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ENGINEERING SPECIFICATION

BTVs for electron beam line PART OF WP 4

ABSTRACT:

This engineering specification summarizes all the engineering work done related to the BTV beam profile measurement system in the electron beam line that is part of AWAKE Project Work Package 4.

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ANNEX A1 [TITLE].....		STAND ALONE DOCUMENT

1. PURPOSE AND SCOPE

This engineering specification summarizes **all the engineering work** done related to the beam transverse profile measurement system in the electron beam line that is part of AWAKE Project Work Package 4. More specifically, it describes the BTV system that has been engineered at system-level design; it lists the various **requirements** with respect to interfaces, integration with other systems and infrastructures, installation and commissioning; it summarizes the status with respect to management aspects such as cost, schedule and procurement.

2. ENGINEERING DESIGN

2.1 DETAILED DESCRIPTION OF THE SYSTEM/EQUIPMENT

The Engineering specification document describing the BTVs for the proton and common beam line gives a general description of BTV system. This document deals only with the BTVs installed in the electron beam line.

The electron line, visible at the right side of Figure 1 hosts only two BTVs. The emittance before the bending magnet is measured using a first BTV profile monitor and the quadrupole scan technique. The dipole bending magnet will be used as a spectrometer for the electron beam and a BTV station will be used to measure the beam profile. From the profile the absolute energy and the energy spread will be inferred.

For both stations CTFBIMTV tanks, currently used in CTF3 facility, will be reused after the stop of CTF3 (end of 2016).

[Narrative description of the system/equipment including various sketches, figures, etc. this sub-section is likely to be used in the AWAKE Project Technical Design Report editorial work.]

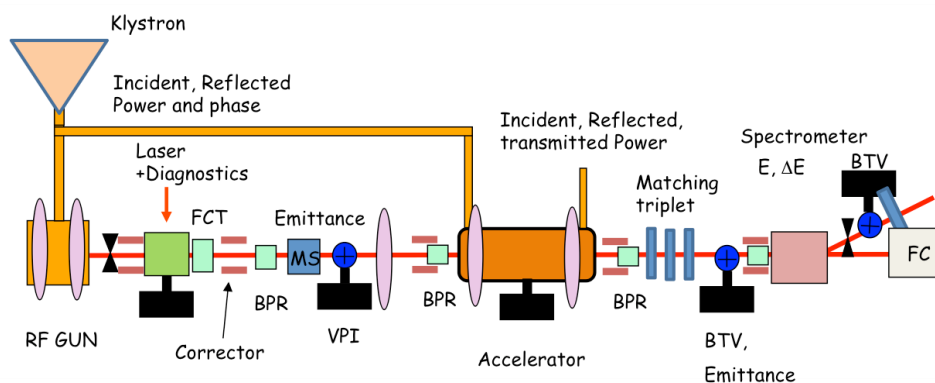


Figure 1 — Schematic drawing of the electron gun and the beginning of the electron beam line.

2.2 TECHNICAL PARAMETERS

The overall parameters of the BTVs are listed in Table 1

Parameter	Unit	Value
Spatial resolution	μm	50
Typical frame rate	Hz	1-10
Field of view	mm x mm	20x20 – 40x28
Type of source		e ⁻
Aperture diameter	mm	40
Mechanical length	mm	273

Table 1 – General technical parameters for BTVs.

2.3 PRODUCT BREAKDOWN STRUCTURE AND CODING

What follows is a general PBS for all BTVs.

PBS
1. Tank
1.1. vacuum chamber
1.2. vacuum chamber support
1.3. stepper motor or pneumatic actuator
1.4. screen support
1.5. OTR/scintillator screen
1.6. viewport
1.7. lamp for screen illumination
2. Imaging system
2.1. support for optical elements and camera (e.g. optical rail)
2.2. attenuation filters motor (e.g. filter wheel)
2.3. attenuation filters
2.4. single or multiple optical elements (lenses, mirrors)
2.5. camera
3. Data acquisition / control
3.1. power and data cables
3.2. BTV control card

Table 2 – General PBS for BTV systems

[The PBS / Bill of Material, and the items and functional position codes provided to date. This subsection can consist of a table.]

2.4 LAYOUTS AND SCHEMATICS

The Table 3 summarizes the BTV names, their positions and basic description.

Name	Position (m)	EDMS #	Notes
CC.MTV.0253 (BTV0)	1.63104	CTFBIMTV0001, CTFBIMTV0100, CTFBIMTV0101	To be reused from CTF3, new screens
CC.MTV.0970 (BTV1)	2.48504		

Table 3 – Layout names, position and EDMS numbers for BTVs

[This sub-section shall list the various layouts, schematics, process/utility flow diagrams (PFDs/UFDs), pipe and instrumentation diagrams (P&IDs) input/output lists, etc. that were prepared and released in the engineering design phase. This material can be presented as a table; the corresponding EDMS nos. shall be provided.]

2.5 CAD 3D-MOCK-UPS AND 2D-DRAWINGS

Name	EDMS #	Maturity
CC.MTV.0253 (BTV0)	CTFBIMTV0001, CTFBIMTV0100, CTFBIMTV0101	Drawings available for execution
CC.MTV.0970 (BTV1)		

Table 4 – BTVs 2D-drawings.

[This sub-section shall list the 3D-mock-ups and 2D-drawings that were prepared and released in the engineering design phase. This material can be presented as a table; the corresponding EDMS nos. shall be provided.]

2.6 MANUFACTURING, ASSEMBLY AND TESTS

These BTVs will be refurbished and new screens will be produced. A functionality tests followed by cleaning, vacuum tests and fine screen alignment are needed.

[This sub-section shall list all the provisions considered with respect to the manufacturing, assembly and tests of the system/equipment and its components.]

3. INTEGRATION AND INTERFACES

3.1 DIMENSIONAL REQUIREMENTS AND PARAMETERS

The dimensions of the BTV tanks and their supports are provided in the EDMS documents listed in Table 3. All these systems are already integrated in the beam line layouts.



[This sub-section shall summarize all the **requirements** and **parameters** in term of **space** required to install, operate and maintain the system/equipment, including mechanical interfaces with neighbour systems and equipment.]

/! The content of this sub-section shall be prepared together with EN-MEF-DS (configuration management section) and EN-MEF-INT (integration section).

3.2 UTILITIES REQUIREMENTS AND PARAMETERS

3.2.1 CONTROLS AND COMMUNICATION

For the BTV control see CERN document [CERN-AB-Note-2008-041-BI](#) and for the stepping driver EDMS #1474436.

[This sub-section shall summarize all the **requirements** and **parameters** in term of **controls**: accelerator controls, industrial controls, alarms, GSM/WIFI, fieldbuses, etc.]

/! The content of this sub-section shall be prepared together with BE-CO, EN-ICE, GS-ASE and IT-CO.

3.2.2 VACUUM

The vacuum requirements for the AWAKE beam lines (at the BTV positions in range of 10^{-8} to 10^{-7} mbar) are consistent with the BTV operation. For detailed specification of vacuum systems see EDMS #1410427.

[This sub-section shall summarize all the **requirements** and **parameters** in term of **vacuum**: bake-outs, sectorization, etc.]

/! The content of this sub-section shall be prepared together with TE-VSC.

3.2.3 AC AND PULSED ELECTRICAL POWERING

Only General Service for racks was requested by DIR document (EDMS #1481242).

[This sub-section shall summarize all the **requirements** and **parameters** in term of **electrical powering**: AC, pulsed, etc.]

/! The content of this sub-section shall be prepared together with EN-EL and TE-EPC.

3.2.4 CABLING

[This sub-section shall summarize all the **requirements** and **parameters** in term of **cables**: and cable pulling, incl. power cables, signal cables, optical fibres, etc.]

/! The content of this sub-section shall be prepared together with EN-EL.



3.2.5 CRYOGENICS

Cryogenics is not needed for the BTV systems.

[This sub-section shall summarize all the **requirements** and **parameters** in term of **cryogenics**.]

/! The content of this sub-section shall be prepared together with TE-CRG.

3.2.6 COOLING

Cooling is not needed for the BTV systems.

[This sub-section shall summarize all the **requirements** and **parameters** in term of **water cooling**: row water, demineralized water, chilled water.]

/! The content of this sub-section shall be prepared together with EN-CV.

3.2.7 VENTILATION

No special ventilation is needed for the BTV systems.

[This sub-section shall summarize all the **requirements** and **parameters** in term of **ventilation**.]

/! The content of this sub-section shall be prepared together with EN-CV.

3.2.8 COMPRESSED AIR

No compressed air is needed for the electron BTVs.

[This sub-section shall summarize all the **requirements** and **parameters** in term of **compressed air**.]

/! The content of this sub-section shall be prepared together with EN-CV.

3.2.9 ALIGNEMENT AND GEODESY

The BTV tanks have their own alignment system (see the drawing documents in Table 3). A standard BTV alignment procedure is defined and followed.

[This sub-section shall summarize all the **requirements** and **parameters** in term of **alignment and geodesy**.]

/! The content of this sub-section shall be prepared together with EN-MEF-SU.



3.3 INFRASTRUCTURE REQUIREMENTS AND PARAMETERS

3.3.1 CIVIL WORKS

Drilling to the floor is needed to attach the BTV supports.

[This sub-section shall summarize all the **requirements** and **parameters** in term of **civil works**.]

/!\ The content of this sub-section shall be prepared together with GS-SE.

3.3.2 METALLIC STRUCTURES AND SUPPORTING DEVICES

Each BTV has a defined support (see the drawings in Table 3). No additional structures are needed.

[This sub-section shall summarize all the **requirements** and **parameters** in term of **metallic structures and supporting devices**.]

/!\ The content of this sub-section shall be prepared together with EN-MEF and EN-MME.

3.3.3 HANDLING MEANS

Transport service will be used for the equipment transport to the AWAKE area and installation.

[This sub-section shall summarize all the **requirements** and **parameters** in term of **handling means**: transportation vehicles, cranes, etc.]

/!\ The content of this sub-section shall be prepared together with EN-HE.

3.4 INSTALLATION REQUIREMENTS

The equipment transported by the transport service to the final location will be installed by BI.

[This sub-section shall summarize all the **requirements** and **parameters** in term of **installation**: (preliminary) installation procedures, scaffoldings, transportation routes, services available for installation, etc.]

/!\ The content of this sub-section shall be prepared together with EN-MEF-OSS (installation organization and scheduling section).



3.5 COMMISSIONING REQUIREMENTS

Functionality tests will be performed.

[This sub-section shall summarize all the **requirements** and **parameters** in term of **commissioning**: (preliminary) hardware commissioning procedures, services required for commissioning, etc.]

[!] The content of this sub-section shall be prepared together with BE-OP and EN-MEF-OSS (installation organization and scheduling section).

4. ORAMS ASPECTS

The BTV system is well established in the whole CERN accelerator chain. Its good operability, reliability, maintainability and safety has been verified within years of smooth operation in various particle beams with different energies. During the AWAKE operation no exceptional conditions are expected which could pose a risk on BTV system functionality. For the most delicate parts of the BTV, i.e. the radiator screens, spare parts are ordered. The standard CCD cameras (not radiation hard) can be easily replaced in case of radiation damage.

4.1 OPERABILITY ASPECTS

[This sub-section shall summarize constraints in term of **operations** and **operability**. If (preliminary) operations strategies and approaches were worked out, they shall be given in this sub-section.]

4.2 RELIABILITY ASPECTS

[This sub-section shall summarize constraints in term of **reliability** of the system/equipment. If reliability analyses were performed, they shall be listed in this sub-section.]

4.3 AVAILABILITY ASPECTS

[This sub-section shall summarize constraints in term of **availability** of the system/equipment. If availability analyses were performed, they shall be listed in this sub-section.]



4.4 MAINTAINABILITY ASPECTS

[This sub-section shall summarize constraints in term of **maintenance** and **maintainability**. If (preliminary) maintenance strategies and approaches were worked out, they shall be given in this sub-section.]

4.5 SAFETY ASPECTS

[This sub-section shall lists specific aspects related to **Safety**. This sub-section shall provide material that is to be used for the editorial work of the **safety file** of the facility being built or upgraded.]

5. MANAGEMENT ASPECTS

5.1 REVISED COST ESTIMATE

Device	description	cost [kCHF]
CC.MTV.0253 CC.MTV.0970	transport	?
	refurbishment	4
	screens	5
	design modification	10
	parts production	10
	total	29+?

[This sub-section shall provide a revised cost estimates for the remaining of the development of the system/equipment. This revised cost estimate shall be compared with the one provided with the Work Package Description document released at the end of the Study Phase of the project.]

5.2 FUNDING AND BUDGETS ASPECTS

Budget shall come from CERN budget code 64940 (AWAKE Beam Instrumentation).

[This sub-section shall recall how the development of the system/equipment is to be funded: CERN budget and budget codes, in-kind contributions, external funding, etc. A particular attention shall be paid on the services to be requested (see § 3) and on their funding.]

5.3 PRELIMINARY SCHEDULE

Device	Planning
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Device	Planning
CC.MTV.0253 CC.MTV.0970	De-installation and transport from CTF3 by Mar 2017; Refurbishment and screen replacement by Apr 2017; Vacuum tests by May 2017; Installation June 2017 If new parts are needed due to conflicts with Faraday cup: Parts re-designed and procured by Mar 2017.

[This sub-section shall provides a preliminary coordination schedule for the remaining of the development, the installation and the commissioning of the system/equipment.]

/! The content of this sub-section shall be prepared together with EN-MEF-OSS (installation organization and scheduling section).

5.4 PROCUREMENT

The BTV assemblies shall be recuperated from CTF3. Parts that will need to be procured are: screens and, when needed, modifications to the tank assembly design due to conflicts with Faraday cups. All such items will be procured in 2016.

[This section shall briefly described the procurement strategy for the system/equipment.]

6. RISKS

[This section shall present in the form of a mini-risk register which were the risks perceived by the holders of the work package or part of the work package and how these risks were mitigated (Response column). Responses shall typically refer to the paragraphs were appropriate the provisions are featured.]

/! This sub-section can be prepared with the help of EN-MEF-QOP .

Table 5 — Summary risk register.

Risk	Response



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