20% F_2 FILLING SYSTEM

CONTROL ARCHITECTURE DESCRIPTION

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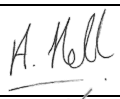
Checked	A Nell Lead Process Engineer	27 October 2020	
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Distribution

1	Pelchem – project team	3	
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Document History

Revision	Date	Status	Prepared by	Reason for new revision
00	2019/12/11	Approved	H van Deventer	First Issue
01	2020/09/11	Approved	H van Deventer	Compressor RIO
02	2020/10/27	Approved	H van Deventer	CCTV system updates

REFERENCES

No.	Document number	Document name	Author	Revision / Date
[1]	12618-4-11-05-001	System Network Architecture	H van Deventer	2020/10/27
[2]	12618-4-11-05-002	CCTV Architecture	H van Deventer	2020/10/27

EXECUTIVE SUMMARY

Pelchem requires a filling system for the filling of ISO tubes, multi-cylinder packs (MCPs) and individual cylinders with up to 20 vol% fluorine in nitrogen. As far as possible, equipment and pipelines of the NF_3 filling system are to be re-used for this 20% F_2 Filling System.

Resonant recommends replacing the existing ABB AC800 series PLC and its associated SCADA system in favour of the more recent AC700F series equipment along with fully licenced PLC and SCADA software.

The existing electrical equipment can be re-used and upgraded at minimal cost in the event of load changes.

The existing CCTV system can be re-used with faulty camera replacement if low definition video is acceptable. If, however, high definition video and data storage is required, a complete replacement of the CCTV system would be necessary.

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ABBREVIATIONS AND DEFINITIONS

Abbreviations

CCTV	- Closed Circuit Television
DCS	- Distributed Control System
DVR	- Digital Video Recording
EC&I	- Electrical, Control and Instrumentation
ESD	- Emergency Shutdown
F_2	- Fluorine
HAZOP	- Hazard and Operability (Study)
HD	- High Definition
HDD	- Harddisk drive
HF	- Hydrofluoric Acid
HMI	- Human-Machine Interface
IO	- Input/Output
ISO	- International Organisation for Standardisation
kPa(g)	- kilopascal (gauge)
MCC	- Motor Control Centre
MCP	- Multi-cylinder Pack
N_2	- Nitrogen
NAS	- Network Attached Storage
OEM	- Original Equipment Manufacturer
PLC	- Programmable Logic Controller
PSV	- Pressure Safety Valve
RIO	- Remote Input/Output
SCADA	- Supervisory Control and Data Acquisition
TCP/IP	- Transmission Control Protocol / Internet Protocol
UPS	- Uninterruptible Power Supply
UTP	- Unshielded Twisted Pair

Definition

Balun	- a wire connector device that allows *UTP* cable to transmit the video signal from CCTV cameras instead of using coaxial cable

1 INTRODUCTION

The function of the 20% F_2 Filling System is to fill various production containers with fluorine and nitrogen gas mixtures. Fluorine (F_2) gas is pre-mixed with dry nitrogen (N_2) gas using a static mixer, before being compressed into ISO tube containers on tube trailers, multi-cylinder packs (MCPs) or individual cylinders.

The gas mixture is compressed using a two-stage, metal diaphragm compressor. Filling of ISO tubes, MCPs or cylinders is done on an *ad hoc* basis as required by a customer.

1.1 Purpose

The purpose of this document is to provide technical overview of the proposed Control System Architecture.

This document:

- Describes the Control System OEM selection.
- Describes the Control System PLC Equipment and requirements.
- Describes the Control System SCADA Equipment and requirements.
- Describes the Control System Network interfaces and requirements.
- Describes the Electrical system interface and requirements;
- Describes the CCTV system interface and requirements;

2 TECHNICAL OVERVIEW

2.1 Proposed Control System OEM selection

The existing PLC is an ABB AC800 series controller specifically used in DCS type systems. The PLC cabinet is located in a sub-level under the NF_3 Control Room.

The existing PLC interfaces via a Profibus network to a RIO cabinet in the NF_3 Filling Area based on the site documentation available. Resonant noted that some of the field input devices have been moved to various different channels than indicated on the drawings issued to Resonant, due to presumed input failure.

The Resonant proposal recommends the continued use of ABB type equipment and controllers based on the ABB installed base, company and personnel knowledge along with familiarity with the products.

Pelchem can however also choose to use different OEM equipment, for example Siemens or Schneider Electric.

Based on the information available to Resonant, the most viable alternate option to the ABB equipment would the Schneider Electric, due the existing Modicon installed base on the plant.

2.2 Proposed Control System PLC Equipment

As mentioned, the existing PLC is an ABB AC800 series controller. Resonant reviewed the existing equipment along with the proposed IO counts for the F_2 Filling system and recommends the replacement of the existing AC800 series equipment.

The replacement is based on the fact that the equipment is more than 15 years old. While ABB still provides support, the level of effort required, along with the cost and time it could take to get replacement parts or spares in the event of a breakdown, would make it too risky to continue with the current system.

Resonant's recommendation is to replace the AC800 with the new AC700F series controller. The controller should be located in close proximity to the SCADA station, which will also act as the engineering station.

Resonant proposes the use of the NF_3 control room access cabinets as the location for the new PLC cabinet. This cabinet will also act as the network cabinet from which the SCADA and historian will interface with the PLC.

The system will also require the removal and replacement of the existing RIO cabinet in the Filling Area. A new primary RIO cabinet will be installed in its place and will provide extended functionality for maintenance and safety.

The proposed RIO cabinet will be fitted with a field HMI to provide direct feedback during commissioning, maintenance and general operation when required. The RIO cabinet will also house the new safety PLC.

The safety PLC will control the main F_2 safety shut-off valve, all the SIL 2 rated instruments as well as the various plant ESDs as inputs.

The existing RIO at the compressor is not an ABB unit and uses Modbus as communications protocol, the interface thereof to the primary RIO needs to be accounted for in the programming of the network converter along with the setup and testing of any GSD or similar type files.

2.3 Proposed Control System SCADA Equipment

Based on the site audit and meetings with ABB regarding the equipment and interfaces, Resonant recommends the replacement of the existing SCADA.

The software version used for the PLC programming has been phased out for more than a decade based on the MS Windows support, with newer and more user-friendly packages and programming proficiency available in the market.

The proposal for the new SCADA hardware would include a new SCADA client which will act as an engineering station when required, along with two new SCADA screens and a separate historian machine that will also interface with the SCADA.

Resonant proposes the use of the NF_3 control room access cabinets as the location for the new SCADA equipment. The PLC cabinet will also act as the network cabinet from which the PLC and historian will interface with the SCADA.

The SCADA/PLC software includes support for dual monitors and an engineering licence with an engineering station hard-key.

The SCADA and PLC licence software is based on fixed IO counts based on the PLC controller with additional IO added on as once-off fees with no yearly subscription services required.

An ABB service level agreement can be requested on a three-yearly basis with a yearly subscription fee for additional value-added services.

2.4 Proposed Control System Network Equipment

Based on the proposed equipment and existing communications protocol used, Resonant recommends the use of the Profibus protocol on the control system level with Ethernet TCP/IP on the SCADA client and historian level.

The proposal requires Profibus communications from the PLC to a Profibus repeater in the PLC cabinet. The repeater serves as a network isolator between the existing AC800 PLC, which is located in the sub-level under the NF_3 control room and controls the motors in the MCC, and the new RIO cabinets in the field. From the repeater a new Profibus cable will replace the existing cable to the Primary RIO, as well as the various connected network equipment downstream.

The Primary RIO will contain a six-way Profibus repeater. Once again, the repeater serves as a network isolator to the RIO rack, safety PLC, compressor RIO, Panel HMI and the existing scales.

The importance of the Profibus repeaters cannot be emphasised enough, as it prevents sub-network faults from affecting upstream communications and provides an easy access point for maintenance and system upgrades.

2.5 Proposed Electrical Equipment

The process electrical system used currently will be kept intact.

Once new or additional equipment is proposed, the current system will be re-evaluated. The change cost of the electrical equipment is expected to be low given the small number of loads required for the F_2 Filling System.

The plant operational lighting and small power requirements have not been evaluated and will be based on the HAZOP findings and CCTV requirements.

The Control System UPS system is based on a local UPS at the PLC and SCADA in the NF_3 control room. A secondary UPS, also located at the NF_3 control room, will supply the Primary and Secondary RIO cabinets. The Primary RIO cabinet will also contain a small tertiary UPS which will provide power exclusively to the safety PLC.

2.6 Proposed CCTV Equipment

The original proposal recommended the use of the existing co-axial based CCTV camera system, with replacement of damaged cameras and cables only.

Based on the clarification meeting, the following was requested:

HD camera equipment with Day and Night vision for security and safety investigation reporting, as well as at least two weeks of storage.

The proposed CCTV camera design consists of 8 off 4MP POE CCTV cameras with IR LEDs for night time use.

A new 16 channel NVR (Network video recorder) with 4 off 6TB hard drives which will provide the system with 14 days to 30 days of storage capacity depending on the storage resolution selected. The selected NVR has various storage resolution options, but the recommended option would be to use the 8-channel x 4MP at 30 frames per second.

The NVR selection would allow for additional cameras to be added at a later stage if required. The NVR can be connected to the plant switch to provide remote camera monitoring if required.

The field located POE switches have been placed in order to limit the routed cable length to each camera to be less than 100m. Each POE load has a cable length limitation of 300m.

Each switch has 4 POE ports and can accommodate 3 of the selected outdoor CCTV cameras based on the power consumption. An additional camera can be added to the POE switch provided that the power budget is not exceeded.

Lastly, a new 24” monitor has been allowed for, to display the CCTV camera feed. Resonant recommends that the CCTV and SCADA monitors are exact matches in order to provide a uniform look and feel to the control room.