What does Process Automation Understand under Diagnosis?

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Technical Track

www.odva.org
What does Process Automation Understand under Diagnosis?

Overview

- Factory and Process Automation
- Same roof but different tasks and focuses
- Field devices diagnostics
- NAMUR NE107 recommendation
- Digital communication protocols and NE107
- EtherNet/IP™ and NE107 possible implementation
What does Process Automation Understand under Diagnosis?

Factory and Process Automation

Manufacturing Industries
- Automotive
- Robotics
- Material Handling
- Machine Tools

Hybrid Industries
- Food & Beverage
- Life Sciences
- Environmental

Process Industries
- Oil & Gas
- Chemical
- Power & Energy
- Primaries & Metal

PLC

DCS

EtherNet/IP™
What does Process Automation Understand under Diagnosis?

Hybrid industries?

- Food & Beverage
- Life Sciences
- Environmental
What does Process Automation Understand under Diagnosis?

Process industries?

- Chemicals
- Oil & Gas
- Power & Energy
- Primaries & Metals
What does Process Automation Understand under Diagnosis?

<table>
<thead>
<tr>
<th>Industrial Tasks</th>
<th>Process Automation</th>
<th>Factory Automation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Typical tasks</strong></td>
<td>heating, cooling, mixing, separating, analyzing, calibrating</td>
<td>Moving, adjusting, mechanical processing, lubricating</td>
</tr>
<tr>
<td><strong>Outdoors</strong></td>
<td>Outdoor plants, wide areas, high requirements on big temperature ranges and</td>
<td>Compact plants, skids, indoor, low requirements on big temperature ranges and</td>
</tr>
<tr>
<td><strong>Continuous process control</strong></td>
<td>Continuous process control, analog values</td>
<td>State recognition, binary signals are dominating</td>
</tr>
<tr>
<td><strong>Law regulation</strong></td>
<td>Law regulation, Approval certificates for components</td>
<td></td>
</tr>
</tbody>
</table>

Technical Tasks
What does Process Automation Understand under Diagnosis?

Process Automation focus
- Safety
- No shut down button
- Long-term running (~20 years)
- Running without downtime (~3 years)

Requirements
- Protect high investment
- Efficient life cycle management
- Predictive maintenance

Intelligent field devices are able to fulfill these requirements!
What does Process Automation Understand under Diagnosis?

**Operator console**
- Process configuration, monitoring and operation

**Maintenance console**
- Performance and condition management of fieldbus devices

Focus on running processes

Focus on running assets

Need to understand themselves
What does Process Automation Understand under Diagnosis?

Diagnostic Information

“My pipe is partly filled”

An empty or partially filled pipe in process application could damage running equipment in the process.

Note: in 4-20mA technology, only failure current shown. Digital communication unlocks field device diagnostic information!
What does Process Automation Understand under Diagnosis?

Diagnostic information

- Sensor/Actuator element failures
  - Tube temperature sensor defect
  - Exciter coils defective
  - Carrier tube temperature sensor defective

- Electronic failures
  - Critical Failure Fault
  - EEPROM Failure
  - Totalizer Checksum Fault

- Configuration/servicing failures
  - Board Incompatibility
  - Software Update in progress
  - Communication I/O Failure Fault
  - Simulation active
  - Configuration error

- Process induced failures
  - Oscillation Amplitude Limit
  - Excitation Current Limit
  - Fluid Inhomogeneous
  - Noise Limit
  - Sensor Asymmetry Exceeded Fault
  - Corrosion
  - Erosion
  - Coating - Build Up
  - Air Entrainment
  - Slug Flow
  - Cavitation
  - Empty Pipe

Delivers several types of diagnostic information
What does Process Automation Understand under Diagnosis?

Standardized overview in maintenance console

![Instrument health status](image)
What does Process Automation Understand under Diagnosis?

Diagnostic information in web server
What does Process Automation Understand under Diagnosis?

Who is NAMUR?

NAMUR is an international association of process automation industry end users. It publishes recommendation documents to help end users by sharing best practices and to guide suppliers and industry foundations on future technology and product development. NAMUR represents approximately 15,000 process control experts, of whom approximately 300 are active in 33 working groups. Member companies include Novartis, BASF, Bayer, Evonik, Shell and Clariant.
What does Process Automation Understand under Diagnosis?

NE107 Status Signals and Symbols

- **Out of Specifications**
- **Function Check**
- **Maintenance Required**
- **Failure**
What does Process Automation Understand under Diagnosis?

Digital communication protocols and NE107 Implementation

Digital communication protocols focused on Process Automation have already implemented NAMUR recommendation in their specs.
What does Process Automation Understand under Diagnosis?

Example of NE107 with FOUNDATION Fieldbus (FF912)

- Four categories of diagnostic information
- Four severity grades
- Sixteen possibilities to map NE107 status signal to a diagnostic information
- Sixteen left possibilities for assigning independently “process induced diagnostic information”
What does Process Automation Understand under Diagnosis?

Manufacturer: Implementation

User: Configuration

Diagnostics
- Sensor Highest Severity
- Electronic Highest Severity
- Configuration Highest Severity
- Process Highest Severity
- Sensor High Severity
- Electronic High Severity
- Configuration High Severity
- Process High Severity
- Sensor Low Severity
- Electronic Low Severity
- Configuration Low Severity
- Process Low Severity
- Sensor Lowest Severity
- Electronic Lowest Severity
- Configuration Lowest Severity
- Process Lowest Severity
- Process Diagnostic Message XY
- Process Diagnostic Message 23
- ...
- Process Diagnostic Message X
- ....
- Process Diagnostic Message Z

Assignment

DCS Mapping

Info 1

Info 5

Info 11

Info 16

Info 32 (max.)
What does Process Automation Understand under Diagnosis?

EtherNet/IP™ and NE107 possible implementation

<table>
<thead>
<tr>
<th>Diagnostic No.</th>
<th>NE107 Status Signal</th>
<th>Channel</th>
<th>Data0, Data1, ...Data N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Byte</td>
<td>1 Byte</td>
<td>1 Byte</td>
<td>N Bytes</td>
</tr>
</tbody>
</table>

E.g. N°802: “pipe partially filled”

“My pipe is partly filled”
What does Process Automation Understand under Diagnosis?
EtherNet/IP™ and NE107 possible implementation

<table>
<thead>
<tr>
<th>Value</th>
<th>4 Bytes (Real, Double Integer)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E.g. mass flow, volume flow, density...</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Status</th>
<th>1 Byte</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E.g. BAD, GOOD or UNCERTAIN → related to the measured value. 0x80, 0x0C, 0x40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Padding</th>
<th>1 Byte</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit</th>
<th>1 Byte</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E.g. ounces/hours. 0x86E, see CIP Spec, Vol 1 Appendix D, Vendor Specific range</td>
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</tbody>
</table>

Data0, Data1, ...
N Bytes
What does Process Automation Understand under Diagnosis?

Conclusion

- Process automation is asking for diagnostic information
- Standardized assignment of diagnostic information to NE107 status signal needed for EtherNet/IP™
- Further technical investigations needed to get NE107 recommendation into CIP specifications.
I appreciate your questions

Endress+Hauser
People for Process Automation