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Pigging -
Mechanical Sequence Control implemented in a digital environment

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Originator: Stephan Sadowski

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Content

Stephan Sadowski

sofis	Head of Business Development
sofis	Regional Sales Manager Europe
NETHERLOCKS safety systems	Branch Manager Germany
GSI SYSTEME	Branch Manager Germany
GSI SYSTEME	Project Manager

Our purpose

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“We protect people, property & planet with our expertise & solutions that guarantee safe & efficient valve operations ”

No injuries. No accidents. No spills. No loss. No downtime.

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Sofis, a Halma company

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Halma: global group of life-saving technology companies.

Founded:	1894
Nr of employees:	7,000
Nr of companies:	45 companies
Net income:	244.2 million GBP (2022)
Listed:	London Stock Exchange (FTSE 100).

Sofis, a Halma company

With our expertise, global service team & partner network, we provide full support & site services.

sofis

2016 MERGED IN	30 YEARS OF EXPERIENCE	7 WORLDWIDE OFFICES
350000 TOTAL NUMBER OF INTERLOCKS INSTALLED	1985 MARKET LEADERS SINCE	100 NUMBER OF EMPLOYEES

Europe	Alphen a/d Rijn, The Netherlands
	Maldon, Essex, United Kingdom
	Stockstadt, Germany
Middle East & Asia	Vadodara, India
	Mumbai, India
Americas	Houston, Texas, USA

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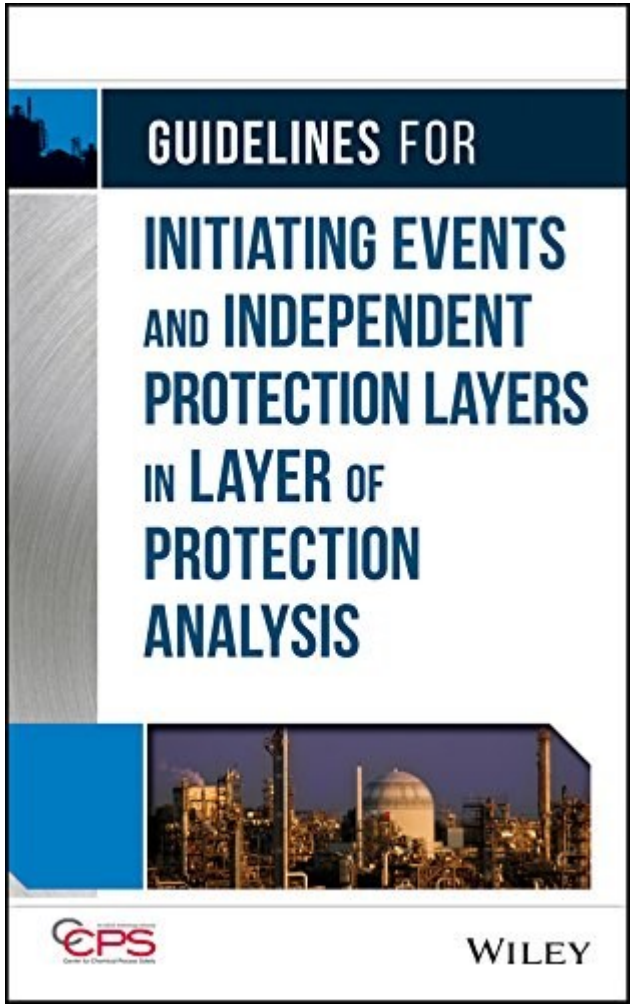
Captive Key System

The Captive Key System is described as follows:

A captive key/lock system employs mechanical linkages that are released by unique keys to prevent movement of a device (such as door handle or valve). This prevent humans from operating the valves in the wrong sequence. The captive key lock capability is an integral part of the hardware design and is not able to be removed or defeated by tools readily available to the worker.

Generic PFD suggested for use in LOPA: 0,01



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Captive Key

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Key Facts

- Fully mechanical
- Operator guiding by unique coded keys
- No misinterpretation of steps
- Safe handling of complex processes
- Easy implementation at brown fields
- Involvement of all kind of equipment
- No additional infrastructure required

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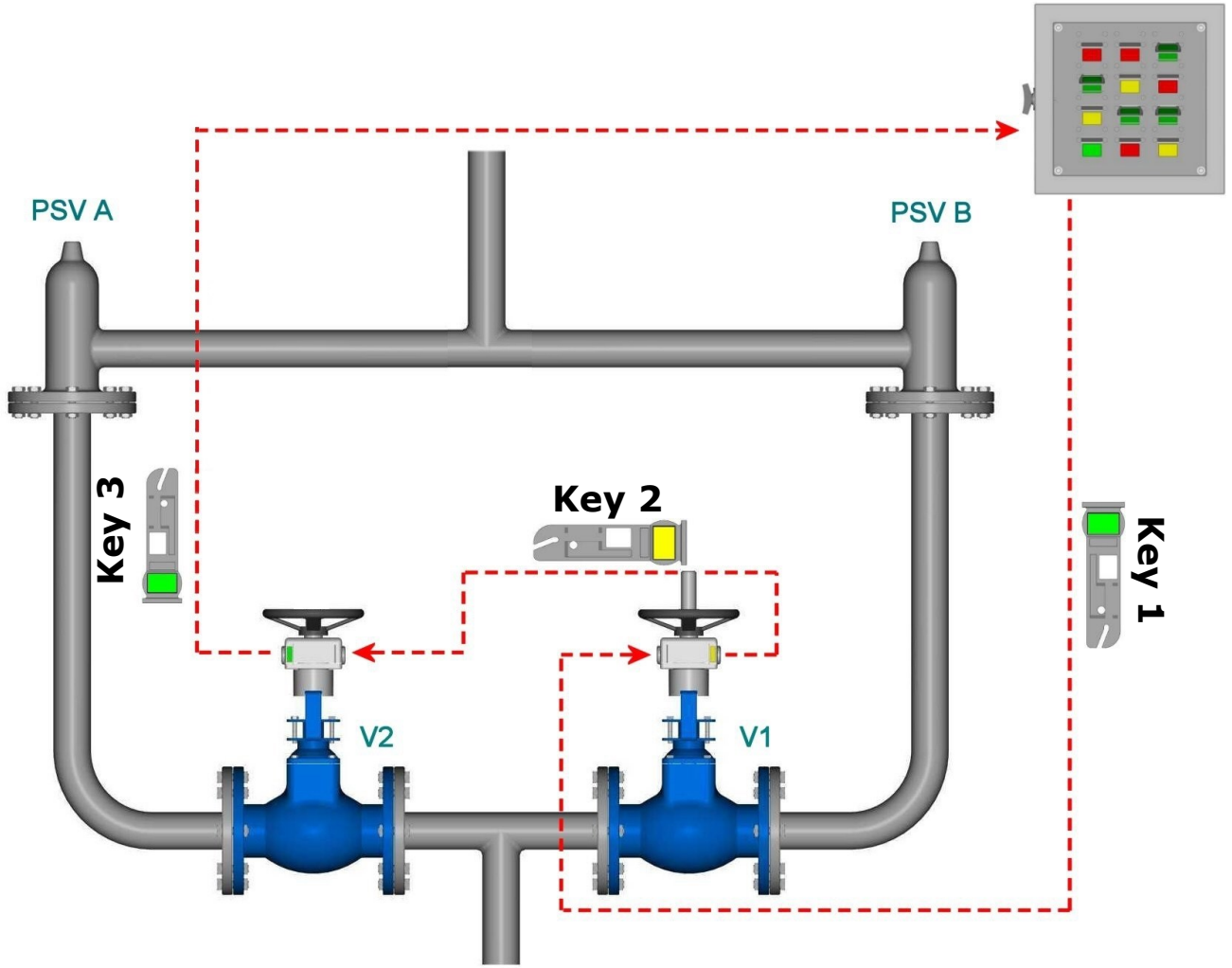
Captive Key



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Captive Key Examples

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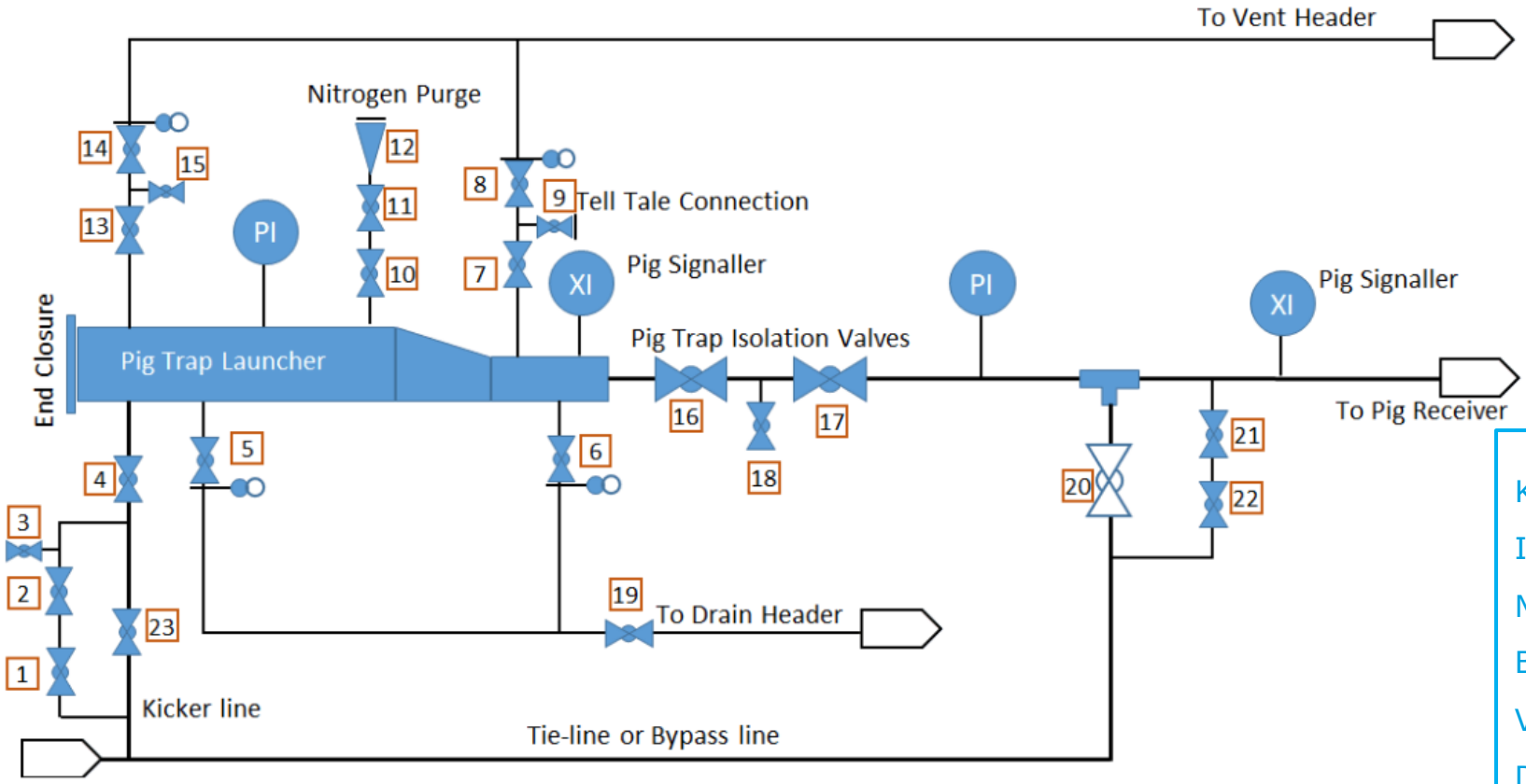
Captive Key used for Pipeline Pigging



Kicker Line Valve 4, 23

Isolation Valve 16, 17

Main Line / Bypass Line Valve 20

Balance Valve 1, 2, 21, 22

Vent Valve 7, 8, 13, 14

Drain Valve 3, 5, 6, 9, 15, 18, 19

Nitrogen Purge Valve 10, 11

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Captive Key used for Pipeline Pigging

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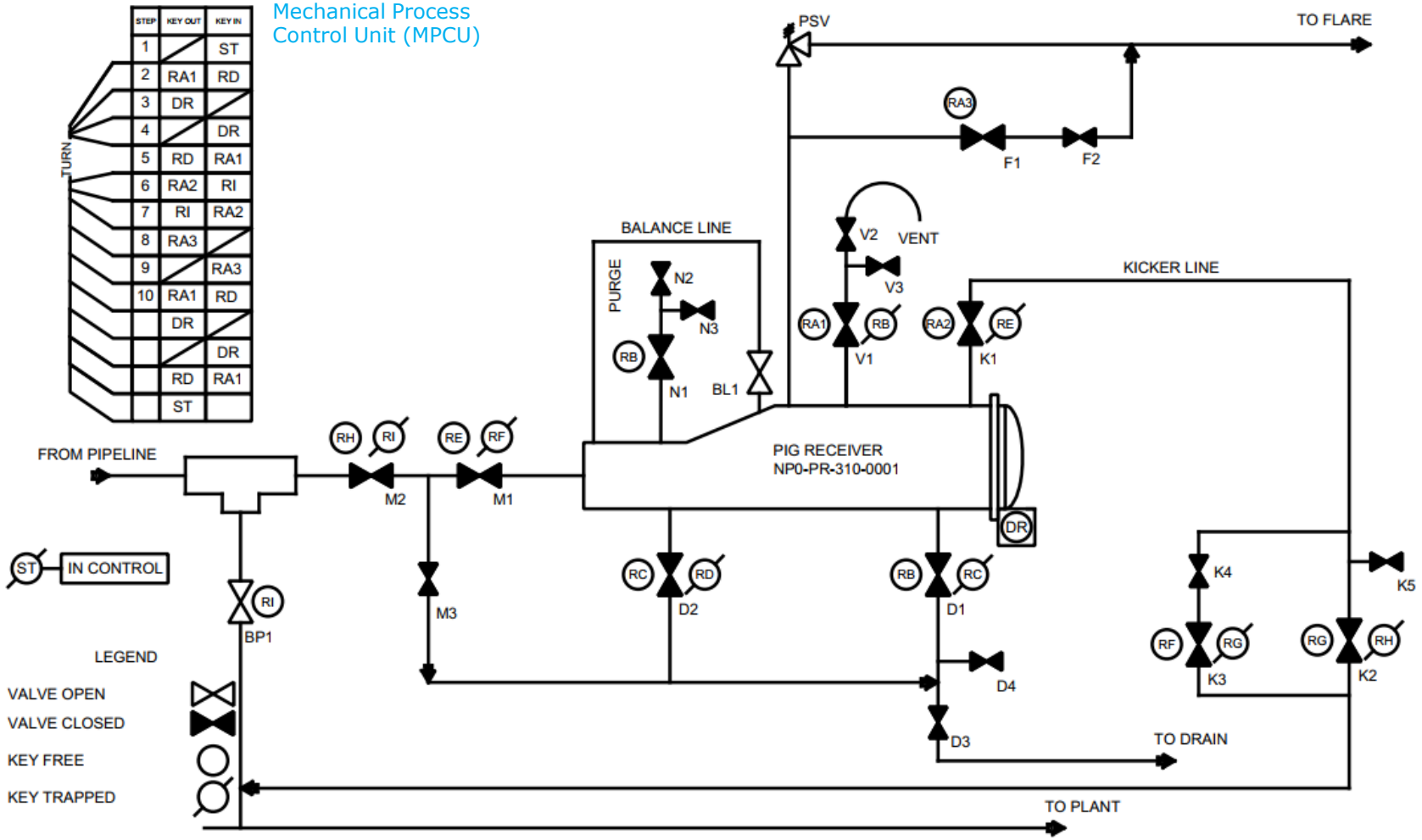
Mechanical Process Control Unit (MPCU)



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Pigging Incident

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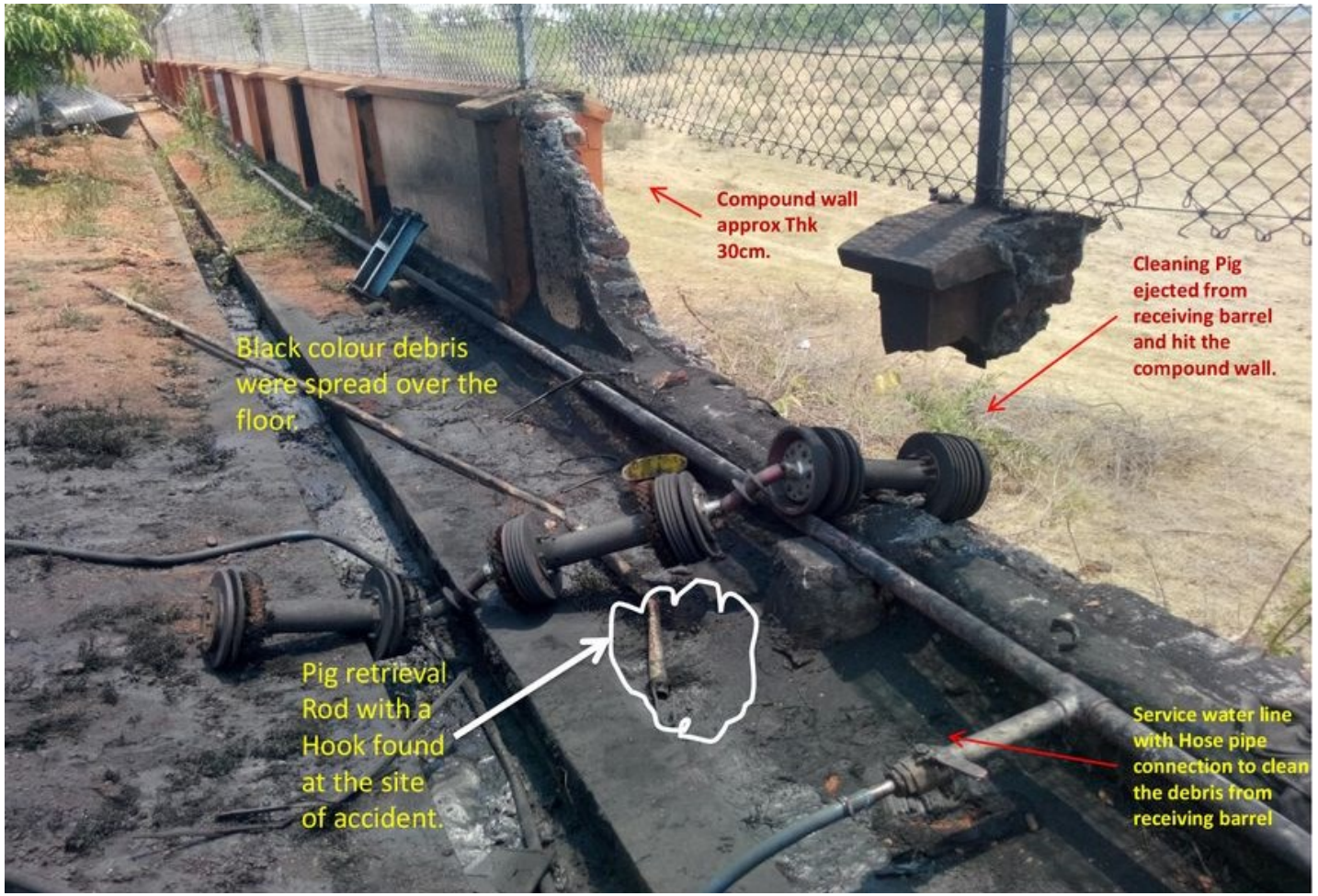
Pigging Incident



Pig Blew out of the Pig Receiver and hit the compound wall (about 9 meters from the Pig Receiver.

Picture from the Petroleum & Explosives Safety Organisation (PESO) Report about the LPG Pipeline Pigging accident.

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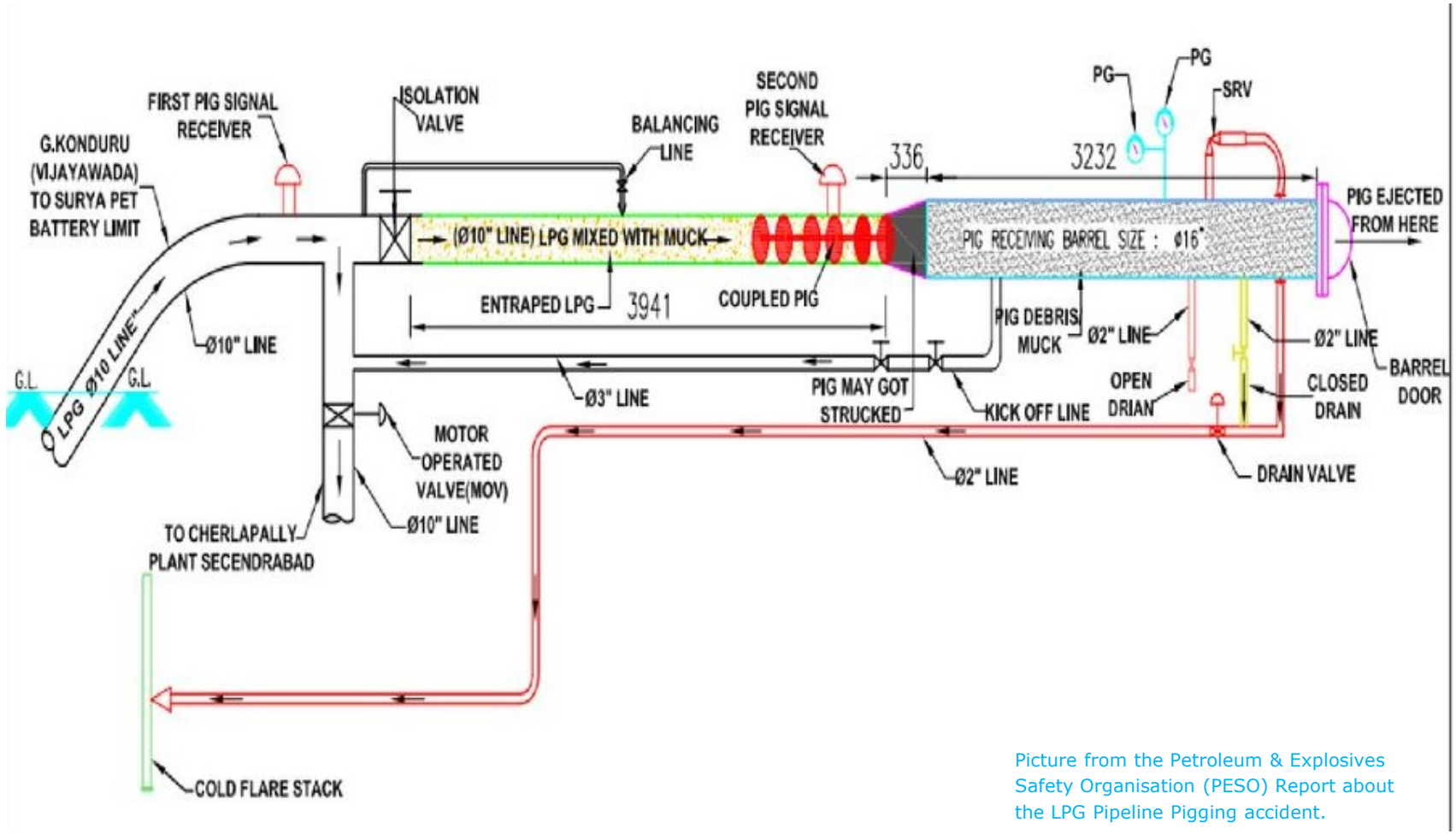
Pigging Incident



Picture from the Petroleum & Explosives Safety Organisation (PESO) Report about the LPG Pipeline Pigging accident.

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Digital Transition

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Example Nord Stream Pipeline

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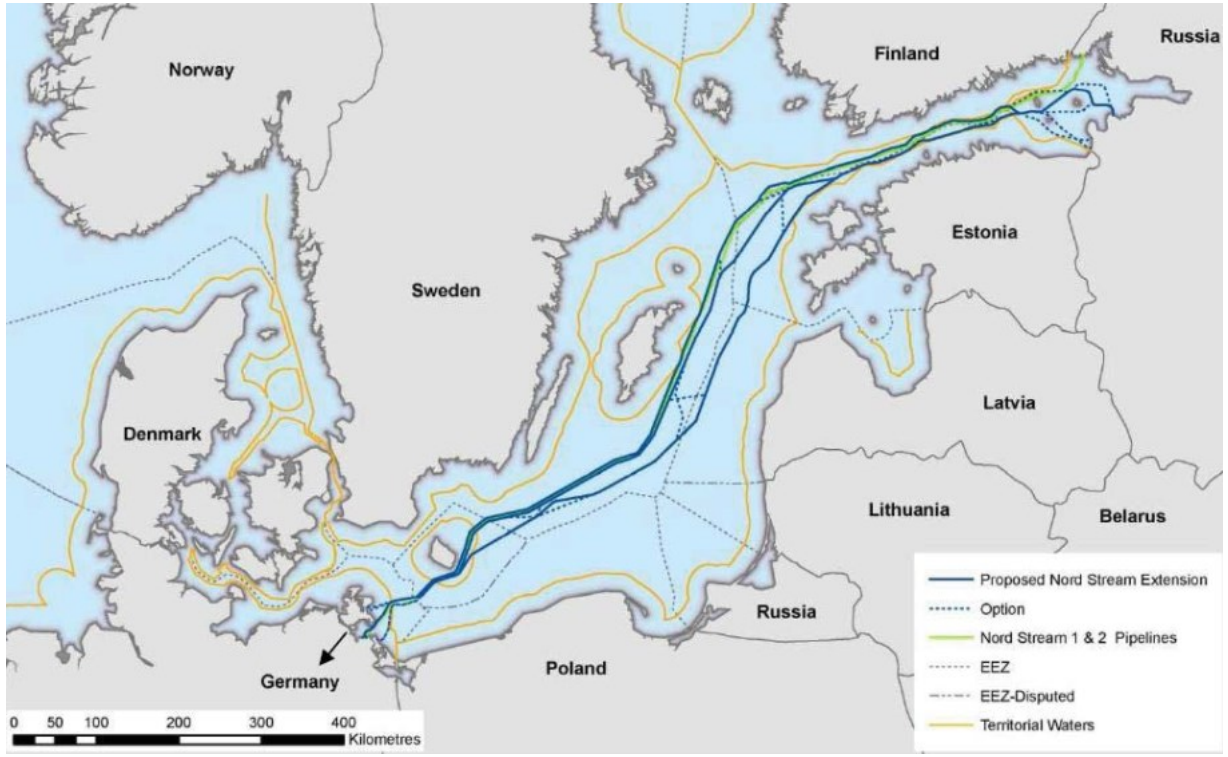
Key facts

- Two 48” subsea pipelines
- Over 1200 km length
- Design Pressure

Segment 1	220 barg
Segment 2	200 barg
Segment 3	177 barg

- Minimum outlet pressure 102 barg
- Design temperature -38 °C up to +60 °C



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Example Nord Stream Pipeline

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Pipeline Facilities

- PIG Trap Area Russia (PTAR)
- PIG Trap Area Germany (PTAG)
- Main Control Centre (MCC) in Zug / Switzerland
- Back-Up Control Centre (BUCC) in Zug / Switzerland
- Compressor Station and Gas Receiving Station are outside of Nord Stream 2 battery limits and operated by third parties.

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General Captive Key concept Requirements

- Pigging only at one pipeline at the time
- Pig launching and receiving for each Pig trap
- Involvement of hand and Motor Operated Valves
- Only one MOV operation at the time
- Status Indication of involved equipment
- Key Management system for Start-, Group- and Master Keys
- Interaction with the Pipeline Control System (PCS)
- Installed next to pig trap (Ex Zone 1)

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Involved Equipment

- Pressure Transmitter (Kicker Line, Pig Trap)
- Pig Signalers 1 and 2
- Pig Trap Door
- MOV´s (Isolation Valve A+B, Kicker Line, Main Line)
- Hand operated valves (Vent Valve´s, Kicker Bypass Valve, Balance Line Valve´s, Sampling System)

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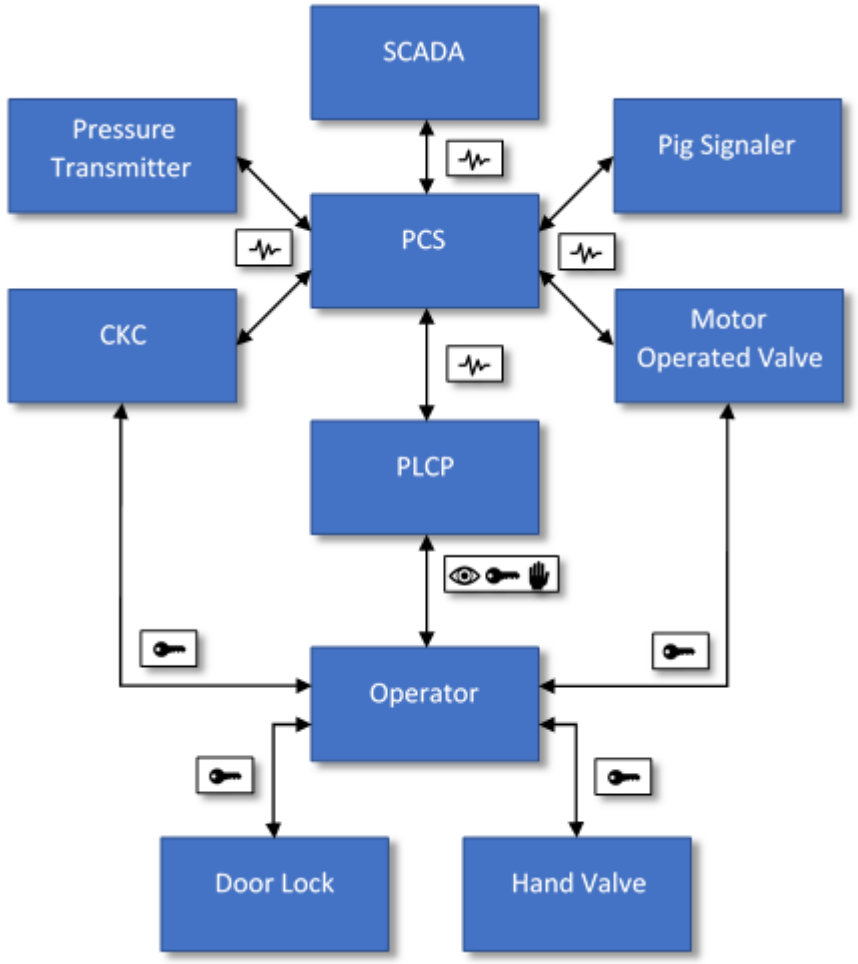
System Architecture

PLCP is the interface between:

- Operator
- PCS
- Hand operated valves
- Motor operated Valves
- Door lock
- Electrical Key Cabinet (CKC)
- Instrumentation devices

The PLCP guide the operator through the pigging operation procedure.

The PLCP (or EPCU) is the electrical comparison of a MPCU



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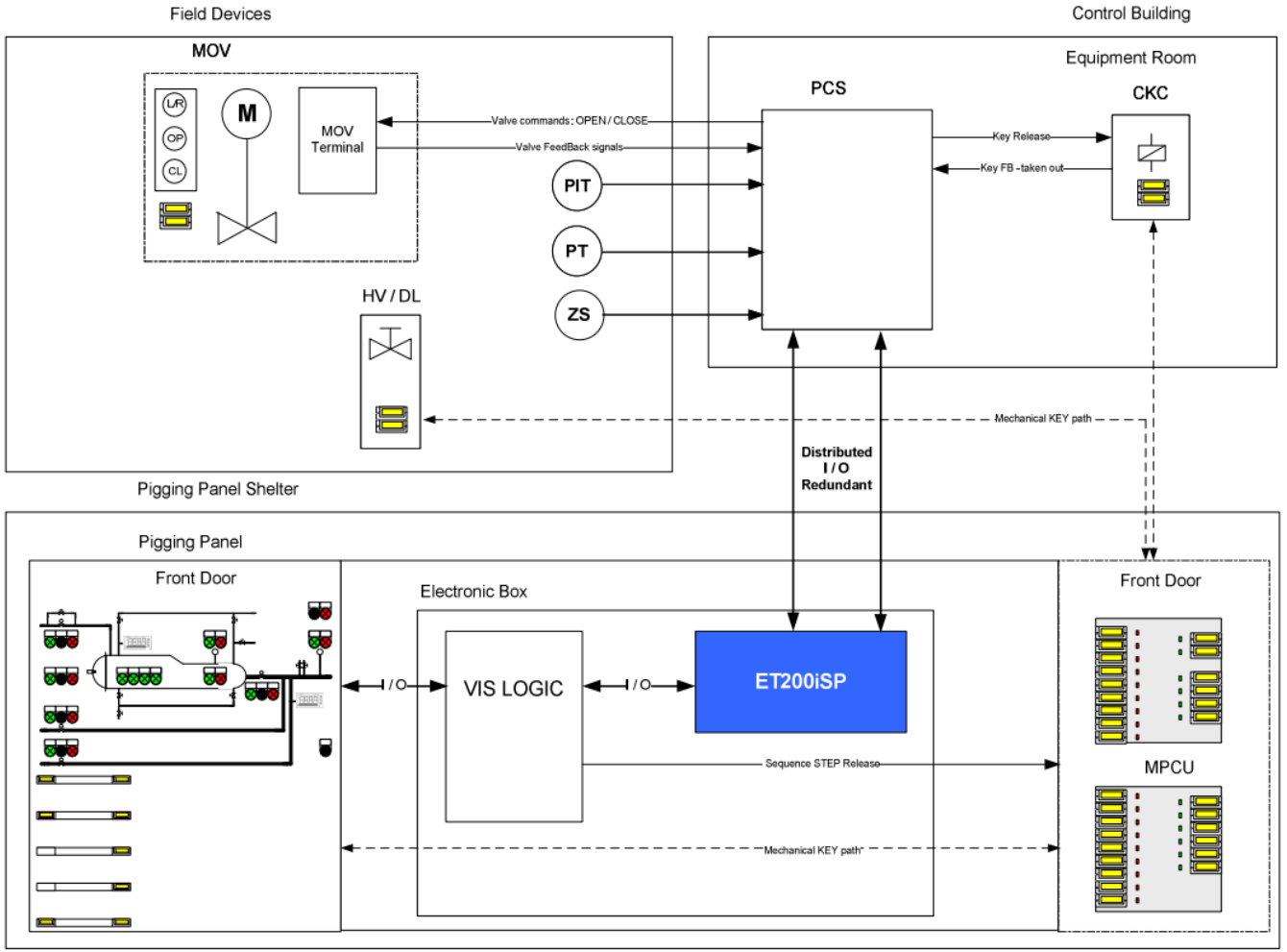
High Level Overview

The command for releasing the keys (start key, group key and master key) is initiated by the SCADA operator in MCC/BUCC



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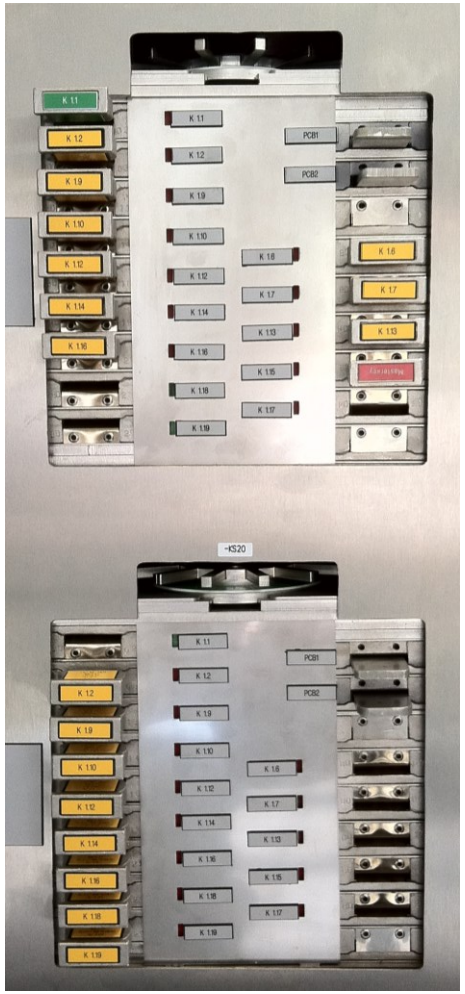
EPCU versa MPCU

- Easy change of the sequence of operation
- One EPCU can be used for launching and receiving
- Sequence variations based on additional information
- Dedicated Status information

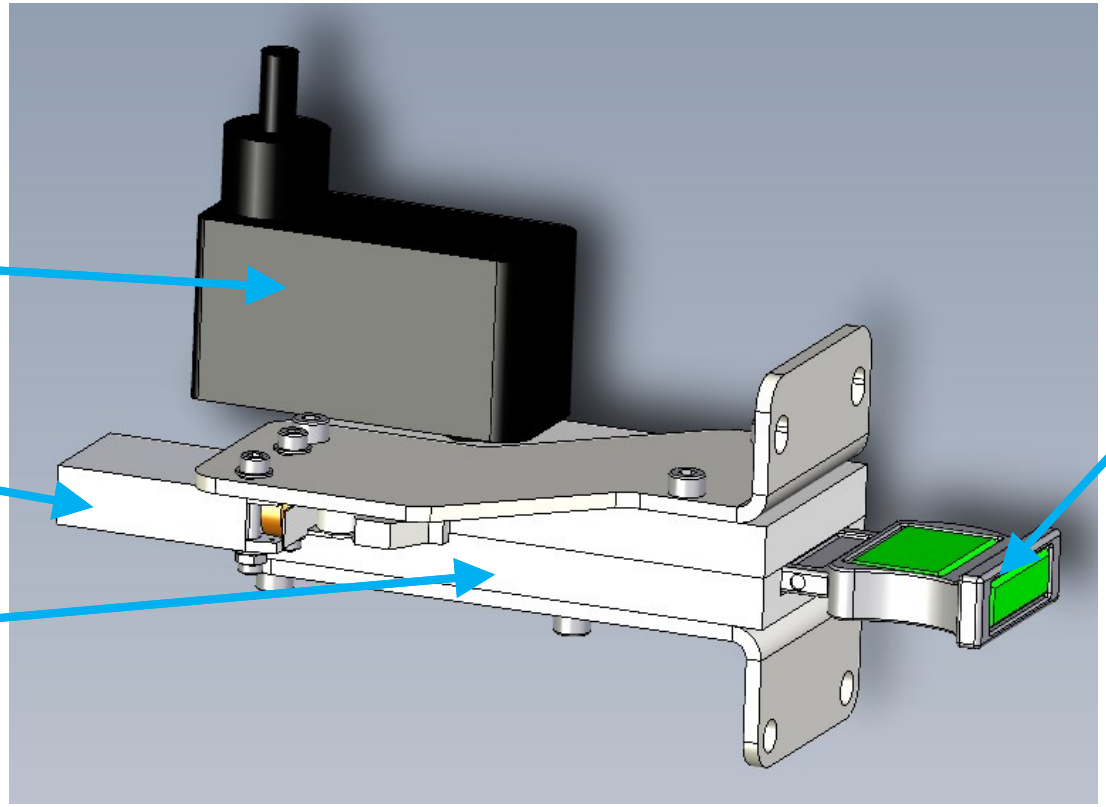


Key Position of an EPCU

Solenoid to trap and release the Key

Limit Switch to indicate the present or absent of the Key

Unique coded Key Position



System Key

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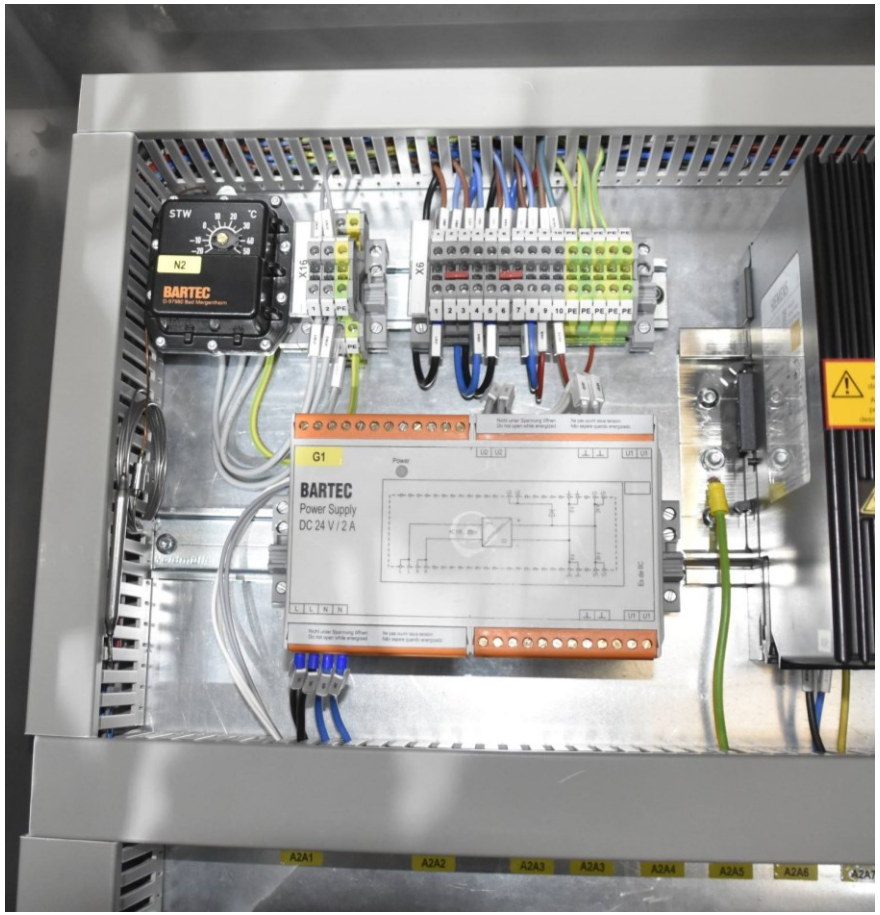

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Thank you for your audience.

Are there any kind of questions?

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