Instrument and control revamping of the old petrochemical plants

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Topics

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- 3. Detailed Technical Survey (DTS) of Existing Plant
- 4. Cost Analysis (Technical and Economic Studies)
- 5. Conceptual Design
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- 8. Purchase Specification, Procurement & Technical Evaluation
- 9. Installation
- 10. Inspection and Test
- 11. Pre- Commissioning and Commissioning

Introduction

- Trip systems work on energize-to-trip philosophy, which is unsafe
- Non availability of spares for pneumatic instruments
- Inaccuracy and slowness of pneumatic transmitters and controllers
- Tedious and difficult to maintain old controllers and recorder inking system
- Wiring becomes too complicated to troubleshoot due to inter looping and changes
- Sequence of operation is mechanical and difficult to maintain
- Management information system is totally missing due to old technology
- Concerns about obsolete equipment.

Advantages and Disadvantages of Foundation Fieldbus Control system practically

- **Device Interoperability**

  With interoperability, one fieldbus device can be replaced by a similar device with added functionality from a different supplier on the same fieldbus network while maintaining specified operations. This permits users to "mix and match" field devices and host systems from various suppliers. Individual fieldbus devices can also transmit and receive multivariable information, and communicate directly with each other over a common fieldbus, allowing new devices to be added to the fieldbus without disrupting active control.

- **Interoperability – no problem with ITK!**

  • **Problems do exist – DD rev issues, noise attenuation, specification compliance, parameter default settings**

Advantages and Disadvantages of Foundation Fieldbus Control system practically

- **Expanded View of the Process**

  Modern fieldbus devices, with powerful, microprocessor-based communications capabilities, permit process errors to be recognized faster, and with greater certainty. As a result, plant operators are notified of abnormal conditions or the need for preventive maintenance, and can make better production decisions. Problems that detract from operating efficiency are more quickly corrected, enabling yields to go up while raw material costs and regulatory problems decrease.

- **Diagnostics a big help in commissioning**
  - **Actual valve position very useful**
  - **Generally not used during commissioning**

- **Not everybody "thinks" FF yet**
  - **Commissioning is more difficult**
  - **Service is more difficult**
  - **More difficult to discuss FF with the customer**

Advantages and Disadvantages of Foundation Fieldbus Control system practically

- **Reduced Wiring and Maintenance Costs**

  FOUNDATION Fieldbus' use of existing wiring and multi-drop connections provides significant savings in network installation costs. This includes reductions in intrinsic safety barrier termination and cable costs, particularly in areas where wiring is already in place.

  Additional cost savings can be achieved through the decreased time required for construction and start-up, as well as simplified programming of control and logic functions using software control blocks built into fieldbus devices.

- **Huge wiring savings**
  - **May be offset by device costs**

- **16 to 32 Devices per segment**
  - **5 – 8 is more practical due to segment design constraints**

Advantages and Disadvantages of Foundation Fieldbus Control system practically

- **Improved Plant Safety**

  Fieldbus technology will help manufacturing plants keep up with increasingly stringent safety requirements. By providing operators with earlier notification and warning of pending and current hazardous conditions, fieldbus allows for corrective action before an unplanned shutdown. Enhanced plant diagnostic capabilities also reduce the need for frequent access to hazardous areas, thus minimizing the risks to field personnel.

- **FF is relatively slow**

- **FF is not certified for safety (yet?)**

- **Easier Predictive Maintenance**

  Enhanced device diagnostics capabilities make it possible to monitor and record such conditions as valve wear and transmitter fouling. Plant personnel are able to perform predictive maintenance without waiting for a scheduled shutdown, thus avoiding or reducing downtime

Advantages and Disadvantages of Foundation Fieldbus Control system practically

- **Enhanced Process Data**

  With FOUNDATION fieldbus, multiple variables from each device can be brought into the plant control system for archival, trend analysis, process optimization studies, and report generation. This access to accurate, high resolution data enables processes to be fine-tuned for better manufacturing throughput and reduced plant downtime. These efficiencies add up to higher plant performance and profitability.

- **Fieldbus improves control system reliability**

  They also save money by reducing the number of instrument interface cards required to connect field instruments to the control system. However, they all save money by being able to use the same field transmitter for a wide range of measured variables.

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- **Control anywhere**
  - **Limited advantages – segment constraints**
  - **PID in devices are not as flexible as in Hosts**
  - **FAT more difficult**

Advantages and Disadvantages of Foundation Fieldbus Control system practically

- **Point and click commissioning (loop check)**
  - **Requires step change in work process**
  - **Mechanical checks still required**
  - **Conventional instruments don't require download time**
  - **"Zeroing" transmitters from the Host – definite advantage**
  - **Remote calibration of valves (if available) saves time and effort**
  - **Custom graphics using device and port parameters provides "at a glance" status during loop check**

- **Engineering savings**
  - **Net increase**

The Old 4-20mA Paradigm

Only 1 value is transmitted
Only one direction

Highway Addressable Remote Transmitter

ST_REV, TAG_DESC, STRATEGY, ALERT_KEY, MODE_BLK, BLOCK_ERR, RS_STATE, TEST_RW, DD_RESOURCE, , MANUFAC_ID, DEV_TYPE, DEV_REV, DD_REV, GRANT_DENY, HARD_TYPES, RESTART, FEATURES, FEATURE_SEL, CYCLE_TYPE, CYCLE_SEL, MIN_CYCLE_T, MEMORY_SIZE, NV_CYCLE_T, FREE_SPACE, FREE_TIME, SHED_RCAS, SHED_ROUT, FAIL_SAFE, SET_FSAFE, CLR_FSAFE, MAX_NOTIFY, LIM_NOTIFY, CONFIRM_TIME, WRITE_LOCK, UPDATE_EVT, BLOCK_ALM, ALARM_SUM
ACK_OPTION, WRITE_PRI, WRITE_ALM

ST_REV, TAG_DESC, STRATEGY, ALERT_KEY, MODE_BLK, BLOCK_ERR, PV OUT, SIMULATE, XD_SCALE, OUT_SCALE, GRANT_DENY, IO_OPTS, STATUS_OPTS, CHANNEL, L_TYPE, LOW_CUT, PV_FTIME, FIELD_VAL, UPDATE_EVT, BLOCK_ALM, ALARM_SUM, ACK_OPTION, ALARM_HYS, HI_HI_PRI, HI_HI_LIM, HI_PRI, HI_LIM, LO_PRI, LO_LIM, LO_LO_PRI, LO_LO_LIM, HI_HI_ALM, HI_ALM, LO_ALM, LO_LO_ALM

Foundation Fieldbus

ST_REV, TAG_DESC, STRATEGY, ALERT_KEY, MODE_BLK, BLOCK_ERR, RS_STATE, TEST_RW, DD_RESOURCE, , MANUFAC_ID, DEV_TYPE, DEV_REV, DD_REV, GRANT_DENY, HARD_TYPES, RESTART, FEATURES, FEATURE_SEL, CYCLE_TYPE, CYCLE_SEL, MIN_CYCLE_T, MEMORY_SIZE, NV_CYCLE_T, FREE_SPACE, FREE_TIME, SHED_RCAS, SHED_ROUT, FAIL_SAFE, SET_FSAFE, CLR_FSAFE, MAX_NOTIFY, LIM_NOTIFY, CONFIRM_TIME, WRITE_LOCK, UPDATE_EVT, BLOCK_ALM, ALARM_SUM ACK_OPTION, WRITE_PRI, WRITE_ALM

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ST_REV, TAG_DESC, STRATEGY, ALERT_KEY, MODE_BLK, BLOCK_ERR, PV, SP, OUT, PV_SCALE, OUT_SCALE, GRANT_DENY, CONTROL_OPTS, STATUS_OPTS, IN, PV_FTIME, BYPASS, CAS_IN, SP_RATE_DN, SP_RATE_UP, SP_HI_LIM, SP_LO_LIM ST_REV, TAG_DESC, STRATEGY, ALERT_KEY, MODE_BLK, BLOCK_ERR, PV SP, OUT, PV_SCALE, OUT_SCALE, GRANT_DENY, CONTROL_OPTS, STATUS_OPTS, IN PV_FTIME, BYPASS, CAS_IN, SP_RATE_DN, SP_RATE_UP, SP_HI_LIM, SP_LO_LIM, GAIN RESET, BAL_TIME, RATE, BKCAL_IN, OUT_HI_LIM, OUT_LO_LIM, BKCAL_HYS, BKCAL_OUT, RCAS_IN, ROUT_IN, SHED_OPT, RCAS_OUT, ROUT_OUT, TRK_SCALE, TRK_IN_D, TRK_VAL, FF_VAL, FF_SCALE, FF_GAIN, UPDATE_EVT, BLOCK_ALM, ALARM_SUM, ACK_OPTION, ALARM_HYS, HI_HI_PRI, HI_HI_LIM, HI_PRI, HI_LIM, LO_PRI, LO_LIM, LO_LO_PRI, LO_LO_LIM, DV_HI_PRI, DV_HI_LIM, DV_LO_PRI, DV_LO_LIM, HI_HI_ALM, HI_ALM, LO_ALM, LO_LO_ALM, DV_HI_ALM. DV_LO_ALM

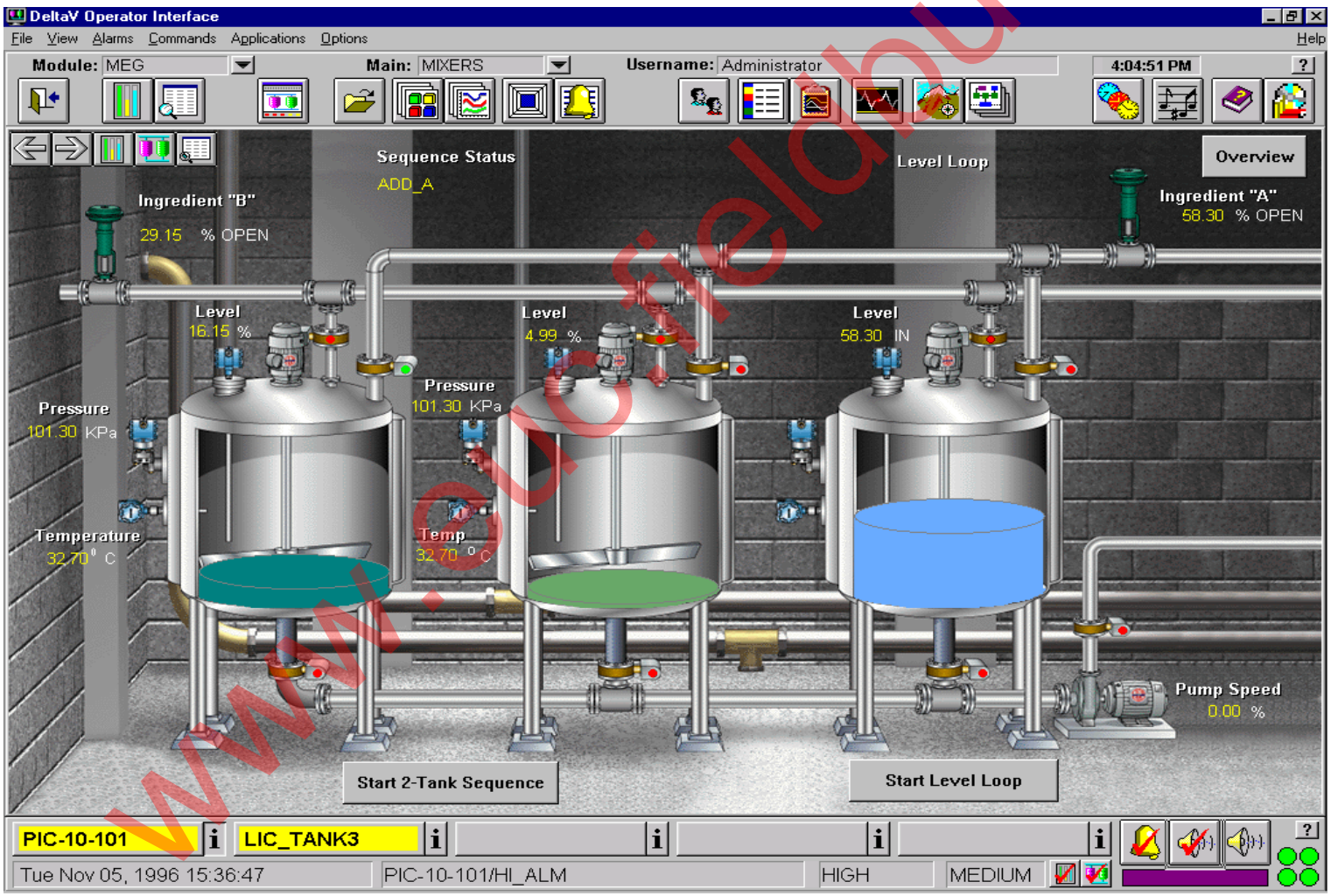
BEFORE

256 I/O

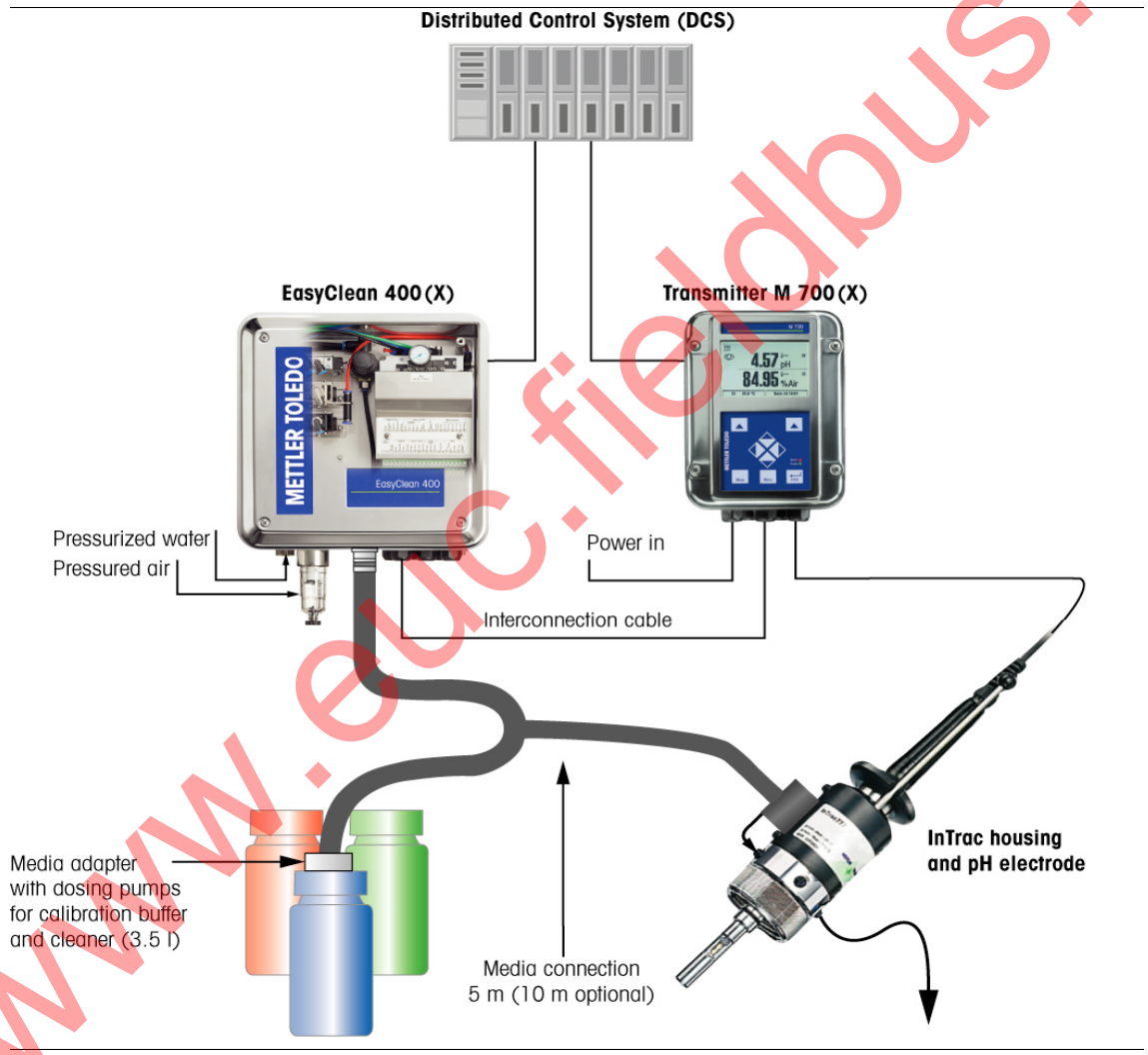
AFTER

4,000 Virtual ‘I/O’

Operator Interface
- Where the Plant is Controlled from



Metler Toledo PH Meter



Metler Toledo PH Meter

- **2-point calibration**

Executes a two point calibration

- **1-point calibration**

Executes a one point calibration

- **Cleaning**

Rinse with water and clean with cleaning agent

- **Parking**

Cleaned electrode will be stored in the flushing chamber (can only be activated via DCS)

- **Service**

Housing will be retracted to service position

- **User defined 1**

Can be defined to the customer's need

- **User defined 2**

Can be defined to the customer's need

Detail Technical Survey (DTS) of Existing Plant

- **Document review:**
  - **PFD and P&ID review**
  - **Sequence and Interlocks**
  - **Instrumentation**
  - **Training**

Cost Analysis (Technical and Economic Studies)

- **Project cost estimation**

Conceptual Design

- **Design Criteria**

The new control system (FCS/DCS) will make use of Foundation Fieldbus and HART technologies as appropriate to provide a comprehensive data network at all levels of the plants.

Using FF technologies is mandatory, except where it is not practical/or technically limited, such as :

- **Process critical loops**
- **Safety related loops**
- **Discrete loops**
- **Field instruments witch have not been registered in Fieldbus Foundation (by enough NO. of approved vendor in NPC vendor list) such as Displacer Level Transmitters, Variable Area Flow Meters, Local Indicators ...**
- **4-20 mA signals between MCC and Control System**

Conceptual Design

- **FF Topology**
  - **Chickenfoot / Crowsfoot, Daisychain / Spur, Star**
  - **Bandwidth—A link can carry about 30 scheduled messages per second. So, you could have three devices, each sending ten messages per second, or 120 devices (connected by repeaters), each sending onemessage every four seconds.**
  - **Power—Using bus powering reduces the number of devices that can be on one link. Additionally, the power supply on each link must be sufficiently large. Some devices are separately powered (such as the National Instruments FP-3000) and thus do not pull power from the link's power supply.**
  - **Wire Resistance—Existing wire in older plants often has high resistance that can reduce the maximum link length.**
  - **Barriers / Isolators—You should limit the power available in hazardous areas.**

Detail Engineering

- Instrument index
- Instrument logic diagram
- Instrument loop diagram
- Instrument hook-up drawing
- Instrument installation detail drawing
- Instrument cable wiring layout
- Instrument cable tray(duct) layout
- Instrument junction box wiring diagram
- Instrument cable schedule
- Instrument bulk material take-off
- FF devices data sheet
- FF Symbols on P&ID
- Fieldbus control system General Specification
- FCS I/O count
- Responsibility matrix
- FCS network philosophy
- FF segment allocation list
- ESD specification
- UPS specification and data sheet

Fieldbus control system General Specification:

- Related specifications and drawings.
- Codes and standards.
- System requirements.
- System overview.
- Equipment location and environment.
- Cable transmission.
- Reliability and redundancy.
- Electrical requirements.
- Grounding requirements.
- Electromagnetic compatibility (EMC).
- FCS signal circuit protection.
- FCS system I/O graphic and reporting.
- Hazardous Area requirements.
- System spare.
- Loading criteria.
- Cabinet design requirements.
- Instrument maintenance management system.
- Diagnostics.
- Documentation and software.
- General requirements.
- Purchaser documentation.
- Functional design specification.
- Software
- Software documentation.
- Execution strategy.
- Responsibilities.
- Project management.
- Schedule.
- Inspection and testing.
- General requirements.
- Manufacturing test.
- System staging.
- System Burn in.
- FAT.
- Database.
- Load test.
- Integration testing.
- SAT.
- QA.

FF devices data sheet

FF instruments data sheets must contain Fieldbus related information such as :

- **Channel No.**
- **Segment No.**
- **Link Master (LAS) capable (Yes/No)**
- **Register at Foundation Fieldbus (Yes/No)**
- **Interoperable (Yes/No)**
- **ITK revision**
- **Device current draw (mA)**
- **Devise in rush current (mA)**
- **Device lift-off minimum voltage**
- **Device capacitance**
- **DD revision (DD files shall be according with Fieldbus Foundation FF-524**
- **Required Function Blocks in the device**
- **Available Function Blocks in the device (Basic F.B, Advanced F.B, Non-standard F.B)**
- **CFF revision (CFF shall be according with Fieldbus Foundation FF-103 document**
- **Polarity sensitive (Yes/No)**
- **Segment terminator location**

Installation

In summary , the revamping implementation will be divided in to three distinct phases:

- **First phase:**

  hot works will be carried out during initial shutdown such as :
  - New nozzles in the equipment or piping.
  - Support for instruments & electrical cable ducts/trays/conduits
  - Support for junction boxes and field instruments
  - Instrument multi core /main cable laying

- **Second phase:**

  Construction activities mainly will be carried out during plant normal operation , by obtaining work permits , such as :
  - FCS/DCS and ESD/PLC's start up and Conducting the SAT
  - Open / Monitoring Loops Hooked up, Loop Checking (Segment Checking)and changed over to FCS/DCS, which in FF part the change over shall beSegment by Segment (because of power, bus terminator,...)

Installation

- **Third phase:**

  Balance critical activities will be completed during later plant shutdown (normally in plant total overhaul), such as:

  - **Critical Loops (Safety related loops) /Closed Loops Hooked up, Loop Checking (Segment Checking) and change over to FCS/DCS, which in FF part the change over shall be Segment by Segment (because of power, bus terminator, …)**

  In this step the Interoperability, Segment Loading calculation and Macrocycle Definition shall be checked.

  - **Safety related Loops, change over to new ESD**
  - **Installation of new Positioners on existing Control Valves.**
  - **MCC modifications if any**

Pre- Commissioning and Commissioning

- **Loop test**

- **Simulation**

  FF systems is capable of simulating various values and status of the function block parameters. This can be used as a good tools for diagnostic , testing of control strategy & fail safe state.

- **Online Communication**

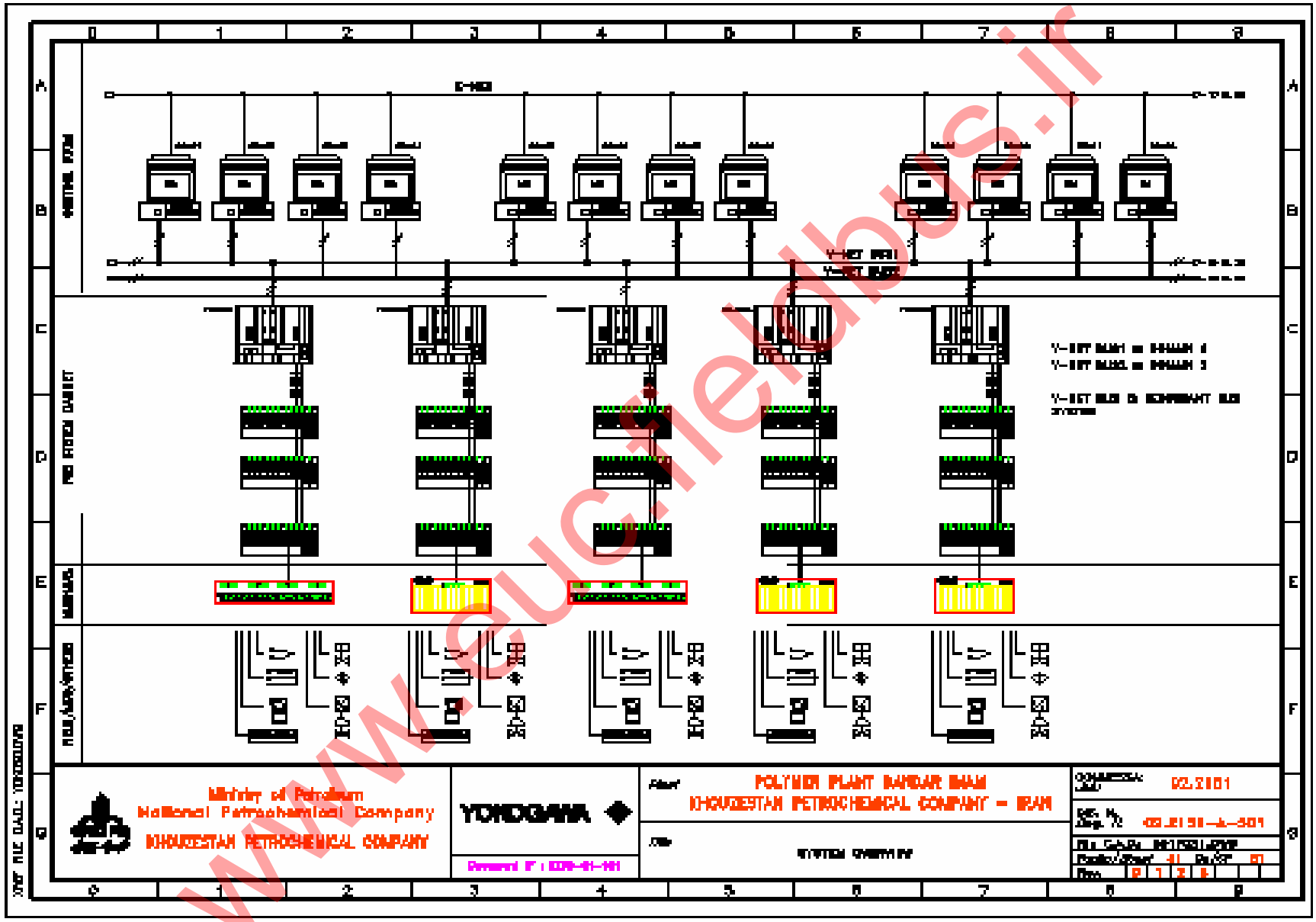
  Parameters can be read or written with online mode.

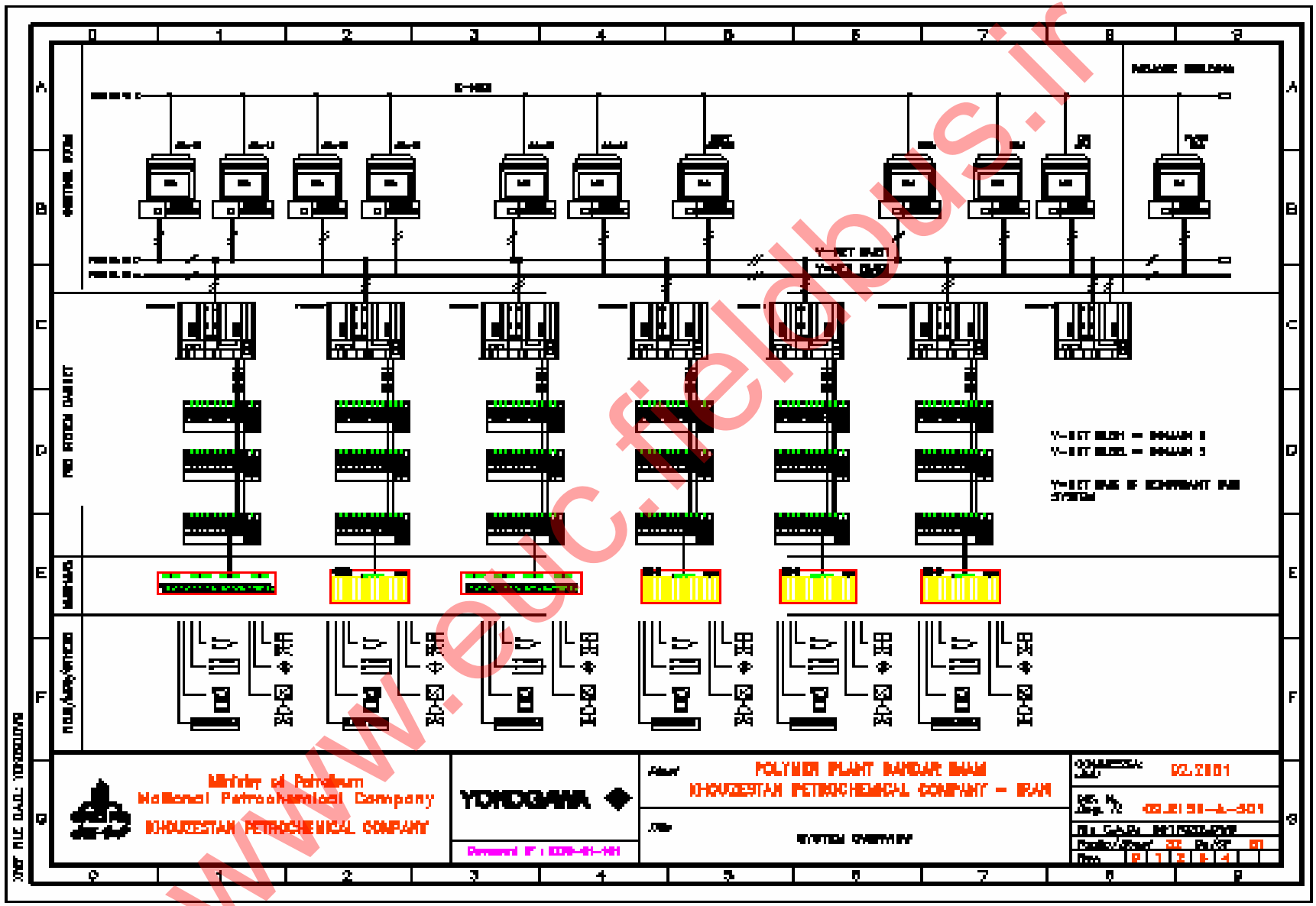
- **Online strategy**

  The status of control strategy (Control loops) can be easily verified through online capability. It is very useful during commissioning. With a sensor failure The OUT status should change to RED color (Bad Output Status)

- **Live list**

  The live list is thus an excellent tool for commissioning, since it is very easy to confirm proper wiring , installation & communication of the field instrument. Once the communication is initiated and the linking device started it is possible to see all the devices that are connected to the channel.





Questions…

Discussion…