LEBT Vacuum Control System - System Requirement Specification

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1. SCOPE

This document lists control requirements to be fulfilled by the integration of LEBT Vacuum Control System into the Integrated Control System of ESS.

The list of requirements is based on the document created by the Vacuum team, part of the Specialized Technical Services Group of the Accelerator Division of the Machine Directorate: Vacuum Symbols and ICS naming [2].

2. ISSUING ORGANISATION

This document is issued by the Integrated Control System (ICS) division of ESS.

3. REQUIREMENTS

Requirements are identified with their device mnemonic defined by the “Vacuum Symbols and ICS naming” [2] document and by their names issued from the ESS Naming Service.

Upward tractability refers to requirements listed by Proton Beam Vacuum Control System - System Requirement Specification [5].

Requirements listed by this document precise some already expressed requirements or lists requirements that are only valid for the subsection concerned by this document.

3.1. Functional Requirements

3.1.1. Control Requirements

3.1.1.1. VEPP: Vacuum Primary Pump Controller

VEPP [2] is the control interface between control system and primary pumps.

Id	Text	Trace up to
LEBT-010:VAC-VPDP-00031_CR.01	Primary pump shall be remotely activated so that the pump can be either started or stopped.	VEPP.CR.01
LEBT-010:VAC-VPDP-00031_CR.02	Primary pump shall be locally controllable so that the pump can be either started or stopped locally from the control rack.	VEPP.CR.02
LEBT-010:VAC-VPDP-00031_CR.03	Primary pump controller shall be resettable remotely so that the pump can be restarted remotely after a failure.	VEPP.CR.03
LEBT-010:VAC-VPDP-00031_CR.04	Control system shall trigger an error and de-energize the controller in case of disconnection of the primary pump from its controller so that the pump is not supplied if the pump is not connected.	VEPP.CR.04
LEBT-010:VAC-VPDP-00071_CR.01	Primary pump shall be remotely activated so that the pump can be either started or stopped.	VEPP.CR.01
LEBT-010:VAC-VPDP-00071_CR.02	Primary pump shall be locally controllable so that the pump can be either started or stopped locally from the control rack.	VEPP.CR.02
LEBT-010:VAC-VPDP-00071_CR.03	Primary pump controller shall be resettable remotely so that the pump can be restarted remotely after a failure.	VEPP.CR.03
LEBT-010:VAC-VPDP-00071_CR.04	Control system shall trigger an error and de-energize the controller in case of disconnection of the primary pump from its controller so that the pump is not supplied if the pump is not connected.	VEPP.CR.04

3.1.1.2. VEPT: Vacuum Turbomolecular Pump Controller

VEPT [2] is the control interface between control system and turbomolecular pumps.

Id	Text	Trace up to
LEBT-010:VAC-VPT-02100_CR.01	Turbomolecular pump shall be remotely activated so that the pump can be either started or stopped according to the process	VEPT.CR.01
LEBT-010:VAC-VPT-02100_CR.02	Turbomolecular pump controller shall be resettable remotely so that the pump can be restarted remotely after a failure.	VEPT.CR.02

Id	Text	Trace up to
LEBT-010:VAC-VPT-02100_CR.03	Turbomolecular pump controller shall trigger warnings in case some dynamics values (such as the current) overpass a threshold. Thresholds will be defined case by case. Dynamics values will be defined later when the hardware will be known.	VEPT.CR.03
LEBT-010:VAC-VPT-03100_CR.01	Turbomolecular pump shall be remotely activated so that the pump can be either started or stopped according to the process	VEPT.CR.01
LEBT-010:VAC-VPT-03100_CR.02	Turbomolecular pump controller shall be resettable remotely so that the pump can be restarted remotely after a failure.	VEPT.CR.02
LEBT-010:VAC-VPT-03100_CR.03	Turbomolecular pump controller shall trigger warnings in case some dynamics values (such as the current) overpass a threshold. Thresholds will be defined case by case. Dynamics values will be defined later when the hardware will be known.	VEPT.CR.03
LEBT-010:VAC-VPT-06100_CR.01	Turbomolecular pump shall be remotely activated so that the pump can be either started or stopped according to the process	VEPT.CR.01
LEBT-010:VAC-VPT-06100_CR.02	Turbomolecular pump controller shall be resettable remotely so that the pump can be restarted remotely after a failure.	VEPT.CR.02
LEBT-010:VAC-VPT-06100_CR.03	Turbomolecular pump controller shall trigger warnings in case some dynamics values (such as the current) overpass a threshold. Thresholds will be defined case by case. Dynamics values will be defined later when the hardware will be known.	VEPT.CR.03
LEBT-010:VAC-VPT-07100_CR.01	Turbomolecular pump shall be remotely activated so that the pump can be either started or stopped according to the process	VEPT.CR.01
LEBT-010:VAC-VPT-07100_CR.01	Turbomolecular pump controller shall be resettable remotely so that the pump can be restarted remotely after a failure.	VEPT.CR.02
LEBT-010:VAC-VPT-07100_CR.01	Turbomolecular pump controller shall trigger warnings in case some dynamics values (such as the current) overpass a threshold. Thresholds will be defined case by case. Dynamics values will be defined later when the hardware will be known.	VEPT.CR.03

3.1.1.3. VVA: Vacuum Angle Valve

Id	Text	Trace up to
LEBT-010:VAC-VVA-00031_CR.01	Angle valve shall be remotely actuated so that the valve can be either opened or closed.	VVA.CR.01
LEBT-010:VAC-VVA-00031_CR.02	Angle valve shall close in case of failure of LEBT-010:VAC-VPDP-00031	VVA.CR.02
LEBT-010:VAC-VVA-02100_CR.01	Angle valve shall be remotely actuated so that the valve can be either opened or closed.	VVA.CR.01
LEBT-010:VAC-VVA-02100_CR.02	Angle valve shall close in case of failure of LEBT-010:VAC-VPT-02100	VVA.CR.02
LEBT-010:VAC-VVA-03100_CR.01	Angle valve shall be remotely actuated so that the valve can be either opened or closed.	VVA.CR.01
LEBT-010:VAC-VVA-03100_CR.02	Angle valve shall close in case of failure of LEBT-010:VAC-VPT-03100	VVA.CR.02
LEBT-010:VAC-VVA-06100_CR.01	Angle valve shall be remotely actuated so that the valve can be either opened or closed.	VVA.CR.01
LEBT-010:VAC-VVA-06100_CR.02	Angle valve shall close in case of failure of LEBT-010:VAC-VPT-06100	VVA.CR.02
LEBT-010:VAC-VVA-07100_CR.01	Angle valve shall be remotely actuated so that the valve can be either opened or closed.	VVA.CR.01
LEBT-010:VAC-VVA-07100_CR.02	Angle valve shall close in case of failure of LEBT-010:VAC-VPT-07100	VVA.CR.02
LEBT-010:VAC-VVA-00041_CR.01	Angle valve shall open automatically in case of failure of LEBT-010:VAC-VPDP-00031.	VVA.CR.02
LEBT-010:VAC-VVA-00041_CR.02	Angle valve shall open automatically in case of failure of LEBT-010:VAC-VPDP-00071.	VVA.CR.02
ISRC-010:VAC-VVA-01100_CR.01	Angle valve shall be remotely actuated so that the valve can be either opened or closed.	VVA.CR.01
ISRC-010:VAC-VVA-01100_CR.02	Angle valve shall be closed if the pressure rise above 1.0 10e-4 mbar and cannot be open before the pressure goes bellow 1.0 10e-5 mbar.	VVA.CR.02
ISRC-010:VAC-VVA-01100_CR.03	Angle valve shall close in case of personnel access to the tunnel.	VVS.CR.02
LEBT-010:VAC-VVA-01100_CR.01	Angle valve shall be remotely actuated so that the valve can be either opened or closed.	VVA.CR.01
LEBT-010:VAC-VVA-01100_CR.02	Angle valve shall be closed if the pressure rise above 1.0 10e-4 mbar and cannot be open before the pressure goes bellow 1.0 10e-5 mbar.	VVA.CR.02
LEBT-010:VAC-VVA-01100_CR.03	Angle valve shall close in case of personnel access to the tunnel.	VVS.CR.02

3.1.1.4. VVG: Vacuum Gate Valve

Id	Text	Trace up to
	Not Applicable - No Vacuum Gate Valve is actually installed on the LEBT vacuum system.	

3.1.1.5. VVS: Vacuum Sector Gate Valve

Id	Text	Trace up to
LEBT-010:VAC-VVS-20000_ CR.01	Sector Gate valve shall be remotely actuated so that the valve can be either opened or closed.	VVS.CR.01
LEBT-010:VAC-VVS-20000_CR.02	Sector Gate valve shall be closed by interlocks in the event of a sudden pressure rises. Pressure interlock thresholds and source, and / or pumps interlocks will be defined case by case.	VVS.CR.02
LEBT-010:VAC-VVS-20000_CR.03	Sector Gate valve shall be closed in case of personnel access into the accelerator tunnel.	VVS.CR.03
LEBT-010:VAC-VVS-20000_CR.04	Reopening policy of gates valves after access to the tunnel needs to be defined.	VVS.CR.04
LEBT-010:VAC-VVS-40000_CR.01	Sector Gate valve shall be remotely actuated so that the valve can be either opened or closed.	VVS.CR.01
LEBT-010:VAC-VVS-40000_CR.02	Sector Gate valve shall be closed by interlocks in the event of a sudden pressure rises. Pressure interlock thresholds and source, and / or pumps interlocks will be defined case by case.	VVS.CR.02
LEBT-010:VAC-VVS-40000_CR.03	Sector Gate valve shall be closed in case of personnel access into the accelerator tunnel.	VVS.CR.03
LEBT-010:VAC-VVS-40000_CR.04	Reopening policy of gates valves after access to the tunnel needs to be defined.	VVS.CR.04

3.1.1.6. VEVF: Vacuum Fast Valve Controller

Id	Text	Trace up to
	Not Applicable - No Vacuum Fast Valve is actually installed on the LEBT vacuum system	

3.1.1.7. VEG: Vacuum Gauge Controller

VEG [2] is the interface between the control system and the vacuum gauge.

Id	Text	Trace up to
LEBT-010:VAC-VGP-00021_CR.01	Vacuum gauge shall be remotely actuated so that the gauge can be either started or stopped.	VEG.CR.01
LEBT-010:VAC-VGP-10000_CR.01	Vacuum gauge shall be remotely actuated so that the gauge can be either started or stopped.	VEG.CR.01
LEBT-010:VAC-VGC-10000_CR.01	Vacuum gauge shall be remotely actuated so that the gauge can be either started or stopped.	VEG.CR.01
LEBT-010:VAC-VGD-10000_CR.01	Vacuum gauge shall be remotely actuated so that the gauge can be either started or stopped.	VEG.CR.01
LEBT-010:VAC-VGP-00081_CR.01	Vacuum gauge shall be remotely actuated so that the gauge can be either started or stopped.	VEG.CR.01
LEBT-010:VAC-VGP-30000_CR.01	Vacuum gauge shall be remotely actuated so that the gauge can be either started or stopped.	VEG.CR.01
LEBT-010:VAC-VGC-30000_CR.01	Vacuum gauge shall be remotely actuated so that the gauge can be either started or stopped.	VEG.CR.01

3.1.1.8. VEPI: Vacuum Sputter Ion Pump Controller

VEPI [2] is the interface between control system and sputter ion pump (getter pump).

Id	Text	Trace up to
	Not Applicable - No Vacuum Sputter Ion Pump is actually installed on the LEBT vacuum system	

3.1.1.9. VEPN: Vacuum Non-Evaporable Getter Pump Controller

VEPN [2] is the interface between control system and non-evaporable getter pump (getter pump).

Id	Text	Trace up to
	Not Applicable - No Vacuum Non-Evaporable Getter Pump is actually installed on the LEBT vacuum system	

3.1.1.10. VTC: Vacuum Thermocouple Gauge

Id	Text	Trace up to
	Not Applicable - No Vacuum Thermocouple Gauge is actually installed on the LEBT vacuum system	

3.1.1.11. VERA: Vacuum Residual Gas Analyzer Controller

VERA [2] is the interface between control system and the residual gas analyser.

Id	Text	Trace up to
LEBT-010:VAC-VGR.10000_CR.01	Vacuum residual gas analyser shall be remotely actuated so that the residual gas analyser can be either started or stopped.	VERA.CR.01

3.1.1.12. VEVMC: Vacuum Mass Flow Meter Controller

VEVMC [2] is the interface between control system and vacuum mass flow meter.

Id	Text	Trace up to
ISRC-010:VAC-VVMC-01100_CR.01	Vacuum mass flow meter shall be remotely actuated so that the mass flow meter can be either started or stopped.	VEVMC.CR.01
ISRC-010:VAC-VVMC-01100_CR.02	Aperture of the vacuum mass flow meter shall be remotely settled so that the mass flow meter can be opened, adjusted or closed.	VEVMC.CR.02
LEBT-010:VAC-VVMC-01100_CR.01	Vacuum mass flow meter shall be remotely actuated so that the mass flow meter can be either started or stopped.	VEVMC.CR.01
LEBT-010:VAC-VVMC-01100_CR.02	Aperture of the vacuum mass flow meter shall be remotely settled so that the mass flow meter can be opened, adjusted or closed.	VEVMC.CR.02

3.1.1.13. VPM: Vacuum Pressure Manometer

Id	Text	Trace up to
ISRC-010:VAC-VPM-00011_CR.01	Vacuum pressure manometer shall be remotely monitored.	VPM.CR.01
ISRC-010:VAC-VPM-00011_CR.02	Vacuum pressure manometer shall trigger an alarm to the main control room in case of low pressure. Pressure alarm threshold will be defined case by case.	VPM.CR.02

Id	Text	Trace up to
LEBT-010:VAC-VPM-00011_CR.01	Vacuum pressure manometer shall be remotely monitored.	VPM.CR.01
LEBT-010:VAC-VPM-00011_CR.02	Vacuum pressure manometer shall trigger an alarm to the main control room in case of low pressure. Pressure alarm threshold will be defined case by case.	VPM.CR.02

3.1.2. Monitoring and Graphical User Interface Requirements

3.1.2.1. VEPP: Vacuum Primary Pump Controller

VEPP [2] is the control interface between control system and primary pumps.

Graphical representation requirements for VEPP [2] are describe by the document: “Vacuum symbols and widgets requirements for control screens” [4].

Id	Text	Trace up to
LEBT-010:VAC-VPDP-00031_MR.01	The GUI shall display pumps OFF status so that the OFF status can be assessed.	VEPP.MR.01
LEBT-010:VAC-VPDP-00031_MR.02	The GUI shall display pumps ON status so that the ON status can be assessed.	VEPP.MR.02
LEBT-010:VAC-VPDP-00031_MR.03	The GUI shall display pump controller’s error status so that the error can be assessed.	VEPP.MR.03
LEBT-010:VAC-VPDP-00031_MR.04	The GUI shall display pump disconnected status so that the error can be assessed.	VEPP.MR.04
LEBT-010:VAC-VPDP-00031_MR.05	The GUI shall display pumps circuit breaker status so that the circuit breaker tripped status can be assessed.	VEPP.MR.05
LEBT-010:VAC-VPDP-00031_MR.06	The GUI shall display pump controller’s LOCKED status so that the locked status can be assessed.	VEPP.MR.06
LEBT-010:VAC-VPDP-00071_MR.01	The GUI shall display pumps OFF status so that the OFF status can be assessed.	VEPP.MR.01
LEBT-010:VAC-VPDP-00071_MR.02	The GUI shall display pumps ON status so that the ON status can be assessed.	VEPP.MR.02
LEBT-010:VAC-VPDP-00071_MR.03	The GUI shall display pump controller’s error status so that the error can be assessed.	VEPP.MR.03
LEBT-010:VAC-VPDP-00071_MR.04	The GUI shall display pump disconnected status so that the error can be assessed.	VEPP.MR.04
LEBT-010:VAC-VPDP-00071_MR.05	The GUI shall display pumps circuit breaker status so that the circuit breaker tripped status can be assessed.	VEPP.MR.05
LEBT-010:VAC-VPDP-00071_MR.06	The GUI shall display pump controller’s LOCKED status so that the locked status can be assessed.	VEPP.MR.06

3.1.2.2. VEPT: Vacuum Turbomolecular Pump Controller

VEPT [2] is the control interface between control system and turbomolecular pumps.

Graphical representation requirements for VEPT [2] are describe by the document: “Vacuum symbols and widgets requirements for control screens” [6].

Id	Text	Trace up to
LEBT-010:VAC-VPT-02100_MR.01	The GUI shall display pumps OFF status so that the OFF status can be assessed.	VEPT.MR.01
LEBT-010:VAC-VPT-02100_MR.02	The GUI shall display pumps ON status so that the ON status can be assessed.	VEPT.MR.02
LEBT-010:VAC-VPT-02100_MR.03	The GUI shall display pump controller’s ERROR status so that the error can be assessed.	VEPT.MR.03
LEBT-010:VAC-VPT-02100_MR.04	The GUI shall display pump controller’s LOCKED status so that the locked status can be assessed.	VEPT.MR.04
LEBT-010:VAC-VPT-02100_MR.05	All the VEPT control parameters shall be monitored by the GUI so that parameters can be assessed.	VEPT.MR.05
LEBT-010:VAC-VPT-02100_MR.06	All the VEPT control parameters shall be writable through the GUI so that parameters can be modified.	VEPT.MR.06
LEBT-010:VAC-VPT-03100_MR.01	The GUI shall display pumps OFF status so that the OFF status can be assessed.	VEPT.MR.01
LEBT-010:VAC-VPT-03100_MR.02	The GUI shall display pumps ON status so that the ON status can be assessed.	VEPT.MR.02
LEBT-010:VAC-VPT-03100_MR.03	The GUI shall display pump controller’s ERROR status so that the error can be assessed.	VEPT.MR.03
LEBT-010:VAC-VPT-03100_MR.04	The GUI shall display pump controller’s LOCKED status so that the locked status can be assessed.	VEPT.MR.04
LEBT-010:VAC-VPT-03100_MR.05	All the VEPT control parameters shall be monitored by the GUI so that parameters can be assessed.	VEPT.MR.05
LEBT-010:VAC-VPT-03100_MR.06	All the VEPT control parameters shall be writable through the GUI so that parameters can be modified.	VEPT.MR.06

Id	Text	Trace up to
LEBT-010:VAC-VPT-06100_MR.01	The GUI shall display pumps OFF status so that the OFF status can be assessed.	VEPT.MR.01
LEBT-010:VAC-VPT-06100_MR.02	The GUI shall display pumps ON status so that the ON status can be assessed.	VEPT.MR.02
LEBT-010:VAC-VPT-06100_MR.03	The GUI shall display pump controller's ERROR status so that the error can be assessed.	VEPT.MR.03
LEBT-010:VAC-VPT-06100_MR.04	The GUI shall display pump controller's LOCKED status so that the locked status can be assessed.	VEPT.MR.04
LEBT-010:VAC-VPT-06100_MR.05	All the VEPT control parameters shall be monitored by the GUI so that parameters can be assessed.	VEPT.MR.05
LEBT-010:VAC-VPT-06100_MR.06	All the VEPT control parameters shall be writable through the GUI so that parameters can be modified.	VEPT.MR.06
LEBT-010:VAC-VPT-07100_MR.01	The GUI shall display pumps OFF status so that the OFF status can be assessed.	VEPT.MR.01
LEBT-010:VAC-VPT-07100_MR.02	The GUI shall display pumps ON status so that the ON status can be assessed.	VEPT.MR.02
LEBT-010:VAC-VPT-07100_MR.03	The GUI shall display pump controller's ERROR status so that the error can be assessed.	VEPT.MR.03
LEBT-010:VAC-VPT-07100_MR.04	The GUI shall display pump controller's LOCKED status so that the locked status can be assessed.	VEPT.MR.04
LEBT-010:VAC-VPT-07100_MR.05	All the VEPT control parameters shall be monitored by the GUI so that parameters can be assessed.	VEPT.MR.05
LEBT-010:VAC-VPT-07100_MR.06	All the VEPT control parameters shall be writable through the GUI so that parameters can be modified.	VEPT.MR.06

3.1.2.3. VVA: Vacuum Angle Valve

Graphical representation requirements for VVA [2] are describe by the document: “Vacuum symbols and widgets requirements for control screens” [6].

Id	Text	Trace up to
ISRC-010:VAC-VVA-01100_MR.01	The GUI shall display valves CLOSE status so that the close status can be assessed.	VVA.MR.01
ISRC-010:VAC-VVA-01100_MR.02	The GUI shall display valves OPEN status so that the open status can be assessed.	VVA.MR.02
ISRC-010:VAC-VVA-01100_MR.03	The GUI shall display valves INTERLOCK status so that interlock status can be assessed.	VVA.MR.03
ISRC-010:VAC-VVA-01100_MR.04	The GUI shall display valves ERROR status so that error status can be assessed.	VVA.MR.04
ISRC-010:VAC-VVA-01100_MR.05	The GUI shall display valves LOCKED status so that locked status can be assessed.	VVA.MR.05
LEBT-010:VAC-VVA-00031_MR.01	The GUI shall display valves CLOSE status so that the close status can be assessed.	VVA.MR.01
LEBT-010:VAC-VVA-00031_MR.02	The GUI shall display valves OPEN status so that the open status can be assessed.	VVA.MR.02
LEBT-010:VAC-VVA-00031_MR.03	The GUI shall display valves INTERLOCK status so that interlock status can be assessed.	VVA.MR.03
LEBT-010:VAC-VVA-00031_MR.04	The GUI shall display valves ERROR status so that error status can be assessed.	VVA.MR.04
LEBT-010:VAC-VVA-00031_MR.05	The GUI shall display valves LOCKED status so that locked status can be assessed.	VVA.MR.05
LEBT-010:VAC-VVA-02100_MR.01	The GUI shall display valves CLOSE status so that the close status can be assessed.	VVA.MR.01
LEBT-010:VAC-VVA-02100_MR.02	The GUI shall display valves OPEN status so that the open status can be assessed.	VVA.MR.02
LEBT-010:VAC-VVA-02100_MR.03	The GUI shall display valves INTERLOCK status so that interlock status can be assessed.	VVA.MR.03
LEBT-010:VAC-VVA-02100_MR.04	The GUI shall display valves ERROR status so that error status can be assessed.	VVA.MR.04
LEBT-010:VAC-VVA-02100_MR.05	The GUI shall display valves LOCKED status so that locked status can be assessed.	VVA.MR.05
LEBT-010:VAC-VVA-03100_MR.01	The GUI shall display valves CLOSE status so that the close status can be assessed.	VVA.MR.01
LEBT-010:VAC-VVA-03100_MR.02	The GUI shall display valves OPEN status so that the open status can be assessed.	VVA.MR.02
LEBT-010:VAC-VVA-03100_MR.03	The GUI shall display valves INTERLOCK status so that interlock status can be assessed.	VVA.MR.03

Id	Text	Trace up to
LEBT-010:VAC-VVA-03100_MR.04	The GUI shall display valves ERROR status so that error status can be assessed.	VVA.MR.04
LEBT-010:VAC-VVA-03100_MR.05	The GUI shall display valves LOCKED status so that locked status can be assessed.	VVA.MR.05
LEBT-010:VAC-VVA-01100_MR.01	The GUI shall display valves CLOSE status so that the close status can be assessed.	VVA.MR.01
LEBT-010:VAC-VVA-01100_MR.02	The GUI shall display valves OPEN status so that the open status can be assessed.	VVA.MR.02
LEBT-010:VAC-VVA-01100_MR.03	The GUI shall display valves INTERLOCK status so that interlock status can be assessed.	VVA.MR.03
LEBT-010:VAC-VVA-01100_MR.04	The GUI shall display valves ERROR status so that error status can be assessed.	VVA.MR.04
LEBT-010:VAC-VVA-01100_MR.05	The GUI shall display valves LOCKED status so that locked status can be assessed.	VVA.MR.05
LEBT-010:VAC-VVA-00041_MR.01	The GUI shall display valves CLOSE status so that the close status can be assessed.	VVA.MR.01
LEBT-010:VAC-VVA-00041_MR.02	The GUI shall display valves OPEN status so that the open status can be assessed.	VVA.MR.02
LEBT-010:VAC-VVA-00041_MR.03	The GUI shall display valves INTERLOCK status so that interlock status can be assessed.	VVA.MR.03
LEBT-010:VAC-VVA-00041_MR.04	The GUI shall display valves ERROR status so that error status can be assessed.	VVA.MR.04
LEBT-010:VAC-VVA-00041_MR.05	The GUI shall display valves LOCKED status so that locked status can be assessed.	VVA.MR.05
LEBT-010:VAC-VVA-00071_MR.01	The GUI shall display valves CLOSE status so that the close status can be assessed.	VVA.MR.01
LEBT-010:VAC-VVA-00071_MR.02	The GUI shall display valves OPEN status so that the open status can be assessed.	VVA.MR.02
LEBT-010:VAC-VVA-00071_MR.03	The GUI shall display valves INTERLOCK status so that interlock status can be assessed.	VVA.MR.03
LEBT-010:VAC-VVA-00071_MR.04	The GUI shall display valves ERROR status so that error status can be assessed.	VVA.MR.04
LEBT-010:VAC-VVA-00071_MR.05	The GUI shall display valves LOCKED status so that locked status can be assessed.	VVA.MR.05
LEBT-010:VAC-VVA-06100_MR.01	The GUI shall display valves CLOSE status so that the close status can be assessed.	VVA.MR.01
LEBT-010:VAC-VVA-06100_MR.02	The GUI shall display valves OPEN status so that the open status can be assessed.	VVA.MR.02
LEBT-010:VAC-VVA-06100_MR.03	The GUI shall display valves INTERLOCK status so that interlock status can be assessed.	VVA.MR.03

Id	Text	Trace up to
LEBT-010:VAC-VVA-06100_MR.04	The GUI shall display valves ERROR status so that error status can be assessed.	VVA.MR.04
LEBT-010:VAC-VVA-06100_MR.05	The GUI shall display valves LOCKED status so that locked status can be assessed.	VVA.MR.05
LEBT-010:VAC-VVA-07100_MR.01	The GUI shall display valves CLOSE status so that the close status can be assessed.	VVA.MR.01
LEBT-010:VAC-VVA-07100_MR.02	The GUI shall display valves OPEN status so that the open status can be assessed.	VVA.MR.02
LEBT-010:VAC-VVA-07100_MR.03	The GUI shall display valves INTERLOCK status so that interlock status can be assessed.	VVA.MR.03
LEBT-010:VAC-VVA-07100_MR.04	The GUI shall display valves ERROR status so that error status can be assessed.	VVA.MR.04
LEBT-010:VAC-VVA-07100_MR.05	The GUI shall display valves LOCKED status so that locked status can be assessed.	VVA.MR.05

3.1.2.4. VVG: Vacuum Gate Valve

Graphical representation requirements for VVG [2] are describe by the document: “Vacuum symbols and widgets requirements for control screens” [6].

Id	Text	Trace up to
	Not Applicable - No Vacuum Gate Valve is actually installed on the LEBT vacuum system	

3.1.2.5. VVS: Vacuum Sector Gate Valve

Graphical representation requirements for VVS [2] are describe by the document: “Vacuum symbols and widgets requirements for control screens” [6].

Id	Text	Trace up to
LEBT-010:VAC-VVS-20000_MR.01	The GUI shall display valves CLOSE status so that the close status can be assessed.	VVS.MR.01
LEBT-010:VAC-VVS-20000_ MR.02	The GUI shall display valves OPEN status so that the open status can be assessed.	VVS.MR.02
LEBT-010:VAC-VVS-20000_ MR.03	The GUI shall display valves INTERLOCK status so that interlock status can be assessed.	VVS.MR.03
LEBT-010:VAC-VVS-20000_ MR.04	The GUI shall display valves ERROR status so that error status can be assessed.	VVS.MR.04
LEBT-010:VAC-VVS-20000_MR.05	The GUI shall display valves LOCKED status so that locked status can be assessed.	VVS.MR.05

Id	Text	Trace up to
LEBT-010:VAC-VVS-40000_MR.01	The GUI shall display valves CLOSE status so that the close status can be assessed.	VVS.MR.01
LEBT-010:VAC-VVS-40000_MR.02	The GUI shall display valves OPEN status so that the open status can be assessed.	VVS.MR.02
LEBT-010:VAC-VVS-40000_MR.03	The GUI shall display valves INTERLOCK status so that interlock status can be assessed.	VVS.MR.03
LEBT-010:VAC-VVS-40000_MR.04	The GUI shall display valves ERROR status so that error status can be assessed.	VVS.MR.04
LEBT-010:VAC-VVS-40000_MR.05	The GUI shall display valves LOCKED status so that locked status can be assessed.	VVS.MR.05

3.1.2.6. VEVF: Vacuum Fast Valve Controller

VEVF [2] is the control interface between control system and fast valves.

Graphical representation requirements for VVA [2] are describe by the document: “Vacuum symbols and widgets requirements for control screens” [6].

Id	Text	Trace up to
	Not Applicable - No Vacuum Fast Valve is actually installed on the LEBT vacuum system	

3.1.2.7. VEG: Vacuum Gauge Controller

VEG [2] is the interface between the control system and the vacuum gauge.

Gauge controller VEG has its own parameters and settings independent from the ones related to the parameters and settings that are applied to the gauges. Each of them shall be identified and accessible.

Graphical representation requirements for vacuum gauges are describe by the document: “Vacuum symbols and widgets requirements for control screens” [6].

Id	Text	Trace up to
LEBT-010:VAC-VGP-00021_MR.01	The GUI shall display gauges OFF status so that the OFF status can be assessed.	VEG.MR.01
LEBT-010:VAC-VGP-00021_MR.02	The GUI shall display gauges ON status so that the ON status can be assessed.	VEG.MR.02
LEBT-010:VAC-VGP-00021_MR.03	Pressure shall be monitor and display on the GUI so that pressure can be assessed.	VEG.MR.03
LEBT-010:VAC-VGP-00021_MR.04	Pressure display on the GUI shall be expressed in millibar so that the pressure unit is coherent.	VEG.MR.04

Id	Text	Trace up to
LEBT-010:VAC-VGP-00021_MR.05	VEG control parameters shall be monitored by the GUI so that parameters can be assessed.	VEG.MR.05
LEBT-010:VAC-VGP-00021_MR.06	VEG gauge control parameters shall be monitored by the GUI so that parameters can be assessed.	VEG.MR.06
LEBT-010:VAC-VGP-00021_MR.07	All the VEG control parameters shall be writable through the GUI so that parameters can be modified.	VEG.MR.07
LEBT-010:VAC-VGP-00021_MR.08	All the VEG gauge control parameters shall be writable through the GUI so that parameters can be modified.	VEG.MR.08
LEBT-010:VAC-VGP-00021_MR.09	Gauge “OFF” status shall display a Pressure of 1000 millibar.	VEG.MR.09
LEBT-010:VAC-VGP-00021_MR.10	VEG “Over-Range” status is set if the gauge’s controller detects that the actual pressure is above the nominal measuring range of the gauge. This status is set if the “over-range status” is true. Pressure display shall be the over-range pressure given by the hardware manufacturer in millibar.	VEG.MR.10
LEBT-010:VAC-VGP-00021_MR.11	VEG “Under-Range” status is set if the gauge’s controller detects that the actual pressure is too low for the gauge to measure, pressure is below the nominal measuring range. This status is set if the “under-range status” is true. Pressure display shall be the under-range pressure given by the hardware manufacturer in millibar.	VEG.MR.11
LEBT-010:VAC-VGP-10000_MR.01	The GUI shall display gauges OFF status so that the OFF status can be assessed.	VEG.MR.01
LEBT-010:VAC-VGP-10000_MR.02	The GUI shall display gauges ON status so that the ON status can be assessed.	VEG.MR.02
LEBT-010:VAC-VGP-10000_MR.03	Pressure shall be monitor and display on the GUI so that pressure can be assessed.	VEG.MR.03
LEBT-010:VAC-VGP-10000_MR.04	Pressure display on the GUI shall be expressed in millibar so that the pressure unit is coherent.	VEG.MR.04
LEBT-010:VAC-VGP-10000_MR.05	VEG control parameters shall be monitored by the GUI so that parameters can be assessed.	VEG.MR.05
LEBT-010:VAC-VGP-10000_MR.06	VEG gauge control parameters shall be monitored by the GUI so that parameters can be assessed.	VEG.MR.06
LEBT-010:VAC-VGP-10000_MR.07	All the VEG control parameters shall be writable through the GUI so that parameters can be modified.	VEG.MR.07
LEBT-010:VAC-VGP-10000_MR.08	All the VEG gauge control parameters shall be writable through the GUI so that parameters can be modified.	VEG.MR.08
LEBT-010:VAC-VGP-10000_MR.09	Gauge “OFF” status shall display a Pressure of 1000 millibar.	VEG.MR.09

Id	Text	Trace up to
LEBT-010:VAC-VGP-10000_MR.10	VEG “Over-Range” status is set if the gauge’s controller detects that the actual pressure is above the nominal measuring range of the gauge. This status is set if the “over-range status” is true. Pressure display shall be the over-range pressure given by the hardware manufacturer in millibar.	VEG.MR.10
LEBT-010:VAC-VGP-10000_MR.11	VEG “Under-Range” status is set if the gauge’s controller detects that the actual pressure is too low for the gauge to measure, pressure is below the nominal measuring range. This status is set if the “under-range status” is true. Pressure display shall be the under-range pressure given by the hardware manufacturer in millibar.	VEG.MR.11
LEBT-010:VAC-VGC-10000_MR.01	The GUI shall display gauges OFF status so that the OFF status can be assessed.	VEG.MR.01
LEBT-010:VAC-VGC-10000_MR.02	The GUI shall display gauges ON status so that the ON status can be assessed.	VEG.MR.02
LEBT-010:VAC-VGC-10000_MR.03	Pressure shall be monitor and display on the GUI so that pressure can be assessed.	VEG.MR.03
LEBT-010:VAC-VGC-10000_MR.04	Pressure display on the GUI shall be expressed in millibar so that the pressure unit is coherent.	VEG.MR.04
LEBT-010:VAC-VGC-10000_MR.05	VEG control parameters shall be monitored by the GUI so that parameters can be assessed.	VEG.MR.05
LEBT-010:VAC-VGC-10000_MR.06	VEG gauge control parameters shall be monitored by the GUI so that parameters can be assessed.	VEG.MR.06
LEBT-010:VAC-VGC-10000_MR.07	All the VEG control parameters shall be writable through the GUI so that parameters can be modified.	VEG.MR.07
LEBT-010:VAC-VGC-10000_MR.08	All the VEG gauge control parameters shall be writable through the GUI so that parameters can be modified.	VEG.MR.08
LEBT-010:VAC-VGC-10000_MR.09	Gauge “OFF” status shall display a Pressure of 1000 millibar.	VEG.MR.09
LEBT-010:VAC-VGC-10000_MR.10	VEG “Over-Range” status is set if the gauge’s controller detects that the actual pressure is above the nominal measuring range of the gauge. This status is set if the “over-range status” is true. Pressure display shall be the over-range pressure given by the hardware manufacturer in millibar.	VEG.MR.10
LEBT-010:VAC-VGC-10000_MR.11	VEG “Under-Range” status is set if the gauge’s controller detects that the actual pressure is too low for the gauge to measure, pressure is below the nominal measuring range. This status is set if the “under-range status” is true. Pressure display shall be the under-range pressure given by the hardware manufacturer in millibar.	VEG.MR.11
LEBT-010:VAC-VGD-10000_MR.01	The GUI shall display gauges OFF status so that the OFF status can be assessed.	VEG.MR.01

Id	Text	Trace up to
LEBT-010:VAC-VGD-10000_MR.02	The GUI shall display gauges ON status so that the ON status can be assessed.	VEG.MR.02
LEBT-010:VAC-VGD-10000_MR.03	Pressure shall be monitor and display on the GUI so that pressure can be assessed.	VEG.MR.03
LEBT-010:VAC-VGD-10000_MR.04	Pressure display on the GUI shall be expressed in millibar so that the pressure unit is coherent.	VEG.MR.04
LEBT-010:VAC-VGD-10000_MR.05	VEG control parameters shall be monitored by the GUI so that parameters can be assessed.	VEG.MR.05
LEBT-010:VAC-VGD-10000_MR.06	VEG gauge control parameters shall be monitored by the GUI so that parameters can be assessed.	VEG.MR.06
LEBT-010:VAC-VGD-10000_MR.07	All the VEG control parameters shall be writable through the GUI so that parameters can be modified.	VEG.MR.07
LEBT-010:VAC-VGD-10000_MR.08	All the VEG gauge control parameters shall be writable through the GUI so that parameters can be modified.	VEG.MR.08
LEBT-010:VAC-VGD-10000_MR.09	Gauge “OFF” status shall display a Pressure of 1000 millibar.	VEG.MR.09
LEBT-010:VAC-VGD-10000_MR.10	VEG “Over-Range” status is set if the gauge’s controller detects that the actual pressure is above the nominal measuring range of the gauge. This status is set if the “over-range status” is true. Pressure display shall be the over-range pressure given by the hardware manufacturer in millibar.	VEG.MR.10
LEBT-010:VAC-VGD-10000_MR.11	VEG “Under-Range” status is set if the gauge’s controller detects that the actual pressure is too low for the gauge to measure, pressure is below the nominal measuring range. This status is set if the “under-range status” is true. Pressure display shall be the under-range pressure given by the hardware manufacturer in millibar.	VEG.MR.11
LEBT-010:VAC-VGP-00081_MR.01	The GUI shall display gauges OFF status so that the OFF status can be assessed.	VEG.MR.01
LEBT-010:VAC-VGP-00081_MR.02	The GUI shall display gauges ON status so that the ON status can be assessed.	VEG.MR.02
LEBT-010:VAC-VGP-00081_MR.03	Pressure shall be monitor and display on the GUI so that pressure can be assessed.	VEG.MR.03
LEBT-010:VAC-VGP-00081_MR.04	Pressure display on the GUI shall be expressed in millibar so that the pressure unit is coherent.	VEG.MR.04
LEBT-010:VAC-VGP-00081_MR.05	VEG control parameters shall be monitored by the GUI so that parameters can be assessed.	VEG.MR.05
LEBT-010:VAC-VGP-00081_MR.06	VEG gauge control parameters shall be monitored by the GUI so that parameters can be assessed.	VEG.MR.06
LEBT-010:VAC-VGP-00081_MR.07	All the VEG control parameters shall be writable through the GUI so that parameters can be modified.	VEG.MR.07

Id	Text	Trace up to
LEBT-010:VAC-VGP-00081_MR.08	All the VEG gauge control parameters shall be writable through the GUI so that parameters can be modified.	VEG.MR.08
LEBT-010:VAC-VGP-00081_MR.09	Gauge “OFF” status shall display a Pressure of 1000 millibar.	VEG.MR.09
LEBT-010:VAC-VGP-00081_MR.10	VEG “Over-Range” status is set if the gauge’s controller detects that the actual pressure is above the nominal measuring range of the gauge. This status is set if the “over-range status” is true. Pressure display shall be the over-range pressure given by the hardware manufacturer in millibar.	VEG.MR.10
LEBT-010:VAC-VGP-00081_MR.11	VEG “Under-Range” status is set if the gauge’s controller detects that the actual pressure is too low for the gauge to measure, pressure is below the nominal measuring range. This status is set if the “under-range status” is true. Pressure display shall be the under-range pressure given by the hardware manufacturer in millibar.	VEG.MR.11
LEBT-010:VAC-VGP-30000_MR.01	The GUI shall display gauges OFF status so that the OFF status can be assessed.	VEG.MR.01
LEBT-010:VAC-VGP-30000_MR.02	The GUI shall display gauges ON status so that the ON status can be assessed.	VEG.MR.02
LEBT-010:VAC-VGP-30000_MR.03	Pressure shall be monitor and display on the GUI so that pressure can be assessed.	VEG.MR.03
LEBT-010:VAC-VGP-30000_MR.04	Pressure display on the GUI shall be expressed in millibar so that the pressure unit is coherent.	VEG.MR.04
LEBT-010:VAC-VGP-30000_MR.05	VEG control parameters shall be monitored by the GUI so that parameters can be assessed.	VEG.MR.05
LEBT-010:VAC-VGP-30000_MR.06	VEG gauge control parameters shall be monitored by the GUI so that parameters can be assessed.	VEG.MR.06
LEBT-010:VAC-VGP-30000_MR.07	All the VEG control parameters shall be writable through the GUI so that parameters can be modified.	VEG.MR.07
LEBT-010:VAC-VGP-30000_MR.08	All the VEG gauge control parameters shall be writable through the GUI so that parameters can be modified.	VEG.MR.08
LEBT-010:VAC-VGP-30000_MR.09	Gauge “OFF” status shall display a Pressure of 1000 millibar.	VEG.MR.09
LEBT-010:VAC-VGP-30000_MR.10	VEG “Over-Range” status is set if the gauge’s controller detects that the actual pressure is above the nominal measuring range of the gauge. This status is set if the “over-range status” is true. Pressure display shall be the over-range pressure given by the hardware manufacturer in millibar.	VEG.MR.10

Id	Text	Trace up to
LEBT-010:VAC-VGP-30000_MR.11	VEG “Under-Range” status is set if the gauge’s controller detects that the actual pressure is too low for the gauge to measure, pressure is below the nominal measuring range. This status is set if the “under-range status” is true. Pressure display shall be the under-range pressure given by the hardware manufacturer in millibar.	VEG.MR.11
LEBT-010:VAC-VGC-30000_MR.01	The GUI shall display gauges OFF status so that the OFF status can be assessed.	VEG.MR.01
LEBT-010:VAC-VGC-30000_MR.02	The GUI shall display gauges ON status so that the ON status can be assessed.	VEG.MR.02
LEBT-010:VAC-VGC-30000_MR.03	Pressure shall be monitor and display on the GUI so that pressure can be assessed.	VEG.MR.03
LEBT-010:VAC-VGC-30000_MR.04	Pressure display on the GUI shall be expressed in millibar so that the pressure unit is coherent.	VEG.MR.04
LEBT-010:VAC-VGC-30000_MR.05	VEG control parameters shall be monitored by the GUI so that parameters can be assessed.	VEG.MR.05
LEBT-010:VAC-VGC-30000_MR.06	VEG gauge control parameters shall be monitored by the GUI so that parameters can be assessed.	VEG.MR.06
LEBT-010:VAC-VGC-30000_MR.07	All the VEG control parameters shall be writable through the GUI so that parameters can be modified.	VEG.MR.07
LEBT-010:VAC-VGC-30000_MR.08	All the VEG gauge control parameters shall be writable through the GUI so that parameters can be modified.	VEG.MR.08
LEBT-010:VAC-VGC-30000_MR.09	Gauge “OFF” status shall display a Pressure of 1000 millibar.	VEG.MR.09
LEBT-010:VAC-VGC-30000_MR.10	VEG “Over-Range” status is set if the gauge’s controller detects that the actual pressure is above the nominal measuring range of the gauge. This status is set if the “over-range status” is true. Pressure display shall be the over-range pressure given by the hardware manufacturer in millibar.	VEG.MR.10
LEBT-010:VAC-VGC-30000_MR.11	VEG “Under-Range” status is set if the gauge’s controller detects that the actual pressure is too low for the gauge to measure, pressure is below the nominal measuring range. This status is set if the “under-range status” is true. Pressure display shall be the under-range pressure given by the hardware manufacturer in millibar.	VEG.MR.11

3.1.2.8. VEPI: Vacuum Sputter Ion Pump Controller

VEPI [2] is the interface between control system and sputter ion pump (getter pump).

Graphical representation requirements for VEPI [2] and VPI [2] are describe by the document: “Vacuum symbols and widgets requirements for control screens” [6].

Id	Text	Trace up to
	Not Applicable - No Vacuum Sputter Ion Pump is actually installed on the LEBT vacuum system	

3.1.2.9. VEPN: Vacuum Non-Evaporable Getter Pump Controller

VEPN [2] is the interface between control system and non-evaporable getter pump (getter pump).

Graphical representation requirements for VEPN [2] and VPN [2] are describe by the document: “Vacuum symbols and widgets requirements for control screens” [6].

Id	Text	Trace up to
	Not Applicable - No Vacuum Non-Evaporable Getter Pump is actually installed on the LEBT vacuum system	

3.1.2.10. VTC: Vacuum Thermocouple Gauge

Graphical representation requirements for VTC [2] are describe by the document: “Vacuum symbols and widgets requirements for control screens” [6].

Id	Text	Trace up to
	Not Applicable - No Vacuum Thermocouple Gauge is actually installed on the LEBT vacuum system	

3.1.2.11. VERA: Vacuum Residual Gas Analyzer Controller

VERA [2] is the interface between control system and the residual gas analyser.

Graphical representation requirements for VERA [2] and VGR [2] are describe by the document: “Vacuum symbols and widgets requirements for control screens” [6].

Id	Text	Trace up to
LEBT-010:VAC-VGR.10000_MR.01	VERA control parameters shall be monitored by the GUI so that parameters can be assessed.	VERA.MR.01
LEBT-010:VAC-VGR.10000_MR.02	VERA control parameters shall be writable through the GUI so that parameters can be modified.	VERA.MR.02

Id	Text	Trace up to
LEBT-010:VAC-VGR.10000_MR.03	Result of the gas analyse shall be display by the GUI so that the result can be assessed.	VERA.MR.03

3.1.2.12. VEVMC: Vacuum Mass Flow Meter Controller

VEVMC [2] is the interface between control system and vacuum mass flow meter.

Graphical representation requirements for VEVMC [2] and VVMC [2] are describe by the document: “Vacuum symbols and widgets requirements for control screens” [6].

Id	Text	Trace up to
ISRC-010:VAC-VVMC-01100_MR.01	Mass flow rate of the mass flow meter shall be monitored and displayed on the GUI so that flow can be assessed.	VEVMC.MR.01
ISRC-010:VAC-VVMC-01100_MR.02	Mass flow rate displayed on the GUI shall be expressed in SCCM so that the pressure unit is coherent.	VEVMC.MR.02
ISRC-010:VAC-VVMC-01100_MR.03	All the mass flow meter’s controller control parameters shall be monitored by the GUI so that parameters can be assessed.	VEVMC.MR.03
ISRC-010:VAC-VVMC-01100_MR.04	All the mass flow meter’s control parameters shall be monitored by the GUI so that parameters can be assessed.	VEVMC.MR.04
ISRC-010:VAC-VVMC-01100_MR.05	All the mass flow meter’s controller parameters shall be writable through the GUI so that parameters can be modified.	VEVMC.MR.05
ISRC-010:VAC-VVMC-01100_MR.06	All the mass flow meter’s control parameters shall be writable through the GUI so that parameters can be modified.	VEVMC.MR.06
LEBT-010:VAC-VVMC-01100_MR.01	Mass flow rate of the mass flow meter shall be monitored and displayed on the GUI so that flow can be assessed.	VEVMC.MR.01
LEBT-010:VAC-VVMC-01100_MR.02	Mass flow rate displayed on the GUI shall be expressed in SCCM so that the pressure unit is coherent.	VEVMC.MR.02
LEBT-010:VAC-VVMC-01100_MR.03	All the mass flow meter’s controller control parameters shall be monitored by the GUI so that parameters can be assessed.	VEVMC.MR.03
LEBT-010:VAC-VVMC-01100_MR.04	All the mass flow meter’s control parameters shall be monitored by the GUI so that parameters can be assessed.	VEVMC.MR.04
LEBT-010:VAC-VVMC-01100_MR.05	All the mass flow meter’s controller parameters shall be writable through the GUI so that parameters can be modified.	VEVMC.MR.05
LEBT-010:VAC-VVMC-01100_MR.06	All the mass flow meter’s control parameters shall be writable through the GUI so that parameters can be modified.	VEVMC.MR.06

3.1.2.13. VPM: Vacuum Pressure Manometer

Graphical representation requirements for VPM [2] are describe by the document: “Vacuum symbols and widgets requirements for control screens” [6].

Id	Text	Trace up to
ISRC-010:VAC-VPM-00011_MR.01	Pressure shall be monitored and display on the GUI so that pressure can be assessed.	VPM.MR.01
ISRC-010:VAC-VPM-00011_MR.02	Pressure monitored by VPM and display on GUI shall be expressed in Bar so that the pressure unit is coherent.	VPM.MR.02
LEBT-010:VAC-VPM-00011_MR.01	Pressure shall be monitored and display on the GUI so that pressure can be assessed.	VPM.MR.01
LEBT-010:VAC-VPM-00011_MR.02	Pressure monitored by VPM and display on GUI shall be expressed in Bar so that the pressure unit is coherent.	VPM.MR.02

3.1.3. Data Acquisition and Archiving Requirements

3.1.3.1. VEPP: Vacuum Primary Pump Controller

VEPP [2] is the control interface between control system and primary pumps.

Id	Text	Trace up to
LEBT-010:VAC-VPDP-00031_DAR.01	No data acquisition requirement has been expressed for VEPP.	VEPP.DAR.01
LEBT-010:VAC-VPDP-00071_DAR.01	No data acquisition requirement has been expressed for VEPP.	VEPP.DAR.01

3.1.3.2. VEPT: Vacuum Turbomolecular Pump Controller

VEPT [2] is the control interface between control system and turbomolecular pumps.

Id	Text	Trace up to
LEBT-010:VAC-VPT-02100_DAR.01	Rotation speed of the turbomolecular pump shall be recorded.	VEPT.DAR.01
LEBT-010:VAC-VPT-02100_DAR.02	Current of the turbomolecular pump shall be recorded.	VEPT.DAR.02
LEBT-010:VAC-VPT-03100_DAR.01	Rotation speed of the turbomolecular pump shall be recorded.	VEPT.DAR.01
LEBT-010:VAC-VPT-03100_DAR.02	Current of the turbomolecular pump shall be recorded.	VEPT.DAR.02
LEBT-010:VAC-VPT-06100_DAR.01	Rotation speed of the turbomolecular pump shall be recorded.	VEPT.DAR.01
LEBT-010:VAC-VPT-06100_DAR.02	Current of the turbomolecular pump shall be recorded.	VEPT.DAR.02
LEBT-010:VAC-VPT-07100_DAR.01	Rotation speed of the turbomolecular pump shall be recorded.	VEPT.DAR.01
LEBT-010:VAC-VPT-07100_DAR.02	Current of the turbomolecular pump shall be recorded.	VEPT.DAR.02

3.1.3.3. VVA: Vacuum Angle Valve

Id	Text	Trace up to
ISRC-010:VAC-VVA-01100_DAR.01	Open status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.01
ISRC-010:VAC-VVA-01100_DAR.02	Close status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.02
ISRC-010:VAC-VVA-01100_DAR.03	Interlock status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.03

Id	Text	Trace up to
LEBT-010:VAC-VVA-00031_DAR.01	Open status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.01
LEBT-010:VAC-VVA-00031_DAR.02	Close status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.02
LEBT-010:VAC-VVA-00031_DAR.03	Interlock status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.03
LEBT-010:VAC-VVA-02100_DAR.01	Open status shall be recorded so that diagnostic and post-mortem investigation can be achieved	VVA.DAR.01
LEBT-010:VAC-VVA-02100_DAR.02	Close status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.02
LEBT-010:VAC-VVA-02100_DAR.03	Interlock status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.03
LEBT-010:VAC-VVA-03100_DAR.01	Open status shall be recorded so that diagnostic and post-mortem investigation can be achieved	VVA.DAR.01
LEBT-010:VAC-VVA-03100_DAR.02	Close status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.02
LEBT-010:VAC-VVA-03100_DAR.03	Interlock status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.03
LEBT-010:VAC-VVA-01100_DAR.01	Open status shall be recorded so that diagnostic and post-mortem investigation can be achieved	VVA.DAR.01
LEBT-010:VAC-VVA-01100_DAR.02	Close status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.02
LEBT-010:VAC-VVA-01100_DAR.03	Interlock status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.03
LEBT-010:VAC-VVA-00041_DAR.01	Open status shall be recorded so that diagnostic and post-mortem investigation can be achieved	VVA.DAR.01
LEBT-010:VAC-VVA-00041_DAR.02	Close status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.02
LEBT-010:VAC-VVA-00041_DAR.03	Interlock status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.03
LEBT-010:VAC-VVA-00071_DAR.01	Open status shall be recorded so that diagnostic and post-mortem investigation can be achieved	VVA.DAR.01
LEBT-010:VAC-VVA-00071_DAR.02	Close status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.02
LEBT-010:VAC-VVA-00071_DAR.03	Interlock status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.03
LEBT-010:VAC-VVA-06100_DAR.01	Open status shall be recorded so that diagnostic and post-mortem investigation can be achieved	VVA.DAR.01
LEBT-010:VAC-VVA-06100_DAR.02	Close status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.02

Id	Text	Trace up to
LEBT-010:VAC-VVA-06100_DAR.03	Interlock status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.03
LEBT-010:VAC-VVA-07100_DAR.01	Open status shall be recorded so that diagnostic and post-mortem investigation can be achieved	VVA.DAR.01
LEBT-010:VAC-VVA-07100_DAR.02	Close status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.02
LEBT-010:VAC-VVA-07100_DAR.03	Interlock status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVA.DAR.03

3.1.3.4. VVG: Vacuum Gate Valve

Id	Text	Trace up to
	Not Applicable - No Vacuum Gate Valve is actually installed on the LEBT vacuum system	

3.1.3.5. VVS: Vacuum Sector Gate Valve

Id	Text	Trace up to
LEBT-010:VAC-VVS-20000_DAR.01	Open status shall be recorded so that diagnostic and post-mortem investigation can be achieved	VVS.DAR.01
LEBT-010:VAC-VVS-20000_DAR.02	Close status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVS.DAR.02
LEBT-010:VAC-VVS-20000_DAR.03	Previous interlock status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVS.DAR.03
LEBT-010:VAC-VVS-20000_DAR.04	Next interlock status shall be recorded so that diagnostic and post-mortem investigation can be achieved	VVS.DAR.04
LEBT-010:VAC-VVS-40000_DAR.01	Open status shall be recorded so that diagnostic and post-mortem investigation can be achieved	VVS.DAR.01
LEBT-010:VAC-VVS-40000_DAR.02	Close status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVS.DAR.02
LEBT-010:VAC-VVS-40000_DAR.03	Previous interlock status shall be recorded so that diagnostic and post-mortem investigation can be achieved.	VVS.DAR.03
LEBT-010:VAC-VVS-40000_DAR.04	Next interlock status shall be recorded so that diagnostic and post-mortem investigation can be achieved	VVS.DAR.04

3.1.3.6. VEVF: Vacuum Fast Valve Controller

Id	Text	Trace up to
	Not Applicable - No Vacuum Fast Valve is actually installed on the LEBT vacuum system	

3.1.3.7. VEG: Vacuum Gauge Controller

VEG [2] is the interface between the control system and the vacuum gauge.

Gauge controller has its own parameters and settings independent from the ones related to the parameters and settings that are applied to the gauges. Each of them shall be identified and accessible

Id	Text	Trace up to
LEBT-010:VAC-VGP-00021_DAR.01	Pressure shall be recorded through the serial communication port of the gauge controller.	VEG.DAR.01
LEBT-010:VAC-VGP-10000_DAR.01	Pressure shall be recorded through the serial communication port of the gauge controller.	VEG.DAR.01
LEBT-010:VAC-VGC-10000_DAR.01	Pressure shall be recorded at maximum 10 kHz so that pressure recorded can be used for accurate diagnostic.	VEG.DAR.01
LEBT-010:VAC-VGC-10000_DAR.02	Pressure shall be recorded in raw value so that the archived value is not corrupted by any scaling.	VEG.DAR.02
LEBT-010:VAC-VGC-10000_DAR.03	Scaling of archived value shall be achieved using the archiving appliance so that the archived value can be used as an understandable value.	VEG.DAR.03
LEBT-010:VAC-VGD-10000_DAR.01	Pressure shall be recorded at maximum 10 kHz so that pressure recorded can be used for accurate diagnostic.	VEG.DAR.01
LEBT-010:VAC-VGD-10000_DAR.02	Pressure shall be recorded in raw value so that the archived value is not corrupted by any scaling.	VEG.DAR.02
LEBT-010:VAC-VGD-10000_DAR.03	Scaling of archived value shall be achieved using the archiving appliance so that the archived value can be used as an understandable value.	VEG.DAR.03
LEBT-010:VAC-VGP-00081_DAR.01	Pressure shall be recorded through the serial communication port of the gauge controller.	VEG.DAR.01
LEBT-010:VAC-VGP-30000_DAR.01	Pressure shall be recorded through the serial communication port of the gauge controller.	VEG.DAR.01
LEBT-010:VAC-VGC-30000_DAR.01	Pressure shall be recorded at maximum 10 kHz so that pressure recorded can be used for accurate diagnostic.	VEG.DAR.01
LEBT-010:VAC-VGC-30000_DAR.02	Pressure shall be recorded in raw value so that the archived value is not corrupted by any scaling.	VEG.DAR.02
LEBT-010:VAC-VGC-30000_DAR.02	Scaling of archived value shall be achieved using the archiving appliance so that the archived value can be used as an understandable value.	VEG.DAR.03

3.1.3.8. VEPI: Vacuum Sputter Ion Pump Controller

VEPI [2] is the interface between control system and sputter ion pump (getter pump).

Id	Text	Trace up to
	Not Applicable - No Vacuum Sputter Ion Pump is actually installed on the LEBT vacuum system	

3.1.3.9. VEPN: Vacuum Non-Evaporable Getter Pump Controller

VEPN [2] is the interface between control system and non-evaporable getter pump (getter pump).

Id	Text	Trace up to
	Not Applicable - No Vacuum Non-Evaporable Getter Pump is actually installed on the LEBT vacuum system	

3.1.3.10. VTC: Vacuum Thermocouple Gauge

Id	Text	Trace up to
	Not Applicable - No Vacuum Thermocouple Gauge is actually installed on the LEBT vacuum system	

3.1.3.11. VERA: Vacuum Residual Gas Analyzer Controller

VERA [2] is the interface between control system and the residual gas analyser.

Id	Text	Trace up to
LEBT-010:VAC-VGR.10000_DAR.01	No data acquisition requirement has been expressed for VERA.	VERA.DAR.01

3.1.3.12. VEVMC: Vacuum Mass Flow Meter Controller

VEVMC [2] is the interface between control system and vacuum mass flow meter.

Id	Text	Trace up to
ISRC-010:VAC-VVMC-01100_DAR.01	No data acquisition requirement has been expressed for VEVMC.	VEVMC.DAR.01
LEBT-010:VAC-VVMC-01100_DAR.01	No data acquisition requirement has been expressed for VEVMC.	VEVMC.DAR.01

3.1.3.13. VPM: Vacuum Pressure Manometer

Id	Text	Trace up to
ISRC-010:VAC-VPM-00011_DAR.01	No data acquisition requirement has been expressed for VPM.	VPM.DAR.01
LEBT-010:VAC-VPM-00011_DAR.01	Pressure shall be recorded at maximum 10 kHz so that pressure recorded can be used for accurate diagnostic.	VPM.DAR.01
LEBT-010:VAC-VPM-00011_DAR.02	Pressure shall be recorded in raw value so that the archived value is not corrupted by any scaling.	VPM.DAR.02
LEBT-010:VAC-VPM-00011_DAR.03	Scaling of archived value shall be achieved using the archiving appliance so that the archived value can be used as an understandable value.	VPM.DAR.03

3.2. Constraint Requirements

3.2.1.1. VEPP: Vacuum Primary Pump Controller

VEPP [2] is the control interface between control system and primary pumps.

Id	Text	Trace up to
LEBT-010:VAC-VPDP-00031_CsR.01	No constraint requirement has been expressed for VEPP.	VEPP.CsR.01
LEBT-010:VAC-VPDP-00071_CsR.01	No constraint requirement has been expressed for VEPP.	VEPP.CsR.01

3.2.1.2. VEPT: Vacuum Turbomolecular Pump Controller

VEPT [2] is the control interface between control system and turbomolecular pump.

Id	Text	Trace up to
LEBT-010:VAC-VEPT-02100_CsR.01	No constraint requirement has been expressed for VEPT.	VEPT.CsR.01
LEBT-010:VAC-VEPT-03100_CsR.01	No constraint requirement has been expressed for VEPT.	VEPT.CsR.01
LEBT-010:VAC-VEPT-06100_CsR.01	No constraint requirement has been expressed for VEPT.	VEPT.CsR.01
LEBT-010:VAC-VEPT-07100_CsR.01	No constraint requirement has been expressed for VEPT.	VEPT.CsR.01

3.2.1.3. VVA: Vacuum Angle Valve

Id	Text	Trace up to
ISRC-010:VAC-VVA-01100_CsR.01	No constraint requirement has been expressed for VVA.	VVA.CsR.01
LEBT-010:VAC-VVA-00031_CsR.01	No constraint requirement has been expressed for VVA.	VVA.CsR.01
LEBT-010:VAC-VVA-02100_CsR.01	No constraint requirement has been expressed for VVA.	VVA.CsR.01
LEBT-010:VAC-VVA-03100_CsR.01	No constraint requirement has been expressed for VVA.	VVA.CsR.01
LEBT-010:VAC-VVA-01100_CsR.01	No constraint requirement has been expressed for VVA.	VVA.CsR.01
LEBT-010:VAC-VVA-00041_CsR.01	No constraint requirement has been expressed for VVA.	VVA.CsR.01
LEBT-010:VAC-VVA-00071_CsR.01	No constraint requirement has been expressed for VVA.	VVA.CsR.01

Id	Text	Trace up to
LEBT-010:VAC-VVA-06100_CsR.01	No constraint requirement has been expressed for VVA.	VVA.CsR.01
LEBT-010:VAC-VVA-07100_CsR.01	No constraint requirement has been expressed for VVA.	VVA.CsR.01

3.2.1.4. VVG: Vacuum Gate Valve

Id	Text	Trace up to
	Not Applicable - No Vacuum Gate Valve is actually installed on the LEBT vacuum system	VVG.CsR.01

3.2.1.5. VVS: Vacuum Sector Gate Valve

Id	Text	Trace up to
LEBT-010:VAC-VVS-20000_CsR.01	No constraint requirement has been expressed for VVS.	VVS.CsR.01
LEBT-010:VAC-VVS-40000_CsR.01	No constraint requirement has been expressed for VVS.	VVS.CsR.01

3.2.1.6. VEVF: Vacuum Fast Valve Controller

Id	Text	Trace up to
	Not Applicable - No Vacuum Fast Valve is actually installed on the LEBT vacuum system	VEVF.CsR.001

3.2.1.7. VEG: Vacuum Gauge Controller

VEG [2] is the interface between the control system and the vacuum gauge.

Id	Text	Trace up to
LEBT-010:VAC-VEG-00011-CsR.01	No constraint requirement has been expressed for VEG.	VEG.CsR.01
LEBT-010:VAC-VEG-10001-CsR.01	No constraint requirement has been expressed for VEG.	VEG.CsR.01
LEBT-010:VAC-VEG-10010-CsR.01	No constraint requirement has been expressed for VEG.	VEG.CsR.01
LEBT-010:VAC-VEG-20020-CsR.01	No constraint requirement has been expressed for VEG.	VEG.CsR.01

3.2.1.8. VEPI: Vacuum Sputter Ion Pump Controller

VEPI [2] is the interface between control system and sputter ion pump (getter pump).

Id	Text	Trace up to
	Not Applicable - No Vacuum Sputter Ion Pump is actually installed on the LEBT vacuum system	

3.2.1.9. VEPN: Vacuum Non-Evaporable Getter Pump Controller

VEPN [2] is the interface between control system and non-evaporable getter pump (getter pump).

Id	Text	Trace up to
	Not Applicable - No Vacuum Non-Evaporable Getter Pump is actually installed on the LEBT vacuum system	

3.2.1.10. VTC: Vacuum Thermocouple Gauge

Id	Text	Trace up to
	Not Applicable - No Vacuum Thermocouple Gauge is actually installed on the LEBT vacuum system	

3.2.1.11. VERA: Vacuum Residual Gas Analyzer Controller

VERA [2] is the interface between control system and the residual gas analyser.

Id	Text	Trace up to
LEBT-010:VAC-VGR.10000_CsR.01	No constraint requirement has been expressed for VERA.	VERA.CsR.01

3.2.1.12. VEVMC: Vacuum Mass Flow Meter Controller

VEVMC [2] is the interface between control system and vacuum mass flow meter.

Id	Text	Trace up to
LEBT-010:VAC-VEVMC-01100_CsR.01	No constraint requirement has been expressed for VEVMC.	VEVMC.CsR.01
LEBT-010:VAC-VEVMC-02200_CsR.01	No constraint requirement has been expressed for VEVMC.	VEVMC.CsR.01
LEBT-010:VAC-VEVMC-10001_CsR.01	No constraint requirement has been expressed for VEVMC.	VEVMC.CsR.01

3.2.1.13. VPM: Vacuum Pressure Manometer

Id	Text	Trace up to
ISRC-010:VAC-VPM-00011_CsR.01	No constraint requirement has been expressed for VPM.	VPM.CsR.01
LEBT-010:VAC-VPM-00011_CsR.01	No constraint requirement has been expressed for VPM.	VPM.CsR.01

3.3. Environmental Requirements

No environmental requirements are applicable to the Proton Beam Vacuum Control system.

3.4. Conventional Safety Requirements

Safety and security requirements not related radiation protection.

3.4.1.1. VEPP: Vacuum Primary Pump Controller

VEPP [2] is the control interface between control system and primary pumps.

Id	Text	Trace up to
LEBT-010:VAC-VPDP-00031_SR.01	VEPP is not used to trigger interlock.	VEPP.SR.01
LEBT-010:VAC-VPDP-00071_SR.01	VEPP is not used to trigger interlock.	VEPP.SR.01

3.4.1.2. VEPT: Vacuum Turbomolecular Pump Controller

VEPT [2] is the control interface between control system and turbomolecular pumps.

Id	Text	Trace up to
LEBT-010:VAC-VEPT-02100_SR.01	VEPT is not used to trigger interlock.	VEPT.SR.01
LEBT-010:VAC-VEPT-03100_SR.01	VEPT is not used to trigger interlock.	VEPT.SR.01
LEBT-010:VAC-VEPT-06100_SR.01	VEPT is not used to trigger interlock.	VEPT.SR.01
LEBT-010:VAC-VEPT-07100_SR.01	VEPT is not used to trigger interlock.	VEPT.SR.01

3.4.1.3. VVA: Vacuum Angle Valve

Id	Text	Trace up to
ISRC-010:VAC-VVA-01100_SR.01	VVA is not used to trigger interlock.	VVA.SR.01
LEBT-010:VAC-VVA-00031_SR.01	VVA is not used to trigger interlock.	VVA.SR.01
LEBT-010:VAC-VVA-02100_SR.01	VVA is not used to trigger interlock.	VVA.SR.01
LEBT-010:VAC-VVA-03100_SR.01	VVA is not used to trigger interlock.	VVA.SR.01
LEBT-010:VAC-VVA-01100_SR.01	VVA is not used to trigger interlock.	VVA.SR.01
LEBT-010:VAC-VVA-00041_SR.01	VVA is not used to trigger interlock.	VVA.SR.01
LEBT-010:VAC-VVA-00071_SR.01	VVA is not used to trigger interlock.	VVA.SR.01
LEBT-010:VAC-VVA-06100_SR.01	VVA is not used to trigger interlock.	VVA.SR.01
LEBT-010:VAC-VVA-07100_SR.01	VVA is not used to trigger interlock.	VVA.SR.01

3.4.1.4. VVG: Vacuum Gate Valve

Id	Text	Trace up to
	Not Applicable - No Vacuum Gate Valve is actually installed on the LEBT vacuum system	

3.4.1.5. VVS: Vacuum Sector Gate Valve

Id	Text	Trace up to
LEBT-010:VAC-VVS-20000_SR.01	VVS is not used to trigger interlock.	VVS.SR.01
LEBT-010:VAC-VVS-20000_SR.02	VVS Interlocks are triggered by digitals signals provided by vacuum devices controllers.	VVS.SR.02
LEBT-010:VAC-VVS-20000_SR.03	Due to the device configuration of the LEBT, there is no voting plan use to trigger interlock to LEBT-010:VAC-VVS-20000.	VVS.SR.03
LEBT-010:VAC-VVS-20000_SR.04	LEBT-010:VAC-VVS-20000 upstream interlock (previous interlock) is triggered by LEBT-010:VAC-VGC-10000.	VVS.SR.04
LEBT-010:VAC-VVS-20000_SR.05	Threshold of the relay output to triggered downstream interlock of LEBT-010:VAC-VVS-20000 is set on the gauge controller that controls LEBT-010:VAC-VGC-10000.	VVS.SR.04

Id	Text	Trace up to
LEBT-010:VAC-VVS-20000_SR.06	LEBT-010:VAC-VVS-20000 downstream interlock (next interlock) is triggered by LEBT-010:VAC-VGC-30000.	VVS.SR.04
LEBT-010:VAC-VVS-20000_SR.07	Threshold of the relay output to triggered downstream interlock of LEBT-010:VAC-VVS-20000 is set on the gauge controller that controls LEBT-010:VAC-VGC-30000.	VVS.SR.04
LEBT-010:VAC-VVS-40000_SR.01	VVS is not used to trigger interlock.	VVS.SR.01
LEBT-010:VAC-VVS-40000_SR.02	VVS Interlocks are triggered by digitals signals provided by vacuum devices controllers.	VVS.SR.02
LEBT-010:VAC-VVS-40000_SR.03	Due to the device configuration of the LEBT, there is no voting plan use to trigger interlock to LEBT-010:VAC-VVS-40000.	VVS.SR.03
LEBT-010:VAC-VVS-40000_SR.04	LEBT-010:VAC-VVS-40000 upstream interlock (previous interlock) is triggered by LEBT-010:VAC-VGC-30000.	VVS.SR.04
LEBT-010:VAC-VVS-40000_SR.05	Threshold of the relay output to triggered downstream interlock of LEBT-010:VAC-VVS-40000 is set on the gauge controller that controls LEBT-010:VAC-VGC-30000.	VVS.SR.04
LEBT-010:VAC-VVS-40000_SR.06	LEBT-010:VAC-VVS-40000 downstream interlock (next interlock) is triggered by RFQ-010:VAC-VGC-10000 and RFQ-010:VAC-VGC-20000.	VVS.SR.04
LEBT-010:VAC-VVS-40000_SR.07	Threshold of the relay output to triggered downstream interlock of LEBT-010:VAC-VVS-40000 is set on the gauge controller that controls RFQ-010:VAC-VGC-10000 and RFQ-010:VAC-VGC-20000.	VVS.SR.04

3.4.1.6. VEVF: Vacuum Fast Valve Controller

Id	Text	Trace up to
	Not Applicable - No Vacuum Fast Valve is actually installed on the LEBT vacuum system	

3.4.1.7. VEG: Vacuum Gauge Controller

VEG [2] is the interface between the control system and the vacuum gauge.

Id	Text	Trace up to
LEBT-010:VAC-VEG-00011_SR.01	LEBT-010:VAC-VGP-00021 shall trigger an interlock if the pressure rise above 1.0 10e-1 mbar so that the atmospheric pressure on the manifold can be assessed.	VEG.SR.04
LEBT-010:VAC-VEG-00011_SR.02	LEBT-010:VAC-VGP-00081 shall trigger an interlock if the pressure rise above 1.0 10e-1 mbar so that the atmospheric pressure on the manifold can be assessed.	VEG.SR.04

Id	Text	Trace up to
LEBT-010:VAC-VEG-10001_SR.01	ISRC-010:VAC-VVA-01100 shall be closed if the pressure rise above 1.0 10e-4 mbar and cannot be open before the pressure goes bellow 1.0 10e-5 mbar.	VEG.SR.01
LEBT-010:VAC-VEG-10001_SR.02	LEBT-010:VAC-VVA-01100 shall be closed if the pressure rise above 1.0 10e-4 mbar and cannot be open before the pressure goes bellow 1.0 10e-5 mbar.	VEG.SR.01
LEBT-010:VAC-VEG-10001_SR.03	LEBT-010:VAC-VGP-10000 shall trigger an interlock if the pressure rise above 1.0 10e-1 mbar so that the atmospheric pressure on the vacuum sector can be assessed	VEG.SR.04
LEBT-010:VAC-VEG-10001_SR.04	LEBT-010:VAC-VGP-30000 shall trigger an interlock if the pressure rise above 1.0 10e-1 mbar so that the atmospheric pressure on the vacuum sector can be assessed.	VEG.SR.04

3.4.1.8. VEPI: Vacuum Sputter Ion Pump Controller

VEPI [2] is the interface between control system and sputter ion pump (getter pump).

Id	Text	Trace up to
	Not Applicable - No Vacuum Sputter Ion Pump is actually installed on the LEBT vacuum system	

3.4.1.9. VEPN: Vacuum Non-Evaporable Getter Pump Controller

VEPN [2] is the interface between control system and non-evaporable getter pump (getter pump).

Id	Text	Trace up to
	Not Applicable - No Vacuum Non-Evaporable Getter Pump is actually installed on the LEBT vacuum system	

3.4.1.10. VTC: Vacuum Thermocouple Gauge

Id	Text	Trace up to
	Not Applicable - No Vacuum Thermocouple Gauge is actually installed on the LEBT vacuum system	

3.4.1.11. VERA: Vacuum Residual Gas Analyzer Controller

VERA [2] is the interface between control system and the residual gas analyser.

Id	Text	Trace up to
LEBT-010:VAC-VGR.10000_SR.01	VERA is not used to trigger interlock.	VERA.SR.01
LEBT-010:VAC-VGR.10000_SR.02	~~LEBT-010:VAC-VGC-10000 shall trigger an interlock trough LEBT-010:VAC-VEG-10010 so that operation at high pressure is prevented. Pressure threshold is set into the gauge controller and hasn't been defined yet.~~	VERA.SR.01

3.4.1.12. VEVMC: Vacuum Mass Flow Meter Controller

VEVMC [2] is the interface between control system and vacuum mass flow meter.

Id	Text	Trace up to
LEBT-010:VAC-VEVMC-01100_SR.01	No constraint requirement has been expressed for VEVMC.	VEVMC.SR.01
LEBT-010:VAC-VEVMC-02200_SR.01	No constraint requirement has been expressed for VEVMC.	VEVMC.SR.01
LEBT-010:VAC-VEVMC-10001_SR.01	No constraint requirement has been expressed for VEVMC.	VEVMC.SR.01

3.4.1.13. VPM: Vacuum Pressure Manometer

Id	Text	Trace up to
ISRC-010:VAC-VPM-00011_SR.01	No constraint requirement has been expressed for VPM.	VPM.SR.01
LEBT-010:VAC-VPM-00011_SR.01	No constraint requirement has been expressed for VPM.	VPM.SR.01

3.4.1.14. VBP: Vacuum Beam Permit

Id	Text	Trace up to
LEBT-010:VAC-VVS-20000_VBP.SR.01	VBP shall provide vacuum permission to machine protection to run the accelerator so that the machine is safe.	VBP.SR.01
LEBT-010:VAC-VVS-20000_VBP.SR.02	VBP shall provide an hardware interlock to the Ion source Control system so that the ion source is stopped in case of degradation of the vacuum condition on the first vacuum sector of LEBT.	VBP.SR.01
LEBT-010:VAC-VVS-20000_VBP.SR.03	VPB shall provide an hardware interlock so that ISRC-010:VAC-VVA-01100 close in case of degradation of the vacuum condition or in case of personal access into the tunnel.	ISRC-010:VAC-VVA-01100_CR.03
LEBT-010:VAC-VVS-20000_VBP.SR.04	VPB shall provide an hardware interlock so that LEBT-010:VAC-VVA-01100 close in case of degradation of the vacuum condition or in case of personal access into the tunnel.	LEBT-010:VAC-VVA-01100_CR.03
LEBT-010:VAC-VVS-40000_VBP.SR.01	VBP shall provide vacuum permission to machine protection to run the accelerator so that the machine is safe.	VBP.SR.01

3.5. Radiation Safety Requirements

No radiation safety and security requirements related to radiation requirements are applicable to the Proton Beam Vacuum Control system.

3.6. Interface Requirements

3.6.1.1. VEPP: Vacuum Primary Pump Controller

VEPP [2] is the control interface between control system and primary pumps.

Id	Text	Trace up to
LEBT-010:VAC-VPDP-00031_IR.01	No interface requirement has been expressed for VEPP.	VEPP.IR.01
LEBT-010:VAC-VPDP-00071_IR.01	No interface requirement has been expressed for VEPP.	VEPP.IR.01

3.6.1.2. VEPT: Vacuum Turbomolecular Pump Controller

VEPT [2] is the control interface between control system and turbomolecular pump.

Id	Text	Trace up to
LEBT-010:VAC-VEPT-02100_IR.01	Turbo molecular pump controller shall use RS232 serial interface so that controller can be accessed at distance.	VEPT.IR.01
LEBT-010:VAC-VEPT-03100_IR.01	Turbo molecular pump controller shall use RS232 serial interface so that controller can be accessed at distance.	VEPT.IR.01
LEBT-010:VAC-VEPT-06100_IR.01	Turbo molecular pump controller shall use RS232 serial interface so that controller can be accessed at distance.	VEPT.IR.01
LEBT-010:VAC-VEPT-07100_IR.01	Turbo molecular pump controller shall use RS232 serial interface so that controller can be accessed at distance.	VEPT.IR.01

3.6.1.3. VVA: Vacuum Angle Valve

Id	Text	Trace up to
ISRC-010:VAC-VVA-01100_IR.01	No interface requirement has been expressed for VVA.	VVA.IR.01
LEBT-010:VAC-VVA-00031_IR.01	No interface requirement has been expressed for VVA.	VVA.IR.01
LEBT-010:VAC-VVA-02100_IR.01	No interface requirement has been expressed for VVA.	VVA.IR.01
LEBT-010:VAC-VVA-03100_IR.01	No interface requirement has been expressed for VVA.	VVA.IR.01

Id	Text	Trace up to
LEBT-010:VAC-VVA-01100_IR.01	No interface requirement has been expressed for VVA.	VVA.IR.01
LEBT-010:VAC-VVA-00041_IR.01	No interface requirement has been expressed for VVA.	VVA.IR.01
LEBT-010:VAC-VVA-00071_IR.01	No interface requirement has been expressed for VVA.	VVA.IR.01
LEBT-010:VAC-VVA-06100_IR.01	No interface requirement has been expressed for VVA.	VVA.IR.01
LEBT-010:VAC-VVA-07100_IR.01	No interface requirement has been expressed for VVA.	VVA.IR.01

3.6.1.4. VVG: Vacuum Gate Valve

Id	Text	Trace up to
	Not Applicable - No Vacuum Gate Valve is actually installed on the LEBT vacuum system	

3.6.1.5. VVS: Vacuum Sector Gate Valve

Id	Text	Trace up to
LEBT-010:VAC-VVS-20000_IR.01	No interface requirement has been expressed for VVS.	VVS.IR.01
LEBT-010:VAC-VVS-40000_IR.01	No interface requirement has been expressed for VVS.	VVS.IR.01

3.6.1.6. VEVF: Vacuum Fast Valve Controller

Id	Text	Trace up to
	Not Applicable - No Vacuum Fast Valve is actually installed on the LEBT vacuum system	

3.6.1.7. VEG: Vacuum Gauge Controller

VEG [2] is the interface between the control system and the vacuum gauge.

Id	Text	Trace up to
LEBT-010:VAC-VEG-00011-IR.01	Vacuum gauge controller shall use RS232 serial interface so that controller can be accessed at distance.	VEG.IR.01
LEBT-010:VAC-VEG-10001-IR.01	Vacuum gauge controller shall use RS232 serial interface so that controller can be accessed at distance.	VEG.IR.01

Id	Text	Trace up to
LEBT-010:VAC-VEG-10010-IR.01	Vacuum gauge controller shall use RS232 serial interface so that controller can be accessed at distance.	VEG.IR.01
LEBT-010:VAC-VEG-20020-IR.01	Vacuum gauge controller shall use RS232 serial interface so that controller can be accessed at distance.	VEG.IR.01

3.6.1.8. VEPI: Vacuum Sputter Ion Pump Controller

VEPI [2] is the interface between control system and sputter ion pump (getter pump).

Id	Text	Trace up to
	Not Applicable - No Vacuum Sputter Ion Pump is actually installed on the LEBT vacuum system	

3.6.1.9. VEPN: Vacuum Non-Evaporable Getter Pump Controller

VEPN [2] is the interface between control system and non-evaporable getter pump (getter pump).

Id	Text	Trace up to
	Not Applicable - No Vacuum Non-Evaporable Getter Pump is actually installed on the LEBT vacuum system	

3.6.1.10. VTC: Vacuum Thermocouple Gauge

Id	Text	Trace up to
	Not Applicable - No Vacuum Thermocouple Gauge is actually installed on the LEBT vacuum system	

3.6.1.11. VERA: Vacuum Residual Gas Analyzer Controller

VERA [2] is the interface between control system and the residual gas analyser.

Id	Text	Trace up to
LEBT-010:VAC-VGR.10000_IR.01	Vacuum residual gas analyser controller shall use RS232 serial interface so that controller can be accessed at distance.	VERA.IR.01

3.6.1.12. VEVMC: Vacuum Mass Flow Meter Controller

VEVMC [2] is the interface between control system and vacuum mass flow meter.

Id	Text	Trace up to
LEBT-010:VAC-VEVMC-01100_IR.01	Vacuum mass flow meter controller shall use RS232 serial interface so that controller can be accessed at distance.	VEVMC.IR.01
LEBT-010:VAC-VEVMC-02200_IR.01	Vacuum mass flow meter controller shall use RS232 serial interface so that controller can be accessed at distance.	VEVMC.IR.01
LEBT-010:VAC-VEVMC-10001_IR.01	Vacuum mass flow meter controller shall use RS232 serial interface so that controller can be accessed at distance.	VEVMC.IR.01

3.6.1.13. VPM: Vacuum Pressure Manometer

Id	Text	Trace up to
ISRC-010:VAC-VPM-00011_CsR.01	No constraint requirement has been expressed for VPM.	VPM.IR.01
LEBT-010:VAC-VPM-00011_CsR.01	No constraint requirement has been expressed for VPM.	VPM.IR.01

4. GLOSSARY

Term	Definition
ICS	Integrated Control System
GUI	Graphical User Interface
LEBT	Low Energy Beam Transfer is a subsection of the LINAC.
RFQ	Radio-Frequency Quadrupole is a subsection of the LINAC.

5. REFERENCES

[1] Proton Beam Vacuum Control System - System Engineering Management Plan - ESS-0090062
[2] Vacuum Symbols and ICS naming - ESS-0043149
[3] Proton Beam Vacuum Interlock System - System Engineering Management Plan - ESS-0087015
[4] Vacuum symbols and widgets requirements for control screens - ESS-0107913.
[5] Proton Beam Vacuum Control System - System Requirement Specification - ESS-0090064.
[6] LEBT Vacuum Control System - System Engineering Management Plan - ESS-0087029.
[7] ISRC + LEBT Vacuum Diagram - ESS-0085792.

6. CHANGES SUMMARY

Version	Description of the changes
1	First issue
2	-LEBT-010:VAC-VGR.10000_SR.02 is not required anymore. -LEBT-010:VAC-VGD-10000_DAR.01: Data acquisition requirements modified from serial to data acquisition system. -LEBT-010:VAC-VPM-00011_DAR.01: Add requirements for VPM on LEBT-010. -Minor correction of the name of the origin of the interface requirements for VERA, VEVMC, VPM. -Minor correction of the name of the interface requirements for VPM.

DOCUMENT REVISION HISTORY

Revision	Reason for and description of change	Author	Date
1	First issue	François Bellorini	2017-05-05
2	Update before commissioning of the LEBT	François Bellorini	2018-01-19