LEBT Vacuum Control System - Interface Control Document

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1. SCOPE

The LEBT Vacuum Control System is a sub-system part of the Proton Beam Vacuum Control System [1].
This document describes the interfaces of LEBT Vacuum Control System.

2. ISSUING ORGANISATION

Vacuum system is designed by the Vacuum team, part of the Specialized Technical Services Group of the Accelerator Division from the Machine Directorate of ESS.

The interface description is written by Integrated Control System Division from the Machine Directorate of ESS.

3. CONTEXT

The Proton Beam Vacuum Control System is the system that controls vacuum equipment's installed on the LINAC at ESS.

The Proton Beam Vacuum System is split into several subsystems. Each of these subsystems has its own control subsystem. This document describes interfaces of the LEBT Vacuum Control subsystem.

4. NOTATION FOR DESCRIPTION

Devices that this document refers to are identified with their device mnemonic defined by the "Vacuum Symbols and ICS naming" [3] document and by their names issued from the ESS Naming Service.

Hardware electrical interfaces that this document describes are defined by the electrical diagram designed [4] by Vacuum Group, part of the Specialized Technical Services Group of the Accelerator Division of the Machine Directorate

Vacuum devices that this document refers to are represented on vacuum layout [7] of the LEBT Vacuum System.

LEBT Vacuum Control System is listed into ESS Functional Breakdown Structure [6]: =ESS.ACC.G01.G01.

All the vacuum components that this document refers to are located in the accelerator tunnel [6]: +ESS.G01.090.1001.100.

All vacuum control equipment and control equipment that this document refers to are located in a rack in the Front End building [6]: +ESS.G01.090.5005.102.001.

LEBT Vacuum System is divided into two vacuum sectors separated by a “Sector Gate Valve” (VVS) [3]. The sector gate valves belong to a higher level system named “Proton Beam Vacuum Interlock System” [2] that is not covered by this document.

“Proton Beam Vacuum Interlock System” belongs to the Vacuum Control System, its tag into ESS Functional Breakdown Structure [6] is: =ESS.ACC.G01.

4.1. Systems and Sub-systems

The tables bellow summarizes the different systems and sub-systems, their names [9] and their tags [5].

Overall Vacuum Systems

Overall Proton Beam Vacuum Control Systems	**=FBS TAG &** ***(-FBS Controller)***	**ESS Name**
Accelerator Vacuum System (Proton Beam Vacuum System)	=ESS.ACC.G01	Has no ESS Name
Proton Beam Vacuum Control (EPICS IOC)	Has No ESS Tag	VacS-ACCV:VAC-IOC-11010
Proton Beam Vacuum Control (EPICS GUI)	Has No ESS Tag	Has no ESS Name
Proton Beam Vacuum Control (PLC System)	=ESS.ACC.G01.K01	Has No ESS Name
Proton Beam Vacuum Control - Interlock PLC System *(CPU)*	=ESS.ACC.G01.K01.K01 *(-K01)*	VacS-ACCV:VAC-PLC-10001
Proton Beam Vacuum Control - Process PLC System *(CPU)*	=ESS.ACC.G01.K01.K02 *(-K02)*	VacS-ACCV:VAC-PLC-01001

Table 1 Overall vacuum control systems

LEBT Vacuum Control Sub-Systems

LEBT Vacuum Control Systems	**=FBS TAG & *(-FBS Controller)***	**ESS Name**
LEBT Vacuum Interlock PLC System *(PLC 'Remote I/O')*	=ESS.ACC.G01.G01.K01.K01.KF01	LEBT-010:VAC-PLCIO-10001
LEBT Vacuum Process PLC System *(PLC 'Remote I/O')*	=ESS.ACC.G01.G01.K01.K01.KF10	LEBT-010:VAC-PLCIO-01001
LEBT Vacuum Gauge Control System	=ESS.ACC.G01.G01.K01.K02	(see Figure 1)
LEBT Vacuum Pump Control System	=ESS.ACC.G01.G01.K01.K03	(see Figure 1)
LEBT Vacuum Valve Control System	=ESS.ACC.G01.G01.K01.K04	(see Figure 1)
LEBT Vacuum Residual Gas Analizer Control system	=ESS.ACC.G01.G01.K01.K06	(see Figure 1)
LEBT Vacuum Data Acquisition System *(IPC)*	=ESS.ACC.G01.G01.K01.K06.KF01	LEBT-010:VAC-IPC-DAQ001
LEBT Vacuum Data Acquisition System (EPICS IOC)	Has No ESS Tag	LEBT-010:VAC-IOC-DAQ001
LEBT Vacuum Data Acquisition System *(PLC Remote I/O)*	=ESS.ACC.G01.G01.K01.K06.K01	LEBT-010:VAC-ECATIO-10001

Table 2 LEBT Vacuum Control Systems

LEBT Vacuum Control Sub-Systems - Location

LEBT Vacuum Control Systems	**+LBS TAG**	**ESS Name**
Rack	+ESS.G01.090.5005.102.001	FEB-030ROW:CNPW-U-001

Table 3 LEBT Vacuum Control Systems - Location.

5. LEBT VACUUM CONTROL SYSTEM ARCHITECTURE DIAGRAM

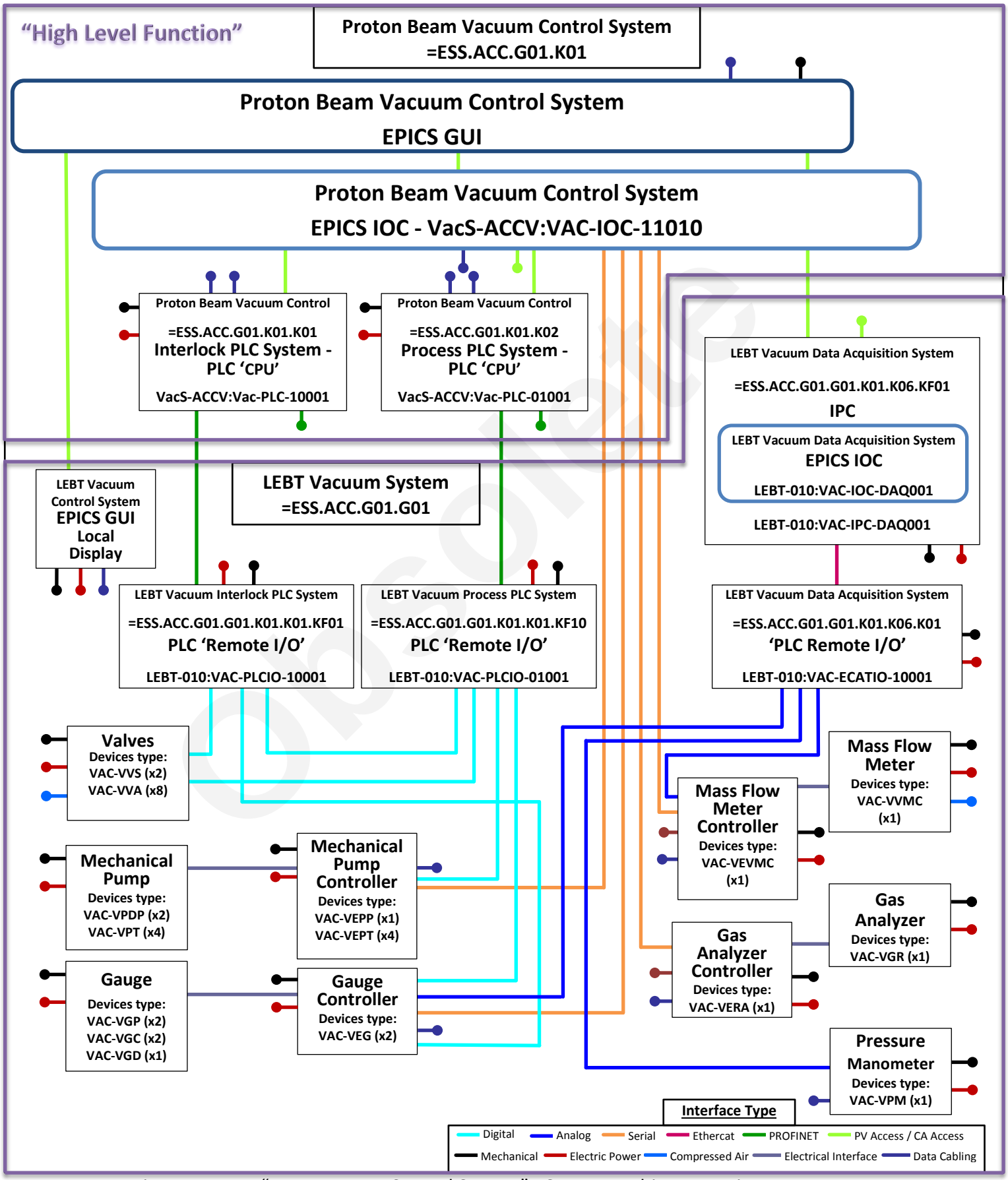

Figure 1 "LEBT Vacuum Control System" - System Architecture Diagram

6. INTERFACES DESCRIPTIONS

6.1. Structural Interface

Structural interfaces are the interfaces between the overall “Proton Beam Vacuum System” and the vacuum control sub-systems it is connected to.

6.1.1. Proton Beam Vacuum Control System - EPICS GUI

The EPICS GUI runs on control screens on the main control room or on any display system connected to the PV Access / CA Access network [8].

6.1.2. Proton Beam Vacuum Control System - EPICS IOC

The EPICS IOC is running inside a virtual control box installed on the server room [8].

6.1.3. Proton Beam Vacuum Control - Interlock PLC System

The Interlock PLC System is a distributed system that controls all the sector gates valves and the entire vacuum beam permit signals of the LINAC.
Each sector gate valve has a dedicated remote I/O node connected to the CPU.

6.1.4. Proton Beam Vacuum Control - Process PLC System

The Process PLC System is a distributed system that controls all the vacuum device controllers that belong to the different sub-systems of the LINAC.
Each vacuum control sub-system has a dedicated remote I/O node connected to the CPU.

“Process PLC System” [1] and “Interlock PLC System” [2] are independent systems.

6.2. Mechanical Interface

6.2.1. Mechanical Pump

6.2.1.1. VPDP: Vacuum Dry Primary Pump

VPDP [3] or VPP [3] are used to generate low and medium vacuum.

VPDP are installed in the tunnel +ESS.G01.090.1001.100 and connected to the pumping system. The primary pump pumps the exhaust (backing) of the high vacuum mechanical pump. It is connected to the high vacuum mechanical pump by a bellow or a manifold.

6.2.1.2. VPT: Vacuum Turbomolecular Pump

VPT [3] are used to generate high vacuum.

VPT are installed in the tunnel +ESS.G01.090.1001.100 and are directly connected to the vacuum chamber or connected to the beam pipe through a manifold.

6.2.2. Mechanical Pump Controller

6.2.2.1. VEPP: Vacuum Primary Pump Controller

VEPP [3] controls VPDPs and / or VPPs.

VEPP is installed in a rack in the Front End building [6]: +ESS.G01.090.5005.102.001.

6.2.2.2. VEPT: Vacuum Turbomolecular Pump Controller

VEPT [3] controls VPT.

VEPT is installed in a rack in the Front End building [6]: +ESS.G01.090.5005.102.001.

6.2.3. Valves

6.2.3.1. VVA: Vacuum Angle Valves

VVA [3] is used to isolate part of the vacuum pumping circuit, to isolate the gas injection line and to isolate the primary pump or turbomolecular pumps.
VVA is also used to connect together, or to isolate one from another, two redundant pumping systems.

VVA are installed in the tunnel +ESS.G01.090.1001.100.

VVA are not installed on the beam line; it is not a beam intercepting device.

6.2.3.2. VVS: Vacuum Sector Gate Valves

VVS [3] is used to isolate two vacuum sectors.

VVS are installed in the tunnel +ESS.G01.090.1001.100.

VVS are installed on the beam line; it is a beam intercepting device when it is closed.

6.2.4. Gauges

6.2.4.1. VGP: Vacuum Pirani Gauge

VGP [3] is used to measure pressure from atmospheric pressure down to medium vacuum.

VGP are installed in +ESS.G01.090.1001.100 on the vacuum chamber, outside of the proton beam line; it is not a beam intercepting device.

6.2.4.2. VGC: Vacuum Cold Cathode Gauge

VGC [3] is used to measure pressure from medium vacuum down to ultra-high vacuum.

VGC are installed in +ESS.G01.090.1001.100 on the vacuum chamber, outside of the proton beam line; it is not a beam intercepting device.

6.2.4.3. VGD: Vacuum Capacitance Gauge

VGD [3] is used to measure from atmospheric pressure down to medium vacuum.

VGD are installed in +ESS.G01.090.1001.100 on the vacuum chamber, outside of the proton beam line; it is not a beam intercepting device.

6.2.5. Gauge controller

6.2.5.1. VEG: Vacuum Gauge Controller

VEG [3] controls VGP and VGC.

VEG are installed in a rack in the Front End building [6]: +ESS.G01.090.5005.102.001.

6.2.6. Pressure Manometer

6.2.6.1. VPM: Vacuum Pressure Manometer

VPM [3] are used to monitor pressure on the gas bottle of the gas injection lines.

VPM is installed in the gas bottle located in the tunnel +ESS.G01.090.1001.100 it is isolated from the plasma chamber and the vacuum chamber by VVA and MFC [3].

6.2.7. Mass Flow Meter

6.2.7.1. VVMC: Vacuum Mass Flow Meter

VVMC [3] is used to regulate the gas flow of the gas injection system.

VVMC is installed in the gas injection line in the tunnel +ESS.G01.090.1001.100 on the gas injection line.

6.2.7.2. VEVMC: Vacuum Mass Flow Meter Controller

VEVMC [3] is used to control VVMC and VGD.

VEVMC is installed in a rack in the Front End building [6]: +ESS.G01.090.5005.102.001.

6.2.8. Residual Gas Analyzer

6.2.8.1. VGR: Vacuum Partial Pressure Sensor for Residual Gas Analyzer

VGR [3] is the sensor for mass spectrometry analysis of the residual gas analyzer.

VGR is installed in +ESS.G01.090.1001.100 on the vacuum chamber, outside of the proton beam line; it is not a beam intercepting device.

6.2.8.2. VERA: Vacuum Residual Gas Analyzer Controller

VERA [3] is connected to the VGR.

VERA is located in a rack in the Front End building [6]: +ESS.G01.090.5005.102.001.

6.2.9. Control equipment

6.2.9.1. LEBT Vacuum Interlock PLC System - PLC Remote I/O

The “Interlock PLC Remote I/Os” are connected to the CPU of the “Proton Beam Vacuum Control - Interlock PLC System”.
It monitors inputs connected to vacuum controller and controls outputs that control the

sector gate valves and vacuum beam permit that belongs to the “LEBT Vacuum Control System”.

PLC Remote I/O’s are located in a rack in the Front End building [6]: +ESS.G01.090.5005.102.001.

6.2.9.2. LEBT Vacuum Process PLC System - PLC Remote I/O

The “Process PLC Remote I/Os” are connected to the centralized CPU of the “Proton Beam Vacuum Control - Process PLC System”.
It monitors inputs and controls outputs connected to the “LEBT Vacuum Control System”.

PLC Remote I/O’s are located in a rack in the Front End building [6]: +ESS.G01.090.5005.102.001.

6.2.9.3. LEBT Vacuum Data Acquisition System - EPICS IOC

The EPICS IOC of LEBT Vacuum Data Acquisition System runs on a dedicated Industrial PC.

The IPC is installed in a rack in the Front End building [6]: +ESS.G01.090.5005.102.001.

6.2.9.4. LEBT Vacuum Data Acquisition System - PLC I/O

The inputs card of the LEBT Vacuum Data Acquisition System is connected to the LEBT Data Acquisition System EPICS control box.

PLC I/O’s are installed in a rack in the Front End building [6]: +ESS.G01.090.5005.102.001.

6.2.9.5. EPICS GUI - Local Display

The local display is an IPC that is running the EPICS GUI.

It is installed in a rack in the Front End building [6]: +ESS.G01.090.5005.102.001.

6.2.9.6. Proton Beam Vacuum Control System - Interlock PLC System - CPU

The CPU of the “Proton Beam Vacuum Control System - Interlock PLC System” controls the PLC Remote I/O modules.

It is located in a rack in the Front End building [6]: +ESS.G01.090.5005.102.001.

6.2.9.7. Proton Beam Vacuum Control System - Process PLC System - CPU

The CPU of the “Proton Beam Vacuum Control System - Process PLC System” controls the PLC Remote I/O modules.

It is located in a rack in the Front End building [6]: +ESS.G01.090.5005.102.001.

6.3. Electrical energizing interface

Controllers controlled by “LEBT Vacuum Control System” are powered by the rack’s power distribution. There is no auxiliary electric power supply required.

6.3.1. Mechanical Pump

6.3.1.1. VPDP: Vacuum Dry Primary Pump

VPDP [3] or VPP [3] is powered by the VEPP [3] it is connected to.
Electrical connection is done according to the electrical diagram [4].

6.3.1.2. VPT: Vacuum Turbomolecular Pump

VPT [3] is powered by the VEPT [3] it is connected to.
Electrical connection is done according to the electrical diagram [4].

6.3.2. Mechanical Pump Controller

6.3.2.1. VEPP: Vacuum Primary Pump Controller

VEPP [3] controls VPDP and VPP, it is VEPP is powered by a 400 VAC 3 phase power supply.
Electrical connection is done according to the electrical diagram [4].

6.3.2.2. VEPT: Vacuum Turbomolecular Pump Controller

VEPT [3] controls VPT, it is powered by a 230VAC mono-phase power strip.
Electrical connection is done according to the electrical diagram [4].

6.3.3. Gauges

6.3.3.1. VGP: Vacuum Pirani Gauge

VGP [3] is powered by the VEG [3] it is connected to.
Electrical connection is done according to the electrical diagram [4].

6.3.3.2. VGC: Vacuum Cold cathode Gauge

VGC [3] is powered by the VEG [3] it is connected to.
Electrical connection is done according to the electrical diagram [4].

6.3.3.3. VGD: Vacuum Capacitance Gauge

VGD [3] is powered by the VEVMC [3] it is connected to.
Electrical connection is done according to the electrical diagram [4].

6.3.4. Gauge controller

6.3.4.1. VEG: Vacuum Gauge Controller

VEG [3] is powered by a 230VAC mono-phase power strip.
Electrical connection is done according to the electrical diagram [4]

6.3.5. Pressure Manometer

6.3.5.1. VPM: Vacuum Pressure Manometer

VPM [3] is powered by a 230 VAC to 24 VDC converter.
Electrical connection is done according to the electrical diagram [4].

6.3.6. Mass Flow Meter

6.3.6.1. VVMC: Vacuum Mass Flow Meter

VVMC [3] is powered by the VEVMC [3] it is connected to.
Electrical connection is done according to the electrical diagram [4].

6.3.6.2. VEVMC: Vacuum Mass Flow Meter Controller

VEVMC [3] is powered by a 230VAC mono-phase power strip.
Electrical connection is done according to the electrical diagram [4].

6.3.7. Residual Gas Analyzer

6.3.7.1. VGR: Vacuum Partial Pressure Sensor for Residual Gas Analyzer

VGR [3] is powered by the VERA [3] it is connected to.
Electrical connection is done according to the electrical diagram [4].

6.3.7.2. VERA: Vacuum Residual Gas Analyzer Controller

VERA [3] is powered by a 230VAC mono-phase power strip.
Electrical connection is done according to the electrical diagram [4].

6.3.8. Control equipment

6.3.8.1. LEBT Vacuum Interlock PLC System - Remote I/O

PLC Remotes I/O are powered by a 230 VAC to 24 VDC converter.
Electrical connection is done according to the electrical diagram [4].

6.3.8.2. LEBT Vacuum Control PLC System - Remote I/O

PLC Remotes I/O are powered by a 230 VAC to 24 VDC converters.
Electrical connection is done according to the electrical diagram [4].

6.3.8.3. Proton Beam Vacuum Control - Interlock PLC System - CPU

PLC CPU is powered by a 230 VAC to 24 VDC converters.
Electrical connection is done according to the electrical diagram [4].

6.3.8.4. Proton Beam Vacuum Control - Process PLC System - CPU

PLC CPU is powered by a 230 VAC to 24 VDC converters.
Electrical connection is done according to the electrical diagram [4].

6.3.8.5. LEBT Vacuum Data acquisition System - Control Box

The IPC is powered by a 230VAC mono-phase power strip.
Electrical connection is done according to the electrical diagram [4].

6.3.8.6. LEBT Vacuum Data acquisition System - PLC I/O

PLC I/O cards are powered by a 230 VAC to 24 VDC converter.
Electrical connection is done according to the electrical diagram [4].

6.3.8.7. LEBT Vacuum Data acquisition System - EPICS GUI - Local Display

The local display IPC is powered by a 230VAC mono-phase circuit breaker. Electrical connection is done according to the electrical diagram [4].

6.4. Pneumatic energizing interface

The compressed air distribution line is distributed along the tunnel of the accelerator in +ESS.G01.090.1001.100.
The compressed air supply is neither part of the scope of the “Proton Beam Vacuum Control System” or of the “LEBT Vacuum Control System”.

6.4.1. Valves

6.4.1.1. VVA: Vacuum Angle Valves

The VVA [3] requires compressed air to be actuated.
Compressed air distribution line is distributed along the accelerator tunnel in +ESS.G01.090.1001.100.

6.4.1.2. VVS: Vacuum Sector Gate Valves

The VVS [3] requires compressed air to be actuated.
Compressed air distribution line is distributed along the accelerator tunnel in +ESS.G01.090.1001.100.

6.4.2. Mass Flow Meter

6.4.2.1. VVMC: Vacuum Mass Flow Meter

The VVMC [3] requires compressed air to be actuated.
Compressed air distribution line is distributed along the accelerator tunnel in +ESS.G01.090.1001.100.

6.5. Data Cabling

Data cabling describes hardware cabled interfaces between systems and sub-systems.

6.5.1. Proton Beam Vacuum Control System - EPICS IOC

“Proton Beam Vacuum Control System - EPICS IOC” is connected to the vacuum devices controllers of the “LEBT Vacuum Control System” through a “Serial To Ethernet” converter as showed in the electrical diagram [4].

The “Serial To Ethernet” converter is connected to the PV Access / CA Access network [8] by a RJ45 socket as showed in the electrical diagram [4].

Connection box is named: FEB-030Row:NetW-CPP-0101.

Connection box is located in a rack in the Front End building [6]: +ESS.G01.090.5005.102.001.

6.5.2. LEBT Vacuum Control System - EPICS GUI - Local Display

The EPICS GUI local display is connected to the PV Access / CA Access network [8] by a RJ45 socket as showed in the electrical diagram [4].

Connection box is named: FEB-030Row:NetW-CPP-0101.

Connection box is located in a rack in the Front End building [6]: +ESS.G01.090.5005.102.001.

6.5.3. LEBT Vacuum Data Acquisition System - EPICS IOC

The “LEBT Vacuum Data Acquisition System - EPICS IOC” is connected to the PV Access / CA Access network [8] by a RJ45 socket as showed in the electrical diagram [4].

Connection box is named: FEB-030Row:NetW-CPP-0101.

Connection box is located in a rack in the Front End building [6]: +ESS.G01.090.5005.102.001.

6.5.4. LEBT Vacuum Data Acquisition System - PLC I/O

The “LEBT Vacuum Data Acquisition System - EPICS IOC” is connected to “LEBT Data Acquisition System - PLC I/O” by an Ethernet cable. Connection is made according to the electrical diagram [4].

6.5.5. LEBT Vacuum Interlock PLC System - Remote I/O

Interlock PLC Remotes I/O are connected to the CPU of the “Proton Beam Vacuum Interlock System” and to the remote I/O belonging to the next vacuum control system by an Ethernet cable. Connection is made according to the electrical diagram [4].

6.5.6. LEBT Vacuum Process PLC System - Remote I/O

The PLC remote I.Os is connected to the CPU of the “Proton Beam Vacuum Control System” by an Ethernet cable. Connection is made according to the electrical diagram [4].

6.5.7. Proton Beam Vacuum Control - Interlock PLC System - CPU

“Proton Beam Vacuum Control - Interlock PLC System” CPU is connected to its Remote I/O’s by an Ethernet cable. Connection is made according to the electrical diagram [4].

Connection box is named: FEB-030Row:NetW-CPP-0101.

Connection box is located in a rack in the Front End building [6]:
+ESS.G01.090.5005.102.001.

6.5.8. Proton Beam Vacuum Control - Process PLC System - CPU

“Proton Beam Vacuum Control - Process PLC System” CPU is connected to its Remote I/O’s by an Ethernet cable. Connection is made according to the electrical diagram [4].

Connection box is named: FEB-030Row:NetW-CPP-0101.

Connection box is located in a rack in the Front End building [6]:
+ESS.G01.090.5005.102.001.

6.6. Data Interfaces & Data exchange

This chapter describes data exchange between the “LEBT Vacuum Control System” and “Proton Beam Vacuum Control System”.

6.6.1. EPICS GUI - Local Display System

The LEBT Vacuum control system exchanges data with Proton Beam Vacuum Control IOC using PV Access / CA Access protocol.

6.6.2. LEBT Vacuum Data Acquisition System

6.6.2.1. EPICS IOC

The “LEBT Vacuum Data Acquisition System - EPICS IOC” exchanges data with the integrated control system using PV Access / CA Access protocol.

IOC configuration is stored in IOC Factory [11]: LEBT-010:VAC-IOC-11010.

6.6.2.2. PLC I/O DAQ

“LEBT Vacuum Data Acquisition System - PLC I/O” exchange data with “LEBT Vacuum Data Acquisition System - EPICS IOC” using EtherCAT protocol.

“LEBT Vacuum Data Acquisition System - PLC I/O” is doing acquisition of analogue values. It has interfaces with vacuum devices controllers as well as with hardware components.

LEBT Data Acquisition system - PLC I/O analogue input configuration and signal configuration is defined in to electrical diagram [4].

LEBT Data Acquisition system - PLC I/O analogue inputs are wired according to electrical diagram [4].

6.6.3. Programmable Logical Controller

6.6.3.1. LEBT Vacuum Process PLC System - PLC Remote I/O

“LEBT Vacuum Process PLC System - PLC Remote I/O” communicates with “Proton Beam Vacuum Control - Process PLC System” using Profinet protocol.

6.6.3.2. LEBT Vacuum Interlock PLC System - PLC Remote I/O

“LEBT Vacuum Interlock PLC System - PLC Remote I/O” communicates with “Proton Beam Vacuum Control - Interlock PLC System” using Profinet protocol.

6.6.3.3. PLCs Remote I/O

“Proton Beam Vacuum Control - Process PLC System” and “Proton Beam Vacuum Control - Interlock PLC System” exchange data through their respective remote I/O modules, as shown on the electrical diagram [4].

6.6.4. Mechanical Pump Controller

6.6.4.1. VEPP: Vacuum Primary Pump Controller

VEPP is connected to “LEBT Vacuum Process PLC System - PLC Remote I/O” with digital input and digital output according to electrical diagram [4].

VEPP	PLC DI	PLC DQ
Start		X
Reset		X
Connected	X	
On	X	
Error	X	
Local Control	X	
Circuit Breaker	X	

Table 4 VEPP - digital data exchange

The interfaces of the PLC function used to control primary pump controller are described by the following document: ESS-0123367.

There is no data exchange over serial communication for VEPP

6.6.4.2. VEPT: Vacuum Turbomolecular Pump Controller

VEPT is connected to “LEBT Vacuum Process PLC System - PLC Remote I/O” with digital input and digital output according to electrical diagram [4].

VEPT	PLC DI	PLC DQ
Start		X
Reset		X
On / Nominal Speed	X	
Error	X	

Table 5 VEPT - digital data exchange

The interface description of the PLC function used to control turbo-molecular pump controller is describes by the following document: ESS-0123368.

VEPT is connected to the Proton Beam Vacuum Control EPICS IOC through RS232 communication.

The data exchange list is hardware dependant. It can be found in the following document: ESS-0218775.

The Serial to Ethernet converter is named: LEBT-010:VAC-SEC-10001.

6.6.5. Valves

6.6.5.1. VVA: Vacuum Angle Valves

VVA is connected to “LEBT Vacuum Process PLC System - PLC Remote I/O” with digital input and digital output according to electrical diagram [4].

VVA	PLC DI	PLC DQ
Open	X	X
Close	X	

Table 6 VVA - digital data exchange

The interfaces of the PLC function used to control angle valve are described by the following document: ESS-0123369.

There is no data exchange over serial communication for VVA.

6.6.5.2. VVA: Bypass Vacuum Angle Valves

VVA is connected to “LEBT Vacuum Process PLC System - PLC Remote I/O” with digital input and digital output according to electrical diagram [4].

VVA	PLC DI	PLC DQ
Open	X	X
Close	X	

Table 7 VVA (Bypass) - digital data exchange

The interfaces of the PLC function used to control the bypass angle valve are described by the following document: ESS-0123371.

There is no data exchange over serial communication for VVA.

6.6.5.3. VVS: Vacuum Sector Gates Valves

VVS is connected to “LEBT Vacuum Interlock PLC System - PLC Remote I/O” with digital input and digital output according to electrical diagram [4].

VVS	PLC DI	PLC DQ
Open	X	X
Close	X	

Table 8 VVS - digital data exchange

The interfaces of the PLC function used to control the bypass angle valve are described by the following document: ESS-0123370.

There is no data exchange over serial communication for VVS.

6.6.6. Gauge controller

6.6.6.1. VEG: Vacuum Gauge Controller

VEG is connected to “LEBT Vacuum Process PLC System - PLC Remote I/O” and to “LEBT Vacuum Interlock PLC System - PLC Remote I/O” with digital inputs according to electrical diagram [4].

VEG is connected to “LEBT Vacuum Data Acquisition System - PLC I/O” with analogue inputs according to electrical diagram [4].

VEG	PLC DI	PLC AI
“LEBT Vacuum Process PLC System - PLC Remote I/O”	X	
“LEBT Vacuum Interlock PLC System - PLC Remote I/O”	X	
“LEBT Vacuum Data Acquisition System - PLC I/O”		X

Table 9 VEG - digital & analog data exchange

VEG is connected to the “Proton Beam Vacuum Control - EPICS IOC” through RS232 communication.

Data exchange list is hardware dependant. It can be found in the following document: ESS-0123108.

The Serial to Ethernet converter is named: LEBT-010:VAC-SEC-10001.

Configuration of the gauge controller and its extension cards are defined in the electrical diagram [4].
Control configuration of the gauge controller and its extension card is stored on CCDB [10].

6.6.7. Mass Flow Meter

6.6.7.1. VEVMC: Vacuum Mass Flow Meter Controller

VEVMC is connected to “LEBT Vacuum Process PLC System - PLC Remote I/O” and to “LEBT Vacuum Interlock PLC System - PLC Remote I/O” with digital inputs according to electrical diagram [4].

VEVMC is connected to “LEBT Vacuum Data Acquisition System - PLC I/O” with analogue inputs according to electrical diagram [4].

VEVMC	PLC DI	PLC AI
“LEBT Vacuum Process PLC System - PLC Remote I/O”	X	
“LEBT Vacuum Interlock PLC System - PLC Remote I/O”	X	
“LEBT Vacuum Data Acquisition System - PLC I/O”		X

Table 10 VEVMC - digital & analog data exchange

VEVMC is connected to the “Proton Beam Vacuum Control - EPICS IOC” through RS232 communication.

The data exchange list is hardware dependant. It can be found in the following document: ESS-0123108.

The Serial to Ethernet converter is named: LEBT-010:VAC-SEC-10001.

6.6.8. Residual Gas Analyzer

6.6.8.1. VERA: Vacuum Residual Gas Analyzer Controller

VERA is connected to the “Proton Beam Vacuum Control - EPICS IOC” through RS232 communication.

The data exchange list is hardware dependant. It can be found in the following document: ESS-0254201.

6.6.9. VPM: Vacuum Pressure Manometer

VPM is connected to “LEBT Vacuum Data Acquisition System - PLC I/O “analogue input according to electrical diagram [4].

There is no data exchange over serial communication for VPM.

6.6.10. VPG: Vacuum Pumping Group

VPG is a logical device, it has no hardware interface.
The interfaces of the PLC function used to control VPGs are described by the following document: ESS-0123371.

7. GLOSSARY

Term	Definition
CCDB	Control Configuration Data Base
CPU	Central Processing Unit
EPICS	Experimental Physics and Industrial Control System
FBS	Facility Breakdown Structure
ICS	Integrated Control System
IOC	Input Output Controller is an EPICS device
IPC	Industrial PC
LEBT	Low Energy Beam Transfer is a subsection of the LINAC.
LBS	Location Breakdown Structure
LINAC	Linear Accelerator
OPI	Operator Interface
PLC	Programmable Logical Controller
RFQ	Radio-Frequency Quadrupole is a subsection of the LINAC.

8. REFERENCES

[1] Proton Beam Vacuum Control System
System Engineering Management Plan (ESS-0090062)
[2] Proton Beam Vacuum Interlock System
System Engineering Management Plan (ESS-0087015)
[3] Vacuum Symbols and ICS naming (ESS-0043149)
[4] Accelerator Vacuum Controls
Wiring diagrams vacuum control racks (ESS-0092887)
[5] Decision summary for ESS naming, tagging and structuring of data (ESS-0036752).
[6] ESS Guideline for ESS Breakdown Structures (ESS-048668)
[7] ISRC + LEBT Vacuum Diagram (ESS-0085792)
[8] ICS Technical Network system requirements specification (ESS-0062062)
[9] ESS Naming Service: https://naming.esss.lu.se/index.xhtml
[10] Controls Configuration Database (CCDB): https://ccdb.esss.lu.se/
[11] IOC Factory (FACT): https://iocfactory.esss.lu.se/

CHANGES SUMMARY

Revision	Description of the changes
1	First issue
2	-LEBT-010:VAC-IOC-11010 replaced by VacS-ACCV:VAC-IOC11010. -LEBT-010:Vac-PLC-01001 replaced by VacS-ACCV:Vac-PLC-01001. -LEBT-010:Vac-PLC-10001 replaced by VacS-ACCV:Vac-PLC-10001. -Update of the system architecture diagram.

DOCUMENT REVISION HISTORY

Revision	Reason for and description of change	Author	Date
1	First issue	François Bellorini	2018-01-19
2	New names for the high level functions.	François Bellorini	2018-02-26