accelerators is vital to keep them operating reliably. Accelerator equipment needs consolidation because of wear and tear to systems, loss of key knowledge, unmaintainability due to subsystems going out of production. In order to reduce the number of technologies to maintain, there has also been a large amount of rationalisation of the types of technology, sometimes meaning otherwise fit-for-purpose equipment is replaced by other technology choices used elsewhere at CERN.

CERN's three primary hadron beam accelerators are the topic of this paper's review of the consolidation requests. They consist of

- Linac2 - 50MeV proton linear accelerator, to remain in service up to 2018 (LS1).
- Linac3 - 4.2MeV/u ion linear accelerator, to remain the future source of ions.
- Linac4 - 160MeV H- linear accelerator, to become the supplier of hydrogen ions from LS1.

Linac3 was constructed through a collaborative effort in the early 1990's and has left a lot of unique equipment.

Linac4 is itself a new facility, but will reuse part of the transfer line presently from Linac2 to the PSB. There are consolidation requests for equipment in this line.

Within this report the main requests for consolidation at these facilities will be summarised, and priorities given from an operational point of view. The operational priorities reflect items that stop the beam production, are single points of failure that cannot easily be overcome, or require a lot of operational support. These priorities are possibly different from those expressed from the equipment group concerned, but both views must be balanced in the prioritization of funding.

Priority 1 is the highest. If no priority is given the task is understood to already be funded by the consolidation project. The date given indicates the best time for the

system to be installed on the accelerator or beam line, if this is relevant.

## *Linac2*

The consolidation requests for Linac2 can be found in Table 1. The very few requests reflect the short time left as part of the injector chain.

## *Transfer Line*

Part of the LT and LTB transfer lines will continue to be part of the LHC injection chain with Linac4.

All the requests are fully justified, and the prioritisation reflects the importance and benefit to operation of having these tasks completed.

The exact combination of magnets and power convertors is not fully finalised, and might lead to additional consolidation proposals.

Although not part of the transfer line, EN-ICE request funds to software support for the low energy emittance meter as part of their continuous software update programme.

## *Linac3*

The Linac3 accelerator was built on a tight budget in the early 1990's, and used in kind contributions from many institutes. Although now fully supported by CERN's equipment groups, much equipment is now more than 20 years old, and some equipment was recovered from Linac1. Furthermore, institutes often provided unique solutions to requirements (which was divided into machine regions), which in particular for magnets and power convertors lead to a large number of system varieties that are difficult to support and maintain spares for, even if they work reliably today.

## *Generic PS requests that affect Linacs*

Several requests are generic for equipment used at CERN and in the PS complex. Amongst these a request from BE-CO to replace the TTL-Blocking timing repeat units is a priority, these systems fail several times a year in the PS complex, and they have no inbuilt diagnostics meaning the cause of faults is often difficult to diagnose.

Table 1: Linac2 consolidation requests

Item	Priority	Group	When	Approx Cost / Approved
Tank Quadrupole Failure Mitigation EN/MME are not confident on the procedure to make a drift tube. Remake drawings and build a prototype (of a presently leaking DT). Useful only if approved now and finished end 2015.	2	BE/ABP EN/MME + others	-	No
Spare RFQ amplifier. Increases difficulty of repair.	-	BE/RF	-	-

Table 2: LT-LTB-BI Linac to PSB transfer line consolidation requests

Item	Priority	Group	When	Approved
Replacement magnets (spares, and operational) (Some convertors are replaced under LIU)	-	TE-MSC	LS2	>1300 kCHF Yes
Power Convertor Controls to FGC3 for ~100 convertors Would eradicate MIL1553 from Linac4 up to PSB injection Decreased maintenance diversity for EPC. Improves ion LBS measurements post LS2 = higher operational priority.	2	TE-EPC	LS2	800 kCHF No
Turbo Pumps Not active – used for pre-pumping, leak detection. If failing these pumps are inaccessible – leading to longer downtime. VSC would prioritise these in their consolidation.	1	TE-VSC	LS2	540 kCHF No
BCTs – exchange of 40yo to Linac4 standard on the LT and LTB line.	-	BE-BI	EYETS	350 kCHF Yes
Emittance meter scanner software – Maintenance of code with new base software versions (e.g. Labview) Maintains development and qualification of Linac4 sources in the test stand.	1	EN-ICE	N/A	0.5FTE ~35 kCHF No
Renovate the HVAC in building 363, for powering of Linac4 to PSB equipment.	2	EN-CV	LS2	270 kCHF No
Warm Magnet Interlock Many magnets are completely unprotected. They have to run at <2xI for Linac4. Would be best coupled with EPC FGC and any magnet installation.	1	TE-MPE	LS2 – with convertor control	150 kCHF (part of 1800 kCHF for full PS complex) No

Table 3a: Linac3 consolidation requests.

Item	Priority	Group	When	Approved
HVAC replacement Must include a major asbestos clean up – not budgeted. Cooling has been a persistent operational issue for Linac3. Post LS1 we will increase typical rep rate from 2 -> 3.6Hz – MD showed little margin for this. Increased operational workload, beam downtime and performance restrictions in summer, to become worse post LS2 if not consolidated.	1	EN-CV GS-SE	LS2	1300 kCHF No
Replace many power convertors in Linac3, including controls. Remove multiple design types, increasing maintainability. Air heat load should not be increased. Some PCs lack spares – they should be prioritized more highly.	2	TE-EPC		900 kCHF No
LBS Line – consolidate for ions. Also requested to LIU-Ions – Negotiation needed. Renovation is best in LS2 when zone is modified for LBE line anyway (easing access).	2	BE-ABP	LS2	1000 kCHF No
Linac3 Triplet Drift tubes There are spares – but possible recurring water leak issue on brazing – Replacement takes ~8-10 weeks. Priority to be modified if one fails.	2	BE-ABP	-	500 kCHF No
The LLRF, upgrade to the Linac4 standard. ABP ops are happy with the present system which fulfils specs and is easy to use.	2	BE-RF	2017	350 kCHF No
Spare magnets and coils. Menagerie of different magnet types, without spares.	-	TE-MSC	Spares	335 kCHF Yes
Turbo pump group renovation High gas loads from the source, even for Pb with O <sub>2</sub> . Higher operational downtime. Adds remote control.	1	TE-VSC	LS2	315 kCHF No
101 MHz amplifiers (Bertronix) Change driver tubes to solid state (the tubes are out of production and spares are finite), Replace Step5 control and interlocks, some amplifier parts reaching end of life.	1	BE-RF	LS2	250 kCHF No
Replace Thompson 14GHz Generator Can delay this until the Thompson generator fails. But that would mean 1 year without a spare.	2	BE-ABP	Wait for failure	150 kCHF No
Replace Critical Source spares when used	-	BE-ABP	2014-2018	150 kCHF Yes
BCT hardware consolidation Replace 40yo BCT on ITH transfer line	-	BE-BI	2014	50 kCHF Yes
Stripper Mechanism – Old, unmaintained design with no spare bellow. Almost complete.	-	EN-STI	2015	106 kCHF Yes
Low energy beam bending chamber Missing spare for this complex rectangular chamber, suffering from beam damage. Being financed from operation money, which leads to holes elsewhere.	1	TE-VSC	Now	100 kCHF No

Table 3b: Linac3 consolidation requests.

Item	Priority	Group	When	Approved
The driver amplifiers for bunchers, debuncher and ramping cavity; Missing spare amplifier for ramping cavity. All three systems are becoming obsolete.	1	BE-RF	LS2	60 kCHF No
Ion Pumps damaged after Ar run Poor vacuum degrades Pb beam performance.	1	TE-VSC	2015	30 kCHF No
The Frank James amplifiers. Replacement of small parts.	1	BE-RF	2016	25 kCHF No
Critical cavity spares (tuners, couplers) for RFQ, IH, bunchers etc. Includes potentially critical items without spares.	1	BE-RF	?	?