

LHC Injectors Upgrade Project

- Organization & Resources -

R. Garoby with the help of M. Meddahi,
using information from GLs and DPOs of TE, EN and BE,
collected with the support of K. Hanke and V. Mertens
and consolidated by J.P. Matheys

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1. LIU Project

Objectives

• Mandate

“The LHC Injectors Upgrade should plan for delivering reliably to the LHC the beams required for reaching the goals of the HL-LHC. This includes LINAC4, the PS booster, the PS, the SPS, as well as the heavy ion chain.”

• Implementation

The LIU Project will:

- Analyse the HL-LHC requirements and propose an upgrade path for the injectors, exploiting the work done by the Task Forces on the „PSB energy upgrade“ and on the „SPS upgrade“,
- Organize the upgrades (WBS with resources and planning) and take care of their realization.

Organization

- **Project team**

LIU Project Leader: R. Garoby – Deputy: M. Meddahi

Linac4 Project Leader	M. Vretenar
PSB Upgrade Coordinator	K. Hanke
PS Upgrade Coordinator	S. Gilardoni
SPS Upgrade Coordinator	B. Goddard

- **Short term plan**

- First meeting of the Project Team: week October 18
- Weekly meetings afterwards
- Off-site meeting with participation of main TF contributors: before end of 2010

Planning

- **Chamonix 2011**

Presentation of procedure followed by the LIU Project + synthesis of questions and required studies at the beginning of 2011 (short talk at the beginning of discussion after the last presentation in the LIU session)

- **April 2011 (for MTP 2011)**

- Recommended upgrade path(es) (technical proposals)
- Detailed work plan for 2011 and 2012 with resources
- Baseline work plan for 2013 till 2016 with resources

2. Estimates of resources, as obtained by the Task Forces

Preliminary Comment

Although the work done prior to the LIU Project will be fully exploited, the upgrade path recommended for the LIU Project may differ from the conclusions of the TFs because:

- Options are still open or not precisely defined (e.g.: e-clouds in the SPS, collimation and scraping, ...)
- The PS, which was not in the mandates of the Task Forces, deserves analysis and certainly needs action
- Results from recent MDs in the injectors have to be taken into account
- Experience operating the LHC will influence the requirements
- The rate of implementation has to correspond to an acceptable spending profile for the organization.

Task Forces summaries (1/2)

[K- Hanke]

PSB 2 GeV

Including Consolidation

	Increased RMS Current [kCHF]	Including Consolidation	
	all beams	Consol. Budget	Increased RMS Current [kCHF] all beams
Total Beam Dynamics	50	0	50
Total Magnets	3850	-210	3640
Total Magnetic Measurements	111	0	111
Total RF	14320	-14320	0
Total Beam Intercepting Devices	700	-700	0
Total Power Converters	20850	-6630	14220
Total Vacuum System	100	0	100
Total Beam Instrumentation	67	-10	57
Total Commissioning	50	0	50
Total Extraction, Transfer, Injection	5763	-550	5213
Total Controls	116	0	116
Total Electrical Systems	1700	0	1700
Total Cooling & Ventilation	5500	-4500	1000
Total RP and Safety	0	0	0
Total Transport and Handling	680	-400	280
Total Survey	50	0	50
Total Project	53907	-27320	26587

Estimates of resources

Task Forces summaries (2/2)

[V. Mertens]

SPS upgrade

Item	Year	2011	2012	2013	2014	2015	2016	2017	Sum
	Budget (in MCHF)								
ZS		0.0	0.1						0.1
Magnet coating (existing chambers)		1.8	2.1	0.3					4.2
Magnet coating (new chambers)		5.8	3.6	2.2	2.6	4.4			18.6
Collimators		0.7	0.7	0.7	2.4	2.4	1.0	1.1	8.9
Wide band transverse feedback		1.4	0.5						1.8
200 MHz RF system		0.9	1.6	2.8	12.2	7.5	1.7		26.5
Beam instrumentation upgrades		0.1	0.8	0.5	0.5	0.3			2.1
New beam dump system		0.3	0.8	1.2	2.3	2.3	1.2		8.1
New extraction kickers		0.3	0.7	1.0	1.8	2.0	0.6		6.4
Sum (case of coating on existing chambers)		5.4	7.1	6.5	19.1	14.4	4.5	1.1	58.1
Sum (case of coating on new chambers)		9.4	8.7	8.4	21.7	18.8	4.5	1.1	72.5

Item	Manpower (in m-y)								
ZS		0.3	0.7						1.0
Magnet coating (existing chambers)		5.4	6.6	1.0					13.0
Magnet coating (new chambers)		5.9	4.3	2.7	3.3	8.3			24.5
Collimators		2.7	2.7	2.7	10.1	11.1	4.1	2.5	35.9
Wide band transverse feedback		2.0	2.0	1.0					5.0
200 MHz RF system		2.0	3.0	4.5	5.8	5.5	4.3		25.0
Beam instrumentation upgrades		0.2	0.2	0.6	1.0	0.5			2.5
New beam dump system		0.7	1.3	4.0	7.3	7.9	5.2	2.0	28.4
New extraction kickers		1.0	2.3	4.8	6.2	6.7	5.3	1.9	28.2
Sum (case of coating on existing chambers)		14.3	18.8	18.6	30.4	31.7	18.9	6.4	139.0
Sum (case of coating on new chambers)		14.8	16.5	20.3	33.7	40.0	18.9	6.4	150.5

Estimates of resources

Data from GLs and DPOs (1/4)

BE

LIU "Missing Manpower"

	2011	2012	2013	2014	2015	TOTAL	
RF							
Injectors upgrade - Not accepted in consolidation	3.6	7.1	3.1	1.3	0.2	15.3	Included in SPS Upgrade sheet
SPS upgrade - Wideband transverse feedback	2.0	2.0	1.0			5.0	
SPS upgrade - 200 MHz RF system	2.0	3.0	4.5	5.8	5.5	20.8	
BI							
SPS upgrade - Needs on top of what's in "25-year consolidation"	0.0	0.0	0.0	0.0	0.0	0.0	One fellow needed 2013-2015
PSB upgrade - Needs on top of what's in "25-year consolidation"	0.0	0.0	0.0	0.0	0.0	0.0	
ABP							
PSB - Collective effects studies	0.5	0.5	0.5	0.5	0.5	2.5	One fellow needed 2011-2015
PSB - Single particle dynamics and optics	0.5	0.5	0.5	0.5	0.5	2.5	One fellow needed 2013-2015
PSB - Commissioning							Only in 2017-2018 (?)
PS - Collective effects studies	0.5	0.5	0.5	0.5	0.5	2.5	One fellow needed 2011-2015
PS - Single particle dynamics and optics	0.5	0.5	0.5	0.5	0.5	2.5	One fellow needed 2011-2015
PS - Commissioning							Only in 2017-2018 (?)
SPS - Collective effects studies	2.0	2.0	2.0	2.0	2.0	10.0	Two fellows needed 2011-2015
SPS - Single particle dynamics and optics	0.5	0.5	0.5	0.5	0.5	2.5	One fellow needed 2013-2015
SPS - Commissioning							Only in 2017-2018 (?)
LIU management	0.5	0.5	0.5	0.5	0.5	2.5	
OP							
LIU management	0.5	0.5	0.5	0.5	0.5	2.5	
						68.6	

Estimates of resources

Data from GLs and DPOs (2/4)

			2011	2012	2013	2014	2015	TOTAL
PBU-PRJ - PSB Upgrade project	TE-ABT	Provide kickers for PSB upgrade	1.5	3.5	4.5	4.0	3.0	16.5
		Provide septa for PSB upgrade	0.1	0.4	1.9	1.2	0.7	4.3
		Provide studies for PSB energy and PS injection upgrade	0.1	0.2	0.2	0.1	0.1	0.7
	TE-EPC	PSB 2GeV auxillary converters			3.6	5.6	5.6	14.8
		PSB 2GeV capacitor discharge			2.4	2.6	2.6	7.6
		PSB 2GeV new MPS electronic for PSB 2GeV		1.0	3.3	5.2	5.2	14.7
		PS Booster upgrade	0.2	0.2	0.6	0.7		1.7
TE-ASC	ABT studies for SPS upgrades	0.8	0.7	0.6	0.6	0.6	3.3	
SPU-PRJ - SPS Upgrade	TE-ABT	Provide electronics and controls for injector chain improvement - SPS Fast Extraction System				0.3	0.9	1.2
		Provide electronics and controls for injector chain improvement - SPS Beam Dump System				1.0	1.5	2.5
		Provide new MKD kickers for SPS upgrades		1.0	1.0	1.6	1.8	5.4
	TE-ASC	Provide new MKE kickers for SPS upgrades		1.0	1.0	1.6	1.8	5.4
	TE-ASC	SPS Upgrade	1.2	1.2	1.2	1.2	1.2	6.0
	LIU management		1	1	1	1	1	5.0
			3.9	9.2	22.7	28.5	27.8	97.1

Estimates of resources

EN

Data from GLs and DPOs (3/4)

Estimates of resources

				2012	2013	2014	2015	TOTAL
PBU-PRJ - PSB Upgrade project	EN-CV	Consolidation PS injector	[Needed] Engineer consolidation PS injector (cooling)			0.5	0.5	1.0
			[Needed] Ventilation process engineer	0.5	0.5	0.5	0.5	2.0
			[Needed] Work Supervisor PS injector (electricity)			0.5	0.5	1.0
			[Needed] Work Supervisor PS injector (ventilation)			0.5	0.5	1.0
								5.0

Data from GLs and DPOs (4/4)

TOTAL IN ACCELERATOR SECTOR (man.years)

	2011	2012	2013	2014	2015	TOTAL
BE	13.1	17.6	14.1	12.6	11.2	68.6
TE	4.9	10.2	23.7	29.5	28.8	97.1
EN		0.5	0.5	2	2	5
Total	18	28.3	38.3	44.1	42.0	170.7

Estimates of resources

3. Comments

Comments

- **Data is incomplete (e.g.: PS, radioactive waste management,...), imprecise because of the insufficient definition of the technical solutions and is inconvenient for integration**
- **Proposed assumptions at this stage:**
 - Total material cost (2011-2015): 26.6 MCHF (PSB) + 52.5 MCHF (SPS) = 79.1 MCHF
 - Manpower estimate (2011-2015): $79.1/0.2 \sim 400$ man.years
 - Since TFs estimates are ~ 200 man.years, assume that all the listed manpower is missing (\Rightarrow 50% can be found from existing staff)
- **Proposed planning:**
 - Until Chamonix2011: LIU project team assembled and trained
 - Chamonix2011: synthesis of available information, list of open questions and required studies at the beginning of 2011
 - Until April 2011: analysis and MDs, preparation of proposal(s)
 - April 2011 (MTP): recommendation of upgrade path(s) (technical proposals):
 - Detailed work plan for 2011 and 2012 with resources
 - Baseline work plan for 2013 till 2016 with resources