Contents

1 Subject of specification 3
2 Scope of validity 3
2.1 Deviations 3
2.2 Exclusions 3
3 Hierarchy of documents 3
4 Definitions and designations 4
5 Description 5
5.1 General requirements for communications systems 5
5.2 Used types of data transmission and exchange 5
5.2.1 HART 5
5.2.2 DE 6
5.2.3 FSK , GPU – data transmission for Tank Gauging Systems 6
5.2.4 Modbus 6
5.2.5 Modbus TCP (Modbus on TCP/IP Ethernet) 6
5.2.6 Profibus 6
5.2.7 OPC 6
5.2.8 ODBC 7
5.2.9 Protocols for BMS 7
5.2.10 Internal protocols of systems 7
5.3 Standards of signals 7
5.3.1 Serial communication 7
5.3.2 Ethernet 7
5.4 Used types of transmission media: 7
5.4.1 Copper cable (twisted pair) 8
5.4.2 Fibre optic 8

This document is the property of Grupa LOTOS SA.. Coping and giving it to other are forbidden without express written authority by Grupa LOTOS SA

5.5 Network devices 8
5.6 Topology of connections 8
5.7 Division on applied communication types by application 9
5.8 Additional requirements and recommendations 10
6 Relevant documents 11
7 Codes and standards 11
7.1 Directives of European Union 11
7.2 Polish Standards 11
7.3 IEEE 11
8 Enclosures 11
9 Record of changes 12

1 Subject of specification

This specification used in conjunction with other technical specifications of LOTOS Group S.A., establishes minimal requirements constituting quality guide for preparation of Control and Instrumentation technical design, in scope of data transmission systems. Some issues not covered by this specification will be subject of detailed standards, or will require specific independent considerations.

2 Scope of validity

This specification shall be used when preparing both quotations and Purchase Orders concerning planned LOTOS Group S.A. new investments and modernizations.

It shall also be a base for preparation of other detailed specifications and quotations relevant for package units or other equipment deliveries.

2.1 Deviations

Any deviation from this specification and the relevant specifications, standards and related documents including proposals, which the bidder claims to be economically and / or technically superior solutions, must be submitted in writing for review and approval by Grupa LOTOS SA. Non-approved exceptions are not acceptable by Grupa Lotos S.A.

The supplier must report in writing any ambiguity in this or any other specifications of Grupa LOTOS SA or non-compliance with the referred documents / standards and obtain a written explanation from Grupa Lotos SA.

2.2 Exclusions

This specification does not relate to transmitting of signals in measuring and signalling circuits that do not constitute communication links, for example, measuring signal – current loop 4-20 mA, signalling – ON/OFF 24 VDC signals. Signals of such types are referred to in specification GLSA 3640 – „DCS and PLC control systems”.

Furthermore, the following subject areas that are covered in scope of other branches design works and supplies, therefore will be excluded from this specification:

- Data transmission within following systems:
  - Electrical Control System for Motor Control Center (MCC)
  - Fire Fighting System
  - Information system for company management (MIS) – superordinated system for financial operations and information management
  - Other computer systems being specified by electric or IT branches.

Connecting of above listed systems with control and instrumentation systems through communication link, however, will proceed according to this specification.

3 Hierarchy of documents

In case of conflicts existing between this specification and other documents, the following order of precedence shall govern:

- The current Polish legislation

- Terms of purchase order / contract and other requirements agreed in writing with GLSA
- Data Sheets approved by GLSA
- This specification
- Other Specifications
- Drawings and other documents
- Standards

4 Definitions and designations

GLSA – Grupa LOTOS S.A.

APC – Advanced Process Control

BMS – Building Management System (Intelligent Building)

CPF – Communication Profile Families – (defined by IEC 61158 standard)

DCS – Distributed Control System

DCOM – Distributed Component Object Model

DE – Digitally Enhanced – Communication standard for intelligent instruments and actors

ESD – Emergency Shut Down System

SIS -Safety Instrumented System

SIL - Safety Integrity Level

FISCO – Fieldbus Intrinsically Safe Concept

FSK – Frequency Shift Keyed modulation based on Bell 202 standard

HART - Highway Addressable Remote Transducer - Communication standard for intelligent instruments and actors

HTML – HyperText Markup Language

ISO – International Standard Organization

LONworks – Local Operating Network

MBP – **M**anchester Coded **B**us **P**owered) – coding of Manchester type data with on–bus supply

MIS – Management Information System

ODBC – Open DataBase Connectivity

OLE – Object Linking and Embedding

OPC – OLE for Process Control (based on DCOM) or Openness Productivity Connectivity (based on e.g. XML)

OPC AE – OPC for Alarm and Event – based on DCOM

OPC DA – OPC for access to real time data – based on DCOM

OPC DX – OPC for exchange of data between OPC servers – based on DCOM

OPC HDA – OPC for access to historical data – based on DCOM

OPC XML DA – OPC for access to real time data – based on XML

OSI – Open Systems Interconnection (Model)

PLC – Programmable Logic Controller

Profibus DP (Decentralized Periphery)

Profibus PA (Process Automation)

SER – Sequence of Event Record

SOAP – Simple Object Access Protocol

SOE – Sequence of Event

XML – Extensible Markup Language

5 Description

5.1 General requirements for communications systems

Data transmission can be divided into internal data transmission – within specific system, which complies to standard of given manufacturer and external data transmission – between systems, which uses commonly accessible standards, thanks to which the system can be considered open system. Transmission of data to superordinated SAP type systems, office systems, can be considered as external transmission of special case. Communication with superordinated systems is characterized by additional requirements in order to ensure safety of control and instrumentation system.

Transmission between systems serves for transferring of data in order to manufacturing process control and visualisation, production reports and other management operations' generation, as well as data storage.

Control and instrumentation systems used are required to be open, thus enabling, by means of communication links, integration of these systems with other systems, as well as easy extendibility. Important criterion for communication links and protocols selection is continuity and reliability of transmission.

Data transmission systems designed in Control and Instrumentation branch shall conform to recommendations of adequately acknowledged standards and organisations. Any deviations from such recommendations have to be adjusted with GLSA.

Supplier of system shall submit parameters and configuration of communication link, as well as data transmission protocol applied, for GLSA revision and approval.

In case where requirement of high link reliability exists, i.e. transmission link is involved in control and/or other important signals transmission, redundant links must be used. In such case supplier of the system shall submit detailed description of redundant links switching over, and shall adjust with GLSA a solution thanks to which adequate configuration of sub-systems that communicate with the system in order to put redundancy into practice shall be possible. As far as possible redundant links shall be routed on separate ducts.

In order to standardize communication solutions applied, available communication technologies are narrowed to those listed in paragraph 5, as allowed for use in GLSA.

5.2 Used types of data transmission and exchange

Below are listed types of data transmission and exchange that are allowed to use in GLSA.

5.2.1 HART

HART protocol provides communication simultaneously on two channels: 4-20mA (analogue signal) and two-direction modulated (in one time transfer in one direction - Half-Duplex) digital channel. It

utilises one pair of wires enabling also sending power supply to an instrument device. HART protocol provides possibility to transfer measured values, instrument status and diagnostics as well as coded information. The protocol is useful for loop tests, re-ranging, and calibration. Furthermore, HART protocol ensures continuous real time data transfer.

The standard of the HART protocol is maintained by HART Communication Foundation.

5.2.2 DE

DE (Digitally Enhanced) protocol was invented by Honeywell for communication between intelligent instrument devices and control systems. Communication based on this protocol utilizes serial data transfer on one pair of wires together with power supply for the instrument device.

Functionality of the DE protocol is similar to HART protocol.

5.2.3 FSK , GPU – data transmission for Tank Gauging Systems

Data transmission systems like FSK, GPU are used for transferring data between level transmitters within Tank Gauging Systems.

5.2.4 Modbus

Defined by "Modicon Modbus Protocol Reference Guide" (PI-MBUS-300 last revision). Communication with use of RS-485 link or fibre optic communication. RTU mod and 19 200 bps bitrate are preferred.

5.2.5 Modbus TCP (Modbus on TCP/IP Ethernet)

Modbus type communication based on Ethernet / client-server layer, with use of standard Ethernet links to TCP/IP protocol.

In systems involved in process control and monitoring with use of communication between computers, Ethernet with TCP/IP protocol shall be used, in preferred solution based on Fault Tolerant Ethernet. In case when supplier applies its own protocol, he shall also deliver TCP/IP protocol gateway.

5.2.6 Profibus

Profibus communication technology is defined by PN-EN 61158, PN-EN 61784 standards. It belongs to Family 3 (CPF 3) of network protocols. It employs 3 layers of OSI reference model: (1) physical layer, (2) data layer, (7) applications layer.

If this communication technology is selected, then design will conform to recommendations of Profibus International (PI) organization, and all parameters related to logical and physical layer of data transmission in Profibus DP and Profibus PA (option) technology will be agreed with GLSA.

5.2.6.1 Profibus DP

Used for distribution of control modules with transmission accomplished in RS-485 or fibre optic technology.

5.2.6.2 Profibus PA (option)

It uses MBP/MBP-IS transmission technology, transmission protocol in DP-V1 version (Master – Slave), and application profiles for devices – PA Devices.

It is preferred to design field instrumentation for explosion hazardous area in Profibus PA technology, with use of FISCO model.

5.2.7 OPC

OPC (OLE for Process Control or Openness Productivity Connectivity) stands for open industrial communication standard based on OLE DCOM/COM or XML/HTML/SOAP technology. OPC

standard is used for communication between industrial equipment, and provides business applications with easily configurable access to data acquired from field (process) as well.

We may distinguish communication OPC (OLE for Process Control) based on DCOM technology: OPC DA – OPC for access to real time data, OPC HDA – OPC for access to historical data, OPC AE – OPC for access to alarms and events, OPC DX – OPC for data exchange between OPC servers and communication based on XML: OPC XML DA – OPC for access to real time data with possible connection to superordinated systems (e.g. MIS).

Because of constant development of OPC technology, another types of this technology can be used when proved in other applications and after they are agreed with GLSA. Version and producer of OPC Client/Server software must be agreed with providers of all system elements connected through this server.

In view of low level of security (difficulties in configuration of firewall as well as in operation between different domains of network) OPC DCOM can not be used for connections to superordinated systems. OPC XML DA is preferred to be used for this kind of application.

OPC standard does not enable operation in real time mode, and cannot be used for time-critical systems.

5.2.8 ODBC

Database access standard. It enables communication of programs with databases on system level.

Adequate ODBC application shall be agreed with GLSA depending on type of database applied in specific solution.

5.2.9 Protocols for BMS

Communication protocols that are used within GLSA for Building Management System (intelligent building), are LonWorks (ANSI/EIA-709.1) and BACnet (PN-EN ISO 16484-5[1]). These are open protocols intended for handling of control systems of equipment installed in an intelligent building, including heating and ventilation equipment.

5.2.10 Internal protocols of systems

Communication in internal networks of control and instrumentation systems – buses. It is assumed, that communication on buses conforms to producer standard and has been repeatedly verified in other applications. System architecture, along with defined redundancy level of its elements, shall be accepted by GLSA in course of bidding action.

5.3 Standards of signals

GLSA uses following standards of signals in Control and Instrumentation Systems:

5.3.1 Serial communication

RS-232, RS-485 (RS-422), FireWire (IEEE 1394), USB 2.0

5.3.2 Ethernet

Ethernet specification according to IEEE 802.3. Used standards of signals are: 10Base-T, 100Base-TX, 100Base-FX, 1000Base-SX, 1000Base-LX; other standards after GLSA approval.

Ethernet socket –RJ45 or DB9 plug (for so-called industrial Ethernet).

5.4 Used types of transmission media:

Selection of media for data transmission shall fulfil requirements of transmission, and specification subject to GLSA approval.

Types of media used for data transmission:

5.4.1 Copper cable (twisted pair)

For Ethernet standard connections in control and instrumentation systems, following copper cable types are used: UTP/STP – unscreened or screened twisted pair, depending on intensity of electro-magnetic field present, Cat. 5e.

Modbus connections are accomplished with screened cable with earthing lead, dedicated to data transmission. Supplier of DCS/PLC system shall state the cable specification.

PN-EN 61158, PN-EN 61784 – specification for Profibus physical layer. For Profibus PA technology, cable of A type is preferred.

5.4.2 Fibre optic

Recommendations for fibre optic cables applied were given in specification GLSA 3750.

Fibre optic technology shall be employed in environments where electromagnetic perturbations that cause high electromagnetic interferences may occur, as well as long distances of transfer, high speed transmission are present.

Patchpanels and patchcords shall be used for connection of fiber optic cables to communication ports of system modules.

It is required to separate control and instrumentation communication network from office network in course of its installation, by means of applying independent fibre optic cables.

Specification of Profibus connection accomplished with fibre optic link, according to PN-EN 61158, PN-EN 61784.

5.5 Network devices

Manufacturers and types of devices used in transmission, such as gateway, bridge, switch, repeater, converter, firewall, shall be agreed with GLSA.

Connections within the system must be made by means of switches.

Firewall functionality shall serve as separation from GLSA factory network.

5.6 Topology of connections

Topology of system elements' connections (i.e. line, „point-to-point", „multi drop", „daisy chain", star, ring, mixed structures) subject to GLSA approval, on the grounds of system architecture documentation supplied on bidding action stage (refer to: Hypothetical system architecture, Attachment No 1).

5.7 Division on applied communication types by application

Types of applied data transmissions, allowed for use in GLSA are divided depending on level, on which the data are transferred in control and instrumentation system.

Item	Level of data transmission in control and instrumentation system hierarchy	Physical layer	Types of data transmission	Examples of application
1	Fieldbus for level transmitters of Tank Gauging System *)	Two wires, twisted and shielded cable	FSK, GPU	Tank Gauging System – fieldbus for level transmitters
2	DCS/PLC – intelligent field devices *)	Two wires, twisted and shielded cable	HART	Measuring transducers, valves – also in intrinsically safe circuits
		Two wires, twisted and shielded cable	DE (Digitally Enhanced)	Allowed for as above – but for Honeywell system (not preferred in relation to HART)
		PN-EN 61158-2 (MBP) (option)	Profibus PA (option)	(option) Measuring transducers, valves – also in intrinsically safe circuits
		RS-485, fibre optic	Profibus DP	Frequency converters, measuring transducers, valves – excluding intrinsically safe circuits
		RS-422, RS-485, fibre optic, allowed (but not recommended) RS-232C	Modbus	Analysers
3	DCS/PLC-PLC	RS-485, fibre optic	Profibus DP, Modbus	DCS/PLC-PLC
		Ethernet, preferred: Fault Tolerant Ethernet	Modbus TCP, Profibus	DCS/PLC-PLC
4	Internal communication, buses	Manufacturer's standard	Manufacturer's standard	Internal DCS bus

5	Between control system computers and DCS/PLC controllers	Ethernet, preferred: Fault Tolerant Ethernet	Ethernet TCP/IP **) for signals other than time-critical OPC, ODBC	Process data servers – operator's stations – other computers of control system – DCS – PLC
6	Computers operating in control systems – superordinated systems	Ethernet,	Ethernet TCP/IP **) OPC, ODBC	Process data server – SAP server in superordinated system
7	Printers	USB preferred for new systems, allowable (but not recommended): RS-232C, RS-422, RS-485	Serial transmission	Local print-out from PC
		Ethernet	Ethernet TCP/IP	Network printing

***)** Intelligent field devices – microprocessor devices able to deliver information about multiple measuring signals, information about equipment operation performance, diagnostic information, and execution of assigned control functions.

****)** In cases where application of protocols different than TCP/IP is necessary, supplier shall provide a gateway to TCP/IP protocol, on computer that is connecting to external system.

5.8 Additional requirements and recommendations

Requirements:

- time synchronization between systems
- communication of control and instrumentation system with superordinated systems (SAP, office, etc.)
- separation of control and instrumentation system from superordinated systems by means of firewall
- real time transfer of key process data for Advanced Process Control (APC)
- diagnosis of communication links and signalling of transmission line damage on DCS diagnostic screen
- separated network levels with use of firewalls for protection against dangerous contents

Recommendations:

- transfer of alarm and event information together with time of their occurrence (Time Stamp), signed in PLC to DCS
- new intelligent devices e.g. PLC, UPS, analysers, weighing systems shall be connected to network of measurement data transmission in order to transfer diagnostic and process data for archiving and accessing them in collective database (e.g. PHD).

6 Relevant documents

Any "Technical Specification" issued by GRUPA LOTOS S.A. listed in Contract Files.

7 Codes and standards

It is in each case understood that quoted standards, regulations, directives and orders are of their latest editions, along with amendments, annexes and supplements in force.

Standards that are specifically connected with computers are principally listed here. Remaining standards related to Control and Instrumentation, are given in specification GLSA 3010 – Instrumentation general requirements.

7.1 Directives of European Union

2006/95/EC	Electrical equipment designed for use within certain voltage limits (LVD)
2004/108/EC	Directive EMC, which will have cancelled 89/336/EEC Directive since July 20. 2007
2008/768/EC	Decision No 768/2008/EC of the European Parliament and of the Council of 9 July 2008 on a common framework for the marketing of products, and repealing Council Decision 93/465/EEC
94/9/EEC	Equipment explosive atmospheres (ATEX)

7.2 Polish Standards

PN-EN 61158-2-3-4-5-6	Digital data communication in measurements and control. Fieldbus for use in industrial control systems.
PN-EN 61784	Digital data communication in measurements and control. Profile sets for continuous and discrete manufacturing relative to fieldbus use in industrial control systems

7.3 IEEE

IEEE 802.3 –Ethernet standard specification

8 Enclosures

Attachment N° 1 – Hypothetical architecture of control system

9 Record of changes

No.	Date	Description	Introduced by
1		This specification entirely replaces the former LOTOS Group S.A. standard No. PR 07 376 with the same title.	M. Domaniewski
2	30-11-2013 (rev. 1)	Review, update, standardize and changes to the Standard within scope of order No. OK/990/2012	Editorial board coordinated by T.Wróbel
-	31-08-2015	Page layout corrections, no contents changes.	T. Wróbel