Aalto University
School of Chemical
Engineering

CHEM-E0115
Planning and Execution of a Biorefinery Investment Project

Automation, Electrical and ICT & Security Engineering
6.10.2022
Aki Suittio/ Antonio Ramirez

Automation engineering

Aalto University
School of Chemical
Engineering

Electrical and Automation Engineering at AFRY

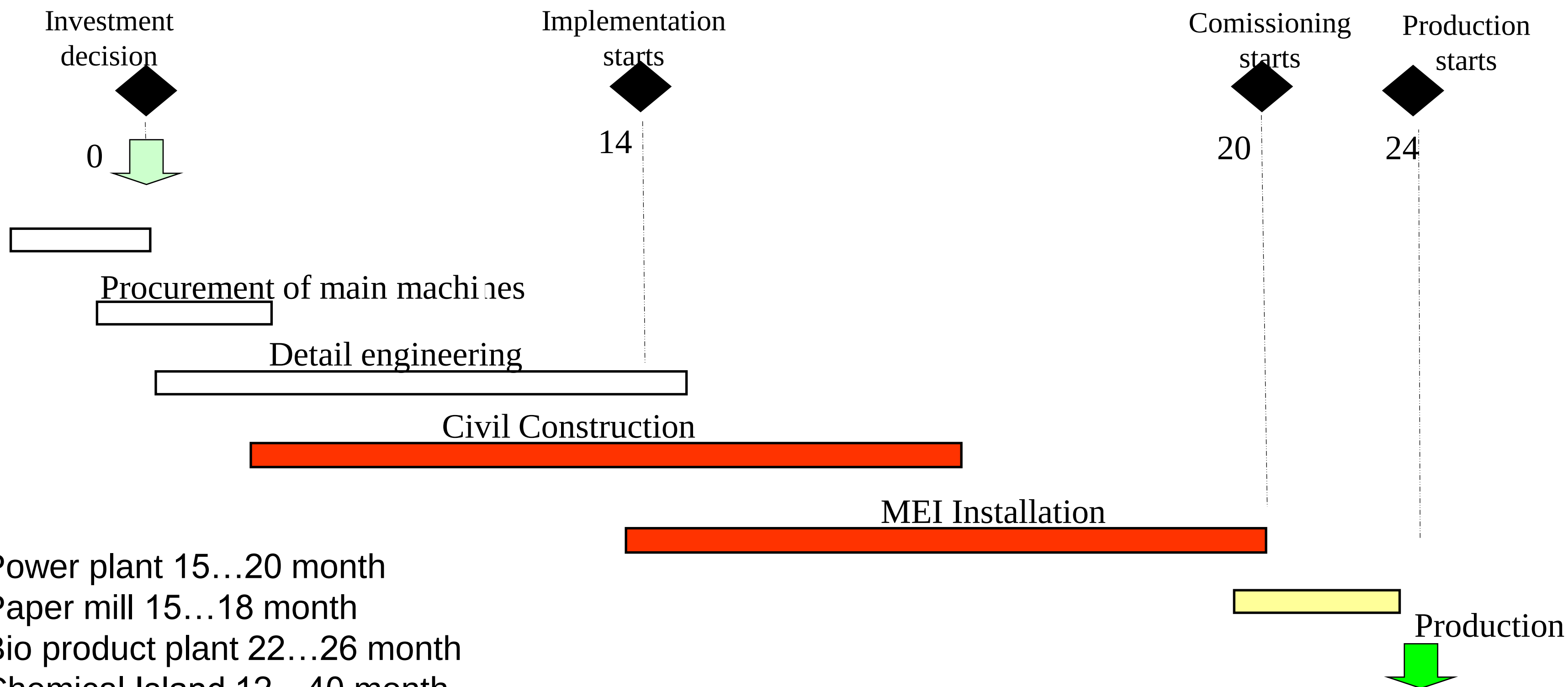
AFRY’s scope of services

- Pre-feasibility studies
- Pre-engineering studies
- Basic Engineering
- Detail Engineering
- FAT and SAT services
- Electrical and Automation Engineering Supervision
- Check-out, commissioning and start-up services
- EPCM Services
- EPC Services

For

- New investments
- Production line relocations and rebuilds
- Control and Monitoring systems and DCS upgrades
- MCC and Power distribution system upgrades
- Small scale upgrade projects and services

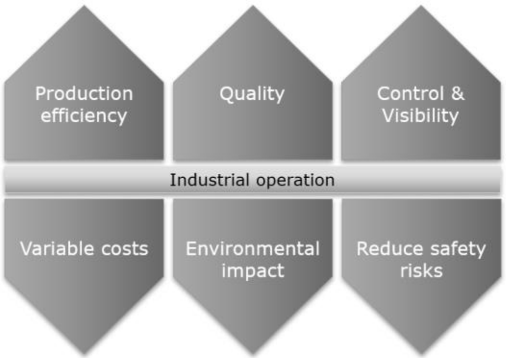
Stages of Projects



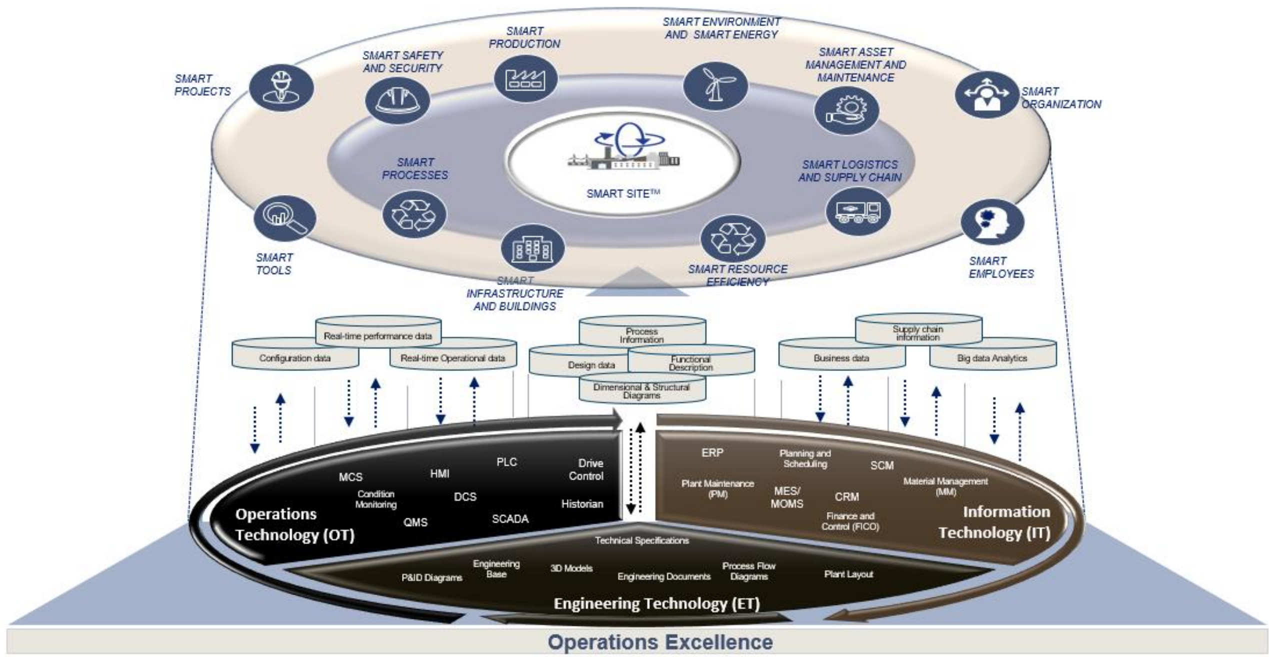
Power plant 15…20 month
Paper mill 15…18 month
Bio product plant 22…26 month
Chemical Island 12…40 month

Smart Site

- Industry needs

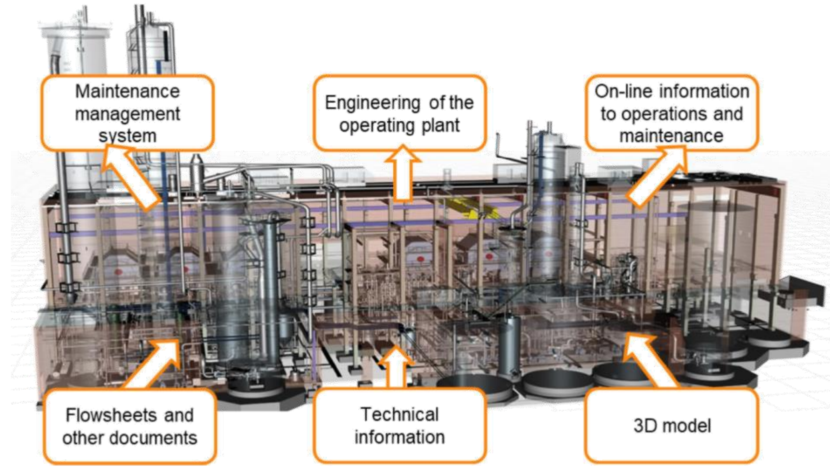


- Establishing 'Smart Data Platform' as the foundation for a digital enterprise



Smart Site

- Model based approach for integrated engineering data management.
- Extends ‘Master Data Management’ with single source of truth across all disciplines.
- Consistently manages technical information throughout plant life cycle.
- Provides easy access for all stake holders using web-based user interface.
- Enables transparency and utilization of data guaranteeing better data quality.
- Provides access to real time data integrating with plant IT (MES, ERP) and control systems.



Detail engineering documents in a paper mill project

		Department									
Document		**00**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**Total**
I110	TECHNICAL REPORT	4		1	2	1	1				**9**
I140	ENQUIRY SPECIFICATION	24		1	4	2	6				**37**
I141	TENDER COMPARISON	23		1	1	1	3				**29**
I160	COMPONENT STANDARD	12									**12**
I170	UNIT PRICE LIST	23									**23**
I226	APPLICATION LIST	2	1	5	5	2	2	1	1		**19**
I242	SIZING OF INSTRUMENTS	1	2	22	17	9	29				**80**
I253	LOOP DIAGRAM	5	2	927	538	183	1124				**2779**
I262	FUNCTION DIAGRAM	0	1	928	527	182	988				**2626**
I291	DEVICE LIST	8	0	8	6	5	11				**38**
I294	PURCHASE SPECIFICATION	14	3	71	79	59	122				**348**
I321	CONTROL AND RACK ROOM LAYOUT			2			8				**10**
I322	PANEL, CABINET AND RACK LAYOUT			1	2	1	1				**5**
I324	HOOK-UP LIST	1									**1**
I325	CONTROL EQUIPMENT AND BOX LIST			2	2	1	2				**7**
I327	MASTER WIRING DIAGRAM	1									**1**
I424	TYPICAL INSTALLATION DRAWING	2	1	2	1		1				**7**
I440	LOCATION DRAWING			28	16	23	50			1	**118**
I442	WIRING DIAGRAM	7	1	242	133	85	319				**787**
I444	CABLE LIST	0	1	5	5	5	5				**21**
I451	NAME PLATE LIST		1	16	21	9	22				**69**
Total:		**127**	**13**	**2262**	**1359**	**568**	**2694**	**1**	**1**	**1**	**7026**

Pre-engineering

Pre-engineering

Conceptual study

Pre-study

Pre-engineering

Basic engineering

Pre-feasibility study

Feasibility study

Extended feasibility study

Main study

Front end engineering

Pre-engineering

The basic solutions for mill automation

- automation and ICT design criteria
- systems : DCS, QCS, WIS, other systems
- level of the automation : field devices
- the basic solutions for implementation : cabling techniques

Size and locations of automation and control rooms (space reservations)

Calculation of investment for automation

In some cases also part of the basic engineering is done during the pre-engineering

- Instructions and standards for procurement and engineering

ISA 95 Functional Hierarchy of Activities

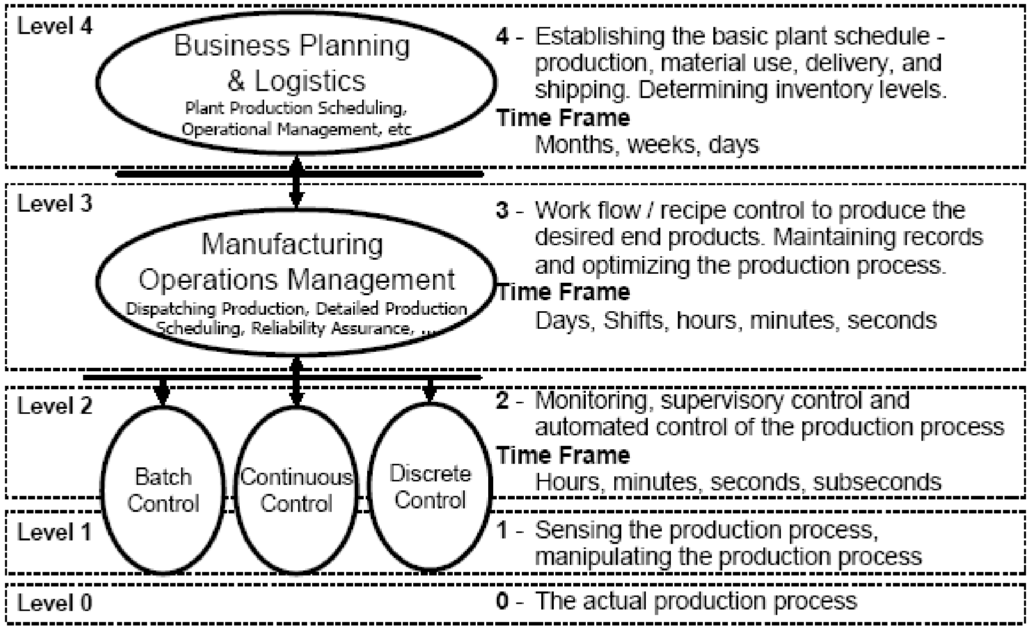


Figure 2 - Multi-level functional hierarchy of activities

The Basic Solutions for Mill Automation

Level 4: Business Planning and Logistics

- Applications for Sales and Distribution
- Applications for Materials Management and Purchasing
- Applications for Maintenance
- Applications for Financial Management
- Applications for Human Resources Management and Payroll
- Applications for Information Management, Data Warehousing
- Applications for Collaboration

Level 3: Manufacturing Operations Management

- Production Management (PPMS)
- Process Information Management (PIMS)
- Dynamic Asset Management (AMS)
- Document Management

The Basic Solutions for Mill Automation

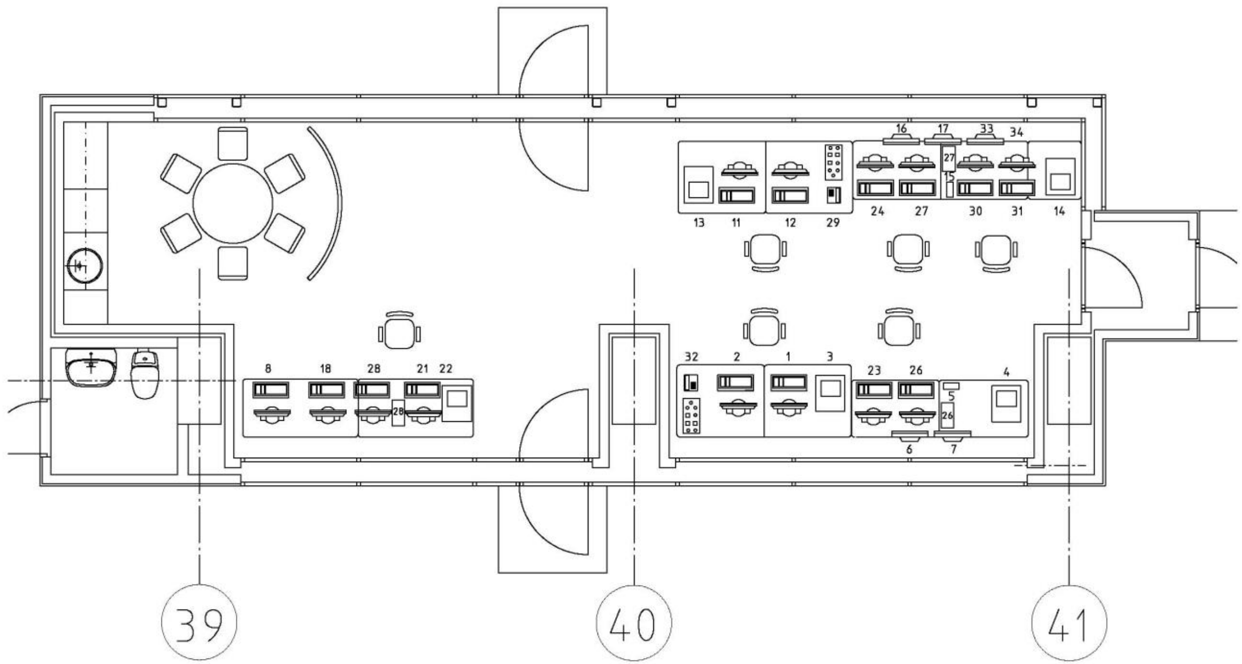
Level 2: Monitoring, Supervisory and Automated Control

- Distributed Control System (DCS)
- Machine Control Systems (MCS)
- Supervisory Quality Controls
  - *Quality Control System (QCS), Web Inspection System (WIS), Web Monitoring System (WMS), Machine Monitoring System (MMS),…*
- Product Management, Warehouse and Logistics Systems
- Physical Access Control System (PACS)

Level 1: Sensing and Manipulating the Production Processes

- Sensors and Transmitters
- Final Control Elements, Remote-operated Control and On-off Valves
- Discrete Switches
- Analyzers

Automation and Control Rooms



Calculation of Investment for Automation

If the cost estimate accuracy is requested to be less than ±5 %, some enquiries shall be prepared;

- DCS (Distributed Control System)
- QCS (Quality Control System)
- PIMS (Process Information Management System)
- PPMS (Paper Production Management System)
- ICT (Information and Communication Technology)

Calculation is based on loop and circuit amounts and AFRY cost files

- Standard instruments
- DCS
- Installation

Special instruments are listed and priced separately

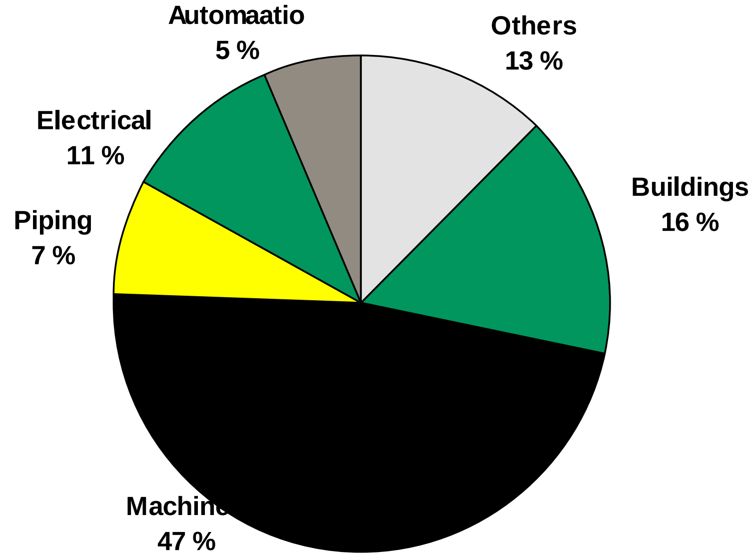
Calculation of Investment for Automation

4ePCM
Sample Project

230 000 tpa

Account No	Pos. Nr.	Quantity	Specification	Unit price	Total	Freight	Erection	TOTAL
31	Paper mill				- 1000 Eur -			
			AREA SUMMARY					
31			Automation, MIS		7 148	0	1 125	8 273
31			Automation					
	1		Field instruments and installation No of instrument loop 750 - Field instruments - Control and on/off valves - Installation	pcs	1 688	0	1 125	2 813
	2		Distributed control system (included software) No of instrument loop 1 300 No of motor controls 400	pcs pcs	1 360	0	0	1 360
	3		Special instruments - retention and consistency measurements		300	0	0	300
	4		QMS - two measuring frames - basis weight, moisture, caliper, porosity - Drive controls - PIMS		1 100	0	0	1 100
	5		QCS - CD controls and actuators		incl. In PM	0	0	incl. In PM
	6		Web break monitoring system		300	0	0	300
	7		Edge Cracking Monitoring		100	0	0	100
	8		Machine Control System		incl. In PM		0	incl. In PM
	9.1		Machine monitoring		incl. In PM			incl. in PM
	9.2		Lubrication monitoring		incl. In PM			incl. In PM
	10		Networks		800			800 0
	11		Production Management System		1 500			1 500
31 -6			Automation	Total	**7 148**	**0**	**1 125**	**8 273**

Calculation of Investment for Automation



5% 850 MEUR = 42 MEUR

Basic engineering

Basic Engineering

General Automation Engineering

- Co-ordination
- Engineering Instructions and Standards
- Procurement Services

Safety of Automation

- Hazard and Risk Analysis
- Safety Requirements Allocation
- Overall Safety Requirements

Process Control System Design (DCS)

- General Process Control System Engineering
- Control and System Room Design

Field Equipment Design

- Measurement and control methods
- Process data acquisition
- Equipment selection
- Process connection design

Co-ordination

Checking and approving of the design, drawings and documents to ensure compliance with the set project standards and criteria

Communication with other disciplines

- Project management
- Process engineering
- Mechanical and piping engineering
- Civil engineering
- HVAC engineering
- Electrical engineering
- ICT engineering (under automation engineering management)

Engineering Instructions and Standards

Automation and instrumentation in machine deliveries

Auxiliary equipment for automation and instrumentation

Automation and instrumentation design criteria

Numbering procedure for automation and instrumentation

Cable standard

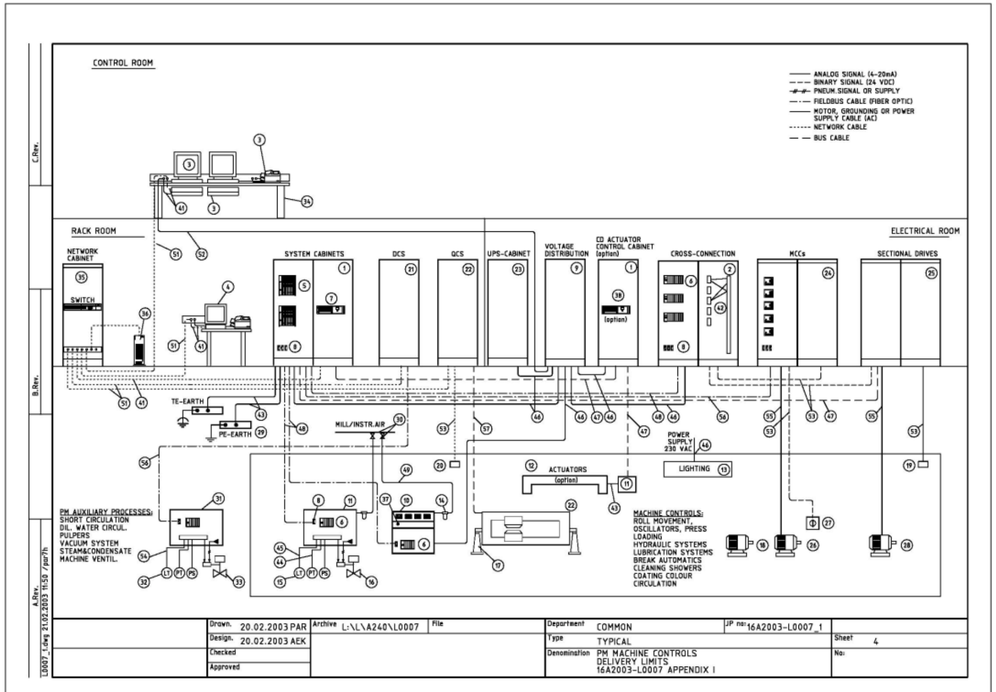
General instruction for automation and instrumentation symbols and identification

Marking and name plates for automation and instrumentation

Function blocks for functional diagrams

Automation and instrumentation commissioning instructions

Automation and instrumentation in machine deliveries



Automation and instrumentation design criteria

BF: FLOW MEASUREMENTS AND SWITCHES

1 PURPOSE OR TASK OF OBJECT

IEC 61346-2 designation B: Converting an input variable (physical property, condition or event) into a signal for further processing.

IEC 61346-2 designation P: Presenting information.

Subclass F: Flow

2 GENERAL

Transmitters shall be used instead of flow switches where possible to enhance the monitoring of functionality of measurement.

3 FLOW MEASUREMENTS AND SWITCHES

3.1 Condensate and Steam

Normally by corner taps (BF.E or BF.F) or ring chamber (BF.G) type orifice plates and differential pressure transmitter (BP.F).

The flow nozzle (BF.M) and differential pressure transmitter (BP.F) will be used for high pressure steam.

If sufficient straight lengths of pipe cannot be achieved, V-Cone flow meter (BF.U) and differential pressure transmitter (BP.F) shall be used.

If the remaining pressure loss must be kept small or enough straight lengths of pipe are not available, measurement shall be carried out by venturi tube (BF.V) and differential pressure transmitter (BP.F).

Annubar type flow meter (BF.P) and differential pressure transmitter (BP.F) could be used in some special cases.

Vortex effect flow meters (BF.K) can be used with small diameter pipes.

4 INSTRUMENTS

4.1 General

All field devices (transmitters, remote controlled valves, analyzers, etc.) shall support EDD (Electronic Device Description) asset management standard.

Field devices, such as limits switches, photocells and similar equipment, shall be installed so that their maintenance and adjustment can be carried out while the equipment is in operation. The devices shall be dust and waterproof, and so constructed and installed that vibration, temperature and dust in the equipment does not damage the devices, or cause disturbances in their function.

Limit switches and corresponding instruments, which are under heavy usage, shall be easily replaceable, being for example plug connected.

Contacts of the 24 VDC field devices shall be gold plated.

Transmitters and positioners shall preferably be using Profibus PA digital communication.

If equipment with Profibus communication is not available, devices with analog 4-20 mA DC signals can be used. 2-wire system is preferred.

The use of 0-20 mA signal will only be allowed in special circumstances.

Transmitters shall not include any signal processing if the calculations can be carried out in the automation system.

Transmitters shall allow measurement of the mA signal while in continuous operation.

The 4-20 mA analog signals connected to the automation system shall be galvanically isolated by the Supplier. This applies both to the input and output signals.

Non-fieldbus based transmitters and positioners shall be HART compatible.

4.2 Magnetic flow meters (BF.B)

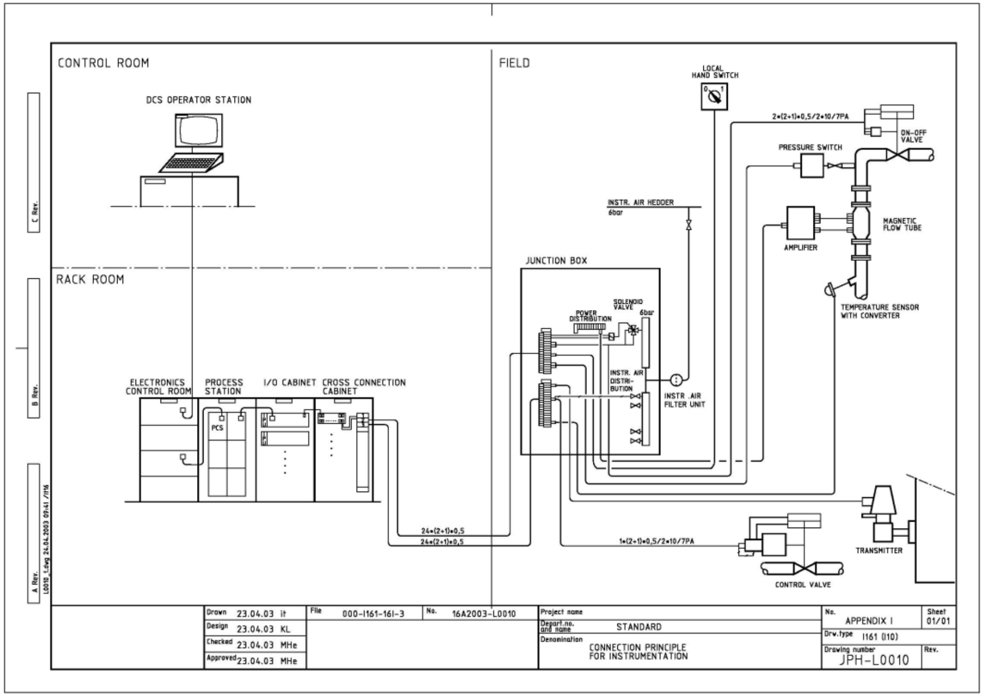
Used for: water, effluent, stock, white water and various chemicals.

The magnetic flow meter flow tubes are normally lined with Teflon or Ceramic and the electrodes are normally of Hastelloy C material. Other materials can be used for special cases.

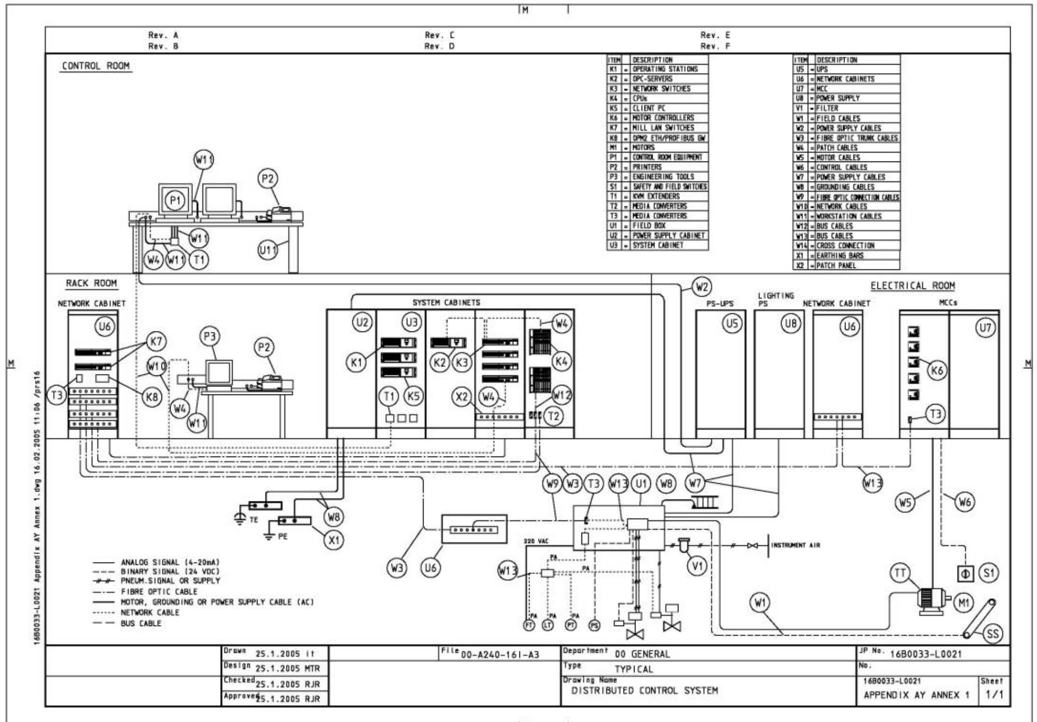
If there is a control valve in the same line with the flow meter, the magnetic flow meter size is preferably selected according to the control valve. For water applications the magnetic flow meter flow tube shall be normally sized for full scale range speed 0.5 - 5 m/s. For other liquids the magnetic flow meter flow tube shall be normally sized for full scale range speed 0.5 – 3 m/s.

Magnetic flow meters shall be used always when it is possible (conductivity > 5 µS/cm and temperature < 180 °C).

Automation and instrumentation design criteria



Automation and instrumentation design criteria



Procurement Services

Technical enquiry specifications

Participation in technical and commercial tender negotiations

- Minutes of meetings

Tender evaluation and comparisons

Equipment and material specifications for purchase requisitions and orders

Technical enquiry specifications

DCS (U)
ICT infrastructure (U)
Control and on-off valves (U)
HP control valves
Magnetic flowmeters (U)
Nozzles and orifice Plates
Vortex flowmeters (U)
Mass flowmeters
Consistency transmitters and pulp sampling valves (U)
Pressure, dP and level transmitters (U)
Temperature sensors and transmitters (U)
Refractometers
Radiometric density measurements
Radiometric level measurements
pH transmitters (U)
Conductivity transmitters (U)
Pyrometers and lime kiln scanner
Special level measurements
Smelt bed cameras

- Flue gas analysers (SO_2, NO_X, CO, CO_2, HCl, HF, CH_4, C_2H_4, C_3H_3, O_2, Dust, Temperature, Flow)
- Flue gas O_2 analysers
- Cooking and washing liquor analysers
- Kappa, brightness and residual chemicals analysers
- Boiler water analysers (SiO_2, pH, Conductivity, O_2)
- Pulp sheet dirt count analysers
- Pulp quality analysers
- Ultrasonic flowmeters
- Viscosimeter
- Weighbridges
- Gas detectors
- CCTV system (U)
- Junction boxes (U)
- Network cabling and installation (U)
- Instrument installation (U)
  - U=Unit price based frame contract

Safety of Automation

Hazard and Risk Analysis

- Hazard and risk reports

Safety Requirements Allocation

- Hazard and risk reports with the safety integrity levels (SIL)

Overall Safety Requirements

- Specification for the overall Safety requirements (Specification of SIL functions)

Process Control System Design (DCS)

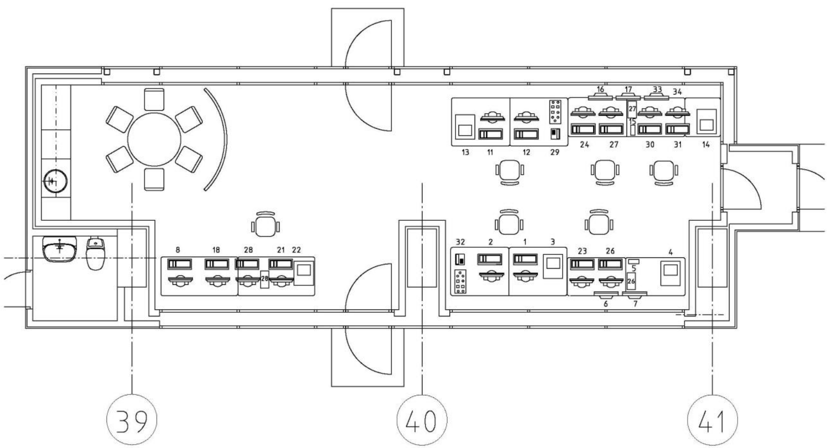
General Process Control System Engineering

- Allocation of I/O's for loops
  - *I/O list (amounts)*

Control and System Room Design

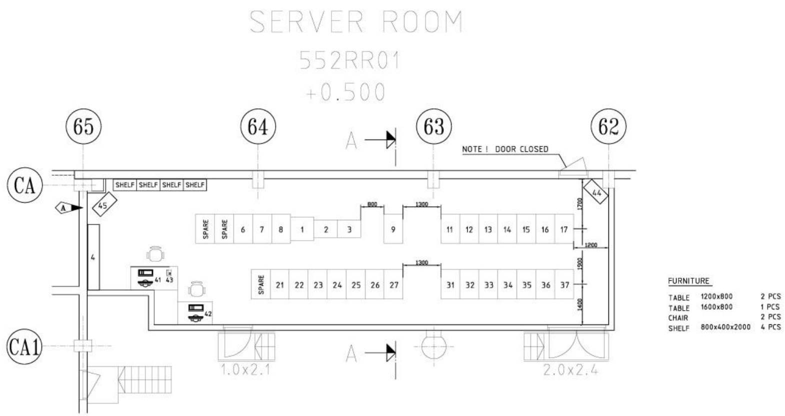
- Specification for control and system room requirements for layout design
- Control and system room layouts
- Requirements and specification of floor and ceiling openings
- Requirements and specification of control and system room HVAC
- Cable tray arrangement drawings in control and system rooms

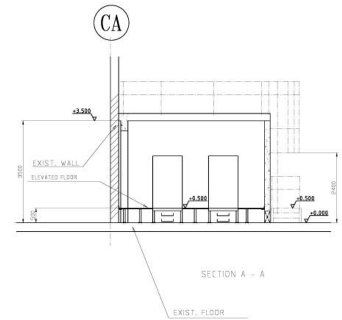
Control and System Room Design



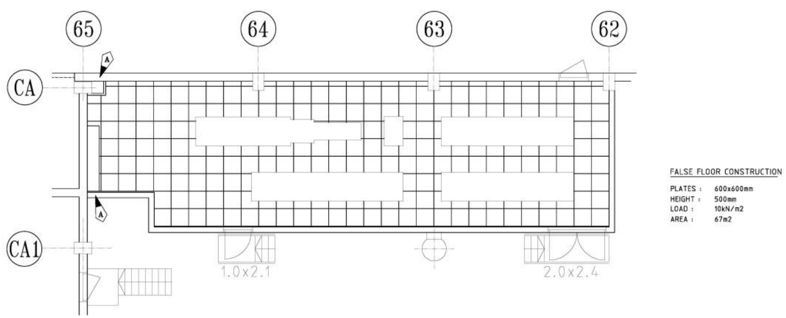
No.	EQUIPMENT	SUPPLIER	POS.NO	NOTE
1	WINDER 1 OPERATOR STATION	WIN	541EB11-2002	
2	WINDER 1 OPERATOR STATION	WIN	541EB21-2002	
3	WINDER 1 PRINTER	WIN	541ES15-2002	
4	TAG PRINTER			
5	WINDER 1 CCTV CONTROL UNIT			
6	WINDER 1 CCTV MONITOR			
7	WINDER 1 CCTV MONITOR			
8	WINDER 1 DRIVE SERVICE WORKSTATION	ABB3	541ES11	
9				
10				
11	WINDER 2 OPERATOR STATION	WIN	541EB11-3002	
12	WINDER 2 OPERATOR STATION	WIN	541EB21-3002	
13	WINDER 2 PRINTER	WIN	541ES15-3002	
14	TAG PRINTER			
15	WINDER 2 CCTV CONTROL UNIT			
16	WINDER 2 CCTV MONITOR			
17	WINDER 2 CCTV MONITOR			
18	WINDER 2 DRIVE SERVICE WORKSTATION	ABB3	541ES12	
19				
20				
21	DCS OPERATOR STATION	ABB	531OS03	
22	DCS PRINTER	ABB	531PRT03	
23	WIS OPERATOR STATION	PAR	PAR-OS2	
24	WIS OPERATOR STATION	PAR	PAR-OS3	
25				
26	MES PC			
27	MES PC			
28	OFFICE PC			
29	TELEPHONE			
30	ROLL CONTROL PC	ROH		
31	INTERMEDIATE STORAGE OPERATOR STATION	KCI		
32	TELEPHONE			
33	INTERMEDIATE STORAGE CCTV MONITOR			
34	CCTV CONTROL UNIT			

Control and System Room Design





No.	EQUIPMENT	SUPPLIER	POS. No	NOTE
1	NETWORK CABINET	SNT	111NC200	
2	NETWORK CABINET	SNT	111NC201	
3	NETWORK CABINET	SNT	111NC202	
4	UPS VOLTAGE DISTRIBUTION PANEL		+552UL11	
5				
6	HP DC380			
7	IBM			
8	IBM			
9	CHINA TELECOM			
10				
11	TIPS1 SERVER			
12	ARRAY DISK			
13	TIPS2 SERVER			
14	APP. SERVER			
15	PMIS1 SERVER			
16	ARRAY DISK			
17	PMIS2 SERVER			
18				
19				
20				
21	LH3			
22	LH3			
23	LC3			
24	5600&X225			
25	SAP			
26	SAP			
27	IBM&AIX			
28				
29				
30				
31	BACKUP SERVER			
32	BACKUP STORAGE			
33	RESERVE SERVER			
34	WEB SERVER (REPORT)			
35	SMC SERVER			
36	RPC SERVER			
37	TRACK ROL SERVER			
38				
39				
40				
41	SERVER MANAGEMENT TERMINAL			
42	SERVER MANAGEMENT TERMINAL			
43	TELEPHONE			
44	BACKUP AIR CONDITIONING UNIT			
45	BACKUP AIR CONDITIONING UNIT			



Field Equipment Design

Measurement and control methods

- Instrumentation of process flow diagrams
  - *PI-diagrams*
- Requirements and specification for field equipment
  - *Selection guide of field instruments and control valves by application type*

Process data acquisition

- Process data acquisition for field equipment selection and sizing
  - *Application list for process data*

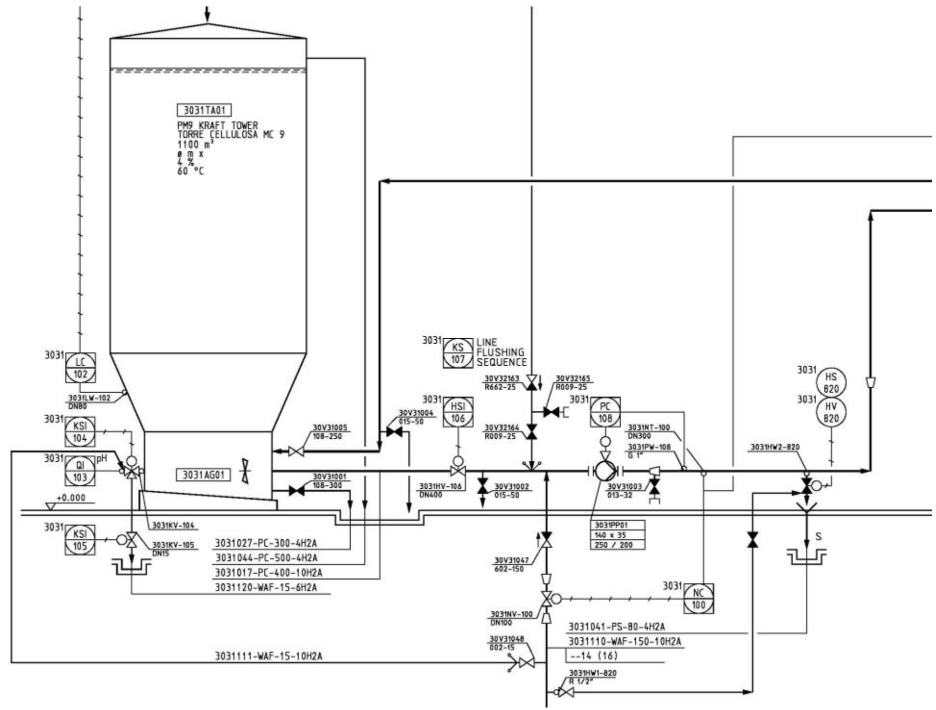
Equipment selection

- Field equipment type definition
  - *Device standard*
- Sizing of flow meters and control valves
  - *Calculation sizing sheets*
- Equipment specification for loops
  - *Specification for equipment in loops*
  - *Calibration list*
  - *Application list*

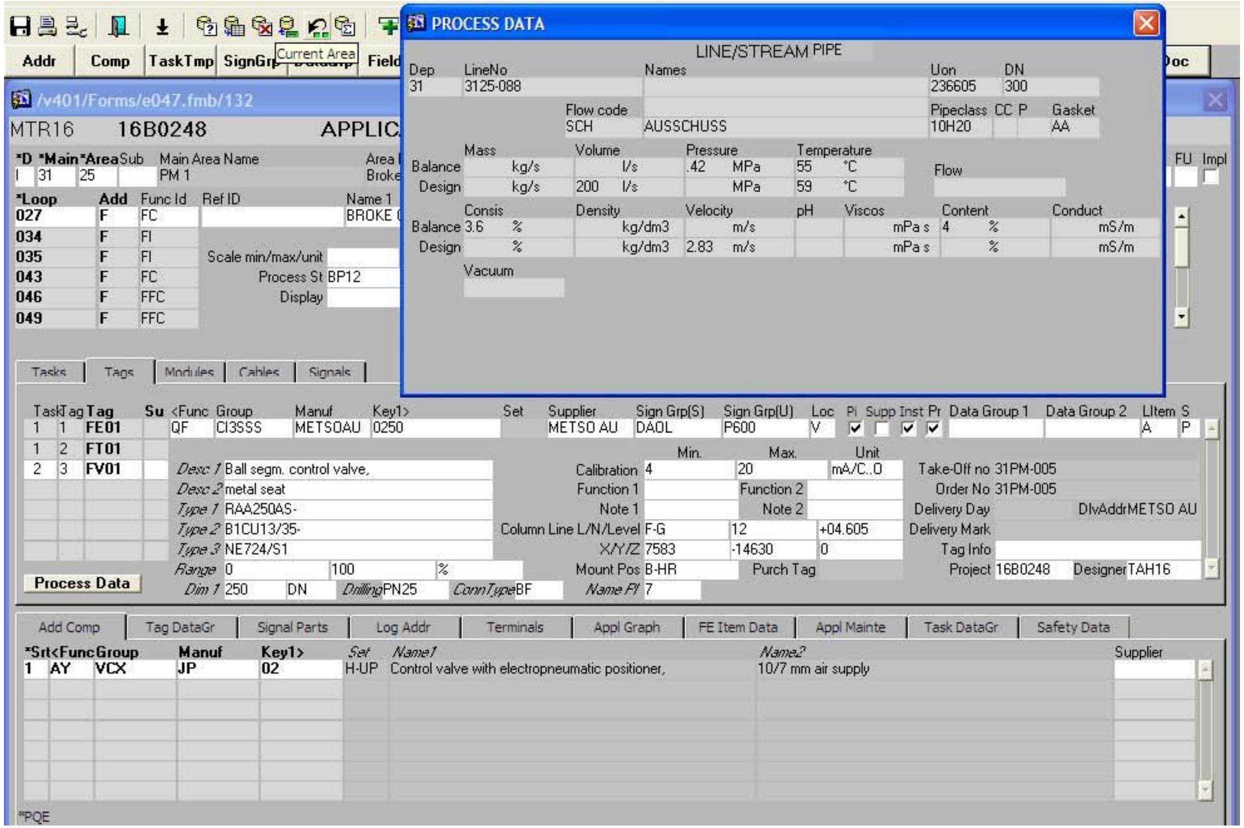
Process connection design

- Requirements and specification for mechanical engineering
  - *Installation instructions for field instruments in process piping and machinery*
  - *Dimensional drawings of process connections and field instruments*

Instrumentation of process flow diagrams => PI-diagrams



Process data acquisition



Equipment selection

CONTROL VALVE SIZING SHEET — NELPROF 3.20

Item	Revision	Tag no	3125F027-FV01
Customer			Sizing 1
Metso Ref.	Metso Contact	Cust. Ref.	
Project		Date / by	5/14/06 / tah16

PROCESS DATA

Pipe size inlet / outlet	mm 300 / 300	Wall thickness	mm 3
Valve duty	BROKE CIRCULATION	Fluid nature	
Description	Mechanical pulp / PP		PULP
Consistency	4 %	Critical pressure	barA 221.2
Molecular weight		Ratio of specific heats	

		Case 1	Case 2	Case 3	Case 4
Flow rate	l/s	200	200		
Upstream temperature	degC	55	55		
Upstream pressure	kPaG	420	420		
Differential pressure	kPa	120	30		
Downstream pressure	kPaG	300	390		
Vapor pressure	barA	0.173	0.173		

CALCULATED PERFORMANCE

		Case 1	Case 2	Case 3	Case 4
Capacity	FpCv	781.76	1677.57		
Percent of full travel	%	65.3	88.1		
Opening in degrees	deg	64.1	84.4		
Sound pressure level	dBA [VDMA]	62	57		
Flow velocity (inlet)	m/s	4.07	4.07		
Terminal pressure drop	bar	3.56	2.73		
Pressure recovery factor (Fl)		0.85	0.76		

VALVE SELECTION

Nominal size	mm 250	Maximum capacity	Cv 3210	FpCv	2964.32
Valve type	SEGMENT				
Valve serie	RA	METAL SEATED SEGMENT VALVE			

ACTUATOR SIZING DATA

Supply pressure	kPaG	500	Valve seat	std Metal
Max shut off dp	kPa	420	Gland packing	PTFE/TFE
Load factor		1	Bearings	PTFE

ACTUATOR SELECTION

Selected actuator: B1C13 — DOUBLE ACTING CYLINDER ACTUATOR

Required open	Nm	98	Required close	Nm	98
Opening load factor	%	15	Closing load factor	%	15

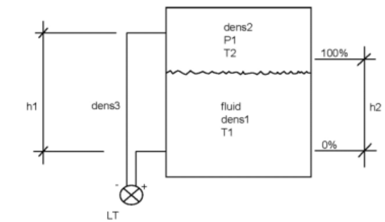
Req control to open	Nm	74	78		
Ctrl open load factor	%	11	12		
Req control to close	Nm	51	25		
Ctrl close load factor	%	8	4		

NOTES

Calibration calculation — 16A2003 — 13.9.2008

Tag number: 531LT0560 **Date:** 16.3.04 **Rev.** -

Description



Fluid:	Condensate	Temperature T1:	105 °C
Density dens1:	951 kg/m³	Pressure P1:	1,00 bar
Density dens2:	1 kg/m³	Temperature T2:	105 °C
Height h1:	0,60 m	Impulse line density dens3:	998 kg/m³
Height h2:	0,60 m		

0% calibration

dP = (dens2 * g * h1) - (dens3 * g * h1)

dP = -5,9 kPa

100% calibration

dP = ((dens1 * g * h2) + (dens2 * g * (h1-h2))) - (dens3 * g * h1)

dP = -0,3 kPa

Process connection design

STANDARD **631-060**

August 23, 2007 1 (1)

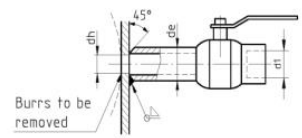
INSTRUMENTATION DESIGN STANDARDS
PRESSURE AND SAMPLING CONNECTION
FOR SERVICE PIPING WITH SHUT OFF VALVE
DN 10 …DN 25, LONG WELDING/INSIDE THREAD END R 3/8…R 1

TZT E3X

1 GENERAL

The pressure and sampling connection covered by this standard is to be welded on to the tanks, pipes or other equipment. This type of ball valve sampling connection is not to be used for hazardous fluids.

2 DIMENSIONS



DN	Thread	de	dh
10	R 3/8"	17.2	12
15	R ½"	21.3	15
20	R ¾"	26.9	20
25	R 1	33.7	25

3 MATERIAL

Material same as the base material onto which the connection is to be welded.

4 NOTES

Strength of the connection to be checked according to pressure and temperature conditions as indicated in the pressure vessels requirements

5 DESIGNATION

Tag, name, DN-thread, material, standard No.
Example: 33CL-PW001, Pressure and sampling connection, DN 15 - R ½", 1.4432, 631-060

Detail engineering

Aalto University
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Engineering

Detail engineering

Safety of Automation

- Engineering Instructions and Standards
- Risk Assessment
- Safety System Design
- Permit Documents and Inspections

Process Control System Design (DCS)

- General Process Control System Engineering

Installation design

- Installation Engineering
- Location Design
- Maintenance design

Detail engineering

Process Control Design

Process Description for Process Control Design

- Alternative 1
  - *Process description*
  - *Interlocking, group start and sequence diagrams*
  - *Functional diagrams for instrument loops*
  - *Distributed Control System DCS graphic display sketches*
- Alternative 2
  - *Process description*
  - *Loop and circuit wise functional descriptions or diagrams*
  - *Distributed Control System DCS graphic display sketches*
- Alternative 3
  - *Process description*
  - *Loop and circuit wise process description*
  - *Distributed Control System DCS graphic display sketches*

LOOP WISE FUNCTIONAL Description for Process Control Design

3031FC-003 PGW PULP TO PM8

PURPOSE AND FUNCTION

To keep the PGW pulp flow from PGW TOWER 1 and PGW TOWER 2 to PM8 at desired value by controlling the flow with valve FV.

Controller gets remote setpoint from PM8 BROKE TOWER level controller. Remote setpoint = level controller output * 1.

INTERLOCKS

Interlock type: 31X

In manual mode interlock signal is true for a time period (pulse) = Valve closes with ramp.In auto mode when interlock signal is true = Valve closes with ramp, control block freezes, mode is kept, mode can be operated during interlock.
In manual mode after the time period (pulse) interlock signal is false = Control block is released for operation, valve stays closed.In auto mode when interlock signal is false = Valve opens with ramp, control block is released for operation when measurement has reached set value (set point - constant) or after a time delay.

Signals:

3031PP02 (PGW TOWER 1 PUMP) is stopped
AND
3031PP03 (PGW TOWER 2 PUMP) is stopped

FAULT INSTRUCTIONS

DOCUMENT HISTORY

3031FC-003 PASTA PGW PER MC8

SCOPO E FUNZIONAMENTO

Mantenere al valore desiderato il flusso della pasta PGW da TORRE PGW 1 e TORRE PGW 2 alla MC8, controllando il flusso con la valvola FV.

Al regolatore è fornito il valore di impostazione remoto dal regolatore di livello della TORRE FOGLIACCI MC8. Valore di impostazione remoto = output del regolatore di livello * 1.

INTERBLOCCHI

Tipo di interblocco: 31X

Nel modo manuale, se il segnale dell'interblocco corrisponde allo stato reale per un periodo (temporizzazione) = La valvola si chiude gradualmente (rampa).

Nel modo automatico, se il segnale dell'interblocco corrisponde allo stato reale = La valvola si chiude gradualmente (rampa), il gruppo di controllo viene disabilitato, il modo rimane invariato, ma è possibile modificare il modo durante l'interblocco.

Nel modo manuale, se il segnale dell'interblocco non corrisponde allo stato reale dopo il periodo di tempo (temporizzazione) stabilito = Il gruppo di controllo viene abilitato al funzionamento, la valvola rimane chiusa.

Nel modo automatico, quando il segnale dell'interblocco non corrisponde allo stato reale = La valvola si apre gradualmente (rampa), il gruppo di controllo viene abilitato al funzionamento quando la misurazione ha raggiunto il valore impostato (setpoint - costante) oppure dopo un ritardo.

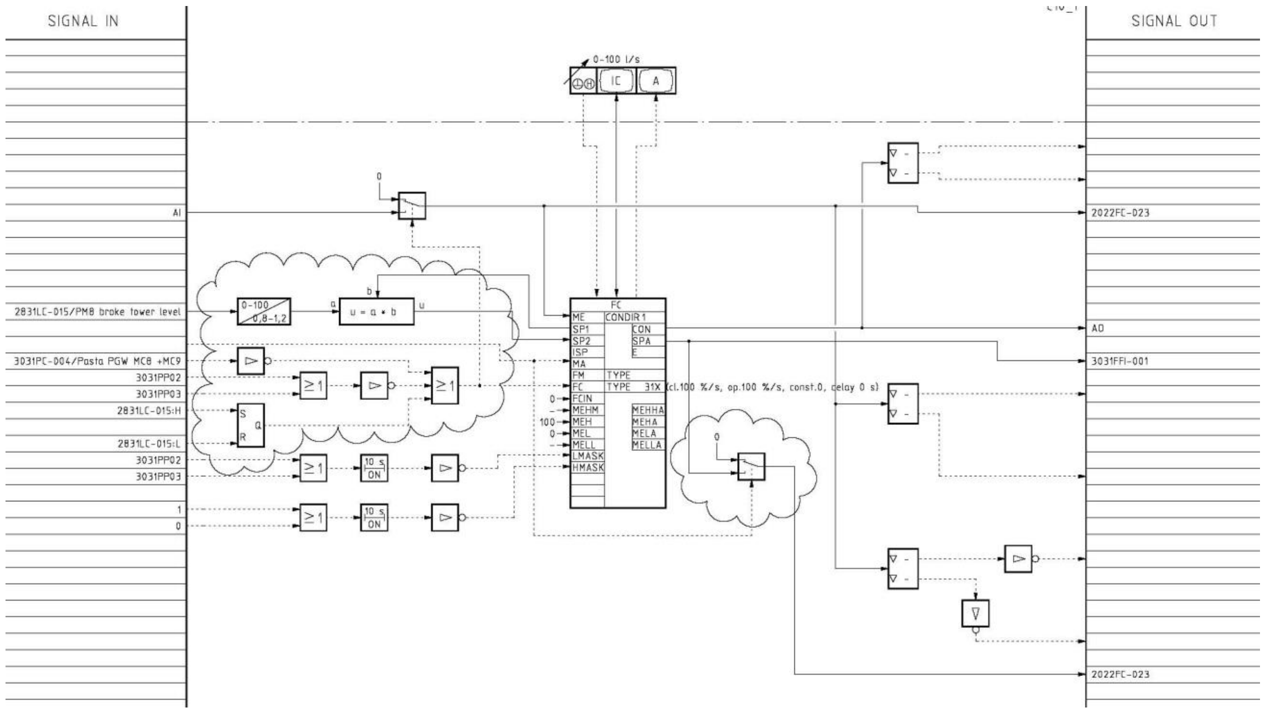
Segnali:

3031PP02 (POMPA TORRE PGW 1) spenta
AND
3031PP03 (POMPA TORRE PGW 2) spenta

ISTRUZIONI IN CASO DI ANOMALIA

TRACCIA DELLA DOCUMENTAZIONE

FUNCTIONAL DIAGRAM for Process Control Design



Safety of Automation

Engineering Instructions and Standards

- Implementation procedure for Safety Related Systems (SRS)

Risk Assessment

- Specification of automation in hazardous and classified areas
- Participation to hazard and risk analysis
- Hazard and risk analyse reports with safety integrity levels (SIL)
- Functional safety requirements

Safety System Design

- Safety Instrumented Systems (SIS)
- Documentation and participation in FAT, SAT and lifetime tests as related to safety system design
- Installation and commissioning planning
- Composing the operation and the maintenance instructions as related to safety system design

Permit Documents and Inspections

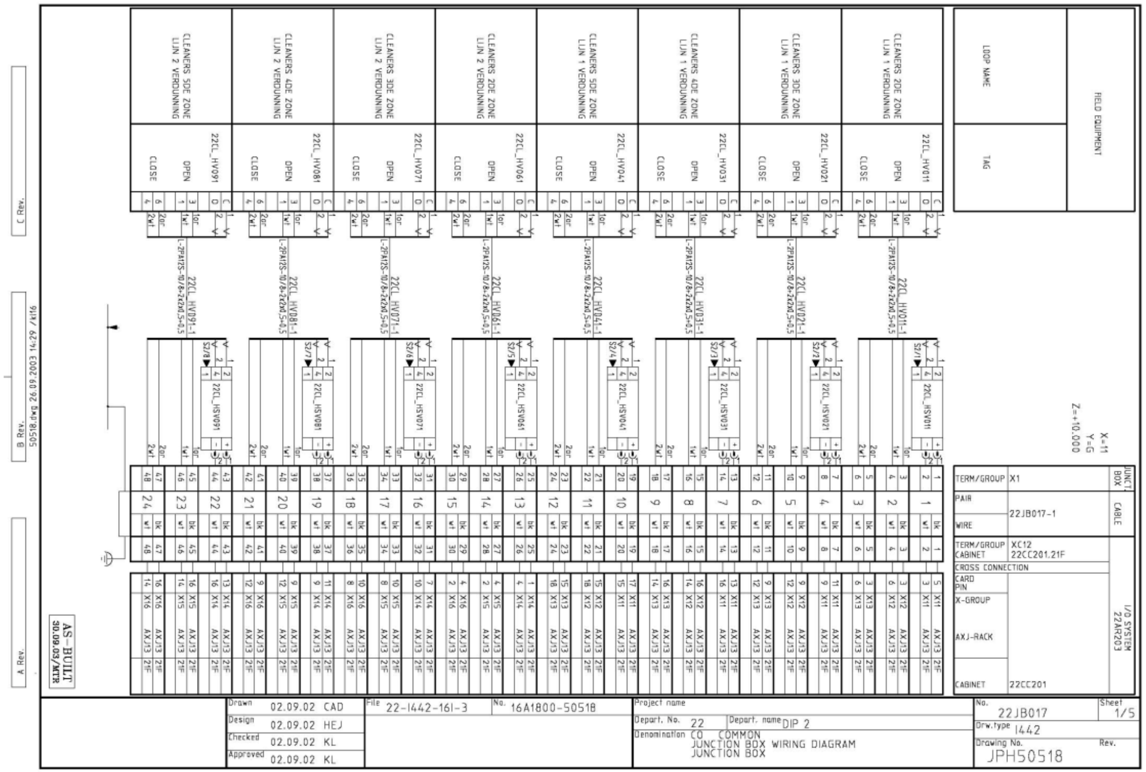
- Permit documents of safety related systems
- Permit documents of automation in hazardous and classified areas
- Permit documents of radioactive material in automation
- Compiling the required documents for verification
- Verification reports handling
- Participation in verification meetings with authorities

Process Control System Design (DCS)

General Process Control System Engineering

- Specification of DCS concept
- Panel, cabinet and rack layouts
- Wiring diagrams for panels, cabinets and racks
- Cross connection layouts
- Wiring diagrams for cross connection
- Allocation of applications in process stations (controllers)
- Allocation of I/O's and signals to the DCS
- Allocation of field bus segments

Cross connection layouts



Installation design

Installation Engineering

- Typical installation drawings and general instructions
- Field box and panel layouts
- Wiring diagrams of field equipment to field boxes and panels
- Wiring diagrams of field bus segments
- Control equipment and box lists
- Cable lists
- Name plate and marking lists
- Application list for installation

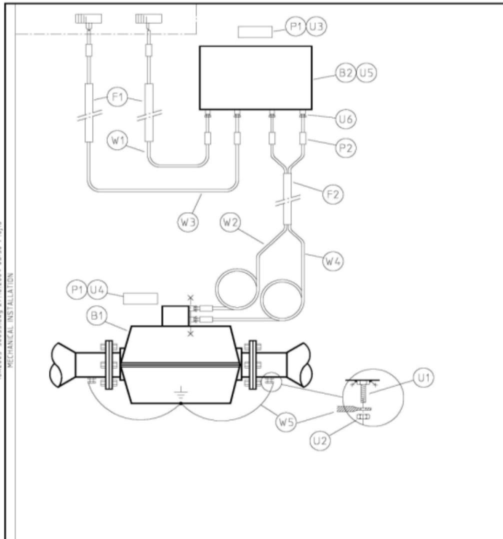
Location Design

- Location drawings for field instruments and boxes

Maintenance design

- Loop diagrams
- Collection of the operation and the maintenance instructions of instruments

Typical installation drawings and general instructions



NOTES:
- Conduit (F2) to be fixed after the insulation of process pipe.

SPECIFICATION

IC = INSTRUMENT CONTRACTOR
IS = INSTR./MACHINE SUPPLIER
MC = MECHANICAL CONTRACTOR
EC = ELECTRICAL CONTRACTOR
P = PURCHASED BY
I = INSTALLED BY
NC = NETWORK CONTRACTOR
B = BUYER

Item	Description	Quantity	Size / Material	Manufacturer Type/Remarks	P	I	Code	Rev.
B1	Magnetic flowmeter	1		According to specification	IS	MC	ITF Y BE01	
B2	Transmitter for magnetic flowmeter	1		According to specification	IS	IC	ITF Y BT01	
F1	Conduit	6 m	20x1.5mm / Mill stand.	Material by mill standard see IY.A.11	IC	IC	EIC Y X020	
F2	Conduit	3 m	30x2.0mm / Mill stand.	Material by mill standard see IY.A.11	IC	IC	EIC Y X030	
P1	Field instrument nameplate	2	Mill stand / Plastic	Type by mill standard 16A2003-L0011	IC	IC	IXM Y IX01	
P2	Cable nameplate	8	Mill stand / Plastic	Type by mill standard 16A2003-L0011	IC	IC	IXM Y IX02	
U1	Bolt, DIN 934	2	M6 / SS2343		MC	MC	MXF BS M6	
U2	Nut and washer, DIN 934	2	M6 / SS2343		B	IC	MXF NS M6	
U3	Name plate holder	1	Mill stand.	Acc. to IY.A.61 det. A1 see IY.A.11	IC	IC	IXM Y XS01	
U4	Name plate holder	1	Mill stand.		IC	IC	IXM Y XS02	
U5	Mounting support for amplifier	1	Mill stand.	Type by mill standard see IY.A.11	IC	IC	IA Y RX02	
U6	Cable gland supplied with instrument	6			IS	IS	IA AN Y	
U7	Clamps and marking accessories	1 set		See IY.A.01	IC	IC	IXM X 001	
U8	Fixing and supporting material	1 set		See IY.A.01	IC	IC	IXM X 002	
W1	Signal cable 2 pair	35 m		Type by mill standard 16A2003-L0018	B	IC	EWS Y S0205	
W2	Magnetic flowmeter signal cable with common shield and individually shielded cores	10 m		Endress+Hauser Included in instrument delivery. 4x0.38 mm2	IS	IC	EWS XX FMF01_C4	
W3	Power supply cable 3x1.5 mm2	35 m		Type by mill standard 16A2003-L0018	B	IC	EWC Y T0315	
W4	Power supply cable for magn flowtube	10 m		Type by mill standard 16A2003-L0018	B	IC	EWC Y M0210	
W5	Bare earthing cable	2 m		U 1x16	IC	IC	EWE C U_016	

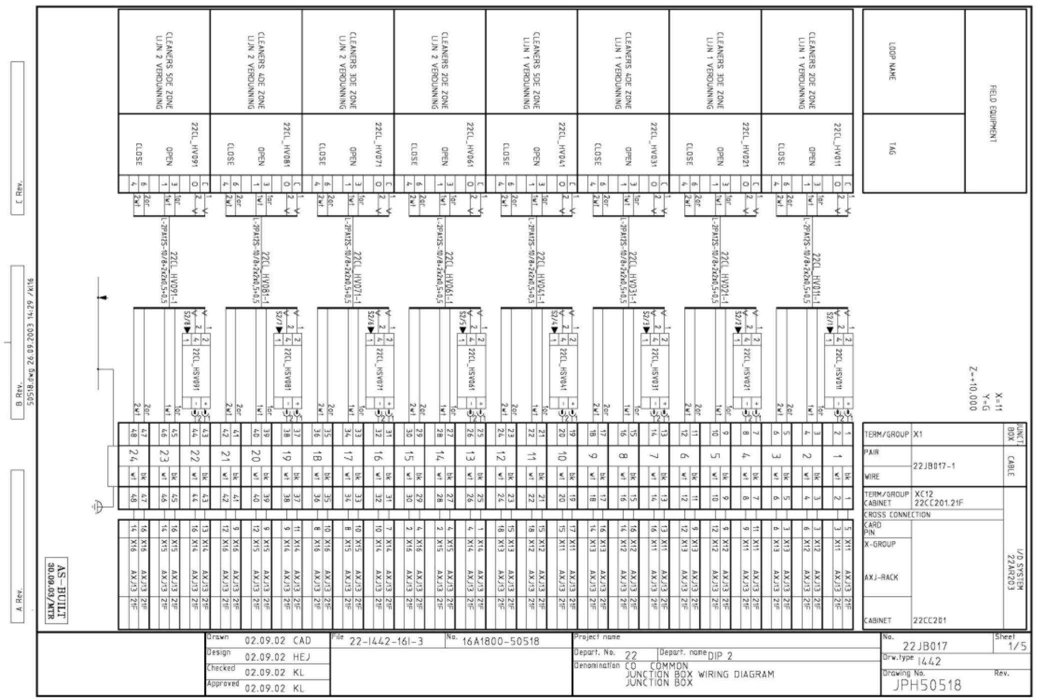
Drawn.	22.10.03	CAD	File 000-1424-161-3 / No. 16A2003-50033
Design.	22.10.03	KL	Project name
Checked	22.10.03	MHe	Depart.no. and name: 000 GENERAL
Approved	22.10.03	MHe	Denomination: Flow measurement with magnetic flowmeter — INSTALLATION DETAIL DRAWING

No. IY FTMF.015 — Sheet 1/1 — Drw.type 160 — Phase 3 — Drawing number JPH-50033 — Rev. A

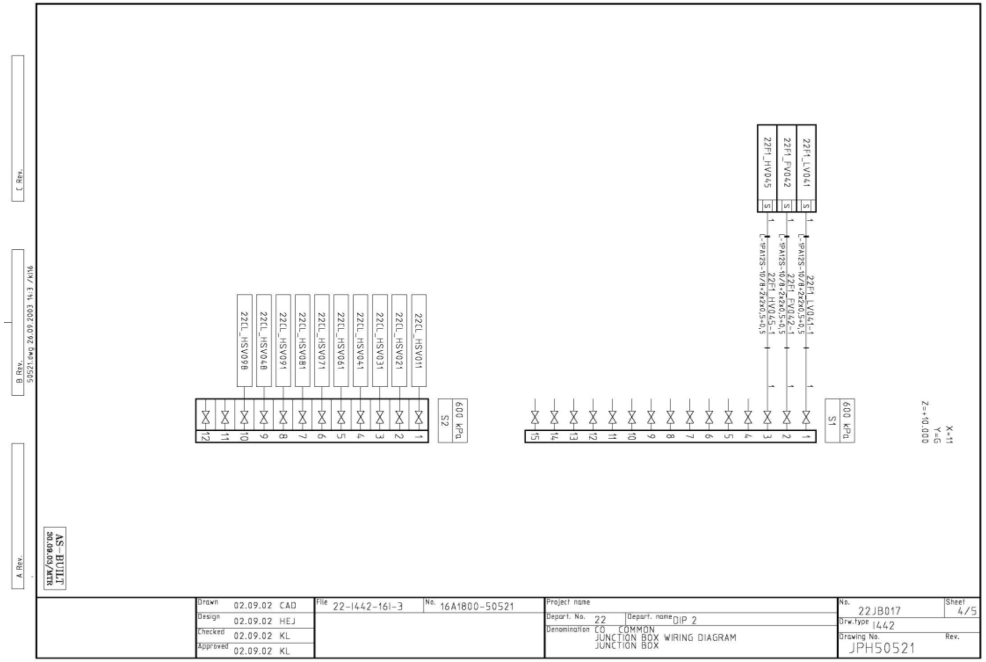
A Rev. 27.10.04 TOJ — B Rev. — C Rev. — 16A2003-50033.dwg 27.10.2004 08:30 /flo/16 — MECHANICAL INSTALLATION

Typical installation drawings and general instructions

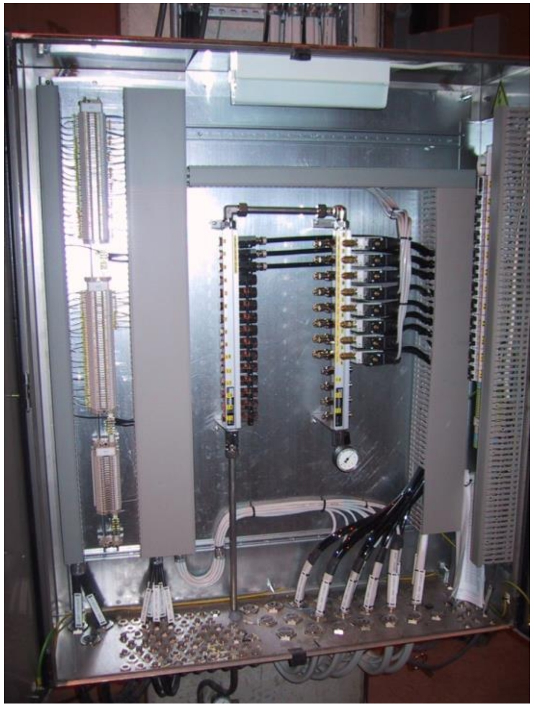
Wiring diagrams of field equipment to field boxes and panels



Wiring diagrams of field equipment to field boxes and panels

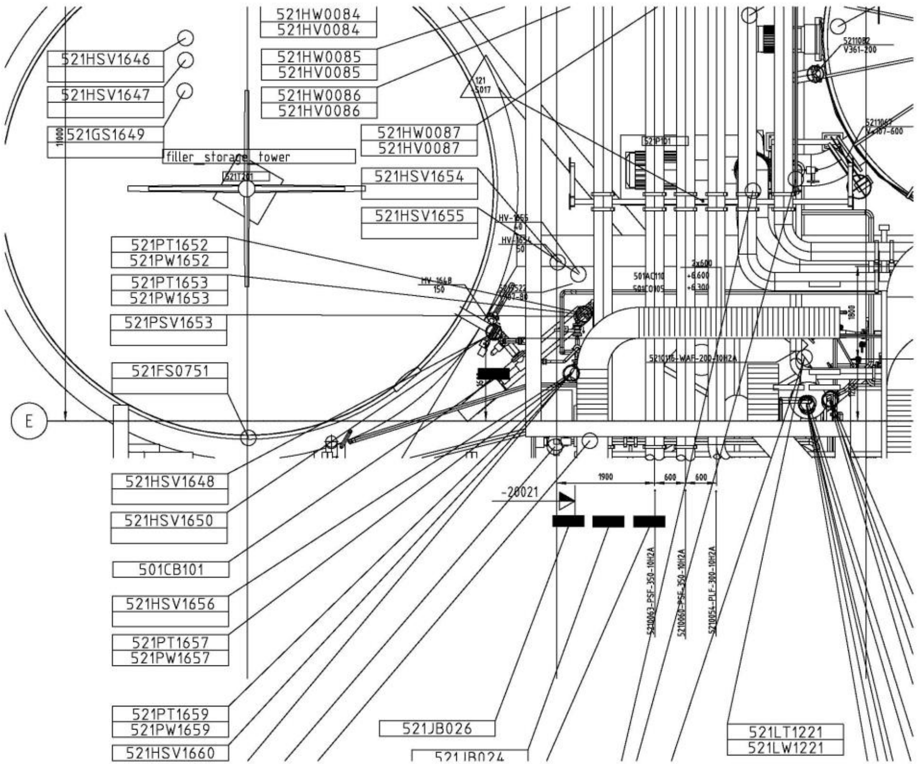


Wiring diagrams of field equipment to field boxes and panels

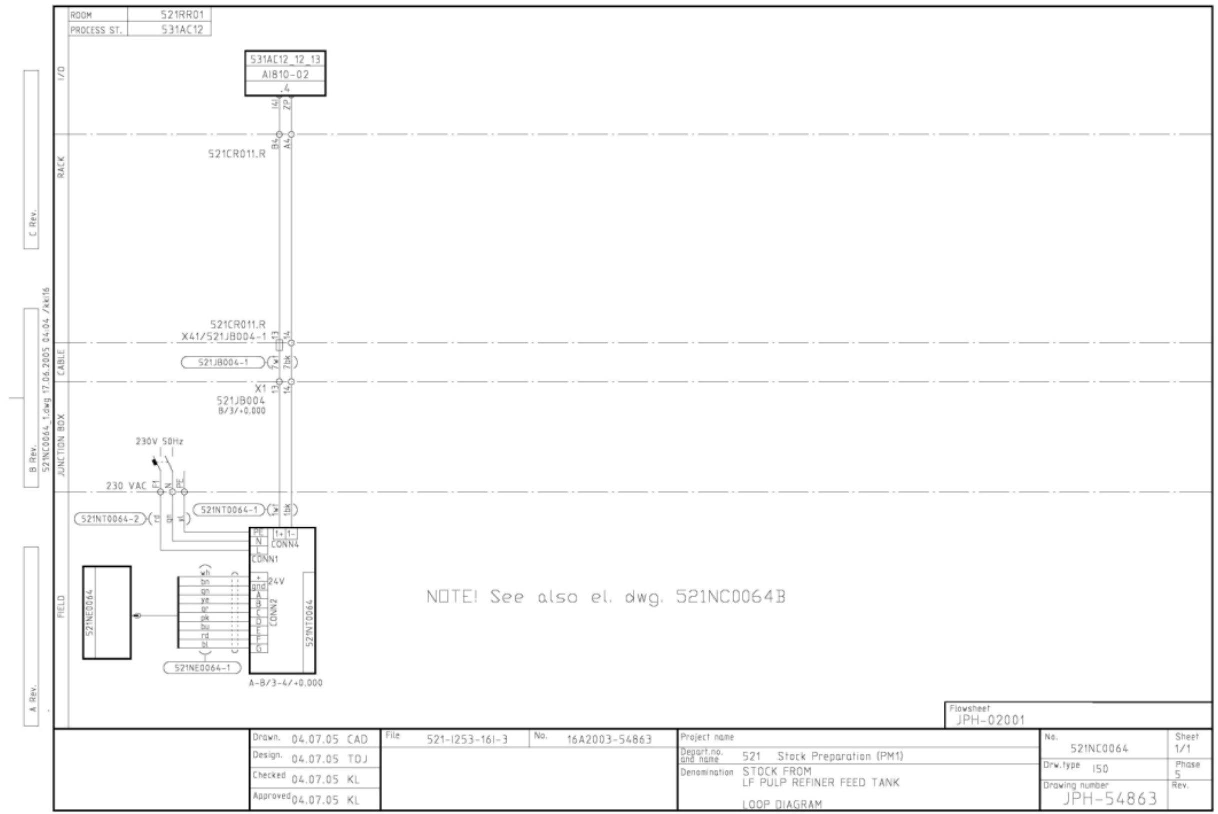


Allocations of instruments in process piping (3D-model)

Location drawings



Loop diagrams



Site Services

Aalto University
School of Chemical
Engineering

Site Services

FAT (Factory Acceptance Test) for DCS

- 4 ...12 weeks
- Application configuration checking in simulation situation
- Base parameters for control loops

Installation supervision

- 6 ... 12 month

Loop checks (SAT Site Acceptance Test)

- 6 ... 12 weeks
- Every signal will be tested (measurements, controls, binary signals

Test runs and commissioning

- 6 ... 12 weeks
- Tuning of the control loops

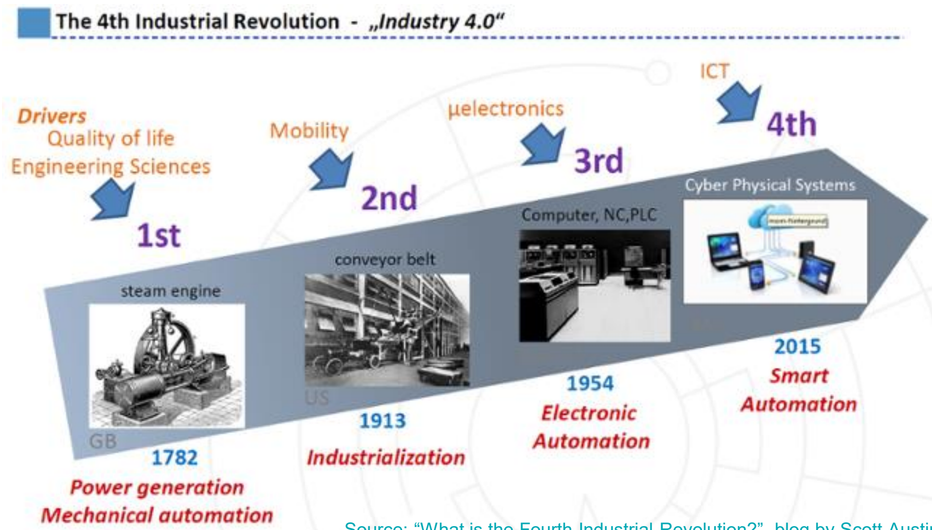
ICT Infrastructure, Data Networks and Physical Security engineering @ AFRY

Aalto University
School of Chemical
Engineering

Contents:

1. ICT & Security

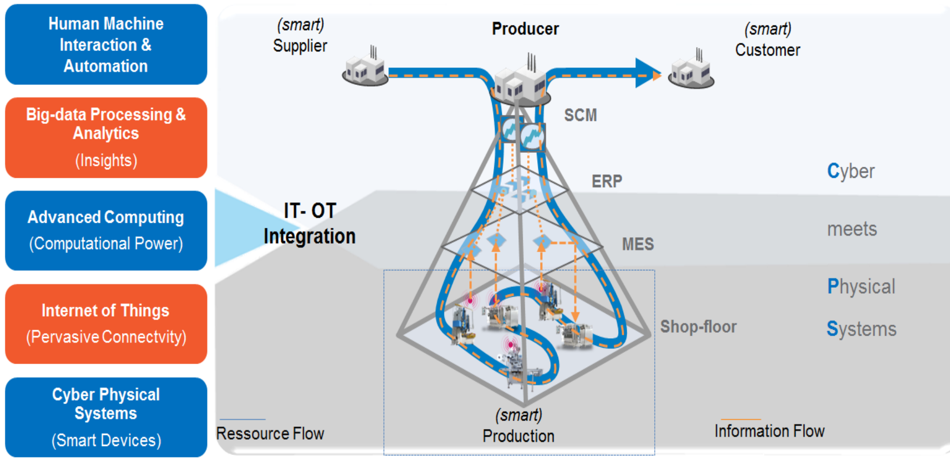
Pope election 2005 vs 2013



Source: "What is the Fourth Industrial Revolution?", blog by Scott Austin

- Amount of network connected devices has increased significantly (IoT, IIoT, others)
- Requirements for real-time data have increased significantly due to desire of digital business operations (digitalization, Industry 4.0…)

1. ICT & Security



Source: Infosys and Institute for Industrial Management (FIR) at RWTH Aachen

ISA 95 Functional Hierarchy of Activities

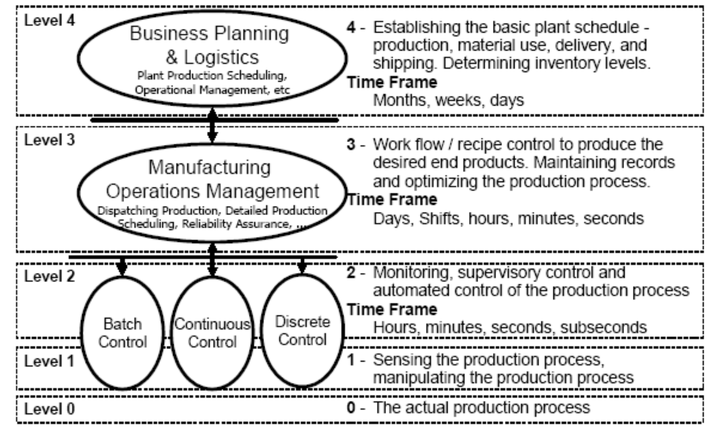


Figure 2 - Multi-level functional hierarchy of activities

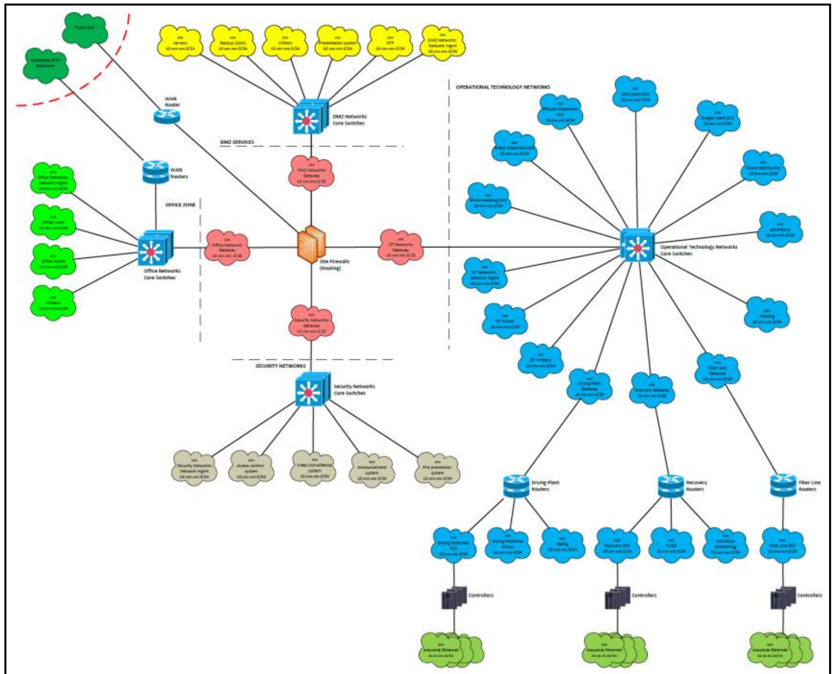
- Intelligence of systems in moving towards lower levels of activities
- Cyber Physical Systems

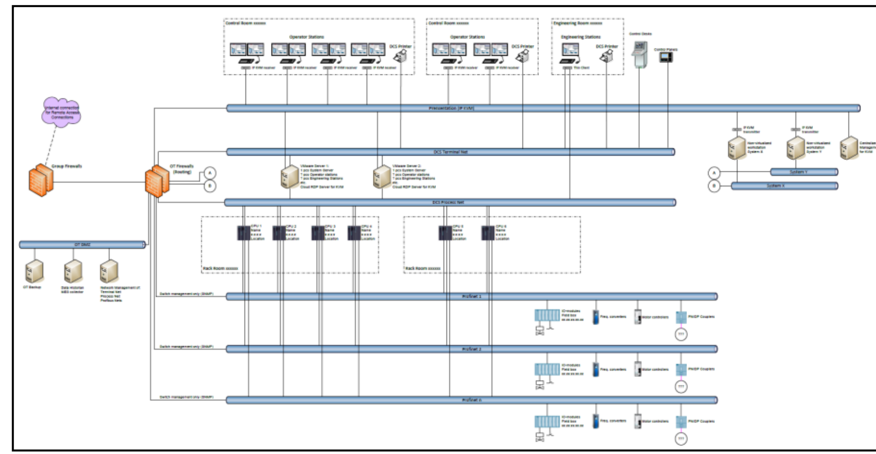
- No cyber security without physical security

2. Scope of pre-engineering project

- Principle diagrams:
  - *VLAN and sub-net diagram*
  - *Fiber optic trunk cabling diagram*
  - *Switch topology diagram*
- Standards & Instructions
  - *Operational Technology ICT*
  - *Sub-netting and addressing*
  - *Cyber Security*
  - *Cabinets, enclosures and rooms*
  - *Physical Security*
- ICT and Security concept
- ICT and Security cost estimate

2. Scope of pre-engineering project





3. Scope of detail engineering project

More instructions and design standards…

- *ICT Infrastructure and Data Networks Installation*
- *Wireless Local Area Network*
- *Cable Standard*
- *Numbering and Identification System for ICT Infrastructure and Data Networks*
- *Marking and Name Plate Standard for ICT Infrastructure and Data Networks*

Enquiry specifications, bid evaluations, participation in technical negotiations, purchase specifications

3. Scope of detail engineering project

Data network architecture and cyber security design for Operational Technology, Security systems and Office Data Networks

The networks shall be segmented as necessary to provide adequate services, redundancy and security to ordinary and mission critical communication and systems.

- *Data network system diagram for Operational technology systems*
- *Sub-network/VLAN diagrams*
- *Switch topology (connectivity) diagram*
- *Switch port VLAN allocation lists*
- *IP address allocation lists*
- *List of systems and equipment applications (software and firmware)*
- *List of systems and equipment communication dependencies and routing*
- *WLAN coverage simulation report*

3. Scope of detail engineering project

2.1. Coverage, Overlap and Performance
Data Rate for Floor 1

Data Rate is the highest possible speed (measured in megabits per second) at which the wireless devices will be transmitting data. Typically the true data throughput is about half of the data rate or less.

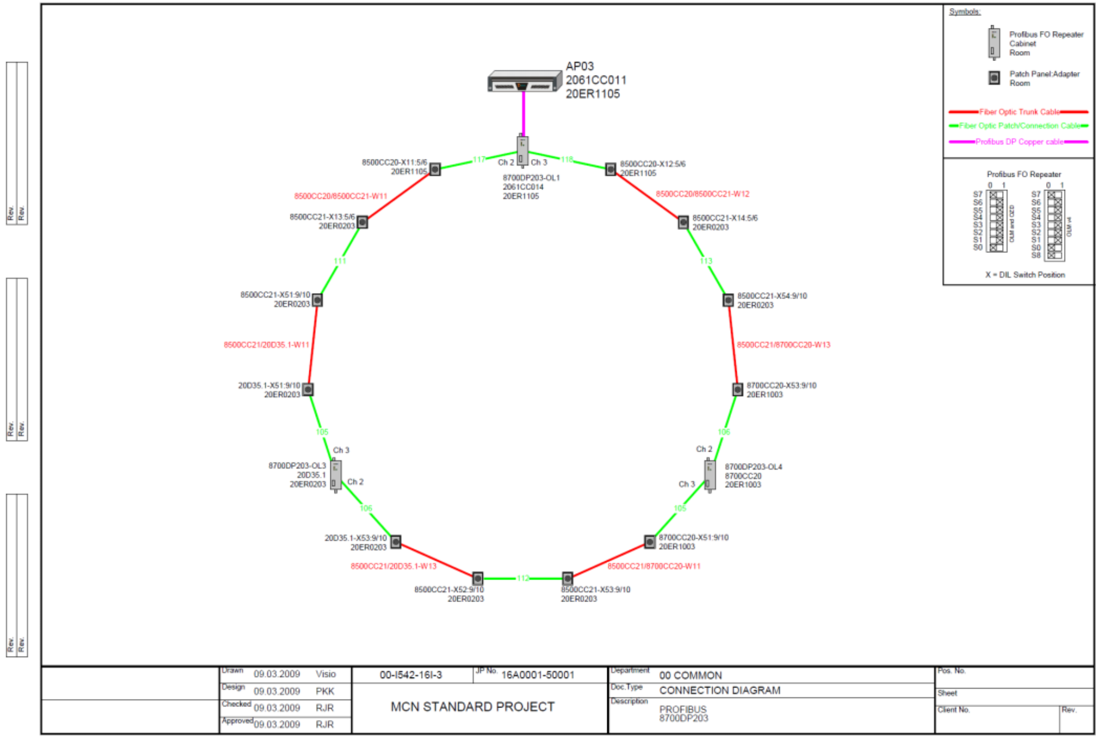
3. Scope of detail engineering project

Data network physical infrastructure design for Operational Technology, Security systems and Office Data Networks

The necessary cabling and wireless communication channels shall be designed and coordinated. Locations for the Network cabinets and field boxes shall be verified together with the engineering party responsible for 3D modelling. Requirements to electrification design and cable tray route design are specified to the engineering parties responsible for those systems.

- *Fibre optic backbone cabling diagram*
- *Cable lists*
- *Fibre allocation lists*
- *Connection diagrams (communication channels)*
- *Location drawings for network infrastructure objects (telecom outlets, network cabinets, WLAN access points, etc.)*
- *Layout drawings of network cabinets*
- *Typical installation drawings for network infrastructure objects*

3. Scope of detail engineering project



3. Scope of detail engineering project

Physical security design

Physical security design process takes into account structural security, multiple security sensor detection, communication and monitoring technologies based on Security risk assessment and intrusion analysis. Protective measures are coordinated with other engineering disciplines. Physical security solutions are designed to be compliant with national and international regulations, industry best practice and commensurated with the risk level and the specific activities and needs of the organization and site.

- *Video surveillance system*
- *Access Control system*
- *Electronic locking system*
- *Intrusion alarm system*

4. Site Services

Installation supervision

- 6 … 9 months

Commissioning & start-up services

- 6 … 12 weeks

Electrical engineering at AFRY

Aalto University
School of Chemical
Engineering

Contents:

1. Electrical engineering

Network Calculation Service

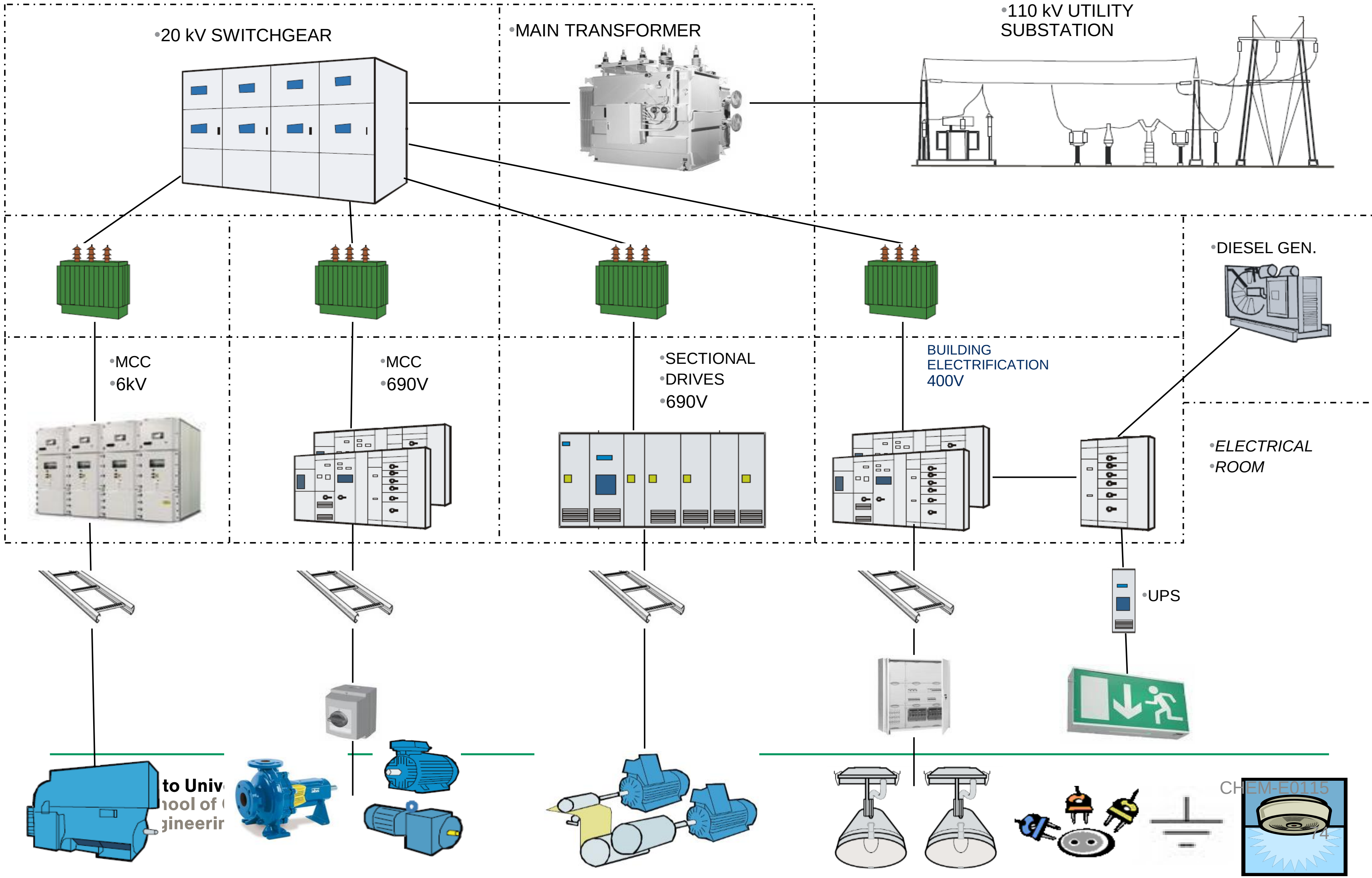
- Short circuit calculations
- Load flow and voltage profile study
- Protective device co-ordination study

Power Distribution Analysis

- Capacity and loading conditions
- Harmonic analysis
- Clear picture of current situation
- Road map for continuous development

2. Scope of Pre-engineering project

- Power distribution one line diagram
- Preliminary short circuit calculations
- Active and reactive power balance
- Brief description of electrical systems
- Specification of required electrical rooms and main cable routes for layout engineering
- Electrical cost estimate


20 kV SWITCHGEAR
MAIN TRANSFORMER
110 kV UTILITY SUBSTATION
DIESEL GEN.
MCC
6kV
MCC
690V
SECTIONAL
DRIVES
690V
BUILDING ELECTRIFICATION 400V
ELECTRICAL
ROOM
UPS

3. Scope of detail engineering project

Engineering instructions and design standards

- *Electrical design criteria*
- *Electrification instructions for machinery suppliers*
- *List of recommended electrical equipment and components*
- *Cable standard*
- *Marking and numbering instructions*
- *Starter and cable sizing table*

Enquiry specifications, bid evaluations, participation in technical negotiations, purchase specifications

3. Scope of detail engineering project

MOTOR Pn kW	MOTOR In A	MOTOR Is A	FUSE (IEC 269) A	FUSE Starting time s	FUSE Size	Fused load break switch	Contactor	Motor controller	Current trafo ratio	Current trafo turns	CABLE MCC-safety switch	max allowed length m	Module size
0..0,25	0,44	1,3	2aM	>50	00					3	NYY-J 4x2,5	934	
0,37	0,59	1,9	2aM	>50	00					3		934	
0,55	0,84	3,3	2aM	>50	00					2		934	
0,75	1,1	4,5	2aM	>50	00					1		934	
1,1	1,5	6	2aM	>50	00							934	
1,5	2,0	10	2aM	11	00							465	
2,2	2,7	14	4aM	>50	00							465	
3	3,7	20	4aM	8	00							308	
4	4,8	31	6aM	7	00							181	
5,5	6,6	42	10aM	50	00							181	
7,5	9	59	16aM	>50	00							107	
11	13	79	16aM	11	00						NYY-J 4x4	110	
15	17	107	25aM	35	00						NYY-J 4x6	131	
18,5	20	152	32aM	13	00						NYY-J 4x10	181	
22	24	180	40aM	23	00							141	
30	32	224	50aM	23	00						NYY-J 4x16	233	
37	38	266	50aM	6	1							139	
45	46	354	80aM	28	1						NYY-J 3x25+16	174	
55	56	375	80aM	16	1						NYY-J 3x50+25	237	
75	78	523	100aM	7	1							185	
90	93	632	125aM	8	1						NYY-J 3x70+35	202	
110	112	750	160aM	16	1						NYY-J 3x95+50	216	
132	134	925	200aM	19	1						NYY-J 3x120+70	240	
160	159	1113	250aM	23	2						NYY-J 3x150+70	188	
200	200	1400	315aM	28	3						NYY-J 3x240+120	290	
250	246	1599	315aM	8	3						NYY-J 3x240+120	290	
315	313	2128	400aM	6	3						2//NYY-J 3x150+70	296	
355	354	2301	500aM	19	3							228	
400	400	2600	500aM	7	3							228	
500	493	3205					Instantaneous settings 1)		4000 A		2//NYY-J 3x240+120	340	
630	614	4175					Instantaneous settings 1)		5000 A		3//NYY-J 3x185+95	330	

If motor current (In or Is), starting time or max allowed length of cable differ from table, dimensioning has to be checked.

Dimensioning allows to replace the motor by next larger rating up to 200 kW.

Max allowed cable length is for 5 s tripping time.
Voltage drop has to be checked separately.
1) Instantaneous overcurrent setting which is used for max. allowed cable length calculation (tolerance 20% included). Dimensioning has to be checked case by case.

PE.20-Part 4 Annex 101
SAMPLE DOCUMENT

Toim.	Toim	Pvm 26.8.2002	Model Project	Piir. nimi	Laitepaikka / Lehti 1/1 / Rev
		Piirt. JVH	Model Project Company	DIMENSIONING TABLE	Keskus / Sovellus EXCEL / Vaihe
		Suunn JVH		MOTOR STARTERS	
Rev.	Rev.	Tark OSS	Osasto n:o / Tekn. kohde n:o	690 V	Piirinumero Motmit690VL20.3 / Laji

3. Scope of detail engineering project

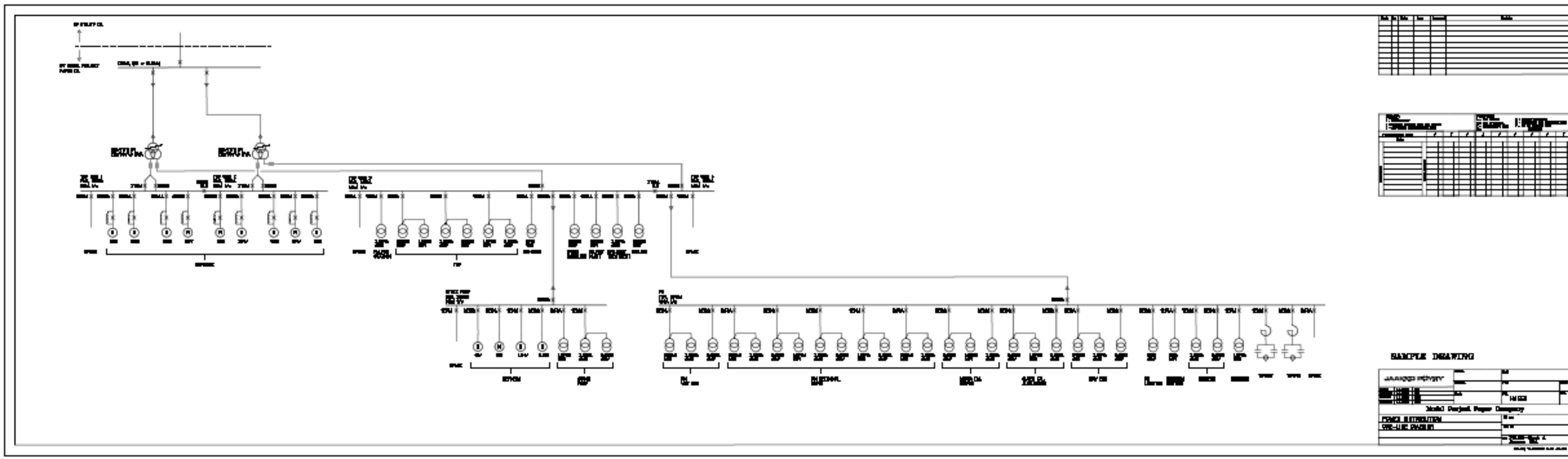
Power distribution

- Power demand calculations
- Active and reactive power balance
- One line diagram
- Short circuit calculations
- Switchgear and transformer specifications
- Protective device co-ordination study
- Distribution of control and auxiliary power
- Emergency power distribution system

Electrical rooms and main cable routes

- Electrical room and cable route requirements
- Electrical room layouts
- Specification of required electrical wall, floor and ceiling openings
- Electrical room cable tray arrangement drawings
- Electrical room HVAC requirements

3. Scope of detail engineering project

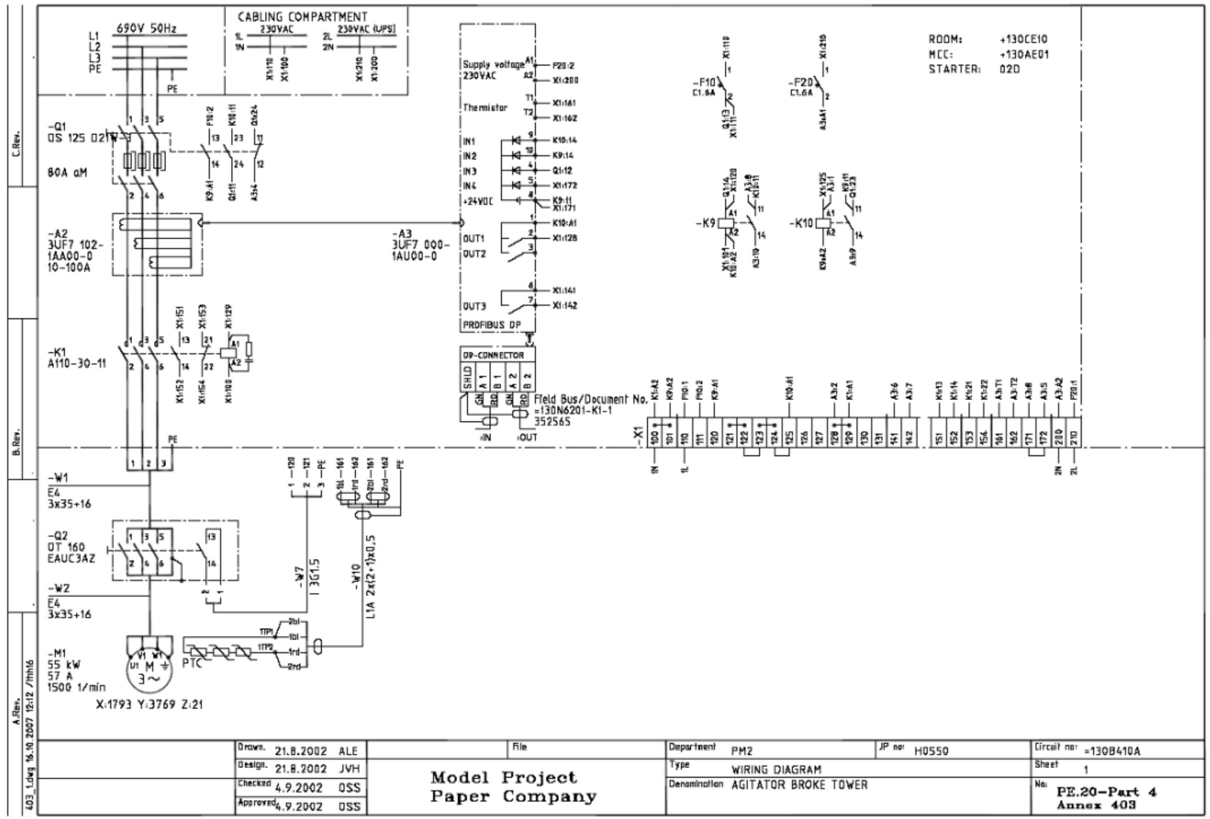


3. Scope of detail engineering project

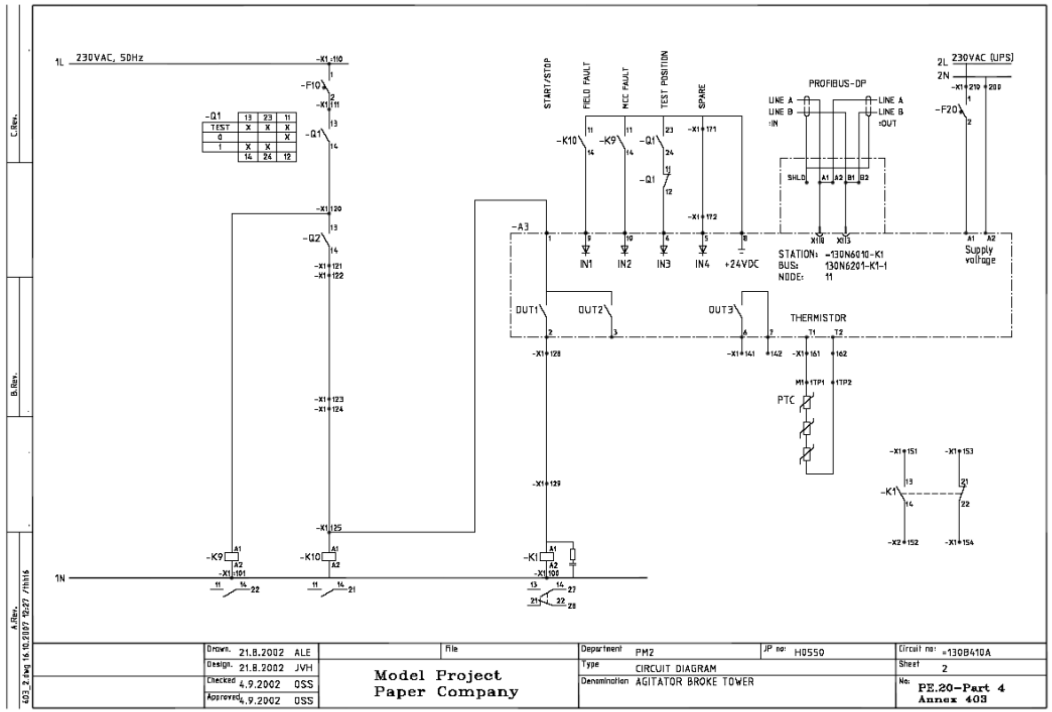
Engineering of process electrification

- Motors, motor control centers and variable speed drives
  - *Electrical application and circuit list*
  - *MCC and variable speed drive specifications*
  - *Motor delivery requisition list*
  - *Variable speed single drives specifications*
  - *MCC layouts*
  - *Starter wiring diagrams*
- Motor control design
  - *Allocation of motors and electrical I/O to control system*
  - *Circuit and wiring diagrams*

3. Scope of detail engineering project



3. Scope of detail engineering project



3. Scope of detail engineering project

Engineering of process electrification

- Installation design
  - *Electrical installation specification*
  - *Typical installation detail drawings*
  - *Electrical equipment location drawings*
  - *Cable tray installation drawings*
  - *MCC and panel lists*
  - *Field equipment lists*
  - *Cable lists*
  - *Control voltage panel specifications*
  - *Grounding layouts*
  - *Grounding connection drawings*

3. Scope of detail engineering project

3. Scope of detail engineering project

Engineering of building electrification

- Lighting design
  - *Lighting design criteria*
  - *Lighting calculations*
  - *Lighting layouts*
  - *Panel specifications*
  - *Lighting fixture specifications*
  - *Installation detail drawings*
  - *Safety and escape lighting*
  - *Lightning protection systems*
  - *Maintenance outlet location drawings*
  - *Installation specification*

3. Scope of detail engineering project

3. Scope of detail engineering project

Engineering of building electrification

- Fire alarm system
- Grounding electrode

Engineering of site

- Heat tracing system
- Temporary construction power
- Mill site lighting layout

3. Scope of detail engineering project

As-built drawings for:

- Application and circuit lists
- MCC specifications and layouts
- Electrical room layouts
- Circuit and wiring diagrams
- Grounding drawings

4. Field Services

- Fat tests (MCC, DCS, Power Distribution Control System)
- Installation supervision
- Commissioning and start-up
- Water run
- Baby sitting

5. Engineering tools

Drawings: AutoCad/Proelina

Lists: Proelina, Access

3D- Modelling: Cadmatic

Power distribution calculations: Neplan, Excel

Low voltage distribution calculations: Excel

Other documents: Microsoft Office
(Word,Excel, Access, Power Point)

6 Co-operation with other engineering parties

ELECTRICAL ENGINEERING IN OTHER AFRY OFFICES

- Most of the big projects are ”shared projects” ; One of the offices is responsible for the project and detail electrical engineering of process areas will be divided between offices in Finland or world wide

POWER DISTRIBUTION

- Utility power company
- Mill
- Process engineering

PROCESS

- Equipment/motor lists
- Motor control engineering

6 Co-operation with other engineering parties

Mechanical and piping engineering

- electrical room dimensions and location
- cable routes for hv power distribution
- fire compartments
- wall and floor openings for cable routes
- motor dimensioning drawings
- foundations for electrical equipment
- layouts for motor location drawings
- cable tray engineering
- location of lighting fixtures
- location of electrical equipment

6 Co-operation with other engineering parties

HVAC engineering

- electrical room heat loads
- ventilation engineering of electrical rooms

Automation engineering

- motor controls

Machine vendors

- motor/load list
- automation
- control voltage distribution

7 Summary

- Electrical engineering at AFRY includes design from utility substation until motor and other loads including also motor controls and data field bus engineering
- Electrical engineering utilizes effective engineering tools and works in close co-operation with other engineering parties
- AFRY electrical engineering services cover the whole project life cycle starting from pre-feasibility study and including necessary engineering, fat tests , installation supervision and testing at site. After the start-up AFRY can provide services for modification projects with local service concept.