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Freeze Dryer — Hardware Design Specification

Purpose: **The aim of this document is to illustrate the machine's electrical hardware architecture and to describe its main components.**

Machine Model : **Lyomax 3**

Serial No. : **EF1114**

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Section 3.2: Added Varistor Module requirement for AC Contactor Coils. Section 3.2: Added Surge Protective Devices (SPD) per UL 1449 3rd Edition Standard for process equipment controls circuits. Section 3.1.5: Added Safety Circuit requirements. Section 3.10.3.3: Add information regarding alarm priority/sorting. Section 3.10.3.5: Updated Isolator Interface			

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1. INTRODUCTION

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The specifications identified in this document are used as a base for the development and qualification of the Lyomax 3 Freeze Dryer (EF1114) electrical and control systems.

References

- Functional Specification, EF1114-FS
- P&ID Process Sheet, EF1114-19-01 Sheet 1
- P&ID Utility Sheet, EF1114-19-01 Sheet 2
- P&ID Hydraulic Sheet, EF1114-19-01 Sheet 3
- Electrical Circuit Diagrams, EF1114-13-0 thru 124
- Electrical Specification, EF1114-13A
- Programmable Device Specification, EF1114-13B
- IO List, EF1114-13C
- Hardwired Interlock Specification, EF1114-13D
- Calibration Specification, EF1114-13E

Overview

This Hardware Design Specification applies to the factory qualification of the Lyomax 3 machine built for Sanofi Pasteur. This document provides Control System hardware and functional objectives for use during the design of the Freeze Dryer. IMA Life is producing a total of one (1) Freeze Dryer (EF1114) for the end user Sanofi Pasteur sold under SA35-00116.

The machine shall be designed to meet the requirements of Functional Specification EF1114-FS.

The Hardware shall be configured according to Electrical Circuit Diagrams EF1114-13-0 thru 124.

The Voltage and Current requirements shall be identified in Electrical Specification EF1114-13A.

The Configurable Devices shall be identified in Programmable Device Specification EF1114-13B.

The PLC IO addressing shall be identified in IO List EF1114-13C.

The Machine Interlocks and Safety Interlocks shall be identified in Hardwired Interlock Specification EF1114-13D.

The Machine Performance and Product Quality Instruments shall be identified in Calibration Specification EF1114-13E.

2. GLOSSARY

2.1 Engineering Units

The following engineering units will be used throughout this document (except where noted otherwise):

Pressure:	PSIA or PSIG
Temperature:	°C
Vacuum:	microns

2.2 Abbreviations / Acronyms

The following abbreviations and acronyms are used throughout this document:

CIP	Clean-In-Place
CR	Control Relay
ECD	Electrical Circuit Diagrams
FD	Freeze Dryer
HMI	Human-Machine Interface
HMI Panel	Stainless-Steel Box with hard-wired switches and / or an operator interface terminal
HP	Hydraulic Pump
HTR	Heater
I/O	Input/Output
KVM	Keyboard, Video and Mouse Extender
LRP	Liquid Ring Vacuum Pump
NIC	Network Interface Card
P&ID	Piping (or Process) and Instrumentation Diagram
PC	Personal Computer
PLC	Programmable Logic Controller
PS	Pressure Switch
SCADA	Supervisory Control and Data Acquisition
SIP	Sterilization (In-Place)
SR	Safety Relay
VFD	Variable Frequency Drive
VP	Vacuum Pump
XS	Proximity Switch
ZS	Limit Switch

3. HARDWARE DESIGN SPECIFICATIONS

This section identifies the Lyomax 3 machines Environmental Conditions, Power Supplies, Computer System, Machine Control System (PLC) Specifications, Peripherals and Interconnections.

Refer to the latest revision of the Network Layout Circuit Diagram EF1114-13-113 for information regarding how the Control System is designed.

Refer to the latest revision of Electrical Circuit Diagrams EF1114-13-0 thru EF1114-13-124 for detailed information on how the Electrical Hardware is installed and wired.

3.1 Environmental Conditions

The Lyomax 3 machine is to function in a typical machine room environment.

3.1.1 Operating Conditions

The Lyomax 3 machine must operate in the following environmental conditions:

- Temperature range is +10 deg C to +35 deg C.
- Humidity is 10% to 80% (non condensing)

3.1.2 Storage Conditions

The Lyomax 3 machine must be stored in the following environmental conditions:

- Temperature range is +0 deg C to +40 deg C.
- Humidity is <80% (non condensing)

3.1.3 Protection Class

The following Electrical Enclosures will originally have a minimum protection rating of NEMA12/IP54:

- Power/Control Cabinet
- Hydraulic Power Unit Junction Box

One (1) meter (3.28 ft) of free space shall exist in front of all power distribution panels and equipment control panels.

The Power/Control Cabinet shall include Panel Lights that will switch on when the cabinet door is opened.

3.1.4 Components

All Instrumentation and Control Devices are to meet CSA or equivalent (CUL) specifications wherever possible.

Electrical control panels shall have at least 25% spare space on the back panel to allow for future expansion.

3.1.5 Safety Circuits

All Safety Circuits are to be designed per the IMA Risk Assessment and ISO 13849.

All emergency stop buttons shall be red mushroom style with yellow background, with no shrouding or covers, maintained, and push-in twist to-release type

3.2 Power Supplies

The Lyomax 3 Machine is to have the following Power Supplies.

Supply Voltage (MDS1)	208VAC/3PH/60HZ
Full Load Current	55.5 AMPS
Largest Load	19.4 AMPS
SCCR	65 KA
Control Voltage	120VAC/24VDC
Instrumentation Voltage	120VAC/24VDC/15VDC
UPS Voltage	120VAC
UPS Power	2 KVA
UPS Run Time	15 Minutes

The Electrical 3-Phase Power to the Lyomax 3 Machine is to be installed using one supply (MDS1) located in the Power/Control Cabinet.

The Electrical 1-Phase Power is derived from the 3-Phase Power Source using a Control Transformer (T1).

Surge Protective Devices (SPD), per UL 1449 3rd Edition Standard, shall be used in process equipment controls circuits for added protection.

Safety Relay protected Electrical Power for Control Devices is to be provided in the Lyomax 3 Power/Control Cabinet.

All AC powered motor contactors shall have a Metal Oxide Varistor (MOV) installed across their input power terminals to absorb power surges.

An Uninterruptible Power Supply (UPS) shall be installed in the Power/Control Cabinet to protect the SCADA, PLC and Instrumentation from a power failure.

NEC Class 2 Electronic Circuit Protection shall be provided for all Instrumentation and for Control Devices that do not meet CSA or equivalent specifications. The output of these circuits is limited to a maximum value of 100 VA (3.7A at 24VDC).

The Lyomax 3 Machines electrical power supply requirements are to be fully defined in Electrical Specification EF1114-13A.

The Lyomax 3 Machines electrical power supplies are to be installed and wired according to Electrical Circuit Diagrams EF1114-13-0 thru 124.

3.3 Computer System

The Lyomax 3 machine will contain the following computer.

3.3.1 SCADA Computer

- The Lyomax 3 will contain one (1) Supervisory Control and Data Acquisition (SCADA) Computer System. The SCADA PC computer (PC1) will consist of a Dell Precision T3620 with a 3.0GHz Four Core XEON Processor, 8GB 2133MHz DDR4 Non-ECCM RAM (2 x 4GB), two 1TB SATA 3.5in Hard Drives configured for RAID1, DVD+/-RW drive and 3 NIC. This PC is equipped with USB memory stick access.

Refer to the Computer System BOM (926EF1114L3) for additional information regarding the Computer System components.

Refer to Software Module Design Specification EF1114-SMDS for detailed information on the operating system and installed software.

3.4 Machine Control System (PLC) Specifications

This section describes the Lyomax 3 machines PLC processor, Rack and Power Supply specifications. Mounted PLC components will be placed for ease of maintenance.

3.4.1 Processor

The Control System will use an Allen Bradley Control Logix Programmable Automation Controller (1756-L71). The processors memory consists of 8MB. The processor contains (1) USB port.

3.4.2 Power Supply

The PLC Rack will use an Allen Bradley Control Logix Power Supply (1756-PA75) to produce the output voltages required to operate the PLC processor, Communication and I/O Modules. The Power Supply accepts an input voltage of 85…265VAC. The Power Supply will supply 5.1 VDC with a 13 Amp capacity.

3.5 Machine Control System (PLC) Module Specifications

This section describes the different modules used in the PLC Rack and includes their specifications.

The PLC system shall be supplied with at least 25% spare installed inputs and outputs for future use.

3.5.1 Communication Module Specification

The PLC Rack will use two (2) Allen Bradley Control Logix Ethernet Communication Modules (1756-ENBT) to communicate with higher level SCADA devices and machine remote I/O devices. Each Communication Module can connect up to 64 TCP/ IP devices with a communication rate of 10/100 Mbps.

3.5.2 Discrete Input Module Specification

The PLC will use Allen Bradley Control Logix Digital Input Modules (1756-IB16) to interface with field devices. The module has 16 input points. Each has a nominal input voltage of 24VDC per point. Each Modules backplane current load is 100mA @ 5.1VDC.

3.5.3 Discrete Output Module Specification

The PLC will use Allen Bradley Control Logix Digital Output Modules (1756-OW16I) to interface with field devices. Each module has sixteen (16) N.O. relay outputs. Each output has an operating range of 5-125 VDC. The maximum backplane current consumption is 150mA @ 5.1VDC.

3.6 Interconnection Specifications

The PLC's Communication Networks are fully described in section 3.11.1.1, Ethernet Network Specifications.

3.7 Machine Control System (PLC) Rack Layout

The Lyomax 3 PLC contains one main rack which is to be located in the Power/Control Cabinet. It is to be labeled RACK1. No secondary racks are required for the Lyomax 3 Machine.

3.7.1 Power/Control Cabinet Rack Layout

The detailed rack layout shall be identified in Electrical Circuit Diagram EF1114-13-119.

3.8 Beckhoff Modular Fieldbus System Specification

The Lyomax 3 Machine uses remote Beckhoff Racks called Bus Terminal Systems (BTS) to communicate with remote field devices. This section describes the Beckhoff Hardware Requirements for the Lyomax 3 Machine. This includes the Bus Terminal Systems, the individual modules that are installed in the BTS, and the Communication Network. This section identifies the Fieldbus Coupler, Bus End Terminal, and all I/O module specifications.

3.8.1 Bus Terminal Systems

The Lyomax 3 Beckhoff Control System will include four (4) Beckhoff Bus Terminal Systems. Each BTS will handle the I/O requirements of a specific Freeze Dryer Sub-System.

The Lyomax 3 Machine will contain the following Bus Terminal Systems.

- BTS 1 – Power/Control Cabinet (RACK51)
- BTS 2 – Condenser Devices (RACK52)
- BTS 3 – Chamber Devices (RACK53)
- BTS 4 – Hydraulic Power Unit (RACK54)

Each BTS shall be supplied with at least 25% spare installed inputs and outputs for future use.

3.8.2 Fieldbus Couplers

Each Beckhoff BTS will use an Ethernet/IP Coupler (BK9105). This buscoupler allows the devices contained in its BTS to communicate with the Ethernet/IP Network. It automatically configures, creating a local process image which may include analog, digital or specialty modules. This buscoupler is suitable for data rates of 10/100 Mbaud.

The Beckhoff Ethernet/IP network is described in Section 3.11.1.1, Ethernet Network Specifications.

3.8.3 Bus End Terminals

Each Beckhoff BTS requires a Bus End Terminal (KL9010). This module is placed at the end of a BTS assembly completing its internal circuitry.

3.8.4 Power Distribution Specifications

The Beckhoff System will use the following power distribution components.

- Fieldbus Coupler (BK9105)
- Fused Power Feed Terminal (KL9210)

3.8.4.1 Fieldbus Couplers

Each Beckhoff BTS will use its Fieldbus Coupler (BK9105) to distribute 24VDC power to I/O and specialty modules connected to it through an internal power bus. Each module on a BTS is connected in series to this power bus.

3.8.4.2 Power Supply Modules

Fused Power Feed Terminals (KL9210) shall be used when a different 24VDC power source is required. All I/O and specialty modules connected after this module will use the new power source.

3.8.5 Digital Input Module Specification

The Bus Terminal Systems will use 2 channel Digital Input Modules (KL1002) or 8 channel Digital Input Modules (KL1408) to interface with field devices.

- KL1002: The nominal voltage required at the power jumper contacts is 24VDC (-15%...+20%), and the typical input current is 5mA.
- KL1408: The nominal voltage required at the power jumper contacts is 24VDC (-15%...+20%), and the typical input current is 3mA.

3.8.6 Digital Output Module Specification

The Bus Terminal Systems will use 2 channel Digital Output Modules (KL2022), 4 channel Digital Output Modules (KL2424) or 2 channel Relay Output Modules (KL2612 & KL2622) to interface with field devices. The module outputs are electrically isolated from the bus.

- KL2022 / KL2424: The nominal output voltage required at the power jumper contacts is 24VDC (-15%...+20%), and the Output Current rating is 2.0A, current consumption is typically 20Ma
- KL2612: Rated load voltage is 125VAC / 30VDC, ohmic switch current is 0.5A AC or 2A DC
- KL2622: Rated load voltage is 230VAC / 30VDC, ohmic switch current is 5A AC or DC, Inductive switch current is 2A AC or DC.

3.8.7 Analog Input Module Specification

The Bus Terminal Systems will use 2 channel Analog Input Modules (KL3062, KL3112), 1 channel SSI Input Modules (KL5001) and 1 channel Incremental Encoder Modules (KL5151) to interface with field devices.

- KL3062: 2 channel, 12 bit resolution, input range of 0-10V, input resistance >130K Ohms
- KL3112: 2 channel, 16 bit resolution, input range of 0-20mA, input resistance 50 Ohm typ. Shunt
- KL5001: 1 channel, 32 bit width, SSI input, current consumption = 20mA without sensor
- KL5151: 1 channel, 32 bit counter, current consumption power contacts = 0.1A (without encoder lead current)

3.8.8 Analog Output Module Specification

The Bus Terminal Systems will use 2 channel Analog Output Modules (KL4022 & KL4032) to interface with field devices.

- KL4022: 2 channel, 12 bit resolution, output range 4 – 20mA, load <500 Ohms.
- KL4032: 2 channel, 12 bit resolution, output range -10 to +10 VDC, load > 5 k Ohms.

3.8.9 RTD/Thermocouple Input Module Specification

The Bus Terminal Systems will use 2 channel RTD Input Modules (KL3202) to interface with field devices.

- KL3202: 2 channel, 16 bit width, setup for Type PT100, resolution of 0.1 deg C per digit

3.8.10 Potential Distribution Module Specification

The Bus Terminal Systems will use 8 channel Potential Distribution Modules (KL9186).

- KL9186: 8 channel 24VDC contact

3.8.11 Interconnection Specifications

The Beckhoff Ethernet/IP network is described in Section 3.11.1.1, Ethernet Network Specifications.

3.8.12 Beckhoff Module Rack Layouts

For detailed Beckhoff Rack layouts, refer to the Electrical Circuit diagram pages listed below.

- BTS 1 – Power/Control Cabinet (RACK51) - Refer to the latest revision of Electrical Circuit Diagrams EF1114-13-13 thru EF1114-13-29
- BTS 2 – Condenser Devices (RACK52) - Refer to the latest revision of Electrical Circuit Diagrams EF1114-13-53 thru EF1114-13-69
- BTS 3 – Chamber Devices (RACK53) - Refer to the latest revision of Electrical Circuit Diagrams EF1114-13-70 thru EF1114-13-99
- BTS 4 – Hydraulic Power Unit (RACK54) - Refer to the latest revision of Electrical Circuit Diagrams EF1114-13-100 thru EF1114-13-104

3.9 SMC Control System Specification

The Lyomax 3 Machines Control System will include three (3) SMC remote racks. These racks will control specific I/O requirement for specific remote electrical devices. The Lyomax 3 Machine will contain the following SMC Racks using the modules described in the following sections.

- MANIFOLD1 – Sterile Filter Rack Valves (RACK71)
- MANIFOLD2 – Chamber/Condenser Valves (RACK72)
- MANIFOLD3 – Drain Valves (RACK73)

Each SMC Manifold shall be supplied with at least 25% spare installed inputs and outputs for future use.

3.9.1 SMC EX250-SEN1 Ethernet IP Fieldbus Node

Each SMC Rack uses an EX250-SEN1 Ethernet/IP Node to communicate with the Ethernet/IP Network. The EX250-SEN1 requires 24VDC for operation and communicates at 10/100 Mbps.

3.9.2 SMC SV2A00-5FU 4 Position Dual 3-Way NC Valve

The SMC SV2A00-5FU is a 4 Position Dual 3-Way NC Valve that has a coil voltage of 24vdc with a built in surge suppressor. The SMC SV2A00-5FU has a response time of 33ms at 0.5MPa (72.5 psi). The A and B ports can be individually controlled.

3.9.3 SMC 2V2100-5FU 2 Position Single Solenoid Valve

The SMC SV2100-5FU is a 2 Position Single Solenoid Valve that has a coil voltage of 24vdc with a built in surge suppressor. The SMC SV2100-5FU has a response time of 25ms at 0.5MPa (72.5 psi).

3.9.4 Interconnection Specifications

The SMC Ethernet/IP network is described in Section 3.11.1.1, Ethernet Network Specifications.

3.9.5 SMC Rack Layouts

For detailed SMC Rack layouts, refer to the Electrical Circuit diagram pages listed below.

- MANIFOLD1 – Sterile Filter Rack Valves (RACK71) - Refer to the latest revision of Electrical Circuit Diagram EF1114-13-31
- MANIFOLD2 – Chamber/Condenser Valves (RACK72) - Refer to the latest revision of Electrical Circuit Diagram EF1114-13-36
- MANIFOLD3 – Drain Valves (RACK73) - Refer to the latest revision of Electrical Circuit Diagram EF1114-13-44

3.10 Peripherals

This section identifies the peripherals that are required for the Hardware Design. These include the Computer (Monitors, Printers), PLC (HMI Panels), and Machine (Control Power Interface, Temperature Limit Controller Reset, Alarm Interface, CIP Interface, Isolator Interface and Potent Process Drain Interface)

3.10.1 Computer System

The Computer System peripherals include the following.

3.10.1.1 SCADA Computer

The SCADA Computer (PC1) requires the following peripherals.

- 19 inch LCD Color Monitor (MON1), 1280 X 1024 Max Resolution, 5:4 Aspect Ratio
- Screen Printer (PRN1) - 600x600 dpi color printer, Ethernet

3.10.2 HMI Panels

The Lyomax 3 Machine is to include two (2) HMI Panels.

3.10.2.1 Loading Side HMI Panel

One HMI Panel will be interfaced to the Lyomax 3 Machine PLC using Ethernet IP and discrete I/O. This HMI will allow the operator to undertake manual functions.

The Ethernet/IP network is described in Section 3.11.1.1, Ethernet Network Specifications.

The HMI Panel will have room for one (1) Proface PFXGP4303TAD HMI, and one (1) button, switch or light.

This HMI Panel is to be constructed out of 316L SS.

This HMI Panel is to be installed adjacent to the Loading Door outside the Isolator.

Location	Device	Function
Main Door	OIT1	PROFACE 5.7 INCH HMI
	PB73	STOP SHELF MOVEMENT AND LOADING DOOR

This HMI is to be wired according to Electrical Circuit Diagrams EF1114-13-92 & 110.

3.10.2.2 Maintenance Room HMI Panel

One HMI Panel will be interfaced to the Lyomax 3 Machine PLC using Ethernet IP and discrete I/O. This HMI will allow the operator to undertake manual functions.

The Ethernet/IP network is described in Section 3.11.1.1, Ethernet Network Specifications.

The HMI Panel will have room for one (1) Proface PFXGP4303TAD HMI, and one (1) button, switch or light.

This HMI Panel is to be constructed out of 316L SS.

This HMI Panel is to be installed on the non-hinged side of the Main Door.

Location	Device	Function
Main Door	OIT2	PROFACE 5.7 INCH HMI
	PB75	STOP SHELF MOVEMENT AND LOADING DOOR

This HMI is to be wired according to Electrical Circuit Diagrams EF1114-13-92 & 111.

3.10.3 Machine Interfaces

The Machine Peripherals include a Control Power Interface, a Temperature Limit Controller Reset Interface, an Alarm Interface, a CIP Interface, an Isolator Interface and a Potent Process Drain Interface.

3.10.3.1 Control Power Interface

The Lyomax 3 Machine is to include an interface that will allow the operator to switch off/enable control power. This interface will be located on the Power/Control Cabinet door face.

The Control Power interface will contain the following the following devices.

- PB8 – Emergency Switching Off Control Power
- PB29 – Reset Control Power
- PB32 – Silence Alarm Horn
- AH1 – Alarm Horn

3.10.3.2 Temperature Limit Controller Reset

The Lyomax 3 Machine is to include an interface that will allow the operator to reset the Silicone Oil Heater (HTR1) Watlow LF Temperature Limit Controller (TSH25A). This interface will be located on the Power/Control Cabinet door face.

This interface will contain the following the following device.

- PB85 – Reset TSH25A

3.10.3.3 Alarm Interface

A normally open relay contact is to be made available in the Power/Control Cabinet. This contact is to be available for customer use as a “Potential Free Contact (Critical Process Alarm)” if that is the intent. Alarm priority/sorting is handled in the SCADA computer only.

This Alarm Potential Free Contact will only be enabled for general alarms and is not intended to be customized.

3.10.3.4 CIP Interface

The Lyomax 3 Machine is to include a CIP Interface. This interface will allow the Freeze Dryer to communicate with the Customer's system regarding the operation of the CIP Cycle.

When the Lyomax 3 requires CIP Fluid, its PLC will energize a 24VDC relay coil using a digital output. This relay is to have a normally open contact that will be made available to the customer. This Potential Free Contacts will signal the following function to the customer.

- Request CIP Fluid

When the requested CIP Fluid is available, the customer will close a potential free dry contact energizing a Lyomax 3 PLC 24VDC Digital Input completing the handshaking operation. IMA is to supply the 24VDC power for the Digital Input. This Digital Input will signal the following function to the PLC.

- CIP Available

When a CIP Cycle is active, the PLC will energize a 24VDC relay coil using a digital output. This relay is to have a normally open contact that will be made available to the customer. This Potential Free Contact will signal the following function to the customer.

- CIP Active

3.10.3.5 Isolator Interface

The Lyomax 3 Machine is to include an Isolator Interface. This interface will allow the Freeze Dryer to communicate with the Customer's system regarding the operation of the Isolator.

When the Lyomax 3 Machine is ready for VHP, the PLC will energize a 24VDC relay coil using a digital output. This relay is to have a normally open contact that will be made available to the Isolator Control System. This Potential Free Contact will signal the following function to the Isolator Control System.

- Ready for VHP

When the Isolator VHP is active, the Isolator Control System will close a potential free dry contact energizing a Lyomax 3 PLC 24VDC Digital Input completing the handshaking operation. IMA is to supply the 24VDC power for the Digital Input. This Digital Input will signal the following function to the PLC.

- Isolator VHP Active

When the Isolator Sterility is confirmed, the Isolator Control System will close a potential free dry contact energizing a Lyomax 3 PLC 24VDC Digital Input completing the handshaking operation. IMA is to supply the 24VDC power for the Digital Input. This Digital Input will signal the following function to the PLC.

- Isolator Sterility Confirmed

When the Isolator guarding is in the safe position, the Isolator Control System will close a potential free dry contact energizing a Lyomax 3 PLC 24VDC Digital Input completing the handshaking operation. IMA is to supply the 24VDC power for the Digital Input. This Digital Input will signal the following function to the PLC.

- Isolator Guarding Not Breached

3.10.3.6 Potent Process Drain Interface

The Lyomax 3 Machine is to include a Potent Process Drain Interface. This interface will allow the Freeze Dryer to communicate with the Customer's system regarding the operation of the Potent Process Drain.

When the Lyomax 3 requires access to the Potent Process Drain, its PLC will energize a 24VDC relay coil using a digital output. This relay is to have a normally open contact that will be made available to the customer. This Potential Free Contacts will signal the following function to the customer.

- Request Potent Process Drain

When the requested Potent Process Drain is available, the customer will close a potential free dry contact energizing a Lyomax 3 PLC 24VDC Digital Input completing the handshaking operation. IMA is to supply the 24VDC power for the Digital Input. This Digital Input will signal the following function to the PLC.

- Potent Process Drain Ready

When the Potent Process Drain is active, the PLC will energize a 24VDC relay coil using a digital output. This relay is to have a normally open contact that will be made available to the customer. This Potential Free Contact will signal the following function to the customer.

- Potent Process Drain Active

3.11 Interconnections

This section identifies the Lyomax 3 Machines interconnection specifications.

3.11.1 Network Specifications

The Lyomax 3 Machine will use Ethernet Networks to communicate with internal devices, external devices, and field devices.

Refer to Network Layout Circuit Diagram EF1114-13-113 for more information.

3.11.1.1 Ethernet Network Specifications

The Lyomax 3 machine will have two (2) Ethernet Networks. One is for the computer network and one is for equipment PLC controllers.

The first network will consist of the SCADA Computer (PC1), one of the PLC Ethernet IP Communication Modules, the Screen Printer (PRN1) and the Remote Access Modem (MODEM1). These devices will be connected together using Ethernet Switch SWITCH1 installed in the Power/Control Cabinet.

The second network will consist of the SCADA Computer (PC1), one of the PLC Ethernet IP Communication Modules, the Power/Control Cabinet Beckhoff Rack (RACK51), the Condenser Beckhoff Rack (RACK52), the Chamber Beckhoff Rack (RACK53), the Hydraulic Power Unit Beckhoff Rack (RACK54), the Sterile Filter Rack SMC Manifold (MANIFOLD1), the Chamber/Condenser SMC Manifold (MANIFOLD2), the Drain SMC Manifold (MANIFOLD3), the Loading Side Operator Interface (OIT1), the Maintenance Room Operator Interface (OIT2) and the Remote Access Modem (MODEM1). These devices will be connected together using Ethernet Switch SWITCH2 installed in the Power/Control Cabinet.

All Ethernet connections will use Category 6 Ethernet Cables (24 AWG stranded twisted pair) with RJ45 connectors

Refer to the latest revision of Control Cabinet Network Switches Circuit Diagram EF1114-13-114 for detailed information regarding the installation of Ethernet Switches SWITCH1 & SWITCH2.

Refer to Section 3 for a listing of the Lyomax 3 Machines Hardware Design Specifications.