Hol

ESS MEBT Mechanical Layout Workshops, 2-5 June 2015

Meeting Dates
2 – 5 June 2015

Location
ESS Bilbao, Spain

Joint-Chairmen
Ibon Bustinduy, Matthew Conlon

Secretary
Matthew Conlon

1. Purpose

To jointly confirm the requirements and to develop the conceptual design (mechanical layout) for MEBT including for quadrupoles, beam instrumentation, bunchers and to the degree possible, chopper and beam dump.

2. Participants

Name		Partner Org	Specialty
Aitor Zugazaga	AZ	Bilbao	vacuum systems
Aurélien Ponton	AP	ESS	accelerator systems
Carlos de la Cruz	CC	Bilbao	Control
David Fernandez	DF	Bilbao	electro magnetic
Fabien Rey	FR	ESS	alignment systems. Participated via Skype, 2 June.
Giles Harper	GH	Bilbao	electric systems
Ibon Bustinduy	IB	Bilbao	MEBT WU Leader, accelerator systems
Igor Rueda	IR	Bilbao	mechanical design
Juan-Luis Muñoz	JM	Bilbao	electro magnetic
Marcelo Ferreira	MF	ESS	vacuum systems
Matthew Conlon	MC	ESS	MEBT WU liaison
Pedro Gronzález	PG	Bilbao	Technical Director
Ryoichi Miyamoto	RM	ESS	beam physics
Seadat Varnassari	SV	Bilbao	beam physics and instrumentation
Tom Shea	TS	ESS	beam instrumentation
Zvonko Lazic	ZL	ESS	mechanical design
Carlos Martinez de Marigorta	CM	Bilbao	Alignment systems. Participated via Skype, 2 June.
Idoia Mazkiaran	IM	Bilbao	Control
Jon Bilbao	JB	Bilbao	Electric systems

3. Agenda, presentations and supporting information

See Indico site: https://indico.esss.lu.se/indico/event/351/

4. Minutes of Meeting

Date / Time	Agenda item and Discussion	Lead participants
2 June		
15:00-16:00	Alignment requirements and design input for stands/support *See the Indico site for FR's presentation and report for this workshop conducted via Skype.*	IB, FR, IR, CM
3 June		
afternoon	Vacuum requirements and design *See the Indico site for MF's presentation and report for this workshop.*	MF, AZ, IM, GH, JB
4 June		
09:00-09:30	Introduction IB welcomed the visitors. MC and IB described the purpose of the workshops, adjusted the agenda items, and summarized the outcomes from workshops, which occurred 2-3 June.	MC, IB
09:30-10:30	Confirm MEBT Level 3 (L3) requirements IB presented the L3 requirements from DOORS and discussed these with AP and the participants: • explaining ESS Bilbao's understanding of each requirement • identifying missing references and missing values or parameters in the requirements, shown as 'XXX', • proposing values or parameters where they were missing • proposing additions, deletions and other changes See actions nr. 1 to nr. 9, inclusive.	AP, IB
10:30-12:30	Beam physics lattice design - MEBT 2015.v0c *See Indico site for RM's presentation.* RM's presentation included specific comments to ESS Bilbao's spreadsheets MEBT_2015_v3_integrated.xlsx of approximate date 150520. ESS and Bilbao agreed the lattice MEBT 2015.v0c as presented by RM. To avoid confusion, the spreadsheets MEBT_2015_v3_integrated.xlsx has not been included in the Indico site, since ESS and Bilbao agreed to adopt the new lattice MEBT 2015.v0c and the	RM, AP, IB

Date / Time	Agenda item and Discussion	Lead participants
	resulting locations presented by RM. The centre locations in the mechanical layout (ESS-34690) presented later in the agenda by ZL, fully complies with MEBT 2015.v0c. See actions nr. 10 to nr. 12, inclusive.	
12:30-13:00	Confirm L4 Beam Magnets and Deflectors (BMD) requirements - Chopper pulser Bilbao has been in discussions with three potential suppliers for the chopper pulser – Kentech Instruments (UK) and FID (Germany), IXYS Colorado (USA). GH presented the L4 BMD requirements for the chopper's pulser and discussed these with AP and the participants: • explaining ESS Bilbao's understanding of each requirement • identifying missing references and missing values or parameters in the requirements, shown as 'XXX', • proposing values or parameters where they were missing • proposing additions, deletions and other changes See actions nr. 13 to nr. 18 inclusive.	GH, AP, SV, CC
14:00-15:30	Mechanical Layout including RFQ-MEBT and MEBT-DTL interfaces L3 interfaces ZL presented layout schematics ESS-003490 which conformed to 'optical' centre locations from lattice configuration MEBT 2015.v0c, without flanges or bellows. ESS-003490 includes proposed interface design for RFQ-MEBT and MEBT-DTL not yet agreed between Bilbao and INFN. Given the constraints presented by RM (slide 7) Bilbao (IB, IR) considered solution a), where BSM, NPM, GRID and FC are located between Q7 and Q8 as best alternative. To be studied the required actual length of this section and for WS and SLIT device between Q6 and Q7. this section is agreed to use as a basis for MEBT 3D model going forward. First ACCT belongs to RFQ, therefore between Q1 and Q2 a single WS is required. Both end vacuum valves belong to RFQ and DTL respectively. See actions nr. 19 to nr. 20 inclusive.	ZL, AP, IR
15:30-16:00	Confirm L4 Electro-Magnetic Resonator (EMR) requirements PG presented the L4 EMR requirements for buncher cavities and discussed these with AP and other participants: • explaining ESS Bilbao's understanding of each requirement • identifying missing references and missing values or parameters in the requirements, shown as 'XXX', • proposing values or parameters where they were missing	IB, AP, PG

Date / Time	Agenda item and Discussion	Lead participants
	• proposing additions, deletions and other changes See actions nr. 21 to nr. 23 inclusive.	
16:00-16:30	Confirm L4 Radio Frequency (RF) requirements See actions nr. 19 to nr. 21 inclusive.	IB, AP
16:30-17:30	Review the design drawings for MEBT bunchers ZL and MF made a preliminary review of the CAD drawings for the proposed prototype / first production buncher procurement. The assessment was that the design was not yet sufficiently mature for procurement. See actions nr. 24 to nr. 25 inclusive.	IR, ZL, MF
17:30-18:00	Review of draft L4 Proton Beam Instrumentation (PBI) requirements ESS and Bilbao had discussed PBI requirements and specifications for MEBT before, but ESS had not provided a list of L4 requirements for PBI before. AP presented a first draft proposed list of requirements with the aim. When agreed by both parties, these L4 MEBT PBI together with specifications for some specific instruments, such as the Emittance Measurement Unit (EMU) would be included with the IKC Agreement technical annex (Schedule). See actions nr. 26 to nr. 34 inclusive.	AP, IB, SV
5 June		
09:00-10:00	Confirm remaining L4 Beam Magnets and Deflectors (BMD) requirements IB presented the remaining L4 BMD requirements and discussed these with AP and other participants: • explaining ESS Bilbao's understanding of each requirement • identifying missing references, missing values or parameters in the requirements, shown as 'XXX', and undefined terms / definitions • proposing values or parameters where they were missing • proposing additions, deletions and other changes See actions nr. 35 to nr. 48 inclusive.	IB, AP, MF, TS, JM, DF
11:00-12:00	General discussions on mechanical layout design Including integration of quadrupoles and instruments, and design for vacuum See actions nr. 19, 20 and 49	ZL, IR, MF, TS, RM, TS, AP, IB, MC
12:00-12:30	Conclusions See summarising actions: • action nr 25 (date for CDR Buncher in Bilbao) and • action nr 46 (review meeting 30 June/01 July in Lund)	all

5. Actions. Updates 150703

Nr	Action	Who	Due
1	Clarify ESS Bilbao's MEBT-related scope and responsibilities in regards to L2 Accelerator and L3 MEBT (section) requirements Statements are to be included in the IKC Agreement Schedule (technical Annex) for MEBT to describe ESS Bilbao's scope and responsibilities in regards to achieving L2 and L3 requirements included in the IKC Agreement. Where necessary, the description and clarification statements of particular L2 and L3 requirements included in the IKC Agreement, should specifically define ESS Bilbao's scope and responsibility in regards to that requirement for MEBT. The wording for the IKC Agreement in this regard is under discussion. This has not been actioned in draft IKC Agreement Schedule, ESS-0034700_150702.	MC, AP	150810
2	L3 MEBT SyR-11 Beam Transmission L3 MEBT SyR-15 Beam Collimation Unclear requirement. Amend the description to clarify the requirement.	AP (TS,RM)	Completed. See DOORS
3	L3 MEBT SyR-16 Beam current range Unclear requirement. Reword the description and/ or add clarification text. Possibly remove the 'maximum step size' phrase.	AP	Completed. See DOORS
4	L3 MEBT SyR-17 Operating vacuum pressure Unclear requirement. Reword the description and/ or add clarification text.	MF (AP)	Completed. See DOORS
5	L3 MEBT SyR-18, 19, 20, 21 Pulse length parameters Unclear responsibilities between ESS and Bilbao in regards to controlling these parameters and being able to achieve these requirements in MEBT. Reword the description and/ or add clarification text to better clarify responsibilities.	AP (TS)	Completed. See DOORS
6	L3 MEBT SyR-23 Ambient air temperature L3 MEBT SyR-24 Humidity level Requirements are repeated as L2 and L3 requirements.	AP (IB)	Completed. See DOORS
7	Missing L2 or L3 requirements for MEBT operating modes. ESS (AP) to consider whether to provide requirements for MEBT operating modes, states and conditions. The outcomes of ESS internal discussions on this subject should be communicated to Bilbao by the due date. Under consideration by AP and under internal discussion at ESS.	AP (TS)	150810
8	Missing L2 or L3 requirements for Reliability. ESS (AP) to consider providing requirements for required MEBT reliability. Options under consideration are: • a system-level reliability target for MEBT, or • reliability targets for selected components, for example for Buncher, Quadruples and/or Chopper. The outcomes of on-going ESS internal discussions on this subject should be communicated to Bilbao by the new due date.	AP (TS)	150810
9	Missing L2 or L3 requirements for Maintainability As per Action #8. The outcomes of on-going ESS internal discussions on this subject should be communicated to Bilbao by the new due	AP (TS)	150810

	date.		
10	Register the lattice design MEBT 2015.v0c in CHESS and ensure that LegoLinac (David McGinnis responsible) and Accelerator integrated model (Nick Gazis responsible) is updated accordingly. ESS is in the process of formalising the identification of the Controlled Items (CI), that is, documents and data, which comprise the Baseline for linac systems at PBS Levels 2- 5, including for MEBT section, and the MEBT system and components delivered by ESS Bilbao. It is unlikely that MEBT 2015.v0c will be a Baseline CI. It is not conformed whether or not, or how LinacLego will be maintained as a repository for Baseline CI.	RM, MC	Completed.
11	Beam-line length allocated for Emittance Measurement Unit (EMU). Lattice design MEBT 2015.v0c allocates a beam-line length of 350mm between Quadrupole (Q) 7 and Q8, for EMU. RM's modelling shows that a length at least of approximately 400mm and perhaps even 450mm, may be acceptable. AP to investigate with Accelerator's Integration Group (AIG) to determine if 350mm is a maximum allowable length for EMU for MEBT in regards to tunnel systems integration, and whether an increase of up to 50mm may be allowable.	AP (RM, TS, IB)	Cancelled. No action necessary until there is a design need to vary from 350mm.
12	Add identifiers and notes to the MEBT layout drawing: • add lattice version identification 'MEBT 2015.v0c' • add identification for beam instruments • add numbering for quadrupoles and buncher cavities e.g. QV 1, CAV 2	ZL	Completed See ESS-0034690.
13	Pulser manufacturers have a standard for pulser triggers, and Bilbao (GH) suggests that there should not be a requirement for pulser triggering. AP to discuss with ESS ICS Machine Protection Group (Annika Nordt). See changed Requirement L4 MEBT.BMD-84	AP	Completed. See DOORS.
14	L4 MEBT.BMD-77 Chopper Nominal Beam Deflection Angle ESS to confirm the value of 4,0 KV in the clarification comments. Requirement is re-titled L4 MEBT.BMD-77 Chopper Maximum Effective Voltage and clarified.	AP	Completed. See DOORS.
15	L4 MEBT.BMD-80 Chopping Efficiency ESS to consider moving this requirement to L3, and rewording or providing clarifying comments to define ESS and Bilbao responsibilities. This requirement has not been moved but its wording has been clarified.	AP	Completed. See DOORS.
16	Not used	-	-
17	L4 MEBT.BMD-83 Chopper Voltage Operating Micro-Pulse Length L4 MEBT.BMD-84 Chopper Voltage Maximum Micro-Pulse Length Bilbao (GH) consider the range of values in requirements BMD-83 and BMD-84 may be unachievable using a single, standard pulser, and hence may be unacceptable technical risk and potential cost and schedule risk. AP to review the requirement, and discuss with ESS ICS Machine Protection Group (Annika Nordt). AP to advise Bilbao of the outcomes. Requirements L4 MEBT.BMD-83 has been deleted. Requirement L4 MEBT.BMD-84 Chopper Voltage Micro-Pulse Length has been clarified.	AP	Completed. See DOORS.
18	L4 MEBT.BMD-89 Chopper Micro-Pulse Voltage Flat-Top Jitter L4 MEBT.BMD-90 Chopper Post-Pulse Noise	AP	Completed. See DOORS.

	ESS to review the requirement values of +/-0.001 of the nominal voltage. Bilbao proposes removing this requirement from L4. Requirement L4 MEBT.BMD-89 Chopper Micro-Pulse Voltage Flat-Top Jitter has been clarified. Requirement is re-titled L4 MEBT.BMD-90 Chopper voltage fall time and clarified.		
19	ESS (ZL) will update ESS-0034690 in accordance with Action 12 and other comments noted during the meeting, confirm data exchange locations and formats with ESS' Accelerator integrator (Nick Grazis) and provide ESS-0034690 CAD data to Bilbao for use in Bilbao's MEBT 3D model (Catia v5).	ZL	Completed.
20	Bilbao (IR) will update the 3D model with input from ESS-0034690, and other inputs as a result of these workshops and on-going design work for quadruoples, beam instruments, chopper, dump and bunchers, and provide this to ESS. Bilbao (IR) to advise ESS (ZL, Nick Grazis and Peo Gustavsson) whether this action has been fully completed. ESS requests that Bilbao upload to CHESS an updated 3D model for MEBT which incorporates the agreed changes.	IR	150626 Bilbao to propose a date.
21	L4 MEBT.EMR-SyR-41 Number of RF pick-up probes ESS to review the number of pick-up probes, and consider tagging this as an interface requirement.	AP	150731
22	L4 MEBT.RF- 60, 70, 80, 90, 100, 110, 120 LLRF ESS (AP) to review these with WP 8, Anders Johansson.	AP	150731
23	L4 MEBT.RF-130 Define cavity frequency tuning range	AP	150731
24	CAD drawings for MEBT buncher ESS (MF, ZL) will review the buncher drawings from vacuum and general mechanical design point-of-view and provide written comments to Bilbao (IR, IB).	ZL, MF	Completed.
25	Date for Critical Design Review (CDR) for MEBT Buncher ESS (MC) recommended that a CDR was necessary so that all ESS interfacing work packages could review the buncher design and procurement specification prior to Bilbao going to procurement. MC requested that Bilbao (PG, IB) review the current schedule for procurement and testing of bunchers to determine an earliest date for CDR in Q3 2015.	PG, IB	Completed.
26	ESS to generally review all draft L4 PBI requirements. Some requirements might be moved to L3. For others, the description may need to be amended or clarification comments included to better define ESS' and Bilbao's respective responsibilities in achieving each requirement. This 'action' is agreed by ESS and Bilbao to be mutually beneficial for the clear identification and execution of responsibilities. It is on-going and shall be continued. More specifically, see action #1.	AP	Action closed.
27	MEBT-L4-PBI-010, 020, 030, 040 Beam diagnostic device operating domain ESS to rewrite these requirements to align with descriptions for beam modes as proposed by TS.	AP (TS)	150731
28	MEBT-L4-PBI-060 Beam current measurement: accuracy Express this value as ± 1mA.	AP	150731
29	MEBT-L4-PBI-070 Beam current measurement: resolution Delete resolution insert precision. Amend the description to clarify	AP	150731

	ESS' need with this requirement.		
30	MEBT-L4-PBI-110, 120 Transverse phase space measurement AP to discuss with Benjamin Cheymol to clarify these requirements. It may be appropriate to incorporate these into L5 specifications, rather than as L5 requirements.	AP	150731
31	MEBT-L4-PBI-200 Transverse beam position measurement: number of measurements Reword this requirement to take into account the agreed configuration of steerers and connected BPM in MEBT.	AP	150731
32	MEBT-L4-PBI-200 Number of BPMs Number of BPMs and their electronics should be consistent. Confirm the number of BPMs required.	AP, RM	150731
33	MEBT-L4-PBI-210 accuracy Question from Bilbao (SV): Should we clarify the required performance of BPMs in this or another requirement? (Single ended now?)	AP, TS	150731
34	MEBT-L4-PBI-XXX NPM Bilbao requests a requirement to clarify the minimum number of ports required for NPM.	AP, TS	150731
35	Definitions document ESS to create a definitions document, with ESS-00xxx reference number, to be used as a reference for terminology used in L4 BMD and potentially other sets of requirements, to avoid ambiguity in requirement titles and descriptions and to reduce the need to define terms in the clarifying text for each requirement. Started by ESS (AP), but not completed.	AP	150731
36	MEBT-L4-BMD-15 Nominal Effective Magnetic Field Length – Quadrupole MEBT-L4-BMD- 29 Steering Direction-Corrector Consider removing these requirements, or reword descriptions or include clarifying comments to make these requirements clearer. Also, it is necessary to define Magnetic field length. See action #35. MEBT-L4-BMD-15 has been removed. MEBT-L4-BMD- 29 Steering Direction-Corrector has been clarified.	AP	Completed. See DOORS.
37	MEBT-L4-BMD-20 Integrated Magnetic Field Gradient Uniformity – Quadrupole Bilbao (IB) proposes removing '±XX% and inserting ±1% Terms also need definition. See action #35.	AP	Completed. See DOORS.
38	MEBT-L4-BMD- 21 Harmonic Content - Quadrupole Bilbao (IB) proposes removing '±XX% and inserting: ± < 100 units per 1e4, or ±1% equivalent Terms also need definition. See action #35. AP to consider including in the description or in clarifying comments the request from MF that verification of this requirement must be done with chamber i.e. under vacuum. IB remarked that magnetic characterization is standard in-air procedure, and this should be untied from magnetic design/manufacturing process.	AP	Completed. See DOORS.
39	MEBT-L4-BMD- 25 Fringe Field Magnitude MEBT-L4-BMD- 26 Remnant Magnitude Field	AP	Completed. See DOORS.

	ESS to reword these requirements and potentially tagging these as interface requirements. Comment from TS that these requirements need to be traced to L4 BPI requirements. For -25 Fringe Field Magnitude Bilbao (IB) proposes removing '…less than XXX gauss' and inserting ±1% Terms also need definition. See action #35. Remove incorrect clarifications for MEBT-L4-BMD- 25 Fringe Field Magnitude.		
40	MEBT-L4-BMD- 27 Full Aperture Amend the requirement description to words similar to '1 mm free gap between chamber and magnet'	AP (MF)	Completed. See DOORS.
41	MEBT-L4-BMD- 28 Vacuum Chamber Inner Diameter Reword the requirement description to clarify that ESS Bilbao shall select a standard pipe diameter should be used, larger than 35.6 mm	AP, MF, IR	Completed. See DOORS.
42	MEBT-L4-BMD- 32 Nominal Magnetic Field Integral – Corrector MEBT-L4-BMD- 33 Operating Range - Corrector MEBT-L4-BMD- 34 Maximum Magnetic Field Integral - Corrector Consider removing BMD-32 (or make the nominal value '0') Consider rewording BMD-33 and -34. Ensure terms are defined. See action #35. MEBT-L4-BMD- 32 has been removed. MEBT-L4-BMD- 33 and -34 have been reworded and clarified.	AP	Completed. See DOORS.
43	MEBT-L4-BMD- 35 Magnetic Field Integral Uniformity - Corrector Ensure terms are defined. See action #35. Bilbao (IB) proposes removing 'better than XX%' and rewording to 'less than 20%'	AP	Completed. See DOORS.
44	MEBT-L4-BMD- 36 Harmonic Content - Corrector Bilbao (IB) proposes removing 'XX-pole' and inserting '10-pole' Bilbao (IB) proposes removing 'lower than xxx%' and inserting 'lower than 50%'	AP	Completed. See DOORS.
45	Add new MEBT-L4 requirement Consider adding a new requirement to address sextapole field. Ensure terms are defined. See action #35. See also clarification for MEBT-L4-BMD- 35 Magnetic Field Integral Uniformity – Corrector (Action#43)	AP	Completed. See DOORS.
46	MEBT-L4-BMD- 37 Radiation Hardness Reword this requirement to better describe the risk and radiation dose to protect against from neutron radiation.	AP	150731
47	MEBT-L4-BMD- 38 Fire Resistance MEBT-L4-BMD- 39 Magnetic Life Time MEBT-L4-BMD- 40 Electrical Safety Reword these requirements to better clarify these requirements more specifically for the MEBT and its quadrupoles. To be further discussed between ESS (AP) and Bilbao (IB).	AP	150731
48	Add new MEBT-L4-BMD(?) requirement(s) Consider adding a new requirements for movable beam dump for	AP	Completed. See

	MEBT chopper. See new requirements: MEBT-L4-BMD- 92 Chopper Dump vertical translation range MEBT-L4-BMD- 44 Chopper Dump vertical translation speed		DOORS.
49	IKC Agreement MEBT Technical Annex review meeting, 30 June or 01 July, Lund. It was proposed to meet to review the technical content for an IKC Agreement Schedule (technical annex). This Schedule would include updated versions of requirements and mechanical layout resulting from the actions from the workshops 2-5 June and any subsequent agreements. This review meeting is proposed at ESS Lund for 30 June or 01 July. ESS (MC) and ESS Bilbao (IB) to confirm the date. The meeting between ESS (MC, AP, ZL, MF, RM) and Bilbao (IB, IR) proposed for 30 June or 1 July in Lund did not occur.	IB, MC	Date to be agreed